ΕΛΛΗΝΙΚΗ ΔΗΜΟΚΡΑΤΙΑ
Εθνικόν και Καποδιστριακόν Πανεπιστήμιον Αθηνών
ΙΔΡΥΘΕΝ ΤΟ 1837

Σχολή Οικονομικών & Πολιτικών Επιστημών

Τμήμα Οικονομικών Επιστημών

The Profit-Based Approach

Αποτίμηση Κεφαλαιακών Τίτλων από τα Θεμελιώδη Μεγέθη: Η Προσέγγιση των Κερδών

Νικόλαος Κ. Στραβελάκης

Αθήνα, Ιανουάριος 2020

Table of Contents

Introduction

The collapse of the subprime market which has triggered the current global depression has initiated an extensive debate on whether the enormous expansion of finance and the deregulation of financial markets over the last thirty years was the actual cause of the crisis. The answer to this question has important implications for the appropriate economic policy to face the crisis and the effectiveness of rules of financial regulation and financial market reform. As the crisis approaches its 13th year these matters tend to become more complicated rather than resolved. The socialization of private losses through state and central bank money has more than doubled sovereign debt on a global scale. At the same time, interest rates have collapsed due to the unlimited liquidity provided by central banks, while stock market prices in the US and the EU increased to record heights. Finally, a huge growing notional amount, approaching at its maximum 25 times the world GDP, of derivative contracts, mostly over-the-counter (OTC) contracts, hangs over the global financial markets.[1]

The theory of asset pricing plays a key part in the formulation of an argument addressing these issues. However, it is underplayed in the literature. The concept of 'moral hazard' (Farhi and Tirole 2012) indicates that, in deregulated markets, practitioners may cause mispricing of financial assets. The argument is that if bank and financial corporation managers know they can transfer their risks to the society, or that they will be 'bailed out' by the state and the central banks if their 'bets' go the wrong way, they will probably take positions[2] which will distort financial asset prices. However, the relevant literature makes no express reference to the determinants of 'fair' asset prices. The same holds true for the theories of 'financialization'. Although, in all versions of the concept, extensive reference is made to various aspects of finance and different types of financial assets, no attempt to 'price' financial assets is made (Tomé 2011). It is only behavioral finance economists (Shiller 2009, Roubini and Mihm 2011) and market practitioners (Taleb 2007) who attempted to deal with the matter. However, their methodology is not different. In the 'behavioral finance' literature the crisis is a consequence of the burst

[1] Shaikh (2016: 231) reports 1.4 quadrillion USD of derivatives outstanding three years into the crisis, '23 times the total value of the world GDP'. The relevant BIS report for June 2011 (dividing the figure by 2 to acknowledge that the contract involves at least one buyer and one seller) reports 708 trillion (BIS 2011). Since these contracts are mostly OTC transactions the risk implemented by this outstanding amount is certainly greater than the notional amount divided by 2. The value for the first half of 2020 was USD 606.810 trillion (BIS 2020).

[2] That they would not take in the absence of such expectations.

of 'asset bubbles' resulting from 'irrational behavior' (Mullainathan and Thaler 2000).[3] Nicholas Taleb on the other hand, in the tradition of mathematicians who place the emphasis on the properties of the time series of asset returns (Mandelbrot and Hudson 2004), considers the crisis a 'black swan event'[4] which cannot be explained analytically, or reflects a sudden change in investment behavior. This is peculiar, to say the least, since the economics profession knows for more than thirty years, that financial asset prices and returns are not in line with the conclusions of 'Modern Investment Theory' (Shiller 1989, Leroy and Porter 1989, Mehra and Prescott 1985, Fama and French 1992, 2004, Caballero, Farhi and Gourinchas 2017). Nevertheless, most of the explanations mentioned above imply that the same models which constantly fail empirical testing are the benchmark. In other words, when many of these theorists talk about mispricing, they imply that actual asset prices were significantly different from the prices calculated from mainstream models like the Capital Asset Pricing Model (CAPM), or Arbitrage Pricing Theory (APT).

The key argument developed herein is that financial asset returns are in line with corporate fundamentals. This means that although aberrations may occur, fundamentals rule in the end. Therefore, it was not actual prices that were well off 'fair' prices, but mainstream models that cannot provide us with a reliable set of asset prices. Moreover, the persistent mispricing of derivatives and asset-backed securities is due to wrong assumptions regarding the level, volatility, and distribution of returns of the underlying assets (Stravelakis 2014). In this regard, the theoretical prerequisites, the mathematical formulation and the theoretical and policy implications of an alternative model that determines asset returns directly from the corporate fundamentals are presented here. The assumptions of the model are empirically tested, for stocks, with data from the S&P 500 index going back to the 19th century.

In a 1997 paper, Anwar Shaikh outlined a framework for stock valuation from the fundamentals. The core of his argument is that 'real competition' (Botwinick 1993, Mueller 1986), as opposed to 'perfect competition', constantly alters the rate of return on corporate investment. This means that – contrary to the postulations of modern investment theory (Elton and Gruber 1991), it is the 'incremental rate of

---

[3] Robert Shiller in 2000 used the term 'irrational exuberance' for the title of his book (Shiller 2009). The phrase has been coined by the then-Federal Reserve Board chairman, Alan Greenspan in a speech delivered at the Annual Dinner and Francis Boyer Lecture of The American Enterprise Institute for Public Policy Research on December 5, 1996 (Greenspan 1996).

[4] A rare, unexpected event resulting from a sudden change in behavior. However, financial crises of various intensities and durations were quite common during the neoliberal era. As Roubini and Mihm (2011) point out, they are 'white' rather than 'black' swans.

profit' that is the determining variable. The 'incremental rate of profit', i.e., the rate of profit on new investment, is a highly volatile measure, which usually differs from the average rate of profit both in measure and variability. The 'incremental rate of profit' also regulates the mobility of capital between industries, as well as between the corporate and financial sectors (Geroski 1990). Therefore, it is also the required rate of return of the stock exchange since it is the measure around which corporate and stock market returns tend to become equalized. The same rationale can be extended to the (mis)pricing of 'derivatives' and 'asset-backed securities' when mainstream models, like the Black-Scholes option pricing model (Black and Scholes 1973), are applied (Stravelakis 2014). Due to the volatility of the 'incremental rate of profit' and the consequent uncertainty which underlies financial investments in real-time, this equalization is a turbulent process where corporate, stock and financial market rates of return constantly fluctuate around each other never becoming exactly equal. Consequently, financial asset valuation should rely on short-term profitability which reflects transitory factors including short-run disequilibrium dynamics. This means also that empirical testing should directly use corporate data, instead of making assumptions on its characteristics, as it is done in mainstream theory. Due to its reliance on short- term profitability, the theory is referred to as the 'Profit-Based Approach'.

The argument presented in Shaikh 1997 is elaborated further herein. First, a full critique of modern investment theory is presented placing the emphasis on the significance of the assumption of perfect competition and perfect capital markets for the solution of mainstream asset pricing models and the conclusions of the efficient market hypothesis. Furthermore, the model is extended to encompass, derivatives and 'asset-backed securities' at the analytical level. Finally, the theoretical and policy implications of the 'Profit-Based Approach': a) on the causes and trigger mechanism of depressions and b) on the determination and limits of regulatory policies are considered.

A few introductory words on the implications of the 'profit-based approach' are appropriate here. The idea that the valuation of financial assets reflects the underlying conditions of profitability is in line with the understanding of accumulation in Capitalism in the classical/Marxian tradition. Capitalism develops in 'long waves' where periods of growth give way to periods of depression, a pattern inherent in the mode of production throughout its history (Ayres 1939, Kondratieff 1984, Shaikh 1992). Read together with the conclusion of the previous paragraph this means that when severe stock market and financial assets fluctuations precede a depression this is not due to asset mispricing, owing to some market distortion. It reflects the underlying conditions of corporate profitability. In short, the cause of the crisis lies in the sphere of production and the contradictions of the profit motive. The reason that financial turmoil may precede the crisis is that financial asset returns are associated with the highly volatile incremental rate of profit, rather than the average rate of profit. This explains why sudden and severe financial market fluctuations may trigger major depressions such as the stock market crash of 1929 and the subprime market collapse in 2007 (Stravelakis 2012, 2014).

This understanding of the underlying causes and the trigger mechanism of depressions addresses major analytical shortcomings of the mainstream and certain heterodox crisis explanations. If the cause of the current depression lies in the sphere of finance and is due to mispricing, as suggested by the theories mentioned above, a crisis may occur at any time. Everyone knows that mainstream asset pricing models never exhibited satisfactory empirical performance. In other words, asset mispricing is the rule, rather than the exception, when mainstream asset pricing models are used as the benchmark. Therefore, financial market corrections should be quite frequent and indeed they are, albeit for different reasons than those suggested by mainstream models. Nevertheless, the numerous financial panic episodes which occurred over the last thirty years, such as, the Black Monday in 1982 and the Asian Crisis in 1999, or the burst of the dot.com bubble in early 2000 did not result in anything even close to what the world has witnessed following the default of Bear Sterns in 2007. Consequently, depressions have additional prerequisites besides stock and financial market panics. By associating stock returns and interest rates with profitability, I attempt to show analytically that interest rates explode when the profit rate remains below a certain limit; the 'rate of profit of enterprise' turns zero or negative and normal accumulation turns to a crisis (Shaikh 1992, Stravelakis 2012). Furthermore, I show analytically that these events may be preceded by severe stock and financial market fluctuations (Stravelakis 2014). These analytical conclusions suggest also that bank recapitalization will have a restricted impact on output and employment because debts are already too high and profits too low for funds to end up supporting corporate investment. This is the reason that despite the trillions disbursed to socialize private losses on a global scale and the consequent surge of sovereign debt worldwide, the economy has entered a long period of zero or weak growth and capital impairment, rather than exiting the depression.

Moreover, the 'profit-based approach' can explain the increase in stock market indexes and other phenomena related to the 2007-2010 breakdown and its aftermath. The incremental rate of profit remained in line with stock market indexes during the collapse of 2007 and the recovery which followed. To give a brief indication, the cumulative (aggregate) real incremental rate of profit for the period 2007-2016 is 32.5% and the real cumulative (aggregate) return of the S&P 500 is 30,2% during the same period, consequently the yearly average real incremental rate of profit is 3.6% and the average real return on the S&P 500 is almost equal 3.35%. In Chapter 4 (Figure 4.3) I present a simulation ending in January 2020 showing that this result holds almost up to date. Shaikh (1997) has found similar results for the period 1947-1992. In Chapter 4, using earnings per share as a proxy for the incremental rate of profit I will show that the relations between profitability and stock market return hold since 1871.

The profit-based approach also explains the persistent mispricing of derivatives and asset-backed securities by the traditional methods of valuation (Black-Scholes option pricing, outright forward pricing, asset backed securities pricing, etc.). This is due to the erroneous assumptions of mainstream theory on the determination, the probability distribution and the variability of returns of the underlying assets. The idea that financial asset prices and returns are determined by corporate fundamentals that exhibit high and persistent variability and trends indicates that any pricing theories based on stationary returns exhibiting limited volatility are wrong. In this context, the excessive impairment of 'fictitious capital', for example, capital recorded in the 'notional amount' of derivative contracts, is possibly reflecting a breakdown in the valorization of productive capital. I have shown elsewhere (Stravelakis 2014) that this can explain the trigger mechanism of the current depression, as well as the persistent growth of the aggregate notional amount of derivative contracts to figures reaching 25 times the world GDP. The Bank for International Settlements reports that the estimated notional amount of derivative contracts in June 2016 is about 544 trillion US dollars (BIS 2016), which means that taking both sides of the contract a total of more than 1 quadrillion dollars. In June 2020, this number was USD 606 trillion (BIS 2020). This amazing phenomenon resulted from financial accommodation of derivative credit lines[5]

[5] Derivative credit lines can support a notional amount even five times the amount of the line. A contract covers a portion of the line equal to the 'implied volatility' of the underlying asset. For example, if one buys an outright forward contract, a common form of an OTC contract, of notional amount 1 million in currency exchange rates he will use only 200,000 of derivative line because the implied volatility is usually assumed at 20%. If the asset exhibits volatility greater than 20% and the line is covered, then he will have to come up with cash, apply for an extension of the line or face forced liquidation of his position. The growth of the derivative market, especially the OTC market, was based on involving more people in the trade, extending lines to roll over positions and offering structured products to make up for the losses.

before and after the outburst of the crisis and it can unleash a new major crisis episode in the immediate future.

The conclusions of the 'Profit-Based Approach' of asset pricing have important implications for financial regulation. Mainstream theory has suggested that regulation would be effective if it restrains 'moral hazard' and addresses 'asymmetric information' by resolving the 'principal-agent' problem. In this regard, proposals for caps on bank managers' bonuses, legislation limiting state guarantees on deposits and greater transparency in the financial statements of banks and financial intermediaries in general, dominate academic debates and policy rules. Nevertheless, because of the highly volatile asset returns, financial corporations operate in a world of true uncertainty, as opposed to calculable risk. Therefore, any regulatory policy relying on the assumption that crises result from financial markets distortion, attributed to moral hazard issues, for example, will prove insufficient as zero or weak growth turns unstable, an event usually preceded by increased amounts of speculative investments. Financial regulation should focus on what kind of assets financial intermediaries can sell and what kind of assets banks, pension funds, corporations and the broad public can hold to protect taxpayers from future bailout costs at least in part (Stravelakis 2014).
The current thesis is broken down into four chapters. The first two focus on a presentation and critique of modern investment theory. The main assumptions and models of mainstream asset pricing will be presented in their context. The emphasis is placed on the association of modern investment theory models with neoclassical equilibrium and their empirical performance. Chapter three outlines the theoretical foundations of the 'profit-based approach' and presents its assumptions and implications. The final chapter presents an empirical evaluation of the S&P 500 index.

Chapter 1
Equalization of Risk-Adjusted Rates of Return and the Present Value Principle

This chapter elaborates on the basic postulates of mainstream theory in contrast to certain assumptions of the 'profit-based approach'. The economics underlying the present value principle and its empirical performance is the main tool for this endeavor. Emphasis is placed on the assumption of the constant required rate of return underlying the principle. This property is mainly responsible for the poor empirical performance of Dividend and Earnings Cash Flow models of stock valuation. In this regard, the relevant literature is presented and discussed. By elaborating on the association of constant or slowly varying required returns with neoclassical equilibrium, the economics underlying the present value formula becomes evident. These analytical insights are used for the presentation of the 'equity risk premium puzzle' which mystifies mainstream finance theory. I show that the 'puzzle' stems from the assumptions of stationary returns and, consequently, calculable risk. This finding will prove useful in understanding the different analytical foundations of mainstream theory and the 'profit-based approach'.

1a. The Economics of the Present Value Formula

Mainstream 'Modern (finance) Investment Theory' is based on the notion of equalization of risk-adjusted rates of return. As we will show in this and the next chapters this holds for the CAPM and APT models, the Markowitz risk-return trade-off, and the equality of expected and actual returns in the efficient market hypothesis. Equalization is a concept with a general application in mainstream economics.[6] As I will show briefly in section 1c and elaborate in chapters 3 and 4, equalization of returns holds also, under a different rationale of course, for the alternative asset pricing framework presented herein.

For the mainstream argument, important aspects of the process of equalization become evident by looking closer to the present value principle. The basic idea is that financial asset returns remain in line with an underlying required rate of return. This will become apparent from the following elaboration/derivation of the present value formula:

[6] The 'law of one price' is one characteristic example. Indeed, it was there at the very beginning of modern economics as the 'Law of Indifference' (Jevons 1879: 98-103).

The actual rate of return is given by the following formula:

$$r_t \equiv \frac{\Delta P_{t+1} + D_{t+1}}{P_t} \qquad (1.1)$$

Definition 1.1 refers to stocks. In mainstream theory, however, risk-adjusted rates of return on stocks, bonds, and financial assets, in general, are equalized.[7] Therefore, the present value principle applies to financial asset valuation over-all. Returning to equation 1.1, the definition is quite straight forward. The return for buying a stock at a time (*t*) and holding it until the time (*t+1*) is equal to the change in stock price (*ΔP*) between time (*t*) and time (*t+1*) plus the company dividend (*D*) distributed in period (t+1). The definition can be solved for the current stock price in which case it looks as follows:

$$P_t = \frac{D_{t+1}}{1 + rror_t} + \frac{P_{t+1}}{1 + rror_t} \qquad (1.2)$$

Although equation (1.2) comes directly from definition (1.1), it is quite different. The current stock price is the present value of expected prices and dividends discounted by a required rate of return denoted by $rror_t$.

Expression (1.2) can be expanded further by substituting a similar equation for P_{t+1} on the righthand side of Eq. (1.2), in which case it will read as follows:

$$P_t = \frac{D_{t+1}}{(1 + rror_t)} + \frac{D_{t+2}}{(1 + rror_t)(1 + rror_{t+1})} + \frac{P_{t+2}}{(1 + rror_t)(1 + rror_{t+1})} \qquad (1.3)$$

In the same fashion, the last term in the right -hand side can take infinite substitutions. Assuming that the residual term, i.e., the last term in the righthand side of (1.3), will tend to zero as the form is expanded further and that the required rate of return is constant, we arrive at the familiar Dividend Discounted Cash Flow (DCF) formula. As we all know the equation, in our case Eq. (1.4), tells us that stock prices are equal to the present value of future dividends:

[7] This is the key concept of the 'risk free asset rate of return' which underlies mainstream models. In neoclassical equilibrium, the risk-free rate of return is the rate of interest. The return on risky assets include the risk-free asset and the 'risk premium' associated with the asset. This concept is introduced in section (1c.2) and is derived/ elaborated further in chapter 2.

$$P_t = \frac{D_{t+1}}{(1+rror)} + \ldots + \frac{D_{t+n}}{(1+rror)^n} \qquad (1.4)$$

Under the additional assumption that dividends grow at some constant rate (g), reflecting growth in corporate profitability under a fixed rate of distribution between dividends and retained earnings, the formula in (1.4) is modified to read the Gordon model (Gordon 1962).

$$P_t = \frac{D_{t+1}}{rror - g}, \qquad rror > g \qquad (1.5.)$$

1b. The Required Rate of Return in Present Value Models: Theory and Empirical Performance

Although the required rate of return ($rror_t$) has not been specified yet, we rushed to assume that it is constant. This assumption was crucial for the derivation of the present value formula. Yet, it raises an important theoretical question: Is this is a matter of mathematical tractability of the present value formula itself, or a result justified also by the underlying theory?

If we assume perfect competition and perfect capital markets, the required (risk-adjusted) rate of return is the long-term interest rate. A measure which in neoclassical theory does not exhibit any inherent variability or any long-term trend. Furthermore, as we will elaborate in this and the next chapter, the properties of the rate of return (profit) in neoclassical equilibrium imply also calculable risk and a roughly stable risk premium. Nevertheless, constant or slowly varying dividends and required returns are also the reason for the poor empirical performance of present value models (DCF, ECF, Gordon, etc.).

In a series of papers written in the 1980s Robert Shiller brought to our attention that variations in stock prices cannot be explained by the volatility of corporate dividends (Shiller 1981, 1989a, 1989b). His insight was that, in an efficient market, the variance of present value stock prices calculated by equation (1.4) above must be greater than the variance of actual stock prices and price indexes (Shiller 1981, LeRoy and Porter 1981). This result can be derived easily if we write the 'efficient market' model as follows:

$$P_t = P_t^* + U_t \qquad (1.6)$$

Where *P* is either a stock price or stock index price estimated by a DCF model (Eq. 1.4). Accordingly, *P** denotes actual prices and *U* is the forecast error. Actual prices and the forecast error are assumed uncorrelated. Therefore, the variance of the estimated prices is the sum of variances of actual prices and the error term. In this context, the following relation holds:

$$VAR(P_t) = VAR(P_t^*) + VAR(U_t) \Rightarrow VAR(P_t) > VAR(P_t^*) \qquad (1.7)$$

Both in the case of individual stocks as well as indexes, the variance of the forecast error is positive. This means that if the efficient market hypothesis holds the variance of present value prices must be greater than the variance of actual prices. A mere comparison of the time series of present value and actual prices is sufficient for rejecting the efficient market hypothesis if expected prices are estimated from present value models.

In his 1989 paper, Shiller extends this result further. The efficient market model has a second important property. If we have two individual stocks or the off-diagonal element of the variance-covariance matrix of a portfolio or a stock index, then the covariance of actual prices should be equal or greater than that of present value prices. This implies of course that the covariance of the forecast error terms is less than zero. In mathematical notation:

$$\begin{aligned} &\text{if } Cov(P_{it}, P_{jt}) = Cov(P_{it}^*, P_{jt}^*) + Cov(U_{it}, U_{jt}) \\ &\text{then } Cov(P_{it}, P_{jt}) < Cov(P_{it}^*, P_{jt}^*) \text{ if } Cov(U_{it}, U_{jt}) < 0 \qquad (1.8) \end{aligned}$$

Equation (1.8) simply tells us that if the covariance of actual prices is to exceed that of present value prices, then the forecast error term of the two share prices must be negatively correlated. In the context of an ‘efficient market’, this case is referred to as ‘positive information pooling’. This means that, in an efficient market, there is an advantage in predicting the aggregate, or index price, of two stocks rather than the price of each stock separately since the variance of the error terms for the index will be less than the sum of the variances of its components denoted herein by (*U*).

Equation (1.8) is therefore a way of generalizing inequality (1.7) to include covariance. Regretfully, this version of the efficient market model fails empirical testing as well. In all calculations conducted by Shiller the covariance of the error terms is positive (Shiller 1989).

This latter result is so important that it questions the heart of portfolio choice theory. It suggests that portfolios exhibit excess volatility compared to the sum volatility of the assets which comprise it when equilibrium prices are calculated from present value models.

In mathematical notation, the empirical investigation in Shiller 1989 shows that:

$$Cov\left(U_{it}, U_{jt}\right) > 0 \qquad (1.9)$$

Therefore, excessive volatility portfolios are the norm in capital markets if expected prices are calculated from DCF models. Other empirical studies show the striking difference between actual and present value prices (Shiller 1989b). In short present value, models fail the assumptions of portfolio choice theory, the efficient market hypothesis, and empirical relevance in general.

1c. The Profit Based Approach

The empirical performance of the present value models poses important theoretical issues. Although these models begin from the key notion of equalization of returns between sectors[8] they apply restrictive assumptions that undermine their explanatory power. Specifically, the assumed smooth growth of dividends and, mainly, the constant discount factors lead to poor empirical results. Moreover, the basic postulates of the efficient market hypothesis and portfolio choice theory are empirically rejected, if investment decisions are formulated on the grounds of present value models (Shiller 1981, 1989a, 1989b). The obvious question is whether these results are confined to the present value models as implied by some mainstream theorists (Campbell 1991) or they relate to modern investment theory overall.

One way of addressing the matter is to consider a possible alternative and elaborate on its assumptions in contrast to modern finance theory, in general, and present value models, in particular. Such an alternative has been outlined by Anwar Shaikh

[8] Meaning the corporate and the financial sector

(Shaikh 1997). Although he retains the key assumption of equalization between corporate and stock market returns, he attempts to describe the process by extending the classical/Marxian theory of competition. The latter suggests that competition creates both the tendency of equalization but also the differentiation of rates of return. In commodity markets, competition inside the same industry tends to differentiate rates of return, whereas competition between industries tends to equalize them. The overall result is a turbulent process where rates of return ceaselessly fluctuate around each other (Botwinick 1993, Mueller 1986).

In chapter 3 I will extend this concept to encompass interest rates and will consider its implications on the valuation of derivatives and asset-backed securities. For now, we will confine our analysis only to stocks. Stocks are the only financial asset where, both in mainstream theory and the 'profit-based approach', returns between the corporate and the financial sector are expected to be (roughly) equal.[9] Yet, the anticipated dynamics of expected returns and the equalization process are quite different in the two theories.

1c.1. Capital Mobility and Equalization of Rates of Return under Constant and Variable Incremental Rates of Return

In the context of the 'profit-based approach,' the question is how the turbulent rate of return of the corporate sector reflects on stock market returns and vice versa. To address the matter, we need to answer two questions. First, the behavior of stock market participants, since we have a large number of non-capitalist participants in the stock exchange.[10] Second, we must specify which rate of return is relevant to the mobility of capital, since it is the mobility of capital between the corporate and the financial sector that brings the equalization of returns. These issues will be dealt with in a formal way in Chapter 3; however, some preliminary remarks are appropriate here.

For the first question, the answer is that only financial capital can make sufficient additions or subtractions of capital, thereby regulating the required rate of return. This means that financial capital rules over non-capitalist small investors. In short, the 'profit-based approach' argues the exact opposite from the main conclusion of the 'efficient market hypothesis'. The latter argues that the absence of restricted or 'asymmetric information' ensures everyone will receive the average market return.

[9] In the 'profit-based approach' interest rates are expected to remain below the profit rate of the corporate sector during periods of normal accumulation. As In will show in chapter 3 this has nothing to do with risk but with the competition between borrowers and lenders and the consequent equalization of returns between different applications of capital (Stravelakis 2012, Shaikh 2015).

[10] The people we call small investors in everyday language.

In contrast, for the 'profit-based approach' the amount of capital under management matters since financial capital regulates the rate of return. The underlying reasoning lies in the response to the second question.

It is quite reasonable to assume that the rate of return on the most recent investment regulates the mobility of capital between sectors (Cohen et al. 1987).[11] Shaikh calls this measure the incremental rate of profit (hereafter *Irop*) and we will stick to the same terminology. If investment in a sector of the economy exhibits higher returns, this will attract fresh funds to that sector. A highly volatile incremental rate of profit implies unceasing adjustments between commodity and financial markets because the equalization of returns between the corporate and the financial sector is constantly disrupted. The reason for the disruption is capitalist competition in the classical sense. It brings the persistent differentiation of returns between corporations, industries, and sectors, resulting from the introduction of new products and production techniques. This means that causality runs from the commodity to the financial sector. In other words, the stock market rate of return tends to become equalized with the incremental rate of profit.[12] For these adjustments to take place sufficient additions or subtractions of capital constantly occur in the financial markets. The magnitude of the required flows suggests that only financial capital is capable of effectively mobilizing such funds and/or build adequate financial assets positions. In this regard, it regulates the rate of return.

One of the key arguments elaborated herein is that constant (or slowly varying), versus highly variable, required rates of return reflect the different theoretical foundations underlying mainstream finance theory and the 'profit-based approach' respectively. This will become evident from the determination of the incremental rate of profit and the elaboration of the equalization between corporate and stock market returns in mainstream theory which follows.

For mainstream theory, the incremental rate of profit is assumed constant or slowly varying for the life of the investment. In an important paper Elton and Gruber (1976) analytically investigate investment selection, required return, and equalization of returns from the mainstream perspective. They investigate alternative 'investment

[11] As I will refer in passing in various instances and elaborate in chapter 3, contrary to mainstream theory, but very much in line with the profit-based approach the incremental rate of profit is expected to be different from the average rate. This result has important implications on stock valuation and the analysis of financial crises as the trigger mechanism of major depressions (Stravelakis 2014).

[12] In the same fashion competition between borrowers and lenders (Stravelakis 2012), leading to equalization between corporate and banking rates of return (Shaikh 2015), ensure that corporate loan and bond rates remain below the rate of profit and consequently equity returns.

opportunities schedules' and their evolution in time. The simplest assumption taken under this rationale is that the growth rate of total investments available at any rate of return is constant over time. This implies that two or more corporations undertaking the same or similar investments will not compete for market shares by lowering prices. Both will act as price takers trying to maximize profit given the market price. Their choice may only affect the number of investment opportunities available for the future at any rate. If the rate of growth of investment opportunities is constant, the investment opportunities schedule looks as follows (similar figures can be found in Elton and Gruber 1976: 527-528):

Figure 1.1

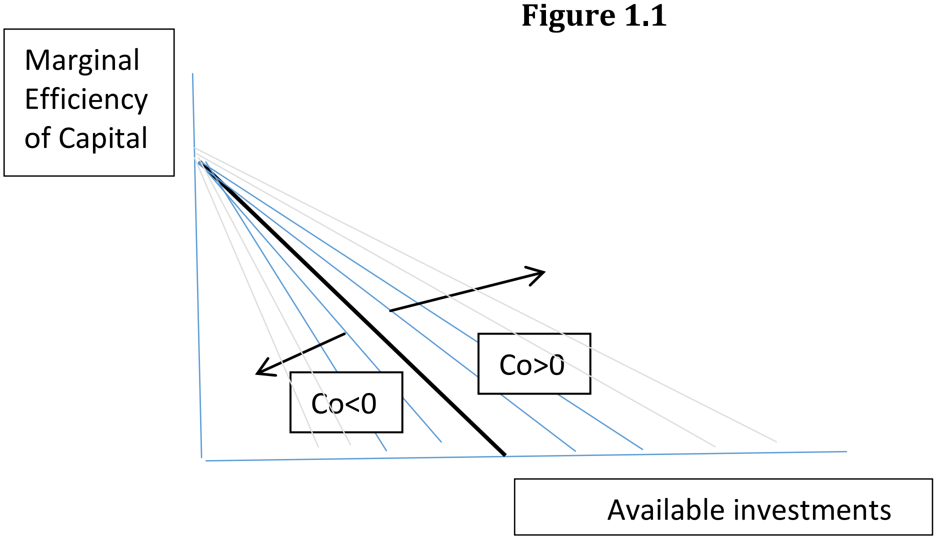


Figure 1.1 shows that the marginal efficiency of capital is negatively associated with the available investments, i.e., the greater the return, the less the number of investments associated with it. The lines to the right-hand side of the black bold line, which represents investment opportunities at the present, are associated with a positive rate of growth in investment opportunities (c_o>0). In other words, the future promises more investment opportunities given the rate of return. The opposite case is depicted by the lines to the left of the black bold line which implies negative growth in investment opportunities. The special case where c_o=0 represents the Solomon (1963) constant investment model. It replicates a situation where investment opportunities remain constant in time, as presented by the black bold line. This means that corporations invest a fixed amount of their profits each period.

It is easy to present this rationale algebraically. The key assumption is that current investment is a function of past investment. This implies that returns remain constant and, in this regard, required returns are determined exogenously. In Elton and Gruber (1976) this is presented in equation (1.10) where I have assumed that (c_o) is positive for the sake of the example. The model can be written as follows:

$$I(t) = c_1 + c_0 A(t) \Rightarrow \frac{dI}{dt} = c_0 \frac{dA}{dt} \text{, given than } I(t) \equiv \frac{dA}{dt} \text{ by definition, then,}$$

$$g(t) \equiv \frac{\frac{dI}{dt}}{I(t)} = \frac{c_0 \frac{dA}{dt}}{\frac{dA}{dt}} = c_0, \qquad c_0 > 0 \qquad (1.10)$$

Where $A(t)$ is total assets, and $I(t)$ is total investment. The latter is equal, by definition, to the time derivative of total assets $A(t)$. Assuming, at the same time, that investment is a linear function of assets as in (1.10), investment opportunities will grow at a constant rate (c_o), the growth rate denoted by $g(t)$.

This result has certain valuation implications which are summarized in equation (1.11). The equation is the solution of the corporate value maximization exercise presented in Elton and Gruber (1976) for exogenously determined time dependency of Investments[13].

$$r + I(0) \cdot \frac{\partial r}{\partial I(0)} = k \ (1.11)$$

In (1.11) (r) is the average rate of return earned from investments at time zero I(0) and the partial derivative $\frac{\partial r}{\partial I(0)}$ the change in (r) due to changes in current investment. Therefore, the term on the left-hand side is the marginal return on investment. If growth is to be maintained the marginal return must be equal to the exogenous shareholders' cut-off rate of return (k).

The relation has a clear economic meaning. For sustainable growth, the rate of return on investment (r) must be a positive function of the invested amount $I(0)$. Otherwise, equation 1.11 indicates that the shareholders' required rate of return (k) will always exceed the return on investment. Therefore, no project will be undertaken. In other words, (k) is the cutoff rate below which the corporation stops investing. It comes as no surprise that under perfect competition greater investment implies higher anticipated return. This point has triggered heated debate over the years between mainstream and heterodox economists, but also inside the heterodox tradition. For neoclassical economists, it is outrageous to assume that corporations will undertake investments that involve a lower rate of profit. This also became the contention of certain heterodox economists (Hilferding, Dobb, Okishio, Roemer).

[13] The idea is that past investments given the exogenous investment opportunities rate c_o

However, all these heterodox economists share the neoclassical assumption of perfect competition which suggests that all corporations are price takers. If contrary to neoclassical assertions, corporations are prepared to cut prices in order to attack the market share of their competitor things change dramatically. Corporations focus on investments that involve lower production costs since they ensure a higher profit margin at the prevailing price which goes together with the ability to introduce a lower price. However, such investments usually involve higher investment costs and higher total costs. "The productive powers of labor must be paid for" as Marx states (Marx, 1973, *Grundrisse*: 776). On these grounds, the Marxian argument of the falling rate of profit is developed. One of the implications of this argument is a highly volatile rate of return on new investment. The long-term tendency of the rate of profit to fall requires new investments involving new products and techniques which enable capitalists to exploit workers more intensively. It materializes through capitalist competition which is fought through the "'cheapening of commodities" (Marx 1867, *Capital*, Vol. I: 626). This indicates among other issues that the notion of risk is quite different between the classical and the neoclassical/modern finance theory. In the classical context, but also in real life, a whole set of new products or techniques can appear simultaneously altering corporate returns. Therefore, financial investments take place in an environment of true uncertainty rather than calculable risk. This is a matter that will come up here-below and in various instances in this and the following chapters.

Before we move to this, some additional attributes of the analytical illustration laid out above must be stressed. In the context of mainstream investment theory, everybody knows the investment opportunities available. Consequently, shareholders set the corporate required rate of return given the risk they are prepared to undertake. Thereafter corporations adjust their projects to meet shareholders' requirements and as result asset values adjust to the required rates of return. This implies that causality runs from the financial, to the corporate sector which means also that required returns are equally available to big and small investors, or, in other words, to both capitalist and non-capitalist stakeholders. It is only privileged information or market distortions described by notions like the 'principal-agent problem' that can give an advantage to particular shareholders or shareholders' groups. Although equalization of returns between the corporate and the financial sector is achieved through equation 1.11 the whole result rests on corporate returns which are assumed roughly constant. Otherwise, the value maximization exercise becomes impossible.

Elton and Gruber (1976) suggest in their paper that the required rate of return (k) is the cost of capital as in the so-called 'Modigliani–Miller theorem'.[14] The latter argues that, in the absence of taxes, corporations are indifferent whether to finance their activity through debt or equity (Modigliani and Miller 1958, 1963, Miller 1988). This comes as no surprise since under a constant investment rate of return and smooth investment opportunities there is no difference whether an investment is financed via debt or equity, since the expected 'rate of profit of enterprise' will be roughly constant.[15] Therefore, corporate default risks are limited and random, in the sense that massive defaults cannot occur in the neoclassical world.

In conclusion, both in mainstream theory and the 'profit-based approach' capital mobility will tend to equalize corporate and stock market returns. However, the process is quite different. In mainstream theory, due to perfect competition and perfect capital markets, investors can identify their required rate of return which serves as the cut-off rate on new investment. This means that the required rate of return is roughly constant since investment opportunities are known in advance and the rate of return remains the same for the lifetime of the investment. Consequently, the average and incremental rates of return (profit) are (almost) equal. The above reveals the rationale behind the constant discount factor in present value models (DCF and ECF). In this world capital mobility between the corporate and financial sectors is quite limited. Investors will add or withdraw equity funds to maintain their required return (k). In practice, they will add capital when the rate of return exceeds (k) and will withdraw capital when the rate of return falls below (k). This implies further that equity trading will be extremely limited. In other words, in the Modern Investment Theory world, stock market positions are long-term rather than short-term.

1c.2. Consumption versus Profitability or Risk versus Uncertainty

As already noted, contrary to modern finance theory, the profit-based approach anticipates highly volatile returns on new investment. On these grounds, it is

[14] This is the reason Elton and Gruber formulate their valuation model as an Earnings Cash Flow Model rather than a Dividend Cash Flow Model. Under the Modigliani-Miller theorem distribution between dividends and retained earnings plays no part in company valuation.

[15] The rate of profit of enterprise is the difference of the rate of profit with the rate of interest. In the context of Modern Investment Theory this is considered as a measure of risk. For Marx, it is the main determinant of corporate investment. In the Modigliani Miller theorem, this wedge is assumed roughly constant. It could be no different in a world where investment lifetime rate of return is known in advance and is closely related to the interest rate which is the risk-free rate of return. Therefore, capital structure plays no part in required returns, in the absence of taxes.

reasonable to attempt to estimate the rate of return on new investment directly from corporate or national income accounts data since competition will constantly bring new values for this measure. One way of specifying this variable is to calculate the rate of return from the ratio of average profit to the total capital invested. However, this is more of an average rate of profit rather than an incremental one. In other words, it is an attempt to estimate the lifetime rate of return on investment without the restrictive assumptions of mainstream theory[16].

Nevertheless, the incremental rate of profit is a short-run measure. Therefore, its definition must reflect this property. Variations in current corporate profitability can serve the purpose since current corporate profits reflect transitory factors including short term disequilibrium dynamics. Studying business cycles as well as crises and depressions has shown that current corporate profitability exhibits great fluctuations during such periods. Moreover, additional aspects reflecting immediate developments in the corporate competitive struggle also reflect on current profitability. Generalizing, the notion of capitalist production as production for profit, which underlies the classical political economy, implies also highly volatile profitability. Therefore, given our previous discussion on causality[17], we can anticipate that extremely high or low profits alter capital flows which bring new profit and loss positions in the stock exchange. This implies that stock market investments are inherently short term. The latter means also that investment decisions are taken in real-time under conditions of true uncertainty, as opposed to calculable risk.

Important theoretical issues relating to the nature of risk arise from this last point. Calculable risk is based on the idea of a risk-free rate. The notion of a rate of return earned by every company or investor stems from neoclassical equilibrium where the (risk-free) rate of return is the rate of interest. However, the level and volatility of the (risk-free) rate of interest also determine the level of the risk premium. The reason is that volatility of returns, both on the 'risk-free rate' and 'risky assets', is expected to come only from fluctuations in the rate of growth of per capita

[16] Although the average rate of profit takes account of variations in capacity utilization it is a 'slow' variable in Marxist political economy. Its main component the 'basic' or 'normal capacity utilization' rate of profit depends on the 'organic composition of capital' which changes quite slowly since it reflects changes in technology, or the 'technical composition of capital' in Marxist terminology.

[17] As we saw, mainstream theory and the profit-based approach hold opposite sides on whether corporations adjust to the required rate of return imposed by the financial market, or vice versa. Mainstream theory argues that shareholders impose the cut off rate of return on corporate investment. Therefore, causality runs from the financial to the corporate sector. In the 'profit-based approach' the opposite holds. The highly volatile incremental rate of profit suggests that the required rate of return of the stock exchange adjusts to the returns in the corporate sector.

consumption.[18] The idea is that people take part in economic activity to gain satisfaction from consuming their wealth. On these grounds, it is not the (mathematical) expectation of the objective monetary outcome which matters but the subjective utility from spending it. This idea was introduced by Daniel Bernoulli in 1738.[19] He showed that the mathematical expectation of independent risky economic endeavors indicates that there is no benefit from diversification. However, if individuals have concave utility functions for consumption[20]/ wealth, implying risk aversion, then they can maximize their utility by diversifying. This idea became the basis of maximizing the utility of consumption and wealth through diversification among financial assets in the 'Modern Investment theory' (Rubinstein 2002). Of course, this implies that individuals may have different (subjective) risk preferences. To overcome this obstacle, mainstream theory applies the known 'representative agent' assumption. In other words, mainstream models assume that all investors have the same utility function.[21]

Important properties of mainstream financial asset valuation models are revealed from this discussion. First, returns on different financial assets must be independent of each other for risk-adjusted returns to become equalized. If individual asset returns are not interdependent, then diversification will not lead to a set of common factors that determine them. As indicated above (section 1b) if asset returns are intercorrelated then portfolios may exhibit excess volatility relative to the assets which comprise them. Moreover, equalization of returns based on the risk- free asset and different risk premia depending on the covariance with the common factor(s) are not attainable. Second, returns must be stationary, since they emerge from the

[18] This can be considered also a contradiction in mainstream theory. If volatility is the source of risk as it is usually assumed, then a 'risk free' asset should be constant.

[19] It is, of course, the formulation of the famous St. Petersburg's paradox that led Bernoulli to develop the notion of a concave (risk-averse) utility function. More to the point, however, is an example provided by Bernoulli referring to the risk undertaken by 'Sempronius'. "Sempronius owns goods at home worth a total of 4000 ducats and in addition possesses 8000 ducats worth of commodities in foreign countries from where they can only be transported by sea. However, our daily experience teaches us that of ten ships one perishes" (Bernoulli 1738, §16). Bernoulli shows that Sempronius can increase his expected utility by diversifying, i.e., by carrying his goods in two ships, rather than one, but not the actual mathematical expectation of his wealth. He adds that "[t]his counsel will be equally serviceable for those who invest their fortunes in foreign bills of exchange and other hazardous enterprises".

[20] Bernoulli (1738) used wealth in his utility function. In neoclassical theory, it is consumption that enters the utility function. See, e.g., Mehra and Prescott (1985) where the utility function depends on the rate of growth of per capita consumption. I adopt this formulation in my discussion of neoclassical theory.

[21] This way banks and financial institutions are pushed out of the mainstream picture of financial markets. As we will see in chapter 3 this is a matter with important implications on the determination of the rate interest and the equalization of returns between different applications of capital.

stable growth rate of per capita consumption underlying neoclassical equilibrium. Third, relative risk aversion is constant. This means that risk preferences do not change with the level of consumption (or wealth).[22]

However, these properties imply also that the volatility of the risk- free asset and the risk premium must be compatible. In other words, the volatility of the risk- free asset should reflect on the level of the risk premium since both depend on per capita consumption and relative risk aversion is constant. The latter implies that, under stationary returns, resulting from neoclassical equilibrium, risk and consequently the risk premium must be quite limited.[23]

Mainstream theory has acknowledged this fact. In 1985 Rajnish Mehra and Edward Prescott (1985) presented a paper where they tried to ascertain the compatibility of the actual risk-free rate and risk premium under the assumptions of an Arrow-Debreu frictionless, liquidity unconstrained model. In such models, it is variations in (the rate of growth of) consumption rather than profitability which determines the level and dynamics of equity prices. This rationale explains also the theoretical foundations underlying DCF models. Dividends reflect asset holders' consumption patterns which determine asset prices, at least in part. These points will become evident from the exposition which follows.

In the neoclassical context, considered hereafter, a stationary rate of return on equities is partially justified from the assumption of a constrained utility function of the following form:

$$U(con, \alpha) = \frac{con^{1-\alpha} - 1}{1-\alpha} \quad (1.12)$$

Equation 1.12 is an increasing concave utility function depending on per capita consumption (*con*) and the parameter (α) which determines the curvature or, in other words, relative risk aversion.[24] Mehra and Prescott assume further that the rate of growth of per capita consumption follows a Markov chain process. This means that it is stationary as well and follows a random growth path.

---

[22] As we will see in chapter 2 these utility functions were introduced as a solution to the irrational behavioral patterns implied by quadratic utility functions underlying the CAPM (Ross 1976, Rothschild and Stiglitz 1970).

[23] As we will show in the next chapter asset pricing models, especially Arbitrage Pricing Theory are built on the exact same principle. In their context, constant risk aversion ensures that risk preferences will not be altered if the number of financial assets is increased.

[24] It is easy to prove that this utility function has the property of constant relative risk aversion (CRRA), as defined by the Pratt-Arrow measure (-*cu''*/*u'*). Simple math shows that this measure is equal to α. This utility function is a staple function of modern macroeconomics. See, e.g., Romer 2012: 50.

The economy has one representative household with ordered preferences following random consumption paths under the utility function 1.12. The latter implies a second behavioral parameter which is a subjective time discount factor denoted by (β).
The anticipated behavioral parameter values are as follows:

$$0 < \alpha < \infty,\ 0 < \beta < 1 \quad (1.13)$$

Furthermore, our economy has one corporation producing one consumption good and offering one single equity traded ex-dividend, where the dividend is corporate output at the time (t). In this context, output is constrained not to be greater than y_t and the rate of growth of output is determined by the following equation:

$$y_{t+1} = x_{t+1} \cdot y_t \quad (1.14)$$

Where $x_{t+1} \in [\lambda_1, \lambda_2, \dots, \lambda_n]$ is the rate of growth which satisfies a Markov chain involving (n) 'states', denoted by λ, for which the following stochastic relation holds:

$$Pr\{x_{t+1} = \lambda_i; x_t = \lambda_j\} = \varphi_{ij} \quad (1.15)$$

Equation 1.15 denotes an ergodic Markov chain i.e., a situation of recurring non-periodical 'states' of the economy with a certain probability (Pr) of occurrence. Furthermore, all λ, s and output at time zero (y_0) are assumed positive. Given this sequence of assumptions the equity price equation can be written as follows:

$$P_t = E_t\{\sum_{s=t+1}^{\infty} \beta^{s-t} \cdot \frac{U'_s}{U'_t} \cdot d_s\} \quad (1.16)$$

Where (d) denotes corporate dividend, U' the first derivative of 1.12, and (E) denotes the conditional expectation operator. Equation 1.16 valuates corporate stocks in terms of the consumption good offered by the single company of our economy. This way the rate of growth of per capita consumption is equal to the rate of growth of the economy. The latter implies that the ultimate objective of investment is future consumption and not profitability as in the 'profit-based approach'[25]. Given 1.14,

[25] In classical political economy profitability is the objective and motivation of economic activity in capitalism. Firms are not passive price takers but actively seek the market share if their competitors.

remembering that the first derivative of 1.12 is $con^{-\alpha}$, and substituting in 1.16 gives the following formula for equilibrium prices:

$$p_t^{e} = E\left\{\sum_{s=t+1}^{\infty} \beta^{s-t} \cdot \frac{y_t{}^{\alpha}}{y_s{}^{\alpha}} \cdot y_s\right\} \text{(1.17)}$$

Equation 1.17 has this form because the first derivative of the utility function (EQ. 1.12 combined with equation 1.14) at the time (s) is $1/y_s^{\alpha}$ and consequently, the first derivative at the time (t)[26] is $1/y_t^{\alpha}$. In the same fashion, the expected dividend at the time (s) is $d_s = y_s$. This formula implies that there exists an ergodic Markov chain defined above (Eq. 1.15) which is denoted by *x*. In this regard, x_t, y_t define all previous shocks in the economy from time zero to time (t). Therefore, they are 'state' variables sufficient to predict the evolution of our economy. Given 1.14 we can write y_s as follows:

$$y_s = y_t \cdot x_{t+1} \cdot \cdots \cdot x_s \text{ (1.18)}$$

Equation 1.18 indicates that equity prices are homogeneous of degree one in y_t. This means that if the endowment at time (t) doubles then equilibrium prices will double as well. Furthermore, since equilibrium prices are dependent on the state variables y_t, x_t then equilibrium prices are time-invariant. The random consumption path assumption, which under the utility function 1.12 also determines investment and output, implies that time becomes immaterial. Equilibrium equity values reflect a set of 'states of the economy' with a certain probability of appearance depending on the current 'state'. For example, a 'bull market' that lasts for the whole week is followed by a second bull market week by a probability of say 90%. Time does not bring new states, it is the random non-periodical repetition of a set of known circumstances. In other words, because returns are stationary our economy is not a dynamic one, where time establishes a trend, but a static one. It is a world where a good grasp of the past is sufficient for weighing your options at the present with relative certainty. This confines risk in real-time to certain probable outcomes with finite probabilities. At the same time, it confines risk premia through the parameter (α) which reflects

Therefore, investment is not abstention from current consumption in anticipation of higher future consumption but an active claim on future profits.

[26] *t* denotes the present.

risk preferences. The whole rationale will become evident by taking the time subscript out of equation 1.17. In other words, we assume $y_t = con$ and $x_t = \lambda_j$. In this event 1.17 can be written in the following equivalent form:

$$p^e(con,i) = \beta \cdot \sum_{j=1}^{n} \varphi_{ij} \cdot \frac{con^{\alpha}}{\lambda^{\alpha}{}_{j} \cdot con^{\alpha}} \cdot [p^e(\lambda_j con, j) + \lambda_j \cdot con] \ (1.19)$$

Equation 1.19 tells us that the current equilibrium equity price is equal to the weighted average of cum dividend prices in each state of the economy discounted by the anticipated rate of growth in each state raised at the level of risk aversion (α). The probability of each sequence (φ_{ij}) serves as the weight and the time discount factor (β) is the coefficient. Since 1.17, 1.19 are homogeneous of degree one in (y_t) it is also homogeneous in (*con*), given that $y_t = con$. This implies that equilibrium prices are a linear function of per capita consumption under the following form:

$$p^e(con,i) = w_i \cdot con \ (1.20)$$

Where (w_i) is a particular constant attributed to each state (*i*). Simplifying 1.19, using 1.20 dividing both sides by (*con*), and equalizing the two forms gives the following relation:

$$w_i = \beta \cdot \sum_{j=1}^{n} \varphi_{ij} \cdot \lambda_j{}^{1-\alpha} \cdot (w_j + 1) \ (1.21)$$

1.21 is a system of n equations, equal to the number of 'states' existing under the Markov chain, with n unknowns which guarantees a unique positive solution. Taking the definition of returns as in equation 1.1, substituting 1.19 and making use of 1.20 gives the following formula for equilibrium returns:

$$r^e{}_{ij} = \frac{p^e(\lambda_j con, j) + \lambda_j \cdot con - p^e(con,i)}{p^e} \ from\ 1.24 \rightarrow$$

$$r_{ij}{}^e = \frac{\lambda_j \cdot w_j \cdot con + \lambda_j \cdot con - w_i \cdot con}{w_i \cdot con} = \frac{\lambda_j \cdot (w_j - 1)}{w_i} - 1$$

(1.22)

Equation 1.22 defines returns as the aggregate of the next 'state' price $P^e = (\lambda_j con, j)$ plus next 'state' dividend $\lambda_j con$ minus current 'state' price

$P^e(con, i)$. It is equivalent to definition 1.1 with the difference that it is time-invariant. This means that it considers the future as a set of known 'states' under the ergodic Markov chain assumption. Making use of the constant scale assumption made above, returns become a function of the rate of growth of per capita consumption (λ_j), which is also the rate of growth of output by assumption (eq. 1.18) and the scale coefficients $w_{i,j}$. Since price equations like 1.19 are homogeneous of degree one on per capita consumption (*con*), this means that the Euler theorem applies, the scale coefficients (w_{ig}) are the derivatives of 1.19 with respect to per capita consumption. Therefore, returns depend solely on fluctuations of the rate of growth of per capita consumption and the scale coefficients. On these grounds, expected returns can be written as follows:

$$R^e{}_i = \sum_{j=1}^{n} \varphi_{ij} \cdot r_{ij}{}^e \quad (1.23)$$

Expected returns (*R*) conditional on the current state (*i*) are the weighted average of returns under all possible 'states' the probability of each state (φ_{ij}) serving as the weight.

To conclude the model, we need to determine returns on the risk-free asset. The latter is a one period bill that pays one unit of the consumption good in the next period with certainty. From equation 1.16 on asset pricing and taking into account that we are referring to a risk-free asset for which $d_s = d = 1$ we arrive at the following form:

$$p_i{}^f = \beta \cdot \sum_{j=1}^{n} \varphi_{ij} \cdot \frac{U'(\lambda_j con)}{U'(con)} = \beta \cdot \sum_{j=1}^{n} \varphi_{ij} / \lambda_j{}^\alpha \quad (1.24)$$

Since we are pricing a 'risk-free' asset the conditional probability operator E(.) is dropped. The additional assumptions eliminating the time subscript are retained and, as result, the price is the weighted average of the reciprocal of the rate of growth at each state raised at the level of risk aversion, the time discount factor serving as the coefficient, and the probability of each state as weigh.

The certain return on the riskless security at 'state' (*con*, *i*) is given by the following formula:

$$R_i{}^f = {}^1/_{p_i{}^f} - 1 \quad (1.25)$$

Equation 1.25 tells us that for a positive return the price of the 'risk-free' asset must be less than unity. In other words, to receive one unit of the consumption good of our economy in the next period you must forego less than a unit in the current period.
The equations so far fully determine the model. For the exercise conducted by Mehra and Prescott however, the variables need to be specified independently from current state conditionality. In this regard, the model is reconstructed using means (time averages) rather than probabilities conditional on the current state. This is achieved by taking advantage of the ergodic property of the Markov chain. The latter enables us to define a set of probabilities at 'state' (i) which satisfies the following relations:

$$\pi = \varphi^T \cdot \pi_i \qquad (1.26)$$

$$\sum_{i=1}^{n} \pi_i = 1, \quad \varphi^T = \{\varphi_{ji}\}$$

Equation 1.26 involves a vector of stationary probabilities at 'state' (π_i) and the vector (π) is the vector of solutions of the system. On these grounds time sample values are assumed to converge in probability to the following expected return formulas:

$$R^e = \sum_{i=1}^{n} \pi_i \cdot {R_i}^e, \quad R^f = \sum_{i=1}^{n} \pi_i \cdot {R_i}^f$$

(1.27)

Equations 1.22-1.27 provide an algorithm suitable for the empirical exercise which seeks an answer to the following question: Is the equity risk premium justified by the underlying fundamentals of neoclassical frictionless equilibrium models? In order to conduct the test Mehta and Prescott restricted the process to the following scenarios of rates of growth of per capita consumption:

$$\lambda_1 = 1 + \mu + \delta, \quad \lambda_2 = 1 + \mu - \delta \ and \ \varphi_{11} = \varphi_{12} = \varphi, \qquad \varphi_{21} = \varphi_{22} = 1 - \varphi \ (1.28)$$

Where (μ) is the rate of growth of per capita consumption which serves also as the rate of growth of output, (δ) is the standard deviation of the rate of growth of per capita consumption, and (φ) is associated with the first-order serial correlation of this growth rate. All parameters were calculated with respect to the stationary distribution implied by the model under equation 1.26. Considering U.S. data for the period 1889-1978 the relevant average values are μ=0,018, δ=0,036. Furthermore, the first-order serial correlation of the rate of growth is (-0,14) which under 1.26 implies that φ=0,46. Afterward using extensive bibliographic references Mehta and Prescott limited the value of α to be less than ten (10) while β remained inside the bracket between zero and unity [0< β <1]. Using this data, they calculated the admissible region of the risk premium calculated from equations 1.27. Figure 1.2 summarizes the results:

Figure 1.2

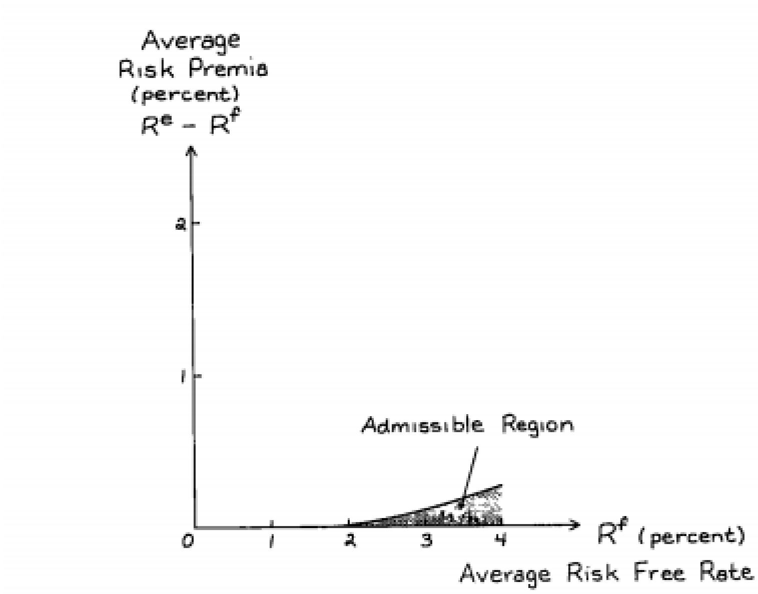


Fig. 4. Set of admissible average equity risk premia and real returns.

Figure 1.2, appearing as Fig. 4 in Mehta and Prescott (1985: 155) plots the admissible risk premium, calculated on the vertical axis, based upon a certain value of the 'risk-free' rate appearing on the horizontal axis. The admissible region is on and below the solid line. Returns on both the risk-free asset and equity depend on the rate of growth of per capita consumption, determined in the model by the technology parameters λ, φ and the behavioral parameters α, β. The real return on the 'risk-free' asset in the United States for the period under investigation was 0,8% whereas the average annual real return on equity index was 6,98%, therefore the average annual risk premium was 6,08%. The maximum admissible risk premium as per Figure 1.2 is 0,35% well off the actual data. This difference has gone down to literature as the 'equity risk premium puzzle'.

If we take a closer look at the benchmark model, then its empirical performance becomes less amazing. In an investment selection process like the one presented under the Elton & Gruber paper (1976), competition does not affect returns. The only source of fluctuations comes from shocks in consumption. The latter reflect on output due to the constant risk aversion concave utility function. In other words, savings and investment are viewed as abstention from current consumption, and the rate of growth of per capita consumption is assumed stationary. In such a world risk is extremely limited and calculable since it depends on the stationary distribution of the rate of growth of consumption. The latter becomes apparent as in the Mehra and Prescott paper. The association between a risk-free rate of 0,8% with small volatility cannot justify a risk premium greater than 0,35% unless risk aversion is much greater than the level of 10. It is the contention that rates of return are stationary which reduces true uncertainty to calculable risk. However, this reduces risk altogether.

One final point needs to be made. If per capita consumption growth is the main determinant of stock market returns, then we implicitly assume capital markets with non-capitalist participants. In the paper considered above financial capitalists are ruled out by assumption since we only consider a 'representative household' as the only shareholder. This means that financial firms like investment funds, hedge funds, bank SPVs, etc., are passive representatives of the consumption patterns and risk preferences of their shareholders. A picture quite different from the actual operation of capital markets especially during the last thirty years.

1c.3. Variable Specification Under the Profit Based Approach

So far, we have argued that under the profit-based approach the stock market rate of return lies in the corporate sector, it is the rate of profit on new investment, otherwise referred to as the incremental rate of profit ($Irop$). Due to uncertainty, the short-term nature of stock investments and the nature of capitalist competition ($Irop$) is heavily dependent on current profitability.

Following Elton and Gruber (1991) we will assume that over short time horizons the incremental rate of profit is given from the following formula:

$$Irop_t = \frac{P_{rt} - Pr_{t-1}}{I_{t-1}}$$

(1.29)

Equation 1.29 tells us that the incremental rate of profit is the variation in real profits (P_r) normalized by last period investment I_{t-1}. The idea is that over short horizons variations in profitability will come mainly from the latest investments, or in other words from the capital most recently employed. If profit is net profit and investment is net of depreciation, then the incremental rate of profit is the net ($Irop$). If depreciation is included, then it is the gross $Irop$ approximates the net measure.

Shaikh (1997) tested the ($Irop$) gross of depreciation but net of all interest payments (for profits) against the return on the S&P 500 index minus the rate of interest. However, this modification of stock market returns does not relate to the notion of the risk premium considered in the previous section. The assumption suggests that the rate of interest is the opportunity cost for financial capital to invest in the stock exchange. As I will elaborate in chapter 3 in the Marxist theory the 'rate of profit of enterprise', i.e., the rate of profit minus the rate of interest, is the main determinant of accumulation. In this context competition between borrowers and lenders will keep interest rates below profit rates, in times of normal accumulation, bringing equality between different applications of capital (Stravelakis 2012, Shaikh 2015).

The two measures were directly compared for the period 1947-1992 and the coefficient of correlation is 0,49. Moreover, the two variables have approximately the same mean and standard deviation. In the classical theory of competition, the equality between corporate and stock market returns is constantly disrupted. The creation of new positions of arbitrage, a process we will call 'turbulent arbitrage' to distinguish it from the traditional notion of arbitrage, suggests that although the two measures can move around each other their linear correlation may be limited. Overall, these statistical findings are supportive of the initial assumptions. In chapter 4 the original and modified versions of equation 1.29 are checked with data for the S&P 500 against average corporate profitability and the real earnings per share. The results are even stronger than those of the original Shaikh paper.

The empirical strength of the profit-based approach becomes evident when tested for the determination of equity prices. More specifically, it is shown that the poor performance of DCF models is not so much due to the assumptions made regarding future dividends, but the constant return assumption. Using the returns specified under equation 1.29 we can calculate anticipated prices as follows:

$$P_t{}^w = P_{t-1} \cdot [1 + (rror_t - y_t)] \quad (1.30)$$

Where the required rate of return is $(Irop + i)$, in other words, the net incremental rate of profit plus the current bank rate of interest less $divy_t$ (dividend yield). It is obvious that equation 1.30 is equivalent to equation 1.2 solved for the future price (P_{t+1}) and the required rate of return is calculated on the grounds of the profit-based approach.

Comparing prices calculated under 1.30 with actual equity prices summarized in the S&P 500 index for the same period gives impressive results.

Warranted and actual prices were divided by the thirty-year real average earnings per share to detrend the data (Shiller 1989). The Pearson correlation coefficient between the two sets of data was 0,8 compared to 0,296 found by Shiller (Shiller 1989) under the standard dividend discount model. Similarly, Barsky and DeLong (1993) with varying dividend growth rates arrive at a 9% R^2 compared to 87.5% found by Shaikh (1997). Moreover, warranted prices calculated using eq. 1.30 have greater variability than actual prices contrary to the findings of Shiller for DCF prices discussed in section 1.b (Shiller 1981).

Summary

This chapter outlined the basic assumptions of the 'profit-based approach' of asset pricing in contrast to the assumptions of mainstream finance theory as expressed in the celebrated DCF models. Although Campbell (1991: 158) states that mathematical tractability "is one reason why the academic literature has focused for so long on this unlikely special case", it appears that DCF models reflect key assertions of mainstream theory.

Constant or stationary returns stem from neoclassical equilibrium where the rate of return is the rate of interest a measure that does not exhibit inherent fluctuations or any trend. The latter depends on the assumptions of perfect competition which together with the assumption of perfect capital markets reflects on mainstream investment theory. This way mainstream theory focuses on the lifetime rate of return of new investment instead of a short- term measure. We showed that under this rationale the required rate of return is constant and exogenously selected by corporate shareholders (Elton and Gruber 1976).

Although the profit-based approach shares the notion that the required rate of return is the rate of return on new investment it suggests that it is a highly volatile measure. This is because it relies on the classical theory of competition where competition is 'war' fought by the cheapening of commodities. Any equalization of returns between industries as well as between the corporate and financial sector is constantly disrupted by developments of all sorts, new products, new techniques etch. The result is a turbulent process where rates of return constantly fluctuate around each other never becoming exactly equal. The latter implies that persistent mobility of capital between the corporate and the financial sector is required in order to move towards equalization of returns, a mobilization that can be accomplished only by financial capital. Therefore, contrary to mainstream theory the stock market rate of return lies in the corporate sector which means also that financial capital regulates the rate of return. A conclusion in contrast to the efficient market hypothesis where, in the absence of privileged information, everyone receives the market rate of return at the end of the day.

Constant or stationary returns have also important implications for the theory of risk. At first, it is clear that focusing on lifetime rates of return on new investment suggests that stock market investments are also long-term. Moreover, in mainstream theory stationary rates of growth of per capita consumption together with constrained utility functions, suggesting constant rates of risk aversion, imply limited risk altogether. These assertions associate the risk premium with the level and volatility of the risk-free asset. In other words, the stationary distribution of the risk-free asset together with the rate of risk aversion determines the stock market return. The underlying notion is that since, through perfect competition, returns do not vary substantially or exhibit any specific trend, then it is only random variations in the rate of growth of per capita consumption that can produce fluctuations on both the returns on the risk- free asset as well as equity. Therefore, risk is quite limited but also calculable since it depends on the stationary distribution of returns of the risk- free asset.

Contrary to the smooth, calculable world of mainstream theory the highly variable required rate of return anticipated by the 'profit-based approach' suggests that stock market investments are inherently short term and take place in real-time under conditions of true uncertainty. In this regard, the profit-based approach turns the focus on developments in current profitability instead of current consumption. Current profitability reflects all sorts of transitory factors including short term disequilibrium dynamics.

Throughout the 1980s these key assumptions of modem finance theory were empirically tested. Shiller together with LeRoy and Porter showed that the volatility of stock prices is much greater than that of warranted prices calculated from DCF models, although the efficient market hypothesis suggests the opposite. To put it differently, the volatility of stock prices is unexplained in the context of mainstream theory. Given the smooth evolution of corporate dividends, this indicates that it is the constant required rate of return assumption which is ‘responsible’ for these empirical results. Shiller (1989) extended this rationale to include covariance of the error term of corporate portfolios constructed on DCF anticipated prices. Contrary to the efficient market hypothesis he found that covariance is positive. This means that there is no ‘positive information pooling’ effect. Risk mounts instead of being reduced as we add shares in a portfolio where anticipated prices come from DCF models. Mehra and Prescott showed that the unexplained variability of prices, under the stationary rate of return assumption, also undermines the calculation of the level of returns by mainstream models. Investigating stock market returns in the U.S. for ninety years they concluded that, with stationary returns in the context of an Arrow –Debreu frictionless, liquidity unconstrained model, the equity risk premium should not exceed 0,35%. The actual average equity risk premium for the period, however, was over 6%. This finding went down in literature as the ‘equity risk premium puzzle’.

The profit-based approach suggests that the rate of return must be calculated directly from the data since we anticipate highly volatile required returns. Furthermore, in our uncertain world, there is no room for risk-free returns. The difference in the incremental rate of profit ($Irop$) from the rate of interest is not a measure of risk. The interest rate is an opportunity cost for investing in the stock exchange. In chapter 3 I will show that interest rates are determined through the competition between borrowers and lenders which leads to the equalization of returns between the different applications of capital. This is the reason they remain below profit rates in times of normal accumulation. Therefore, the ‘wedge’ between stock and bond rates of return, which mystifies mainstream theory, does not have to do with risk but with the capitalist competition.

On these grounds and assuming that in the short run all change in profits comes from the most recent investment, Shaikh (1998), following Elton and Gruber (1991), defined the incremental rate of profit as the change in current profits normalized by investment. The Pearson correlation coefficient between S&P 500 actual returns and the ($Irop$) is 0,49 for the period 1947-1992 and the two sets of data share the same mean and standard deviation. However, the empirical strength of the ‘profit-based approach’ argument becomes apparent when actual prices, summarized by the S&P 500 index, are compared to warranted prices calculated under equation 1.30 for the same period. The coefficient of correlation is 0,87 (Shaikh 1997) as compared to

0,296 found by Shiller (1989) for typical DCF prices. In chapter 4 I will check the performance of a version of the model using real earnings per share as the dependent variable with similar or better results.

However, before we proceed to this elaboration, we need to establish whether and how the stationary rate of return assumption holds in asset pricing models like the CAPM and the APT and the efficient market hypothesis. The discussion will refer also to the recent mainstream elaborations, on behavioral finance, multifactor models, externalities, and market imperfections.

Chapter 2
The Required Rate of Return in Mainstream Asset Pricing Models

Introduction

The first chapter focused on the theoretical foundations and the empirical performance of dividend cash flow models. The discussion on the underlying theory demonstrated the association between constant or slowly varying required rates of return and mainstream equilibrium theory. Two key points were identified in this regard:

1) Mainstream theory focuses on a supposed lifetime rate of return of new investment, instead of a short-term measure. This is because corporations face a smooth investment possibility schedule by assumption. In this world, investors can calculate and implement a cut-off rate of return on new investment since they work on the production possibility frontier. This enables corporate managers to maximize firm value based on shareholders' preferences. Elton and Gruber (1976) have shown, that under these assumptions, the required rate of return for new investment is constant and exogenously selected by corporate shareholders. In other words, stock prices are calculated based on the constant shareholders' required return on new investment which is applied for investment selection. The latter implies that causality runs from the financial to the corporate sector and that capital mobility between the two sectors is very limited.

2) Mainstream theory assumes stationary rates of growth for per capita consumption and constant rates of risk aversion which under perfect competition implies investment decisions on the production possibility frontier. This, besides stationary rates of return, implies calculable and limited risk altogether (Mehra and Prescott 1985).

Point 1 was tested in a series of empirical papers written in the 1980s mainly by Robert Shiller (Shiller 1981, 1989a, 1989b). The tests revealed that variability in corporate dividends cannot explain the variability of stock prices. Point 2 was elaborated in the famous simulation by Mehra and Prescott (1985) which revealed the 'equity risk premium puzzle'.

The present chapter shows that constant or slowly varying required returns also underlie the asset pricing models of modern investment theory and the efficient market hypothesis. It could not be otherwise since these models (especially those based on the efficient market hypothesis) are an extension of neoclassical equilibrium theory in capital markets. However, the discussion will reveal the impact of the specific assumptions of neoclassical equilibrium in producing this outcome. Subsequently, the influence of these assumptions on the empirical performance of the various models is presented and discussed.

The exposition begins with a brief history of the evolution of Modern Investment Theory and the present state of affairs in the mainstream camp. This will facilitate the understanding of the material, although our presentation offers only a brief outline of the evolution of the mainstream theory of asset pricing.

The actual elaboration begins with the Capital Asset Pricing Model (CAPM). This is reasonable since, although its empirical performance is "poor enough to invalidate the way it is used in applications" the CAPM is still the "centerpiece of MBA investment courses" (Fama and French 2004) and dominates the field. Arbitrage Pricing Theory (APT) was offered as a solution to the 'specification problem' underlying the CAPM (Roll 1977, Ross 1976). Therefore, it follows in the presentation.

We attempt to show that, for both models, the key assumption is that the rate of return of one financial asset does not affect the returns on the other assets. In other words, 'particular (share) risk' can be eliminated through diversification. This permits the determination of asset returns from (a) common factor(s), or common 'fundamental asset(s)' in the Arrow – Debreu terminology. It is an idea that stems directly from the notion of perfect competition where corporations are assumed to be price takers. In this regard, their performance does not affect the performance of other corporations since they will not attack the market share of their competitors by applying more productive techniques and reducing prices. In a sense, it assumes a non-competition, world where the success of one corporation does not affect the profitability of its rivals. This is the real meaning of the neoclassical contention that, there exists an adjustment mechanism that smooths out any competitive advantage enjoyed by a certain firm. This has important implications both on individual and aggregate corporate returns. The latter, in the context of neoclassical equilibrium, does not exhibit any specific variability or trend. This is the theoretical foundation of the assumption of stationary returns assumed by mainstream asset pricing models. The idea is that market returns take values that represent different 'states' of the economy, known in advance, with a specific probability of occurrence. In the economic literature, this notion is known as the 'ergodic axiom'. It is the key notion that reduces uncertainty to calculable risk, as shown in the presentation of the 'equity risk premium puzzle' in Chapter 1.[27] In turn, limited and calculable systemic risk, as opposed to the 'particular share risk', determines the market return. Accordingly, the market return in the CAPM or the 'sources of systemic risk' in the APT determines, in a linear fashion, the structure of individual stock returns. The latter reflects the fundamental assumption of mainstream finance, the so-called No-Arbitrage Theorem (Ross 2005: 5), which implies also that the particular and systemic risk are uncorrelated.

Given the expected stationary rates of return suggested by both the CAPM and the APT, their poor empirical performance comes as no surprise. In this chapter's main text an extended presentation of empirical tests for both models is presented and discussed. This is done together with the presentation of some of the initial attempts of mainstream theory to arrive at a reliable pricing theory. I am referring to the theory of 'behavioral finance' (Shiller 2009) as well as ad hoc attempts like the 'Three-Factor Model' (Fama 1996). The main conclusion is that behavioral finance models interpret, the book-to-market value ratio, as a measure of 'exaggeration' in the returns of 'growth stocks' as compared to 'value stocks'. It is a theory which suggests that investors are irrational. However, for behavioral finance theorists, the benchmark of rationality is *homo economicus* and firms behave like the neoclassical competitive firm.

The 'three-factor model' also uses the book-to-market value for determining asset returns. However, Fama and French (1993) introduced the size effect and the market return as additional explanatory variables. They argue that these variables reflect hidden 'state' variables which are sources of undiversifiable risk common to all stocks. In short, they consider the 'three-factor model' as a version of the Intertemporal CAPM. But this is quite problematic. There is no theoretical reason why the performance of diversified portfolios constructed under these criteria reflect 'state variables'. It can be argued that it represents other types of investment behavior as argued by the behavioral economists, or simply undiversifiable particular risk (structural uncertainty) as argued here. The 'three-factor model' is maybe the best of many efforts to introduce variables with considerable correlation with asset returns in order to improve the empirical performance of mainstream models. However, the interpretation of the corporate size effect, for example, as a hidden common source of undiversifiable risk is arbitrary.

[27] As the reader will recall the key assumption in the model presented by Mehra and Prescott is that the rate of growth of consumption follows an 'ergodic Markov chain'.

The chapter moves on with the discussion of the assumptions and conclusions underlying the 'efficient market hypothesis'. This elaboration addresses a question raised in Chapter 1. As the reader may recall, in the previous chapter, I wondered whether the rejection of key assumptions of the efficient market hypothesis is due to the model used for determining asset returns or the hypothesis itself. The question has been posed by the Nobel Prize laureate and father of the efficient market hypothesis Eugene Fama. He has suggested that the hypothesis fails because of the models used for calculating returns (Fama 1991). Nevertheless, Fama acknowledges that market efficiency tests are a 'joint hypothesis' problem (Fama 1991). In other words, one cannot draw precise inferences about the degree of market efficiency separately from the performance of asset pricing models. The critique elaborated here takes this rationale further. I argue that since both asset pricing models, and the efficient market hypothesis are based on almost the same assumptions the empirical rejection of the mainstream asset pricing model(s) also implies the rejection of the efficient market hypothesis. Some authors (LeRoy 1989, Campbell 1991) have argued that the efficient market hypothesis tests are inconclusive because they are restricted to testing the 'martingale model' (Samuelson 1965, Mandelbrot 1966) because of Fama's restrictive assumptions.[28] However, they have not presented any alternative price specification model and, more importantly, they tend to underplay the restrictions imposed on financial asset returns by the assumptions of neoclassical equilibrium. The key point made here is that one cannot build just any financial asset pricing model from the neoclassical equilibrium assumptions. Recent mainstream theory elaborations have resulted in a series of models that can justify high price volatility (section 2g). However, these models do not rely on the volatility of asset returns resulting in high volumes of financial asset transactions. Mainstream economists have admitted this when they state that "the idea that economists have unlimited confidence in the efficiency of financial markets is at least thirty years out of date" (Tirole 2017: 306).

Nevertheless, and irrespective of the economists' limited confidence in it, the efficient market hypothesis justified the enormous deregulation of the financial markets following 1980. It was only after the 2007/09 financial turmoil that the profession expressly admitted that the efficient market hypothesis does not hold. At the academic level, besides behavioral finance, theories of financial bubbles (for example Tirole 1985), principal-agent problems (for example Phillipon & Reshef

[28] This means that only versions of the present value model have been tested. Below (section 2f) the present value formula can be derived from the assumptions of the martingale model.

2012), financial panics (for example Gertler, Kiyotaki and Prestipino 2016, 2020), and arbitrage frictions (for example Farhi and Tirole 2012) dominate current research. A brief discussion of this set of theories closes the references outlined in this chapter. The main issue raised herein is that these papers, presented by mainstream theorists, are devoted to explaining why financial asset prices and returns diverge from those calculated from the traditional models. This is certainly not a pricing theory, moreover, it is difficult to develop a pricing theory on these grounds. It is exceedingly difficult, to say the least, to try to model the systematic divergence of actual prices from those calculated by the underlying theory. For these reasons, neoclassical theory focuses on identifying a legal and institutional framework that will supposedly remove negative externalities and will lead to an equilibrium of similar properties to that of perfectly competitive commodity markets and efficient financial markets (Roth and Wilson 2019). This is the current discussion on financial regulation on which so much has been said and so little has been accomplished.

In the meantime, corporate finance actions are selected and reasoned from the traditional models as if nothing has happened. In other words, the above is far from being a purely theoretical discussion. For example, the CAPM is broadly used to determine the 'cost of capital'. In other words, equity returns derived from the CAPM are equivalent to the parameter (k) determining the 'cut-off' rate of return on new investment we elaborated in the previous chapter. The CAPM generates the required returns we used to discount dividends in DCF models. On such arbitrary specification, trillions of dollars and euros changed hands especially in the first decade of the new millennium through corporate acquisitions, share capital reductions, and distribution of special dividends, as well as other corporate actions. I have argued elsewhere (Stravelakis 2012, 2014) that because of low-profit rates prevailing over the last thirty years, corporate growth was based on boosting return on equity (ROE), in other words, the ratio of net profits to corporate equity. This was done mainly by increasing leverage and engaging in short term speculative investments. Justification for these corporate actions came from mainstream investment theory and models like the CAPM since the argument was that by increasing leverage the cost of capital will be reduced and corporate value will rise. However, as we will show in Chapter 3 this accumulation pattern has a limit determined by corporate profitability and when the limit is reached the system collapses as it did in 2007 triggering the current depression. For now, we should keep in mind that our elaboration has important policy implications.

2a. A brief History of Mainstream Asset Pricing

This section will attempt to place the main theoretical contributions that underlie mainstream asset pricing in a historical perspective. The objective is to understand the historical context in which the main concepts analyzed in the chapter were inserted in the bulk of mainstream theory and this way to get a better grasp of their content. In order to trace the history of the ideas presented in this chapter, we need to go back to the 1930s.

In the 1930s the theory of financial asset pricing had the content of what we nowadays call 'financial analysis'. It suggested that assets have an intrinsic or fundamental value which is reflected in its discounted cash flow. Actual prices were expected to fluctuate around 'fundamental value' prices (Graham and Dodd 1934, Williams 1938). On these grounds, financial analysts were expected to recommend buying (selling) financial assets on the basis that the actual price is above (below) the fundamental value. The analysis focused on making projections on the future cash flows (in the case of stocks) since the theory gave little or no guidance on the required rate of return which served as the discount factor. Analysts made assumptions about future demand for the commodity produced by the analyzed company, future development of substitutes, the probability of an economic recession, and possible changes in the corporate regulatory environment (LeRoy 1989).

The underlying idea was that those who performed or had the knowledge of the results of economic analysis would beat the market because they would buy the stocks priced below their fundamental value and sell those priced above their fundamental value. Nevertheless, by 1933 it was almost clear that people receiving professional advice were not doing considerably better than the rest (Cowles 1933). The Alfred Cowles' paper suggested that the recommendations of the main brokerage houses did not outperform the market. On these grounds, Cowles concluded that the people paying for these recommendations were wasting their money.[29] The next year the Stanford professor of economics and statistics Holbrook Working (1934) argued that stock prices develop patterns that look like a 'random walk'. In this regard stocks and financial asset prices were unpredictable. Some

[29] Of course, this statement is by no means justified. Analysis may fail due to wrong corporate data and assumptions, inefficient markets, or expectations influencing the fundamentals like the reflexivity theory of George Soros presented in the next chapter.

years later this idea was developed into the 'random walk hypothesis' (Kendall 1953).[30]

Eventually, economists connected Kendall's findings with the insights of a dissertation written half a century earlier (Bachelier 1900).[31] Bachelier had conducted an empirical study of French government bonds finding that their prices were consistent with the random walk model. The independence of the future from the present and the past but also the independence of the price of one financial asset from the other underlies the random walk hypothesis. Prices were assumed to move randomly, and their increment had a zero average. Therefore, they exhibit no trend. Moreover, their independence permits the calculation of a probability for the appearance of a certain price from the time series. However, this idea can be elaborated further. When the frequency of observations of a random process is excessively big, or in other words, the 'step' is very short, the random walk hypothesis converges to a 'Brownian Motion'. The latter is a continuous time analog of the random walk hypothesis also appearing in the work of Bachelier (See section 2b.1). By the early 1950s the random walk hypothesis for stock prices was a shift towards 'buy and hold' strategies for stocks as compared to active trading that was recommended before. The idea was that if stock price movements were random, then there is not much profit in active trading. Nevertheless, the new ideas of financial economists neither reduced the huge trade volumes of the stock exchanges and the financial markets in general, nor the number of the supposedly useless financial analysts employed by the industry.

At the academic level, the random walk hypothesis was considered at the time a great defeat for neoclassical economics. In the 1950s many economists believed that if financial asset prices follow a random walk this means that they do not obey the 'laws' of neoclassical pricing. This was the reason portfolio diversification introduced by Harry Markowitz in (1952) and developed to the dissertation he defended in Chicago in 1954 were practically ignored throughout the decade (Markowitz 1959). In an interview, he gave in 2015 Markowitz recalled that Milton Friedman who was in his committee said the following words during his Ph.D. defense: "I have read your dissertation. I don't find any flaws in it, but this is not a dissertation in economics, and we can't give you a Ph.D. in economics for a

[30] Kendall's results on the random walk hypothesis were confirmed by the famous study of Granger and Morgenstern (1963)

[31] For the sake of completeness, it should be noted that historians of economic thought point out that many of the ideas elaborated by Bachelier were initially presented by the French stockbroker Jules Regnault (1863).

dissertation that is not economics". (Markowitz 2015: 4). It is indicative of the situation in the profession back then. Mainstream economics was in desperate need of a framework that would bring together neoclassical economic fundamentals and the random walk hypothesis.

The first insight in that direction came from Harry Roberts (1959) who pointed out that in a market of rational individuals one would expect the instantaneous adjustment of prices to new information and that the latter is also implied by the random walk model. In other words, fundamental analysts entering the market would constantly compete away any possible trading gains. It was the beginning of what we now call the No-Arbitrage Theorem (Ross 2004:1-21) as well as the efficient market hypothesis.

Although Roberts (1959) offered insight he did not offer a resolution to the theory of asset pricing. This was done by Paul Samuelson by using a less restrictive assumption than the random walk, namely the 'martingale model'[32] (Samuelson 1965, 1973, Mandelbrot 1966). Until Samuelson's model came out people worked with the restrictions of a random walk model followed by the additional assumption that the increments (the error terms) have a zero mean. The martingale restricts the moments to the next period and not to higher moments like in the random walk model. In other words, the next period price is completely independent of the current information for martingales. The latter is equivalent to assuming that the current price is equivalent to the present value of future dividends. This is derived in a similar fashion with the development of the present value formula in section 1a of the previous chapter but with additional assumptions as presented in section (2g.2) of this chapter.

Despite its theoretical consistency the martingale model suffered from a serious defect. It assumes that investors are risk-neutral. In other words, the discount factor is the risk-free interest rate. As we saw in the previous chapter subjective risk aversion was a part of the Bernoulli paper in 1738 and this idea was incorporated into Arrow–Debreu intertemporal equilibrium models (Mehra & Prescott 1985). Therefore, mainstream theory needed asset price and return equilibrium models that incorporated risk aversion. These were the Capital Asset Pricing Model (CAPM) (Sharpe 1964, Lintner 1965, Mossin 1966) and the Arbitrage Pricing Theory (Ross 1976). Both models rely on the No-Arbitrage Theorem like the Martingale Model as

[32] The name comes from a town in Provence called Martigues. When flipping a coin, for example, the residents of Martigues double the bet whenever they lose. This way they wrongfully assume that they will make a certain gain. The term was used because in French it has a similar meaning to arbitrage in the sense it is conceived by mainstream theory.

it will become clear in sections 2b and 2e respectively. The CAPM relies on the normality assumption of asset returns, whereas the APT is derived from the Intertemporal Equilibrium Model.

Nevertheless, the analytical issue remained in the sense that there was no direct empirical proof that the theory of neoclassical competitive equilibrium could be applied to the financial markets. This was the main objective of the paper by Eugene Fama (1970) that marked the traverse of the dividing line between "the prehistory of efficient markets … and the modern literature" (LeRoy 1989: 1592). In his paper Fama (1970) attempted an empirical confirmation of the efficient market hypothesis by associating it with martingales. His original (Fama 1970) and subsequent (Fama 1976) definition raised a series of theoretical issues that are discussed extensively in section (2g). But the most important part was that the constant discount factor he applied in the context of the martingale model led to a series of empirical works that questioned the relevance of the hypothesis (Shiller1981, 1989a, 1989b, LeRoy and Porter 1981, Le Roy 1989). The main points of those studies were presented in section 1c.1 of the previous chapter and have to do with the unexplained volatility of stock prices. Between 1981 when the first papers came out and 1989 when the critique of Shiller and LeRoy has been accepted, an exchange of econometric arguments took place. The key issues were small sample bias (Flavin 1983), and the violation of the stationarity assumption for dividends even for large samples (Kleidon 1986). However, around 1988 it was shown that the stock price variance bounds for DCF models were violated even when the alleged stationarity violations were removed (Gilles and Leroy 1991).

The contribution that removed all doubts was the paper by Mankiw, Romer and Shapiro (1985). They suggested that the expected value of the square of differences of an optimal estimator from the actual price must be smaller than the expected value of the square of differences of some non-optimal estimator.[33] Similarly, market efficiency suggests (Mankiw et al. 1985) that, because the correlation between the square of the differences of the optimal estimator and the actual price and the investors' information variables must be zero, the expected value of the square of the differences between the actual price and some naïve estimator must be greater than the difference (of the square of the expected value) of the optimal from the same naïve estimator.[34] When the model was estimated, with DCF prices as optimal

[33] In mathematical notation $E(p_t{}^{*} - p_t^o)^2 \geq E(p_t{}^{*} - p_t)^2$. Where $p_t{}^{*}$ is actual price p_t is the optimal estimator and p_t^o some naïve estimator.

[34] In mathematical notation $E(p_t{}^{*} - p_t^o)^2 \geq E(p_t - p_t^o)^2$.

estimators, both inequalities appearing in footnotes 33 and 34 had the opposite direction rejecting the efficient market hypothesis.

These empirical findings marked a turning point for mainstream finance at the end of the 1980s. Some people, including Robert Shiller, considered the findings mentioned in the previous section as proof that a rational neoclassical equilibrium like the one underlying the efficient market hypothesis does not exist. It is the contemporary expression of an old debate starting from Keynes and Pigou on 'animal spirits' (Matthews 1984). They tried to apply irrational behavior in order to explain financial asset volatility and pricing. It is the theory of behavioral finance (Shiller 2009) elaborated in section 2d.4 of this chapter. Eugene Fama tried to recalculate DCF models using the solution of the one-period CAPM (see section 2b) as the discounting factor. Besides the fact that the CAPM prices are not necessarily martingales, because risky assets may have negative expected return and still be part of the market portfolio (Ohlson 1977, LeRoy 1989), this attempt did not offer clear empirical support for the efficient market hypothesis. Eugene Fama and Kenneth French suggested that the problem was the CAPM and not the efficient market hypothesis. Their (1992) empirical test of the CAPM was conducted for this reason. It was the death knell of the CAPM since it rejected its central hypothesis about the positive correlation of risk and return (see section 2d.3.). Fama then turned to his three-factor model (1996) in an attempt to find a reliable pricing model (see section 2d.4).

The acknowledgment of the empirical failure of the mainstream pricing models broadened the problem since it was not about DCF models and martingales anymore, but it involved the No–Arbitrage Theorem itself. The paper by Grossman and Stiglitz (1980) which recognized that financial markets with positions of 'costly arbitrage' may diverge from equilibrium introduced a new set of theories which elaborate on the hypothesis that financial markets may not reflect the conditions of neoclassical equilibrium although the participants are rational in the neoclassical sense. These references, which presently dominate mainstream finance, are briefly presented in section 2g which closes this review chapter.

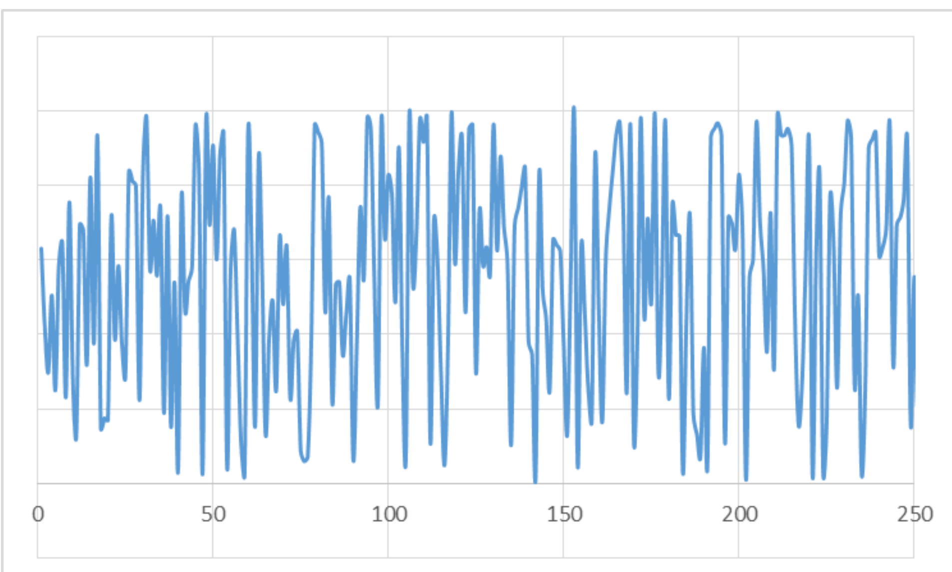
The overall purpose of the chapter is to underline that any effort, by mainstream economics, to explain any diversion of the actual prices from the anticipated ones is attributed to irrationality, negative externalities, and various types of frictions of the financial markets alone. This is the exact opposite approach from the 'profit-based approach' which rejects neoclassical equilibrium but accepts that financial markets, in the end, reflect corporate fundamentals. In the profit-based approach of course fundamentals are highly volatile, and expectations influence fundamentals. It is a world where the Non-Arbitrage Theorem cannot hold. The latter will become evident from the elaboration of the mainstream asset pricing models which follows.

2b. The Assumptions of the CAPM

The CAPM was introduced in the mid-sixties by William Sharpe, John Lintner, and Jan Mossin who arrived independently to the same model (Sharpe 1964, Lintner 1965, Mossin 1966). The idea was to construct a pricing model in the context of the Markowitz risk/ return tradeoff (Markowitz 1952, 1959). Therefore, it comes as no surprise that the first assumption of the model is that investors make investment decisions, on buying or selling specific assets, exclusively on the mean and standard deviation of asset returns. This we will call *Assumption 1* of the CAPM.

Assumption 1 implies, of course, that asset returns are assumed to follow the normal distribution since it can be fully specified by its mean and its standard deviation alone. This property is due to the symmetric shape of the distribution which implies that the prices of the variable are evenly distributed around the mean. In an important book written in 2000 (Mandelbrot and Hudson [2000] 2004) and titled *The (Mis)Behavior of Markets* the mathematician Benoit Mandelbrot showed that if converted to continuous time series random variables following the normal distribution will produce a motion that looks as follows:

Figure 2.1
Brownian motion



This is the Brownian motion in Figure 2.1. It reflects a mean-reverting process following random non-periodical fluctuations of constrained amplitude. It is a process following rules equivalent to the ergodic Markov chain, an assumption elaborated in the previous chapter and implies a stationary required rate of return. Mandelbrot brought up this point to underline the striking difference between the actual probability distribution of stocks, commodities, exchange rates, and other asset prices and returns and the normal distribution assumed by the mainstream theory. These findings have given rise to a voluminous literature which attempts to explain the current depression from a miscalculation of risk. Under the normal distribution, the probability of any price more than three standard deviations away from the mean is extremely small (0.27%), while under different probability distributions deviations from the mean have higher probabilities. Therefore, the probability of extreme events is systematically downplayed in mainstream asset pricing models. Having this in mind the financial analyst Nicholas Taleb titled his book *The Black Swan* (Taleb 2007), to picture the surprise of the Old World to the news that swans are not only white and beautiful, as everyone thought before Europeans set foot in Australia, but black and ugly swans exist as well. The book is the most popular example of this part of the literature. We will return to these points in the discussion of the empirical evaluations of the CAPM. At the present, we need to put some economics behind the normality/ stationary returns assumption.

Certain portfolio choice theorists do not assume that returns on each and every stock or asset are normally distributed. What they suggest is rather that as we add shares in a portfolio of risky assets the distribution of returns of the portfolio will tend to become normally distributed by virtue of the Central Limit Theorem. However, this assumption implies that prices and returns of the individual shares comprising the portfolio are uncorrelated, otherwise the properties of the Central Limit Theorem do not apply. How can returns relating to shares of corporations operating in the same economy, belonging to the same industry be uncorrelated? The answer is that they cannot. Even textbook presentations of the CAPM suggest that correlation between stock returns exists, however, they attempt to sidestep the matter by suggesting that correlation is not so severe and returns on a sufficiently large portfolio will be 'approximately normal' (Haugen 2001: 203). The father of portfolio choice Harry Markowitz seems perfectly aware that this is not the case when he stated that "[t]his presumption, that the law of large numbers applies to a portfolio of securities, cannot be accepted. The returns from securities are too intercorrelated. Diversification cannot eliminate all variance" (Markowitz 1952: 79).

Irrespective of the above, the idea of uncorrelated stock returns is problematic on the analytical level as well. If risk-adjusted returns are to be equalized, then there is no way for stock returns to remain uncorrelated unless individual equity returns follow the normal distribution. This means that (risk-adjusted) return differentials between corporations or industries appear randomly and are smoothened out very shortly. In other words, such variations do not emerge intensely and persistently since perfect competition restrains corporate investment selection. As mentioned already corporations are assumed not to undertake projects below a certain rate of return as in the Elton and Gruber model (1976), discussed in the previous chapter.[35]
In conclusion, uncorrelated and loosely correlated asset returns imply a world where corporate returns diverge randomly from the average. This is an idea which stems directly from the notion of perfect competition. Although this argument is consistent with neoclassical theory, it contradicts financial data.
Under this rationale, investment decisions can be presented as a utility maximization exercise where investors hold a quadratic utility function. In this regard the utility of investors' portfolio is measured as follows:

$$2.1 \quad U_j = a_0 + a_1 \cdot V_J + a_2 \cdot V^2{}_j$$
$$a_0, a_1 > 0, \qquad -2 < a_2 < 0$$

Where V_J stands for the value of portfolio j. Equation 2.1 is different from equation 1.16. While 1.16 is a total utility function that depends directly on per capita consumption and involves constant relative risk aversion, 2.1 measures utility coming out of the value of a particular portfolio where risk aversion varies with the level of wealth. The shortcomings of the quadratic utility function were the first main point[36] of criticism by Roll and Ross and the introduction of the APT (Ross 1976, Roll 1978).
It is not difficult to show that equation 2.1 has a maximum for $V_j' = -\frac{a_1}{2 \cdot a_2}$ which suggests that the appetite for wealth, indeed, the appetite for profit, becomes saturated. It is the neoclassical notion that investment is driven by anticipations of future consumption given risk preferences. This is an understanding of capitalism quite different from that of classical political economy where economic activity is driven by an unsaturated appetite for profit. When equation 2.1 reaches its

[35] The model shows that this investment behavior prevails because of the smooth investment possibility frontier faced by all firms.
[36] The second was the specification of the market portfolio.

maximum risk, aversion turns infinite and people do not receive any satisfaction from additional wealth. In other words, over a certain level of wealth people are willing to consume all their income, or rich people take fewer risks than poor people. A clearly unrealistic assumption.

Thus, it is not surprising that when turned in mathematical expectation form equation 2.1 is perfectly equivalent to the normal distribution assumption, in the sense that one can pick either, in order to justify investment decisions based exclusively on variance and expected return. This is derived as follows:

$$2.2\ \ E(u) = \sum_{j=1}^{n} h_j \cdot u_j, \qquad \sum_{j=1}^{n} h_j = 1, \ \ substituing\ 2.1$$

$$\rightarrow . E(u) = \sum_{j=1}^{n} h_j \cdot (a_0 + a_1 \cdot V_j + a_2 \cdot V_j^2) = a_0 + a_1 \cdot E(V) + a_2 \cdot E(V^2)$$

Equation 2.2 defines expected utility E(u) as the weighted average of probable levels of utility $(h_j \cdot u_j)$ associated with a particular portfolio value as defined by equation 2.1. Since the sum of probabilities is equal to one ($\sum_{j=1}^{n} h_j = 1$), then from the statistical identity:

$$E(V^2) \equiv (E(V))^2 + \sigma^2(V)$$

equation 2.2 is modified as follows:

$$2.3\ \ E(u) = a_0 + a_1 \cdot E(V) + a_2 \cdot (E(V))^2 + a_2 \cdot \sigma^2(V)$$

Therefore, under a quadratic utility function expected utility from investing in a portfolio is exclusively a function of expected value and variance of the portfolio. This is equivalent to the normal distribution assumption of portfolio returns.

Although this utility maximization exercise can be incorporated into a world of consumption-driven (profit saturated) investment decision process, the unrealistic risk behavior implied by quadratic utility functions is fraught with problems. This has led mainstream economists to consider stationary returns as a result of the equalization of returns under the neoclassical equilibrium. Constant relative risk aversion functions like 1.16 were the result of this intellectual endeavor. The latter ensures that returns are stationary while the rate of growth of per capita consumption and asset price are jointly determined. This is the rationale behind the Mehta and Prescott model presented in the previous chapter. Irrespective of the differences between mainstream theorists the bottom line remains that the capital asset pricing model implies stationary equity returns. This is analogous to the assumption underlying the present value principle discussed in Chapter 1. We will keep returning to this point throughout chapter 2.

Assumption 1 of the CAPM ensures that investors will choose between 'mean-variance efficient' portfolios based on their risk preferences. However, this assumption is not sufficient to close the return determination process. Two additional heroic assumptions are required. First that all investors are in agreement regarding the joint distribution of assets between period *t-1* to period *t*. This means that as we begin from market clearing (efficient) prices in period *t-1* all investors share the same 'correct' probability distribution of returns. We will call this Assumption 2 of the CAPM.

Assumption 2. People decide based on expected return and standard deviation and share the same investment horizon. As a result, they hold the same market portfolio. Their risk preferences will be reflected in the ratio in which they hold this mean-variance efficient portfolio and the risk-free asset by virtue of the so-called 'separation theorem' (Tobin 1958). The idea of a 'representative household' deciding between current consumption and purchasing a sole equity proportionately with a risk-free asset, as suggested by Mehra and Prescott (1985) is quite relevant. James Tobin (1983) was quite clear about this point arguing that Assumption 2 turns the CAPM into a 'representative agent model'. If read together, the first two assumptions suggest that the market is dominated by non-capitalist investors. Actually, the mere existence of financial capital has no impact since everyone will receive the market rate of return. This efficient market hypothesis conclusion is derived from the solution of the CAPM where all investors are assumed to hold the same portfolio of risky assets, the 'market portfolio'[37]. Based on such arguments unprecedented deregulation of financial markets was implemented following 1980. Individuals, pension funds, equity funds, etc. were allowed to hold practically any asset at any proportion since the risk was contained and markets 'self – regulated'.

The third and final assumption (hereafter *Assumption 3*) lifts the liquidity constraints. It suggests that everybody enjoys unrestricted borrowing and lending at the 'risk-free' rate. In other words, the interest rate remains the same irrespective of the amounts borrowed and is equal for all investors. The idea that the risk-free rate does not depend on the amounts borrowed points directly to the neoclassical theory where the rate of interest is the (risk-free) rate of profit. The second part suggesting

[37] This does not mean that CAPM prices fully comply with the Fama definition of the efficient market hypothesis as already indicated (section 2a.) and elaborated below.

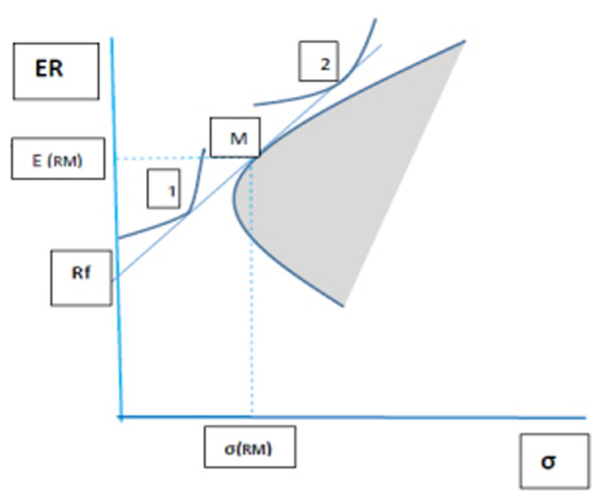
that all borrowers are charged the interest rate on some sovereign bond is unrealistic. However, it is not unrealistic in the context of the model. Since returns follow the normal distribution risk is quite limited. Therefore, it is reasonable to assume that differences in lending rate spreads will be rather small. Unfortunately, this was not a discussion that remained in the walls of academia. During the last thirty years, huge amounts were lent out on the grounds of low risk of default, the US subprime real estate market is the most known but not the only example.

Mainstream literature has focused on Assumptions 2 and 3 in order to face the poor empirical performance of the model. What we will argue throughout this discussion is that the crucial assumption is the 1st assumption. Reliance on stationary returns, implied by the first assumption, is the reason the CAPM never turned to an empirical success although it was modified in various directions. For example, Fischer Black (Black 1972) substituted unrestricted borrowing with free short selling of the market portfolio. Merton (1973) presented the intertemporal CAPM (ICAPM) which introduces additional 'state' variables besides market return. However, I will show that stationary returns dominated the empirical findings. In order to elaborate in this direction, we need first to solve the original model.

2c. The Solution of the CAPM

The model solution always begins with the familiar graph (Figure 2.1) which appears in textbook presentations (Haugen 2001: 207) and in sophisticated reviews (Fama & French 2004).

Figure 2.2



From assumption 1 we derive the bullet-shaped efficient set for risky securities, (the shaded area on Figure 2.2). Each point in the region represents individual securities. The solid line that envelops the shaded part is the 'minimum variance frontier' and consists of minimum variance portfolios of risky assets. This means that all portfolios on the frontier are 'minimum variance of expected return' portfolios at the specific level of expected return. The positive tradeoff between variance and expected return holds for the increasing part of the minimum variance frontier. The normal distribution of returns assumption enables the algebraic solution of the optimization exercise which minimizes variance given the expected return or maximizes expected return given variance.

Assumptions 2 and 3, imply (a) that all investors share the same minimum variance frontier and (b) that any asset uncorrelated to the market portfolio earns a risk-free return (Rf). It is not difficult to establish that the point of tangency of the line connecting the risk-free asset return and the 'frontier' (point M) defines the portfolio with the highest expected return/ risk ratio. This means that the following fraction receives its maximum value at point (M):

$$2.4 \; E(RM)_p = \frac{E(RM) - Rf}{\sigma(RM)}$$

Equation 2.4 tells us that all investors will be willing to hold this specific portfolio irrespective of their risk preferences since it is optimal to any other portfolio based on the risk/ return tradeoff. In other words, in the presence of a risk-free asset, risk preferences are separated from the stocks to be held. This is the so-called 'separation theorem' (Tobin 1958).

One hard lesson of the crisis which began in 2007 was that the risk-free rate has definition problems. This matter has sparked important theoretical discussions in the mainstream literature relating the quantitative easing and the 'zero lower bound', i.e., the appearance of negative returns for 'risk-free' assets. Assets that were considered as risk-free, for example, US treasury bonds, were downgraded and exhibited strong volatility in their yields. Central banks were forced to implement excessive asset purchase (quantitative easing) programs to prevent a collapse in the price of sovereign bonds. The idea of a risk-free asset stems from neoclassical equilibrium theory and the relative constancy of the (risk-free) basic rate of profit (return). The non-existence of such assets undermines the solution of the CAPM as well as of the Black-Scholes option pricing formula. This is not a point raised only by heterodox economists. Recent work from mainstream economists (Caballero *et al*.

2017, Rogoff 2017, Obstfeld and Taylor 2017) acknowledges this point. However, they try to explain the matter from a shortage in the supply of safe assets and the latter to institutional shortcomings. At the end of the chapter, this and other matters of recent mainstream work on finance will be discussed.

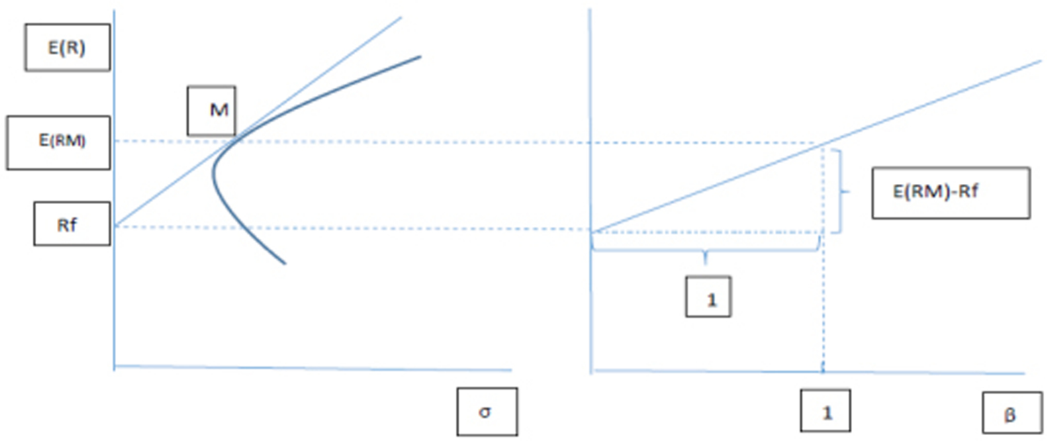
Investors, under assumption 3, can adjust their holdings to their risk preferences by allocating their wealth between the risk-free asset and the market portfolio (M). Specifically, low risk investors, i.e., their indifference map lies to the left of portfolio M (case 1 on the previous chart) will purchase the risk-free asset as well as portfolio (M). High-risk investors r, in turn, have their indifference map placed to the right of point M (case 2) this means that they will borrow at the risk-free rate (Rf) and use the proceeds to purchase the portfolio M. The line connecting the risk-free asset return to the expected return of portfolio (M), the 'capital market line' as it is called, together with the indifference map solves investors' utility maximization exercise.

Since all investors hold some proportion of *the same portfolio* of risky assets (M) the latter can be no other than the market portfolio. This means that, in the context of the CAPM, for the market to clear the market portfolio must be on the minimum variance frontier. It is the key conclusion of the model which is derived from assumptions 2 and 3 based on assumption 1.

The risk-return tradeoff lies at the heart of the CAPM and leads to an amazing result. All investors hold the same (market) portfolio. In this regard, returns of individual shares are determined on the grounds of their risk contribution to the market portfolio. It is a form of equalization of risk-adjusted rates of return between different assets which also implies the equalization of corporate returns to investors' cost of capital as discussed in the previous chapter (Elton & Gruber 1976).

The presumption that all investors hold the market portfolio implies a linear relation between stock returns and market return, where market return serves as the explanatory variable. This means that the risk contribution associated with a particular share is its covariance with the market. If we normalize covariance of individual stocks returns with market return by dividing covariance with the variance of the market portfolio, we arrive at the familiar CAPM betas (β). In this determination process, corporate competition affects neither individual stock required returns nor risk. Any source of (residual) risk, besides covariance with the market, is eliminated through diversification. The CAPM context implies that investors do not care about 'particular' risk because they all hold the market portfolio. However, this means also that corporate competition does not affect market returns which points to neoclassical equilibrium and perfect competition[38]. Given the above we can graphically present the determination of individual stock returns as follows:

Figure 2.3



The structure presented in Figure 2.3 suggests that we can move from the expected return (E(R)) and standard deviation (σ) terrain to the expected return-beta (β) terrain. This happens because we know two points on the expected return-(β) space and because the relation between the market return and individual stock return is assumed linear. The two points are (Rf) where beta is zero and E(RM) where beta is equal to unity. Linearity is ensured by the (single common) 'factor model' assumption made for corporate returns and its effect on corporate variance. From the above, it is evident that the slope of the line in the expected return – beta terrain, the 'securities market line' is equal [E(RM)-RF], in other words, the market risk premium, which is assumed constant for the investment horizon. Therefore, the securities market line is given by the following equation:

2.5 $E(Rj) = Rf + \lfloor E(RM) - Rf \rfloor \cdot \beta_j$

[38] This means that competition does not materialize technical innovations that offer a cost advantage over competitors but involve a higher investment cost that reduces the rate of profit at the new equilibrium prices following its implementation. If perfect competition prevails such investments will never take place because corporations are price takers. This point will be fully elaborated in chapter 3.

Equation 2.5 is of course the familiar equation of the CAPM we have all encountered in our readings one way or the other, where (Rj) stands for return on security (j) and (βj) is the beta factor related to the particular stock.

The CAPM is a model where corporate competition and the resulting fundamentals turn immaterial since investors' required returns are determined only from the expected return of the market portfolio. It is quite remarkable that these factors play no part in the formation of corporate or market required returns. This is achieved by assuming that market returns are stationary and normally distributed at least for the model investment horizon. Corporate fundamentals do not affect required returns, both for the market as well as for individual stocks, because the idea of neoclassical equilibrium underlies these assertions. Given the technology, corporations are price takers and, in this regard, their (risk-adjusted) returns become fully equalized not exhibiting any inherent volatility or trend. This together with assumption 2 justifies Mehra and Prescott (1985) who reduce the whole economy to a single representative company and a representative agent (household) model in the context of which the only fluctuation in returns comes from random shocks in the rate of growth of per capita consumption. A view of the capitalist economy which lies at the opposite of classical political economy, where striving for profits is the main initiative of production and growth. This view of the capitalist economy also explains why a highly unrealistic model, like the one introduced by Mehra & Prescott (1985), was used to test the level of the equity premium and its results were broadly accepted by the academic community triggering the debate over the 'equity risk premium puzzle'.

When applied to the goods and factors of production market the neoclassical notion of equilibrium, although unrealistic, does not face logical consistency problems since the exchange of goods and factors can take place at the equilibrium price. When extended to capital markets, however, the idea of full equalization of returns and the resulting asset market clearing prices, implied by the CAPM, suggest that in equilibrium there are no transactions. Every investor will hold the market portfolio for the whole investment horizon without effecting transactions in the meantime. This unrealistic view of the capital markets underlies all mainstream asset pricing models and not the CAPM only. One does not need to be an expert to know that mass adjustments in capital markets take place all the time resulting in voluminous daily transactions and the 'unexplained volatility' of stock prices elaborated in Shiller (1981) and LeRoy and Porter (1981). With this in mind, we will review the empirical tests of the CAPM.

2d. Empirical Tests of the CAPM

It comes as no surprise that the empirical evaluations of the CAPM mount up over the years contributing important findings with theoretical and econometric consequences. Due to the volume and diversity, we have categorized the relevant literature primarily according to the specific assumptions of the CAPM under investigation and secondarily between early and recent tests of the theory. The basic assumptions placed under investigation were: 1) expected returns on all assets are linearly related to their betas, and no other variable has marginal explanatory power 2) the beta premium is positive, meaning that the expected return on the market portfolio exceeds the expected return on assets whose returns are uncorrelated with the market return, 3) in the Sharpe-Lintner version of the model, assets uncorrelated with the market have expected returns equal to the risk-free interest rate, and the beta premium is the expected market return minus the risk-free rate. Early tests were more focused on cross-sectional and time-series regressions of the model, whereas recent tests were mainly focused on identifying alternative variables and models with explanatory power which undermine the postulations of the CAPM.

2d.1. Testing Risk Premia

Following the publication of the Sharpe-Lintner-Mossin papers (Sharpe 1964, Lintner 1965, Mossin 1966), the initial empirical tests focused on the properties of the 'securities market line', its intercept, and its slope. This was done by exploring the relation between market return and beta. The tests were cross-sectional regressions between average asset returns against estimated asset betas.

However, important problems of estimation were detected. On the one hand, beta estimations for individual assets were imprecise creating estimation problems, and on the other, regression residual values had common sources of variation such as industry effects. The latter creates downward bias in ordinary least squares estimates.

These estimation problems were addressed in a series of empirical papers appearing in the early 1970s. Specifically, Blume (1970), Friend and Blume (1970), and Black, Jensen, and Scholes (1972) began working with portfolios to improve betas' estimation precision. The underlying reasoning was that if the CAPM can explain securities returns it can explain also portfolio returns. Of course, there are problems with this reasoning because, although we are unable to test if the CAPM can estimate individual returns, we take it for a fact it can test portfolio returns. On the estimation side securities were grouped in portfolios according to their betas, starting from a

‘low beta group’ and moving to ‘high beta groups’. Grouping, however, shrinks the range of betas and reduces statistical power. Nevertheless, this practice is standard.
Fama and Mc Beth (1973) presented the solution for the common variation of residual values. Instead of running a single regression of average monthly returns on betas, they run regressions month after month. Then they calculated the time series means for the slope, the intercept, and the standard errors of the means. This data is used thereafter to test whether the average premium for beta is positive and whether returns for uncorrelated assets (with the market portfolio) are equal to the risk-free rate. With this technique, standard errors are captured through variations of the intercept and slope in the repeated regressions. Therefore, residual correlation is captured through repeated sampling without being actually estimated. This technique is also considered standard in the literature.
Jensen (1968) performed the first time series test of the Sharpe-Lintner version of the CAPM. The idea was that since beta times excess return is equal to the asset risk premium, then for a regression of the form:

$$2.6\ R_{it} - R_{ft} = a_i + \lfloor R_{Mt} - Rft \rfloor \cdot \beta_{it} + \varepsilon_{it}$$

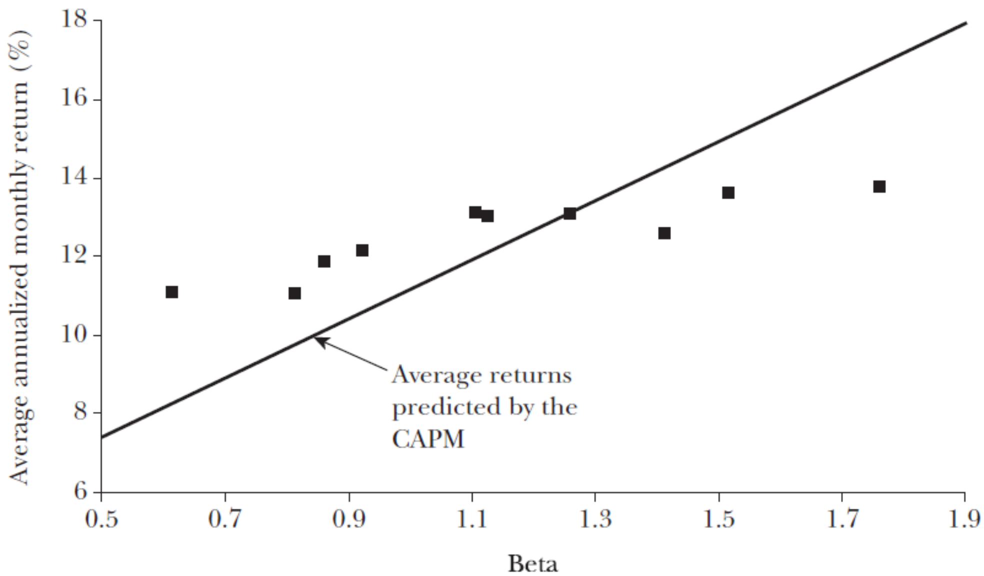
the intercept otherwise referred to as the Jensen alpha (a_i) must be zero for every asset.
These were the main types of empirical tests implemented. Unfortunately, all of them firmly reject the assumptions of the Sharpe – Lintner version of the CAPM. The cross-sectional tests found a positive relation between return and beta, but the slope of the curve is too flat. In other words, the estimated intercept is greater than the risk-free rate and the risk premiums are not in conformity with betas as suggested by the CAPM. These were the results of Douglas (1967), Black, Jensen, and Scholes (1972), Miller and Scholes (1972), Blume and Friend (1973), and Fama and MacBeth (1973). Moreover, the same results were confirmed in Fama and French (1992). Time series tests such as Friend and Blume (1970), Black, Jensen, and Scholes (1972), and Stambaugh (1982), also confirm the too flat relation between beta and average return. In the time series studies the estimated intercepts of excess asset returns on excess market returns, i.e., the alphas in equation 2.6, are positive for assets with low betas and negative for assets with high betas.

Fama and French (2004) provide an updated version of the evidence. They investigated the relation between expected return and beta from 1928-2003 for the

NYSE, and for shorter periods, ending also in 2003, for the AMEX and the NASDAQ. They used data on every stock registered in the Center for Research in Security Prices of the University of Chicago (CRSP) database. The only condition was the existence of average monthly returns going back two years.[39] Then they calculated betas on every stock available which they used to form ten value-weighted portfolios. Based on the post-ranking portfolio betas average returns were calculated for each portfolio for the next twelve months. This process was repeated year after year until 2003. Finally, a second set of portfolio betas was calculated by regressing average monthly portfolio returns against the CRSP value–weighted portfolio of US common stocks. The results are presented in the figure that follows (Fama and French 2004: 33).

Figure 2.4

Average Annualized Monthly Return versus Beta for Value Weight Portfolios Formed on Prior Beta, 1928–2003



The solid line is the 'securities' market line associating average expected returns with betas. If the CAPM was a perfect match for securities returns, then returns would lie on the solid line ranked from low to high betas. However, the actual returns of the ten portfolios do not follow this pattern. The ten squares represent the actual relation between returns and betas for the ten portfolios examined in Fama

[39] The desirable return history for each stock was five years average monthly returns.

and French 2003. Although a slight positive relation between returns and beta appears this is quite different from the pattern suggested by the CAPM. In fact, there exist specific cases where returns in low beta portfolios are higher than returns in high beta portfolios.

These findings led portfolio choice theorists to suggest that the Sharpe–Lintner version of the CAPM is firmly rejected. However, the version proposed by Fischer Black (1970), where the only assumption is that a positive relation between return and beta exists, seemed to hold.

2d.2. Do Market Betas Explain Asset Returns?

Irrespective of differences in the anticipated intercept and slope of the securities market line, all versions of the CAPM argue that differences in betas should explain differences in returns between assets or asset portfolios. This assertion stems directly from the assumption that the market portfolio is mean-variance efficient which underlies the CAPM.

One way of addressing the matter is to show that additional variables do not add explanatory power in determining expected returns. For instance, in the classical paper of Fama and Mc Beth (1973) if one adds additional explanatory variables then the regression coefficients of these variables should not be reliably different from zero. Thus, Fama and Mc Beth (1973) used squared market betas (to test linearity between expected return and beta) and the residual variances from the regressions of asset returns on market returns. The latter was used to indicate whether beta was the only measure of risk needed to explain expected returns. They concluded that both variables did not add explanatory power on expected returns, therefore the equal weight portfolio they used as market proxy was on the minimum variance frontier.

Another way of testing whether beta is the only factor explaining market returns is to investigate whether the intercept, i.e., the Jensen alpha in equation 2.6 above, is zero for all stocks. In the Sharpe-Lintner version the intercept is the difference between the assets return over the risk-free asset and the excess return predicted by the model (see equation 2.6). If the Jensen alpha (a) is significantly different from zero, then there is no way of grouping shares into portfolios. The reason is that a statistically significant constant term (a), implies that specific stock characteristics, such as, the price-earnings ratio, play a part in stock returns. In other words, the market portfolio is not mean-variance efficient. On these grounds, a set of empirical tests trying to identify the impact of certain indicators on stocks or portfolio returns appeared in the literature. The tests grouped shares according to high or low price-earnings ratios portfolios and tested whether the econometric estimation of equation 2.6 for both portfolios resulted in intercepts (a_i) not significantly different from zero. If this was affirmative, then it was considered a verification that the market portfolio was minimum variance efficient.

Although quite straightforward at the analytical level, this approach led to controversies regarding the appropriate statistical test for determining whether the intercepts are significantly different from zero or not. The dispute was settled by Gibbons, Ross, and Shanken (1989) who proved that the F test has the best small sample properties. Therefore, it is the appropriate test for evaluating the statistical significance of the intercept. What the test does is to construct proxies of the market portfolio since the F test establishes which sample (of risky assets in our case) fits the population best.

Gibbons, Ross, and Shanken (1989) extended the use of the test in cross-sectional regression where it was tested whether the inclusion of additional variables adds explanatory power to the patterns exhibited by stock market returns. Nevertheless, in all cases what is tested is whether the portfolio constructed as the market proxy rests on the minimum variance frontier. This gave rise to the so-called 'specification problem' i.e., whether the actual market portfolio can be specified and the CAPM can be empirically tested. We will discuss this point below with the Arbitrage Pricing Theory since it was one of the reasons for its introduction.

For now, we can point out that at the end of the 1970s the profession held the position that although the Sharpe-Lintner version of the CAPM cannot explain the risk premia, the softer version of the model introduced by Fischer Black (1970), in other words, the postulation that market betas were sufficient to determine expected returns, was empirically sound (Gibbons 1982, Stambaugh 1982, Fama and Mc Beth 1973).

2d.3. Recent Tests

The 'soft' version of the CAPM which was considered sound in the early tests of the model was severely challenged in the more recent tests. In other words, evidence is mounting that expected returns are unrelated to market beta.

At first, a series of papers identifying additional variables influencing expected returns appeared following the late 1970s. Basu (1977) showed that stocks with higher earnings to price ratios had higher returns than those predicted by the CAPM. Banz (1981) argued that when stocks are shorted based on market capitalization average returns on small (capitalization) stocks tend to be higher than those predicted by the CAPM. Bhandari (1988) made a similar claim for stocks with high debt to equity ratios. However, the works which received the greatest attention in this line of papers were those associated with the impact of book to market equity ratios on stock returns (Stattman 1980, Rosenberg, Reid & Lanstein 1985). These empirical studies conclude that stocks with high book to market equity ratios have high average returns not captured by their betas.

It is worth noting that all these studies introduce ratios that depend on stock prices (earnings to price, capitalization, book to market value) as explanatory variables. This is not surprising since prices include information about expected returns. In other words, the price ratios are indications of differences in expected returns between stocks which cannot be eliminated through diversification. Some mainstream theorists (Ball 1978) tend to acknowledge this fact. Nevertheless, they do not associate it expressly with competition both within the corporate sector and between the corporate and the financial sector, as it is done in the profit-based approach.

This last point will become evident below in the discussion of the three-factor model introduced by Fama and French (1996) as an alternative to the CAPM. For now, in order to conclude the recent empirical evaluations of the CAPM, we will refer to the empirical study Fama and French of 1992. Many economists consider this study as the fatal blow of the CAPM. The study concludes that all the additional variables discussed so far: earnings/price, debt/equity, book/market, add explanatory power to the determination of expected returns. Furthermore, the study confirmed further empirical studies on the slope (Lakonishok & Shapiro 1986). The latter indicates that the slope of the security market line was even flatter than the one calculated in the early empirical work on the CAPM. As Fama and French put it in a 2004 review paper for the *Journal of Economic Perspectives*: "If betas do not suffice to explain expected returns, the market portfolio is not efficient, and the CAPM is dead in its tracks" (Fama and French 2004: 36).

2d.4. Explanations and Alternatives.

The empirical failure of the CAPM could not be ignored by mainstream theory. Important economists have attempted to provide theoretical explanations and alternative pricing models. The initial attempts fell into two categories. First, that risk has additional sources besides market volatility which are missed by the CAPM. This is the idea behind Intertemporal CAPM introduced by Merton (1973) and elaborated by Fama and French (1993, 1996) in what is known as the 'three-factor model'. Second, the behaviorist approach. The latter suggests that investors are irrational, and this results in market behavior different from the assumptions of the CAPM and neoclassical rationality in general.

Arbitrage Pricing Theory is also an alternative to the CAPM, theoretically close to the ICAPM and the 'three-factor model'. However, it does not suggest that the CAPM has failed. It argues that CAPM is not a testable theory. For this reason, it will be considered separately in the next section.

The Merton ICAPM (1973) was the first attempt for a more sophisticated asset pricing model. The idea was the same as in the models of intertemporal equilibrium. Variables representing different states of nature, known in advance, in accordance with the ergodic axiom, influence current (investment) decisions. These include but are not limited to labor income, the price of consumption goods, and future investment (portfolio) opportunities. Of course, all these variables follow the assumptions of neoclassical equilibrium which also determines their impact on expected asset prices and portfolio returns. The Mehra and Prescott (1985) model on the risk premium puzzle is a good example of the ICAPM rationale. However, in the ICAPM it is not per capita consumption variance that produces stock price variations. The risk-return tradeoff stands like in the CAPM; the difference is that investors are also concerned with the covariance of portfolio returns with the 'state variables'. Therefore, the optimal portfolio is not single-factor efficient like in the CAPM, but multifactor efficient. Fama (1996) has shown that if free risk-free lending is assumed, or if free short selling is allowed, the ICAPM concludes, like the CAPM, that clearing prices imply that the market portfolio is (multi) factor efficient. Of course, in the case of the ICAPM additional betas, besides the market beta, are required to determine expected returns.

Nevertheless, the introduction of 'state variables' with neoclassical properties would lead to similar empirical results like the ones of the CAPM. Probably it was for this reason that Fama and French (1993) introduced the 'size effect' and the book/ market ratio as additional explanatory variables of stock returns. At the same time, they argued without giving further theoretical intuition that these ratios reflect

‘unidentified state variables that produce undiversifiable risks…’ (Fama and French 2004: 38). In support of this claim, they pointed out that returns on small firms stock covary more with each other than with the returns of large firms and the same is true for the returns of high book to market stocks as compared to low book to market value stocks. This, of course, is clearly circular reasoning since Fama and French assume that the covariance of stock returns implies a reaction to a common underlying factor and is not the result of the forces of real competition. For example, the covariance of the returns of ‘growth’ can be the result of gaining market share from their industry competitors. In fact, Fama & French implicitly admit this: in a 1995 paper they report that earnings and sales of ‘small’ and ‘growth’ companies covary more with each other. Nevertheless, they do not think that earnings growth determines returns and not some ‘unidentified state variable’. In short, they assume that the properties of neoclassical equilibrium and perfect competition hold, then they interpret their empirical findings taking their assumption for a fact.
On these grounds, Fama and French (1993, 1996) proposed a three-factor model for the determination of expected returns.

2.7 $E(R_{it}) - R_{ft} = \beta_{iM} \cdot [E(R_{Mt}) - R_{ft}] + \beta_{is} \cdot E(SMB_t) + \beta_{ih} \cdot E(HML_t)$

The term on the left-hand side of 2.7 is the expected return of stock or portfolio (i) minus the return on the risk-free asset. The first term on the right-hand side is the market β times the market premium. The second term (SMB) denotes the expected difference in returns of small minus big firms times the relevant β. Finally, the last term on the right-hand side is the expected difference of high book to market value portfolios minus the returns on the low book to market value portfolios. Although, the price ratios reflect *ad hoc* assumptions the model still has specification problems because the volatility of returns is so great that substantial uncertainty exists on the expected premiums.

It was for this reason that Fama and French tested the following model

2.8 $R_{it} - R_{ft} = \alpha_i + \beta_{iM} \cdot [R_{Mt} - R_{ft}] + \beta_{is} \cdot E(SMB_t) + \beta_{ih} \cdot E(HML_t) + \varepsilon_{it}$

The idea was, in a similar fashion to the Jensen α, that if α is zero for all stocks this implies that the three variables capture most of the variation of asset or portfolio returns. The model is claimed to have empirical success. Fama and French 1998 argue that it performs better than the intertemporal CAPM. Mitchel and Stafford (2000) suggest, although this means that the model does not hold, that α_i measures how rapidly stock market prices respond to new information. Carhart 1997 uses the model to study mutual fund performance. Finally, Ibbotson and Associates are among the market practitioners which offer the model as an alternative to the CAPM for calculating the 'cost of capital'.

Irrespective of the validity of these empirical findings the model has theoretical shortcomings as admitted by Fama & French themselves. The SBM and HML variables have nothing to do with the variables that are supposed to concern the investors under the assumptions of all versions of mainstream theory. It is for this reason that Fama & French have argued that the variables (SBM, HML) are 'mimic' of the relevant 'state variables'. Their argument is that if additional well diversified portfolios are sufficiently different from the market portfolio this is adequate reason to consider them mimic to some undefined 'state variable'.

However, this vague justification of the additional explanatory variables enables other schools of thought to interpret the statistical findings of the three-factor model differently. For example, the behavioralists argue that the HML variable, which is mainly responsible for the superior performance of the model as compared with the CAPM, is not a mimic of some 'state variable' but the result of investor overreaction[40] to all high book/ market value stocks. Therefore, this chain reaction is wrongfully interpreted as hidden risk factors. in this context, the discussion turns to whether the premia calculated by equation 2.8 are rational or not.

Fama and others (Stein 1996) have argued that certain applications of the 'three-factor' model do not require a definition of rational, irrational, or sample-specific average return premiums. Specifically, they argue that the response of prices to new information, the performance evaluation of managed portfolios, and estimating the cost of capital does not depend on whether return premiums are rational or not. What they mean is that, in the 'three-factor' model time regression (eq. 2.8), if the diversified portfolios capture the variation of stock returns then we can estimate the above-mentioned factors irrespective of whether returns are rational. However, this is a perfectly arbitrary argument, on one hand, it presupposes that the parameter α

[40] The Behavioralists suggest that investors systematically overreact to high book-to- market value stocks leading to pricing bubbles. The argument is more thoroughly discussed below.

is a measure of price response to new information and/ or mutual fund management performance something which is not proved. On the other, it considers that forward looking risk premiums, reflecting the cost of capital, are relevant irrespective of whether they are sample-specific (i.e. the result of chance), or not. The latter is not true. In short, it is evident, that if diversified portfolios are assumed to mimic underlying state variables then returns have certain properties that apply to the neoclassical equilibrium. If these variables are assumed to reflect other types of investment behavior, as argued by the behavioralists, or of undiversifiable 'particular' risk (structural uncertainty), as argued here, then stock returns do not follow the patterns assumed by modern investment theory. Therefore, it is wrong to attribute universal properties to versions of the ICAPM like the 'three-factor' model.

In fact, the idea of inserting variables in mainstream asset pricing models exclusively on the grounds of statistical correlation and then trying to theorize on the implicit and explicit nature of these variables is highly problematic. For instance, Jagadeesh and Titman (1993) identified a 'momentum effect'[41] in individual stock performance distinct from the value effect allegedly captured by the book to market equity ratio. J&T showed that stocks that outperform the market for a period of three to twelve months continue to outperform the market for the next few months. This is a finding which can support behavioralist arguments suggesting 'irrational'[42] behavior, or the 'reflexivity expectations theory' of George Soros we will discuss in the context of the profit-based approach. However, risk theorists tried to incorporate this pattern in their framework like the value and size effects discussed above. Carhart 1997 argued that they could add a 'momentum effect' in the 'three-factor' model, i.e the difference in the returns of portfolios of 'winners' and 'losers'. Winners and losers standing for portfolios over-performing and under-performing relative to the market respectively. His rationale was quite simple if well diversified portfolios can qualify as a mimic of underlying state variables why not add one more variable. However, how can one justify estimates of the cost of capital, which is assumed stationary, from a model where a short-term effect, like the momentum effect, appears as an explanatory variable? Actually, as we will see in the next section, where we discuss the Arbitrage Pricing Theory, the reduction of return variability to a set of common

[41] The 'momentum effect' is not the only standardized fact identified in literature. For instance, Franken and Lee 1998 and Piotroski 2000 argue that on portfolios formed on price ratios stocks with higher expected cash flows have higher returns. They consider this an indication of irrational pricing. Overall mainstream theory is engaged in a futile debate whether it is bad (irrational) pricing or bad asset pricing model responsible for the empirical failure of the CAPM.

[42] Rationality assume in the mainstream sense, i.e. in the context of the so called 'homo economic us.

factors involves a set of strong neoclassical assumptions on competition and equilibrium which impose restrictions on the structure of asset returns. Therefore, the insertion of such variables is not just arbitrary but contradicts the underlying theory in many cases.

Closing this reference to mainstream explanations of the failure of the CAPM note must be made to the argument of the behavioralists. There is one more reason for this since they argue that crisis is the result of the inherent generation of 'bubbles' in capital markets (Shiller 2003, 2009). In the current crisis, the subprime loans market and the related asset-backed securities was the place where the bubble was witnessed. As mentioned already the reason for these bubbles, for the behavioralists, is the inherent exaggeration of investors either through irrationality or animal spirits In the case of stocks, the crucial measure is the book to market equity ratio the latter reflecting value and growth stock returns and/ or business cycle patterns. However, the main problem of the behavioralist rationale is the idea that asset bubbles are the result of irrational behavior which implies of course that CAPM reflects rational returns and asset prices. Their critique is similar to the discussion on perfect and imperfect competition in the theory of the firm and more generally to the insertion of imperfections to the neo-classical model. Here the imperfections are due to 'cognitive bias', 'group thinking' and 'herd behavior'. To put it in more abstract terms, for the behavioralists, people do not behave like 'homo economic us', i.e a person with fixed preferences, in our case risk preferences, who does not relate to, or is influenced by anybody else, or as Amartya Sen puts it a 'social Moran'. His behavior is dominated by collective behavior which is considered irrational. The latter gives rise to phenomena like asset bubbles.

The argument of the profit-based approach, elaborated here, is different. Capital markets do not experience stationary returns under neoclassical rational behavior. Returns are inherently non- stationary, and this is because of a highly volatile required rate of return reflecting the underlying conditions of corporate competition and profitability. In this world of true uncertainty, individuals do not share the same views about market returns, it is financial capital that keeps market returns in line with the underlying fundamentals. Therefore, asset bubbles are not ruled out, mainly because expectations can temporarily influence fundamentals (Soros 2009, Shaikh 2016) but despite exaggerations in the end fundamentals rule.

We will return to this point in the conclusions of this chapter and chapter three, for now, we need to understand further the implications of models which attempt to determine stock returns by a set of common factor(s) of variation. The 'three-factor' model belongs in this category and has the property to stand between the CAPM and

Arbitrage Price Theory (hereafter APT). The reason is that it is based on an assumption shared by both the ICAPM and APT, i.e. that well diversified portfolios can enter in return determination as a mimic of 'state variables'. In this regard, this section serves also as a bridge to pass to the presentation of the APT.

2e. Arbitrage Pricing Theory

2e.1. The Market Portfolio Specification Problem

To understand how the APT model was developed we need first to understand the critique of the CAPM advanced by Richard Roll (1977). The argument was of both theoretical and empirical nature and suggested that the CAPM was never tested properly and will never be. The reason is that on the theoretical level there is no clear specification of which assets are excluded from the market portfolio. For instance, 'human capital' should be included in the market portfolio or not? Of course, there are also technical limitations in constructing the 'market portfolio'. Practical problems reflecting data availability for the candidate assets pose a barrier in defining the true 'market portfolio'. In this regard Roll argued that using proxies for the market portfolio in empirical studies tells us nothing about the CAPM.

It should be noted in passing that the whole debate on the specification of the market portfolio gives rise to a rather obvious criticism. In the CAPM the 'market portfolio' is not a construction serving the purpose of empirical testing, it is the portfolio held by all investors irrespective of their risk preferences. Therefore, investors should be capable of obtaining this portfolio quite easily. Rolls' critique acknowledges that even academic researchers with analytical skills, technical means, and ample time are facing difficulties in defining the key variable for the determination of asset returns on a purely theoretical level.

Mainstream economists surpassed this logical inconsistency, as they have done so many times with various issues and entered into a debate of defining the appropriate market proxy. Stambaugh (1982) included corporate and government bonds in testing a series of market portfolios. He concluded that the empirical results were not sensitive to the inclusion of these assets mainly because the volatility of the portfolio was dominated by the volatility of stocks. However, his results were not accepted because he used only US data. Fama and French (1998) showed that when testing the CAPM against a global portfolio the resulting betas cannot explain returns. They argued that CAPM failures mainly appeared on stocks with high book to market equity ratios and high P/E ratios. This finding gave rise to multifactor asset pricing models like the 'three-factor model'. Of course, the inclusion of price ratios in resolving the empirical failure of CAPM can be considered circular reasoning since prices, included in both ratios, are a main determinant of returns.

Mainstream theorists surpassed also this second logical inconsistency and concluded that using reasonable proxies will not assist them in defining a market portfolio close to the minimum variance frontier (Fama & French 2004). The frustration, reflected in this pessimistic comment, is not limited to the empirical findings mentioned so far. Mainstream economists are also puzzled by the fact that portfolios constructed by sorting pricing ratios have returns that are not positively related to market betas. For instance, Lakonishok, Shleifer, and Vishny (1994) report that ten portfolios of US stocks shorted based on book to market equity ratios (the lowest B/M ratio for portfolio 1 and the highest for Portfolio 10) have market betas negatively correlated to returns. Actually, Portfolio 1 has the highest beta.

Instead of considering the effects of the assumptions of the CAPM in order to explain its empirical performance, some economists suggested that the market portfolio specification is the cause of the empirical failure of the CAPM. In this regard, they offered an alternative model, the APT, which retained the Non -Arbitration property of the CAPM without the need to refer to a 'market portfolio'. Moreover, the APT did not rely on the normality assumption for asset returns and the quadratic utility function of the CAPM which were difficult to justify, to say the least.

2e.2. The Arbitrage Pricing Theory

As Roll and Ross (1984) argue in an early review paper, at the heart of the theory stands the contention that only 'a few factors' affect average stock returns[43]. The idea is that although a great number of factors affect the daily volatility of stocks and bonds only a few factors move the returns of aggregate portfolios. This implies of course that the volatility of diversified portfolios will be limited compared to the volatility of individual shares since the latter have additional sources of variation. As we recall from chapter 1 this fact contradicts data presented by Shiller (1988a, 1988b) indicating that positive covariance exists between the error term of individual shares, the latter indicating that portfolios vary more than the shares comprising them. Roll and Ross (hereafter R&R) begin by assuming the exact opposite.

Given their initial point, they reduce anticipated volatility even further by suggesting that anticipated variations of these 'factors' will be incorporated into market prices

[43] Technically speaking the limitation in the number of factors is intended to justify that the total number of assets must always be greater than the total number of factors and avoid matrix singularity.

therefore it is the unanticipated variations that cause the volatility of shares. In the R&R world, investors acknowledge that unanticipated events may affect the returns of their portfolios but the mere fact that these events are 'unanticipated' suggests that they do not know the magnitude or direction of these events. However, since stock returns depend on 'few known factors', investors can calculate the sensitivity of returns to their variations. The latter implies of course that other factors that affect individual stock returns, otherwise referred to as sources of 'idiosyncratic risk', are canceled out through diversification. Therefore, investors are left to worry only about sources of systematic risk.

In the case of the CAPM 'particular risk' another name for 'idiosyncratic risk' is also eliminated through diversification and the market portfolio becomes the only common source of risk. Although the risk-return mechanism of the APT is modified relative to the CAPM, as we will see shortly, the fact that idiosyncratic risk can be eliminated justifies the assumption that risk factors affecting returns are common to all shares. In the CAPM risk elimination implied that stock returns follow the normal distribution and equivalently that investors possess quadratic utility functions. However, the CAPM can be seen also as a 'single factor model' where variations in individual returns among companies or branches of the economy are isolated events that cannot affect the returns of the market portfolio. This implies that variations in returns of a single company do not affect returns on other companies because all firms are assumed, price takers. Another way of stating this is the assumption that the residual variance of individual stock returns is uncorrelated with each other.

This means that competition between companies may exist however it is reduced to the notion of perfect competition. If real competition between firms of the same industry is present the result is a strong correlation of residuals of individual companies. The idea is that companies would reduce prices to attack competitors' market shares and as a result higher returns of the one would imply lower for the other, or lower returns for both. Under a similar rationale, competition between industries, or intra-industry competition, is expected to yield a positive correlation in the returns of companies in the same industry, and a negative correlation is expected in the returns of stocks belonging to different industries. The idea is, that capital mobility towards an industry with higher returns than the average will lead to increased investment which will tend to reduce industry returns. In other words, corporate returns will move in the same direction, the latter appears as a positive correlation of industry returns.

Overall, in the classical notion of competition adopted by the profit-based approach corporate returns affect returns of other companies as well as industry and market returns. One implication of this argument is that 'idiosyncratic risk' cannot be eliminated and stock returns cannot be determined as the result of unexpected variations of a common factor or factors. As we have seen in chapter 1 this implies true uncertainty instead of calculable risk[44] and variable, non - stationary required returns. As it will become evident in chapter 3 it implies also a different type of arbitrage.

As already discussed above, in the CAPM the reduction to a single factor model is done implicitly through the assumptions underlying investment decisions taken on the mean and variance of stocks and portfolios implying that returns follow the normal distribution. In the APT this is done explicitly by assuming a linear factor(s) model of the following form:

2.9 $R_j = E_j + \beta_j \cdot f + e_j$

Where R is the return on the stock j broken down into three constituent parts: the expected return E, the sensitivity of the share to unexpected variations to the common factor f (βj), and the idiosyncratic factors e. Of course, we have assumed that stocks respond to changes to a single common factor, denoted by f, for the sake of simplicity. Therefore, the assumption that returns of one stock do not affect returns on other stocks is explicitly introduced, and together with the assumption that factor f variations are uncorrelated with e ensures linearity in the formation of stock returns. Consequently, the total risk becomes the sum of factor risk and idiosyncratic risk. Assuming further that the expected value of f and e is zero we end to the familiar mainstream relation that actual returns are (roughly) equal to expected returns. Moreover, since all sources of deviation of actual from expected returns have zero mean, expected returns are constant. Finally, it should be noted that the model can be generalized by assuming n securities and k factors. In that event, R is an nX1 vector, β and f are n x k matrixes, and e an n x n diagonal matrix since the only nonzero elements will appear in the main diagonal.

The assumptions underlying factor(s) models, especially regarding idiosyncratic risk, place the familiar restraints on portfolio risk and variance. In this regard the following relations hold:

$$\sigma^2(e_p) = \sum_{n=1}^{n} x_n^2 \cdot \sigma^2(e_n)$$

[44] Actually, positive covariance between error terms of different stocks calculated by Shiller (Shiller 1988 a, b) and presented in Chapter 1 is an indication of correlation between residuals assumed away by mainstream models.

This relation reflects the assumption that idiosyncratic factors are uncorrelated between stocks. Therefore, portfolio variance $(\sigma^2(e_p))$ is equal to the weighted average of the idiosyncratic risk of the stocks participating in the portfolio, where x is the weight. It goes without saying that as we add shares to the portfolio the square of the weight (x_n) will tend to zero, in other words, idiosyncratic risk will be diversified.

Furthermore, it holds:

$$\sigma^2(R_p) = \beta_{1p}^2 \cdot \sigma^2(f_1) + \beta_{2p}^2 \cdot \sigma^2(f_2) \ldots\ldots \beta_{kp}^2 \cdot \sigma^2(f_k) + \sigma^2(e_p)$$

Because we have assumed that there is no correlation between idiosyncratic variance $(\sigma^2(e_p))$ and factor variance $(\sigma^2(f_i))$, portfolio variance is the weighted average of factor variance where the square of portfolio betas (βip) are the weights. It should be noted in passing that the assumption of uncorrelated factors is quite arbitrary. For instance, Roll and Ross in their 1984 paper suggest that adequate factors are: 1) unanticipated changes in inflation, 2) unanticipated changes in industrial production, 3) unanticipated changes in bond premiums[45], 4) unanticipated changes in the term structure of interest rates. The question then becomes how can one assume that there is no covariance between industrial production and price changes? This was probably the reason APT theorists abandoned specific factors for testing the APT and either refer to implicit factors[46] or attempt to associate price ratios to underlying state variables, like in the 'three-factor model'.

Before we discuss these matters further, we need to specify portfolio betas for the sake of completion. They are specified by the following equation:

$$\beta_{1p} = \sum_{k=1}^{n} x_n \cdot \beta_{1n}$$

In other words, portfolio beta for factor one is the weighted average of the factor betas of individual securities included in the portfolio.

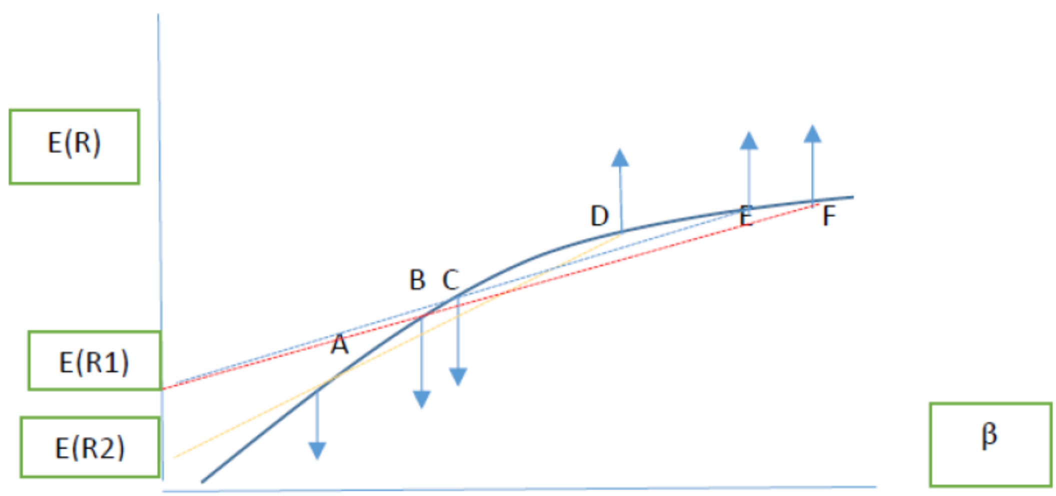
These restrictions are sufficient to solve the model. However, the points raised so far on the model assumptions require some further discussion before we move to the solution. Because of the unrealistic scenarios arising from the assumption of zero covariance between factors the literature tends to explain the APT models from the intuition underlying Arrow-Debreu security pricing (Huberman and Wang 2005). The 'factors' are 'primitive assets' paying or not paying a premium in different

[45] By risk premiums we refer to interest rate differences between low- and high-grade bonds.

[46] Common factors that exist although we do not/ cannot specify to which factors we are referring to.

'states' of the world. In the context of the APT, we should think of this rationale as an expression of asset returns from the sum of expected and unexpected returns of k 'fundamental assets'. The 'fundamental assets' are no other than the factors of the model. This is the reasoning underlying also the ICAPM and explains how the 'three-factor model', elaborated above, is related to the APT.
However, the most important point that can be derived from this elaboration is that the model relies on perfect competition and consequently neoclassical equilibrium. This ensures that the ergodic axiom holds. In other words, stationary returns reflecting a stationary neoclassical equilibrium are a prerequisite for zero covariance between 'factors' even if we treat them as 'Arrow-Debreu securities'. This implies of course that equity risk premiums will be limited, as suggested by Mehra and Prescott, and elaborated in the previous chapter, something which, as we saw, contradicts actual data. With this in mind, we will proceed to the model solution.
We will use the familiar figure of the APT

Figure 2.3



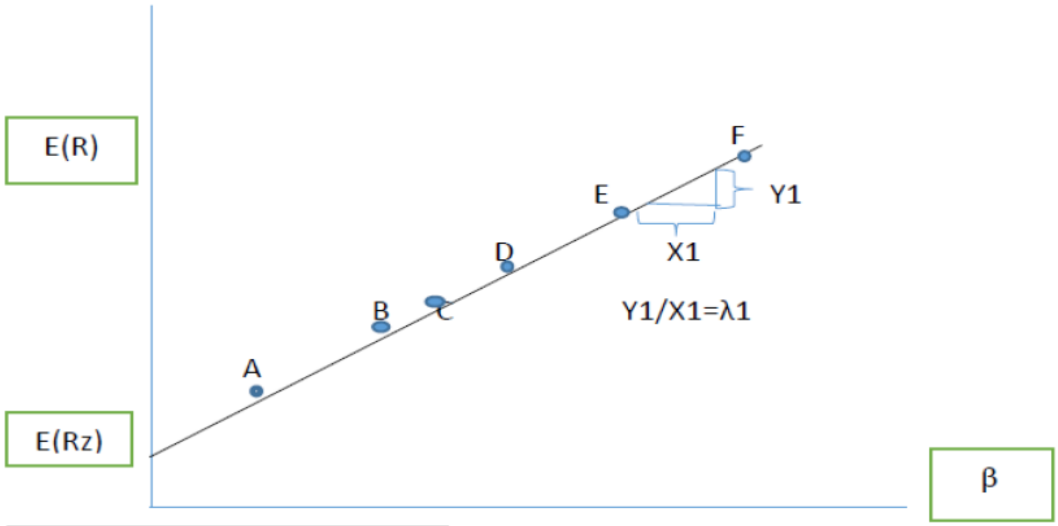
We assume that a single factor explains all covariances between stocks. For the sake of the exercise, we will assume that the relation of expected return with beta takes the nonlinear form presented in the chart where A, B, C, D, E, F are different stocks. Finally, we will assume that free short selling is permitted. If this structure prevails, and idiosyncratic risk can be diversified by adding stocks in the portfolio then unlimited positions of riskless arbitrage can be attained. For instance, an investor can sell stock A short and use the proceeds to invest in stock D. This way he will make a return equal to E(R2) which is riskless, because it has a zero beta, and requires no capital as well. Similarly, a riskless return equal to E(R1) can be enjoyed by selling stocks B, C short, and using the proceeds to buy stocks E, F respectively. Millions of combinations arise from this practice. For example, an investor could sell the portfolio of (A, D) which has return E (R2) and use the proceeds to purchase portfolios (B, F) and (C, E) both of which have returns E(R1) and so on.

It is amazing that perfect competition and the consequent assumption of the elimination of particular risk, through diversification, gives rise to an unlimited number of positions of (riskless/ costless) arbitrage. This is a notion quite different from 'turbulent arbitrage', a notion used in the context of the profit-based approach, where competition and cyclical effects, reflected on the incremental rate of profit, constantly give rise to positions of arbitrage, under true uncertainty, which results to new positions of profit or loss (Shaikh 1997). In the APT arbitrage cannot last for long. Short selling and the subsequent purchase of stocks together with the formation of portfolios alter stock returns. Consequently, prices and returns of stocks A, B, C (short sold) will fall and prices and returns for stocks D, E, F (which are purchased) will rise. In the end, the theory assumes that the relation between return and factor risk will become approximately linear like in equation 2.9 with the difference that particular risk e has been removed (is zero)[47].

We can show this graphically for the single factor case as follows:

[47] Actually, with the assumptions in hand approximate linearity prevails. It has been shown that exact linearity appears if we assume: 1) bounded utility functions, like the concave utility functions used by Mehra and Prescott 1985, 2) utility maximization decisions, 3) capital markets clear. (Connor 1983). Of course, in this context the model looks more like an equilibrium model, for example like the ICAPM, rather than an arbitrage theory solution.

Figure 2.4



The chart tells us that riskless portfolios will receive a return E(Rz), the risk-free rate, while risky portfolios will have a linear relation with factor risk (the beta factor) based on the slope (λ1) of this equivalent of the 'securities market line'. The coefficient λ1 is usually referred to as the price of factor 1. All this is summarized in the following equation of expected returns (for security A):

2.10 $E(R_j) = E(R_z) + \lambda_1 \cdot \beta_{1j}$

The equation confirms that expected returns are constant as already stated[48]. Moreover, it confirms that the whole process rests on the assumption of diversifiable particular risk which implies perfect competition and neoclassical equilibrium. Arbitrage Price Theory presents quite clearly how constant or stationary required returns are derived from the assumptions of mainstream economics and the significance of the notion of perfect competition in this analytical conclusion. This means, among other issues, that the 'profit-based approach' relies on a different understanding of economics as a whole and asset pricing in particular.

The assumption of zero covariance between factors enables the generalization of eq 2.10 for many factors. We will skip the exhaustive presentation since it does not add any theoretical insights to the points we have raised so far. In the case of many factors the expected returns equation for n securities and k factors takes the following form:

[48] It must be noted that the APT is not a one period model like the CAPM it can hold for multiple periods therefore the stationarity of expected returns is much stronger and more explicit in its context.

2.11 $E(R_n) = E(R_z) + \sum_{n=1}^{k} \lambda_\kappa \cdot \beta_{\kappa n}$

Comparing the APT and the CAPM has shown that the two models share the assumption that particular risk is diversifiable and asset returns are constant (or stationary) and exogenously given. For the APT, the latter is reflected in the assumption that factors are Arrow-Debreu securities. If this rationale is extended to the CAPM it can be formally proved that the two models are equivalent. This is shown here below:

Let us assume, for the sake of simplicity, that the expected return on any stock is given by a two-factor model represented by the following equation:

2.12 $E(R_n) = E(R_z) + \lambda_1 \cdot \beta_{1,n} + \lambda_2 \cdot \beta_{2,n}$

We will assume further that the two factors represent two portfolios, or 'primitive assets' in the Arrow Debreu sense. In this regard we can write factor prices as follows:

2.13 $\lambda_1 = \chi_1 \cdot [E(R_M) - E(R_z)]$

2.14 $\lambda_2 = \chi_2 \cdot [E(R_M) - E(R_z)]$

Where x1, x2 are the weights of the two portfolios that comprise together the market portfolio. So the equations tell us that the factor prices are equal to the market portfolio risk premium times the weight of each portfolio in the market portfolio. Substituting equations 2.13, 2.14 in equation 2,12 we get:

$$E(R_n) = E(R_z) + [\beta_{1,n} \cdot x_1 + \beta_{2,n} \cdot x_2] \cdot [E(R_M) - E(R_z)]$$

As we have shown above because the idiosyncratic risk is eliminated through diversification and there is no covariance between factors the following relation holds for the market portfolio:

$$\beta_M = \sum_{P=1}^{M} x_P \cdot \beta_{P,n}$$

If portfolio betas are the weighted average of securities factor betas comprising the portfolios market portfolio beta will be the weighted average of the portfolios comprising the market portfolio. Therefore, equation… can be written as follows:

$$E(R_n) = E(R_z) + \beta_M \cdot [E(R_M) - E(R_z)]$$

The equation, of course, is no other than the familiar equation of the CAPM (eq 2.5) we derived above. Under the same rationale, the ICAPM and the three-factor model are also constructed. Their only requirement, supporting the equivalence of the two models, is that the selected portfolios are associated with factor prices (λ) maintaining a linear relation between betas and the market portfolio. It is the celebrated Non-Arbitrage Theorem (Ross 2004: 1-21) that underlies all versions of mainstream asset pricing irrespective of differences in the assumptions of the underlying each specific model.

This last elaboration proves among other issues that the assumption which underlies mainstream asset pricing models is no other than the assumption of perfect competition and consequently stationary neoclassical equilibrium. This assumption is implicitly introduced in the CAPM through the ergodic axiom and the normally distributed asset returns and explicitly in the APT through the zero correlation of sources of idiosyncratic risk. As we saw both versions justify constant or slowly varying required returns like the ones used in DCF models. For DCF models and the CAPM, we have already referred to their poor empirical performance. Does this hold for the APT as well?

2e.3 Empirical Tests of the APT

Although the APT was introduced as a solution to the specification problem of the CAPM it has important specification problems of its own. The main problem is that the assumption of zero covariance between factors is so obviously wrong that it pushes empirical testing towards techniques that do not require explicit reference to the underlying factors.

In their initial empirical attempt Roll and Ross (1980) had positioned the theory in the context of the Arrow–Debreu security pricing, implying perfect competition and perfect capital markets. At the same time, they make an effort to dissociate the empirical testing from factor specification. But they did not stop there, they suggested that a theory 'should be tested by its conclusions, not by its assumptions' (Roll and Ross 1980) and they continue 'O(o)ne should not reject the APT hypothesis

…by merely observing that returns do not exactly fit a k-factor linear process'[49]. Extending the methodology of reducing their empirical test further, R&R, reduced their investigation in testing the following hypothesis:

$$2.15\ E(R_n) = E(R_z) + \lambda_1 \cdot \beta_{n,1} + \cdots + \lambda_\kappa \cdot \beta_{n,k}$$
$$null\ hypothesis\ \lambda_1 = \lambda_2 = \cdots \lambda_\kappa = 0\ null\ hypothesis\ (rejection)$$
$$\lambda_k \neq 0\ alternative\ hypothesis\ (non\ rejection)$$

In words, they test whether the null hypothesis suggesting that all factor prices (λ) are zero. If this is jointly not true then, R&R suggest, that 'we cannot prove that the theory is true…W(w)e can only fail to reject it' (R&R 1980).

Although empirical testing was reduced to the non-rejection of the theory the problem remains: how can we define nonzero values for some λs without specifying the factors they refer to. In this regard, R&R used the technique known as 'factor analysis' which does not require variable specification. The input in empirical testing is the covariance matrix between the returns of the securities participating in the sample. Then the betas that explain the covariance are calculated. This is done by constructing portfolios of different weights from the securities in the sample. The portfolios are considered to explain the systematic portion of security returns and, for this reason, residuals are usually subtracted from security returns. The computer program continues to insert (index) portfolios until the probability the next portfolio will explain a significant fraction of covariances between stocks drops below a predetermined level.[50]

There is a strong resemblance between 'factor analysis' and the technique of using diversified portfolios as explanatory variables in the three-factor model. The resemblance lies in the application of portfolios as a mimic of unidentified variables. In Roll and Ross, this is accomplished by constructing index portfolios whereas in other empirical models portfolios are constructed, for example, by ranking shares by their size and/ or their book to market value as in the three-factor model.[51] To put it in mathematical notation, in a multifactor model the covariance of returns between any two stocks are assumed to be given by the following equation:

[49] Actually, R&R found significantly different risk - free rates and differences in the significance of factor prices among subgroups of shares as we will elaborate in various instances here-below.

[50] There are different techniques for identifying factors in 'factor analysis' here I present the simplest one the one of predetermined levels of probability for the sake of presentation.

[51] Actually, the APT literature includes empirical tests which combine the two methods as we will see below.

$$2.16\ Cov(R_1, R_n) = \beta_{1,1} \cdot \beta_{1,n}\sigma^2(I_1) + \beta_{2,1} \cdot \beta_{2,n} \cdot \sigma^2(I_2) + \cdots + \beta_{k,1} \cdot \beta_{k,n} \cdot \sigma^2(I_k)$$

In words, the covariance of returns of any pair of stocks is equal to the sum variance of the underlying factors represented by the index portfolios (I) multiplied by the factor betas for the two stocks. This implies, of course, that residuals are fully uncorrelated, or in other words that idiosyncratic risk is fully diversified and that factors are uncorrelated as well. All these we know already from the previous discussion, the additional assumption made by factor analysis is that factor variance is equal to one (1) or that factors are random variables following the standard normal distribution. The computer program calculates then the betas from the previous equation which brings the covariance matrix as close as possible to the covariance matrix calculated directly from the sample stock returns.

Knowing the factor betas then factor prices (λ) must be calculated. This is done similarly to the technique implemented for the estimation of the security market line in the CAPM[52] (Black, Jensen, and Scholes 1972, Fama and Mc Beth 1973). In practice what is done is to run cross-sectional regressions for E(Rn) by estimating equation 2.15 above. The whole investigation relies on the contention that if estimated λs are not jointly equal to zero then the theory cannot be rejected as we have stated already. Roll and Ross conducted this test on 42 groups of 30 stocks each for the period July 1962 to December 1972 and found that there must be common factors (maybe four) that determine returns. In reporting this result, R&R overpassed the alarming result that the number of factors was altered from 'maybe four' to 'maybe two' if instead of a 6% E(Rz) the risk-free rate is calculated from the regression. Moreover, R&R did not comment on the fact that in only 88% of the 42 groups we have at least one significant factor (one λ different from zero). What does this mean for the remaining 12% of the groups? How does it affect the evaluation of the results? Finally, what happens if $(R_z) = \lambda_0$, in other words, the risk-free rate calculated from the regression[53], is different between subgroups beyond the level of statistical error[54]?

Acknowledging that they are testing a very weak hypothesis, Roll and Ross, tried to strengthen their results by testing the zero λ hypothesis against a specified rather

[52] If simple OLS regressions were run to calculate λs the problems of estimation bias would appear as already discussed in the empirical tests of the CAPM this is why similar techniques involving cross sectional regressions were implemented.

[53] In the empirical studies of the APT the risk-free factor is usually denoted by λo here we use mostly $E(R_z)$. Both notations whenever used mean the same thing.

[54] Actually, the test concludes that λos differ significantly across the 42 groups of stocks. We elaborate on this point here-below.

than an unspecified model. The idea is that if there are additional variables not associated with undiversifiable risk 'which are found empirically important the APT would be rejected' (R&R 1980)[55]. In this regard, R&R included individual stocks' standard deviation as an additional explanatory variable. In practice to the five-factor regressions (four undefined factors plus λo) discussed above they added the following variable:

$$\sigma_n = \sqrt{\sum_{t-1}^{T} (R_{nt} - R_n)/T}$$

It comes as no surprise that when tested against the original data the variable was found statistically significant adding about 20% in the adjusted R^2 of the regression. To salvage the model R&R suggested that it was skewness in the distribution of returns which is responsible for this result. In other words, they identified that one of the key assumptions of the model, that returns are normally distributed, is responsible for the correlation between the sample mean and the sample standard deviation. But instead of considering this observation as an additional reason for the rejection of the APT,[56] they suggested that we should remove skewness to assess whether the individual standard deviation is significant or not.

In this regard, they calculated the expected (average) returns from a subset of the data, factor prices from a different set, and stock standard deviation from a third set. When this technique was applied, and the distribution of returns was artificially altered and the correlation between the two variables (average returns and standard deviation) is lost. I have argued elsewhere (Stravelakis 2014) that if returns are generated from the fundamentals, they follow a Dagum distribution (Dagum 1977) rather than the normal distribution. The Dagum distribution is strongly skewed to the right and resembles the actual distribution of stocks and commodity returns as reported by Mandelbrot (Mandelbrot 2002) and others. We will return to this point in chapter four.

The statistical findings of factor analysis for the APT are highly questioned even by those who accept the techniques applied for their derivation. Haugen (2001), in an effort to underplay empirical findings rejecting the APT, points out that factor

---

[55] This statement is indicative of the interpretation of price ratios by risk theorists. If price ratios were assumed independent of 'state' variables this would imply the overall rejection of pricing models. Of course, in this statement we consider the CAPM as a single factor model.

[56] Although R&R make no reference to this point, probably because they believed that skewness in individual stock returns would be removed by portfolio formation, it is clearly circular reasoning first to remove the evidence of undiversifiable risk in order to conclude that it does not exist.

analysis involves severe computational problems. This is why the tests are reduced to subpopulations of stocks which can identify common factors but reject the theory because of different risk-free rates and/ or factor prices between subgroups. One could object to such findings because the subpopulation of stocks isn't large enough. Therefore, for these theorists, additional findings of R&R paper (R&R 1980) pointing out that the intercept of eq 2.11 (or alternatively eq. 2.15) is not identical among subgroups as suggested by the theory and factor prices differ are not sufficient for the rejection of the theory. Lehman and Modest (L&M 1985) argue that breaking stocks into subgroups leads to "weak tests of the APT both within and across subgroups". In the R&R paper of (1980) for instance, we are not concerned with the actual factor prices but only if they are jointly equal to zero.

In short, although the R&R paper had failed to confirm the theory regarding 1) The equality of λos among subgroups, 2) The equality and statistical significance of λs among groups, 3) The insignificance of idiosyncratic risk variables in portfolio returns Lehman and Modest (1985) considered the APT an 'unsettled case'. Actually, their paper, besides reviewing previous empirical studies, aimed to conduct strong tests of all the assumptions of the APT. What they have added to the estimation technique is the ability to conduct maximum likelihood estimations of factor betas (otherwise referred to as factor loadings) and idiosyncratic factors for large cross-sections of security returns. This way the 'problem' of equality of intercepts is 'hidden under the carpet' (due to the large sample of stocks) and the significance of factor risk premiums problem is addressed.

The tests conducted using the maximum likelihood method calculate betas associated with individual stock returns. For the sake of clarity, we will briefly present the procedure. This presentation is complementary to the discussion of equation 2.15 and the points related to the factor method. Generalizing, eq 2.16 the assumption of a joint normal distribution of security returns and factors suggests that their covariance matrix follows the Wishart distribution (Wishart 1928). The log-likelihood Wishart equation is:

2.17 $L(\Sigma|S) = \frac{-NT}{2} \cdot \ln(2\pi) - \frac{T}{2} \cdot \ln|\Sigma| - \frac{T}{2} trace(S \cdot \Sigma^{-1})$

Where:

$\Sigma = E[\tilde{r}_t \tilde{r}_t'] = BB' + D$

Differentiating its log-likelihood form with respect to β and idiosyncratic variances and setting the derivatives equal to zero to find a maximum gives the following equations (Lehman and Modest 1985):

$$-T \cdot \Sigma^{-1} \cdot [\Sigma - S] \cdot \Sigma^{-1} \cdot B = 0$$
$$-T \cdot Diag[\Sigma^{-1} \cdot (\Sigma - S) \cdot \Sigma^{-1}] = 0$$

Where: T is the number of observations (the degrees of freedom), B is the [n x k] matrix of betas, S is the [n x n] sample covariance matrix of returns, and Σ=BB'+D where D is the [n x n] matrix of idiosyncratic variances. Diag $[\Sigma^{-1} \cdot (\Sigma - S) \cdot \Sigma^{-1}]$ is a diagonal matrix including only the diagonal elements of $[\Sigma^{-1} \cdot (\Sigma - S) \cdot \Sigma^{-1}]$. Finally, the prime symbol (') stands for the transpose matrix and 'trace' means the sum of the main diagonal of the square matrix $(S \cdot \Sigma^{-1})$.

It can be shown that maximum likelihood estimation is impossible unless we assume that individual stock returns do not influence each other or that the matrix of idiosyncratic disturbances is diagonal.

It is obvious that for a large B and D matrices iterations of eq 2.15 are prohibitive for arriving at results via this method. However, Jorgenson (1967) has shown that for an estimate of D we can calculate betas from the principal eigenvalues of a matrix of the following form:

$$S^* = D^{-1/2} \cdot S \cdot D^{-1/2}$$

However, this solution requires repeated computation of the eigenvalue matrix of S* which is cumbersome and time-consuming even with present-day computational means. Imagine how devastating things were thirty years ago when most of these works came out. For this reason, the EM algorithm is employed for the solution (Dempster, Laird & Rubin 1977, Rubin and Thayer 1982). The algorithm has the property of running regressions and the largest (non-diagonal) matrix[57] inversion is the factor k x k matrix. The insight is that if the factors were known then maximum likelihood betas would be calculated by the multivariate regression of the factors on demeaned returns (actual returns minus expected returns). On the other hand, if the B, D matrices were known factors would be identified by the conditional expectation given demeaned returns. Therefore, if we can regress on the unknown factors and

[57] The computation also involves the matrix D which is assumed diagonal because of our assumptions on idiosyncratic risk.

subsequently calculate the conditional probability of the betas we find, then each iteration is a maximization process which increases the log-likelihood eq 2.17 until it converges towards a local maximum (L&M 1985)[58].

The EM algorithm is applicable in the APT factor analysis because the probability density function represented by eq 2.17 is factorable. This is due, as we have stated above, to the assumption that both mean returns and factors are jointly normally distributed. In this regard and before we move on with our exposition of the maximum likelihood factor analysis conducted by Lehman and Modest (1985) some important points must be stressed. It should be evident by now why R&R (1980) explicitly stated that a theory 'should be tested by its conclusions, not by its assumptions'. One needs no more than a few minutes to find out that stock index returns are not normally distributed. Moreover, the applied testing method is not 'neutral' as one would presume since it presupposes that certain assumptions hold, although they are not independently tested in its context.

Having stressed these points, which can be referred also to other empirical studies of modern investment theory, I move to the L&M empirical study results. The study consisted of calculating betas and λs with the likelihood method outlined above and then test the results by constructing mimic (minimum idiosyncratic risk) portfolios as independent variables and subsets of the stock exchange index as dependent variables. When the empirical studies were based on 'subset portfolios' constructed basis firm size (capitalization) the evidence rejects the APT both regarding the uniformity of the risk-free intercept as well as the determination of common factors. In short, Lehman and Modest conclude that the APT cannot explain the return of such portfolios. However, when 'subset portfolios' are constructed on dividend yield (high versus low) and/or own variance the results are supportive of the APT.

The results are quite illuminating. When firms are sorted basis their competitive position, reflected in the dividend yield and own variance, their idiosyncratic risk if you prefer, then their returns reasonably depend on their reaction to macroeconomic factors, and the APT appears to hold. If sorted based on criteria unrelated to their competitive position like market capitalization the APT fails. This is precisely the criticism of the profit-based approach to mainstream investment and finance theory. However, the critique is not based on the structure of the empirical tests but the perception of the operation of capitalist markets as a whole. The next

[58] The exposition of the Lehman Modest (1985) methodology is not intended to present their complete model. I want to stress only the fact that the normality assumption for both factors and returns is a prerequisite for the validity of the econometric method.

section presenting the efficient market hypothesis will elaborate further on some of these issues.

2f. The Efficient Market Hypothesis

2f.1. Introduction and Summary

The discussion on the efficient market hypothesis is necessary not only because of its impact on finance and financial regulation policies but also because it summarizes the discussion over the critical assumptions of the mainstream models discussed so far in the current and previous chapter. At the theoretical level, it brings up both the common factors and the different assumptions underlying mainstream theory. But its greater advantage was that it arrived at highly convenient conclusions for the financial industry. It justified unprecedented deregulation of the financial markets following 1982 which continued even when overwhelming evidence suggested that the efficient market hypothesis contradicted empirical findings, and these findings were published in top academic journals. Deregulation proceeded without impediments and although I do not argue that financial deregulation was the cause of the 2007 crisis, it certainly aggravated its consequences.

Having discussed the evolution of the argument in section 2.a here I will focus on the modern version. The theory came to the forefront of the discussion on finance through a review paper written in 1970 by the father of the efficient market hypothesis Eugene Fama. There he described the concept with a single phrase: 'a market is efficient if security prices reflect at all times all available information'. The definition was considered misleading by important mainstream economists (LeRoy 1989, Lucas 1978) since it associated market efficiency with 'martingales' (Samuelson 1965). As we will see shortly, the Samuelson 'martingale' model implies risk neutrality. This contradicts the assumption that investors are risk-averse which underlies a good part of mainstream theory. If risk aversion is incorporated in a model of asset pricing, the latter will not necessarily retain the martingale properties. The compatibility of information efficiency, 'martingale' properties and risk aversion was a challenge for the 'efficient market' hypothesis.

Fama did not realize the theoretical implications of his definition of market efficiency in his 1970 paper. His main objective was to establish an empirically testable outline for the theory. This was no other than the investigation of whether asset returns are serially correlated. In other words, the presentation of statistical proof that asset prices cannot be predicted by past prices. However, the theoretical contradictions were evident. On the one hand, he applied the risk-neutral 'martingale model' and at the same time, he applied the 'random walk hypothesis' which contradicts risk neutrality (LeRoy 1976, 1989). Moreover, a good part of the profession considered Fama's 1970 definition of information efficiency as a mere tautology[59] that does not restrict the stochastic process of price. The reason is that, in the 1970 paper, he considers only the deviation of price from its conditional expectation a 'fair game' and not asset returns. These shortcomings invalidated his main argument, the idea that market efficiency could not be tested without an equilibrium model. In other words that the empirical investigation of market efficiency is a joint hypothesis test. It aims to ascertain whether asset returns are generated from mainstream pricing models (for example the CAPM or the APT discussed above) and 'reflect all available information' at the same time.

The criticism led Fama to present a restatement of the concept (Fama 1976a, 1976b). This is how the theory is taught in finance courses today. Specifically, in the amended version, (the strong form of) the efficient market hypothesis[60] implies rational expectations, market-clearing prices, and prices reflecting intrinsic values. This amended definition removed the criticism of tautology. However, the theoretical problems remained. From various works of his (1970, 1976a, 1976b, 1991, 2007) it appears that Fama considered that the equality of prices with intrinsic values pointed to the martingale model as presented by Samuelson (1965, 1973). At the same time, he assumed, that asset returns follow a 'random walk'. The latter is crucial for the empirical tests because it implies that return distributions repeat themselves through time. In other words, returns are assumed 'stationary' (Fama 1970). Stationarity is crucial for empirical testing because the usual statistic of correlation assumes a constant mean.[61]

---

[59] Fama assumed that only the deviation of price from its conditional expectation is a 'fair game' that is:

$$E(y_{t+1} \vdots \Phi_\tau) = 0$$

And

$$y_{t+1} = p_{t+1} - E(p_{t+1} \vdots \Phi_t)$$

Where p is price, Φ is the available information and t is time. Taking conditional expectations on both sides we get:

$$E(y_{t+1} \vdots \Phi_\tau) = E(p_{t+1} \vdots \Phi_\tau) - E(E(p_{t+1} \vdots \Phi_t) \vdots \Phi_\tau)$$

This means simply $E(p_{t+1} \vdots \Phi_\tau) = E(p_{t+1} \vdots \Phi_\tau)$ which is a tautology.

[60] The 'strong form' refers to frictionless market where everybody has free access to all relevant information. There exist milder definitions of market informational efficiency the semi strong and weak form of market efficiency. In the weak form, only past information is incorporated in asset prices in the semi strong form all publicly available information.

[61] In other words, non - stationarity asset return distributions are statistically biased towards rejection.

But the 'random walk' is not compatible with risk neutrality which underlies the martingale model. If the 'random walk' assumption applies, then investors will be interested to bid away serial dependence in higher conditional moments of returns and not only in the next period. Focusing only on the next period is what mainstream theory expects risk-neutral investors to do. Therefore, if compatibility with the martingale model is lost together with the abolition of risk neutrality then the equality of prices with intrinsic values as assumed by Fama is lost as well. Fortunately, the martingale model is compatible with Arrow – Debreu equilibrium in the sense that Arrow-Debreu prices can be calculated as the mean of the known 'states of nature' weighed by a set of 'risk-neutral probabilities' and discounted with the risk-free rate (Ross 1977, Hong 2009). The existence of this set of 'risk-neutral' probabilities implies that the market equilibrium is arbitrage-free. In turn, this condition, which underlies the Arrow – Debreu equilibrium (Arrow & Debreu 1954) and is referred to as the condition for 'complete markets', assumes perfect information. Therefore, it is compatible with the efficient market hypothesis which assumes similarly, but more loosely, that 'prices reflect all available information'. In short, the incorporation of risk-averse investors in the efficient market hypothesis requires the adoption of the 'ergodic' axiom. This means that the future is viewed as a repetition of known 'states' of nature with a certain probability of occurrence.

Under more restrictive assumptions on the time path of the rate of growth of dividends and consequently consumption the discount factor is constant, and prices are martingales without any further qualification. This was proved by Ohlson (1977) in a reply comment on LeRoy's (1973) critique of Fama's definition of 'efficient markets'. Ohlson showed that if the rate of growth of dividends is serially uncorrelated then the discount factor is constant, and prices are martingales. It is an assumption equivalent to the ergodic Markov chain assumption on the rate of growth of consumption applied by Mehra and Prescott (1985) and presented in section 1c.2 of the previous chapter. Overall, any variability of asset returns due to risk aversion is quite limited and has small or no value in empirical tests since any predictability of future from past returns is partial (LeRoy 1989: 1604). The discussion is valid only because it reveals the key assumptions underlying the conditions of compatibility of market efficiency with risk aversion.

Although the martingale properties do not generally hold in a world of risk-averse investors, this was the definition of market efficiency which prevailed. It generated two main families of empirical tests. The first checked whether there exist trading strategies that can beat 'buy and hold'. While the second tested whether information available at time t-1 could lead to a correct assessment of the expected return of a financial asset other than the equilibrium value. We should keep in mind that Fama's dissertational thesis on market efficiency (1965) came out around the time of the publication of the Sharpe – Linter version of the CAPM. It was part of an intellectual effort to prove that capital markets can be relatively safe for everybody if they are information efficient. This conclusion overshadowed the assumptions underlying the argument. The 'hypothesis' enjoyed uniform acceptance until the profession came to acknowledge the 'anomalous[62] evidence on the behavior of returns' (Fama 1991). The work of LeRoy and Porter (1981) and Shiller (1989) presented in section 1.b of the previous chapter, as well as other empirical studies, showed that actual asset returns do not follow the patterns implied by the assumption of market efficiency. Mainstream finance entered a debate on whether this was due to market inefficiency, the application of an inadequate asset pricing model, or the definition of market efficiency. At the same time, a series of alternative theories appeared. We have outlined already behavioral finance and the 'three-factor' model in section 2.d.4. and will consider the current discussion in the mainstream camp in the next section (2.g).

However, policymakers continued to operate as if these findings were not there. A huge deregulation of financial markets was implemented following 1982 on the assumption that markets are efficient, can calculate risk correctly, and, therefore, are self-regulated. The events of 2007/2008 were, among other issues, the tragic refutation of this assertion. Quite reasonably the debate in the mainstream has intensified since as briefly discussed below and elaborated in the next section of this chapter.

The key criticism of the efficient market hypothesis, from the side of the profit-based approach, is that market efficiency, in other words, neoclassical equilibrium with 'rational expectations', cannot be separated from the model which determines equilibrium prices. The efficient market hypothesis, in the sense of information efficient prices, can hold in a world where prices are determined from an Arrow–Debreu equilibrium model under certain qualifications, or provided that the rate of growth of consumption is serially uncorrelated. If prices and returns are generated from a different model as argued herein then expectations are formed differently as well. The latter does not mean that financial asset returns always diverge from their equilibrium values. It means that corporate fundamentals and consequently returns are highly volatile. Moreover, the anticipated volatility of expected returns is reflected in investors' expectations which alter corporate fundamentals creating

[62] Anomalous from the viewpoint of mainstream theory

persistent positions of turbulent (risky) arbitrage. This argument will be elaborated in the next chapter.

2f.2. The model

In the efficient market theory, the emphasis is on the properties of the market. For this reason, it was developed on the grounds of the broader possible model of investment behavior. This is no other than the celebrated 'fair game' model (Bachelier 1900, Samuelson 1965, Mandelbrot 1966, Fama 1970). Although, the model applies to all types of financial markets it is usually presented for common stocks and I will follow this practice. The model concludes that in a (neoclassical) efficient market the conditions of equilibrium can be stated in terms of expected returns. This means that expected and actual returns do not systematically diverge. In other words, the knowledge of past prices does not increase expected profits. In the terminology of probability, this is expressed by calling prices a 'martingale'[63] (Mandelbrot 1966, Samuelson 1965). In mathematical notation a 'martingale' is denoted as follows:

2.18 $E(x_{t+1} \vdots \Phi_\tau) = x_t$

The equation (2.18) tells us that (χ) is a martingale if the conditional expectation E(..) for (χ) subject to the informational set Φ for t+1 is the current price x_t.

The stochastic process (y) is a 'fair game' if the following condition holds:

2.19 $E(y_{t+1} \vdots \Phi_\tau) = 0$

From equations 2.18, 2.19 it is obvious that if $x_{t+1} - x_t$ is a fair game then (χ) is a 'martingale'. In terms of financial market equilibrium, this means that if the rate of return is a 'fair game' then the present value of cum dividend prices is a 'martingale'. The proof is kind of straight forward. If the rate of return is the sum of capital gain and dividend yield less 1 then by equation 2.19 the following relation holds:

2.20 $p_t = \dfrac{E(p_{t+1} + d_{t+1} \vdots \Phi_\tau)}{1 + r}$

if the information set is unambiguous then 2.20 can be written as follows:

2.21 $p_t = \dfrac{E_t(p_{t+1} + d_{t+1})}{1 + r}$

---

[63] LeRoy (1989) gives us an illuminating explanation of the word martingale: 'The word martingale refers in French to a betting system designed to make a sure franc. Ironically, this meaning is close to that for which the English language appropriated the French word arbitrage. The French word martingale refers to Martigues, a city in Provence. Inhabitants of Martigues were reputed to favor a betting strategy consisting of doubling the stakes after each loss so as to assure a favorable outcome with arbitrarily high probability.'

Where (p) is the price and (d) the dividend and (r) the rate of return defined above. If h denotes the number of shares held by the mutual fund, the value of the fund at time (t) discounted back at date zero is:

2.22 $v_t = \frac{p_t \cdot h_t}{(1+r)^t}$

If we assume further that the fund purchases shares with the yearly dividend then the following relation holds:

2.23 $v_{t+1} = p_{t+1} \cdot h_{t+1} = (p_{t+1} + d_{t+1}) \cdot h_t$

Then the expected value of the fund is:

$$E(v_{t+1}) = \frac{E(p_{t+1} \cdot h_{t+1})}{E[(1+r)^{t+1}]} \text{ substituting 2.23 } \rightarrow E(v_{t+1}) = \frac{E\big((p_{t+1} + d_{t+1}) \cdot h_t\big)}{E[(1+r)^{t+1}]}$$

$$\text{using 2.21 } \rightarrow E(v_{t+1}) = \frac{p_t \cdot h_t}{(1+r)^t} \text{ and because of 2.22 } E(v_{t+1}) = v_t$$

Which is a martingale by definition (Eq. 2.18).

Samuelson (1965, 1973) and Mandelbrot 1966 used these results to establish an 'efficient market hypothesis' on the grounds of economic theory. Their idea was that contrary to the more restrictive 'random walk assumption', variables following the neoclassical equilibrium model can lead to financial asset prices that are martingales and consequently financial asset returns that are unpredictable[64]. When this rationale is applied in the determination of stock prices the dividend cash flow model is derived. This was elaborated by Samuelson in his 1973 paper which I will present briefly below[65]. There Samuelson put forward the relevance of a well-known result from probability theory, the rule of iterated expectations. The rule states that the expected value of a random variable is the sum of the expected values of that random variable conditioned upon a second random variable.

Let us see how the present value formula can be derived using this tool. From Eq. 2.21 we know that:

[64] A small reference to the history of the evolution of these ideas is appropriate here. The random walk assumption appeared in the 1930 s' as an explanation of the volatility of financial asset prices which was unexplainable from neoclassical equilibrium fundamentals. In this regard it can be considered a fore runner of the efficient market model presented herein. Important academic work did not appear until the early 1950 s' and was that of Kendall (1953) which concluded that stock prices follow a 'random walk'. Under this perspective the work of Samuelson (1965, 1973) and Mandelbrot (1966) were efforts to consolidate financial asset volatility with fundamental analysis. An effort which has proved unsuccessful as discussed by Shiller 1989, Mehra & Prescott 1985 and other analytical and empirical works on the assumptions of modern investment theory presented in this and the previous chapter.

[65] Samuelson s' 1965 paper presents the same argument for forward prices. In 1973 he applied the same concept for stock prices.

2.24 $p_t = \frac{E_t(p_{t+1} + d_{t+1})}{1+r} \rightarrow p_{t+1} = \frac{E_{t+1}(p_{t+2} + d_{t+2})}{1+r}$ *substituting back we get*

$$\rightarrow p_t = \frac{E_t\left(\frac{E_{t+1}(p_{t+2} + d_{t+2})}{1+r} + d_{t+1}\right)}{1+r}$$

Assuming infinite memory, in other words, that any information set Φ_{t+1} is assumed superior to Φ_t , the iterated expectations rule says that $E_t(E_{t+1}(p_{t+2})) = E_t(p_{t+2})$ and the same holds for dividends. Therefore, the extended form of 2.24 can be written as follows:

2.25 $p_t = \frac{E_t(d_{t+1})}{1+r} + \frac{E_t(d_{t+2})}{(1+r)^2} + \frac{E_t(p_{t+2})}{(1+r)^2}$ *substituing for* p_{t+2} *and so on we get*

$$p_t = \frac{E_t(d_{t+1})}{1+r} + \frac{E_t(d_{t+2})}{(1+r)^2} + \frac{E_t(d_{t+3})}{(1+r)^3} + \cdots + \frac{E_t(d_{t+n})}{(1+r)^n} + \frac{E_t(p_{t+n})}{(1+r)^n}$$

if the no bubble solution $\frac{E_t(p_{t+n})}{(1+r)^n} \approx 0$ *holds we arrive to the familiar relation*

$$p_t = \sum_{n=1}^{\infty} \frac{E_t(d_{t+n})}{(1+r)^n}$$

The last equation of 2.25 tells us that the current price equals the discounted value of expected future dividends. It is similar to the derivation of the present value formula in chapter 1 section 1a with the difference that there we referred to actual dividends and the required rate of return is not the risk-free rate like here. However, with the martingale assumption defined by equation 2.18, the two measures are not expected to systematically diverge. Therefore, Samuelson's formulation implies that in an efficient market stock prices equal intrinsic values. This result bears two important properties of neoclassical equilibrium which are responsible for its empirical failure as pointed so far in various instances and will be elaborated further in the remainder of this chapter. First equilibrium is not a center of gravity around which actual prices or returns fluctuate but a point of rest since equality of equilibrium and actual price is assumed to prevail. Second, the discount factor the rate of interest (profit) which is supposed to prevail in equilibrium is constant and equal for all types of assets.

This brings us to the main point of criticism of the profit-based approach to the mainstream theory outlined in the last paragraph of the previous section and elaborated further hereunder. The 'profit-based approach' does not claim that actual and equilibrium prices systematically diverge, as argued by behavioral finance theorists (Shiller 2003, 2009). It argues that equilibrium security prices are not those calculated from a neoclassical equilibrium model, implied by the efficient market hypothesis[66]. The reason is that returns follow the incremental profit rate which is not constant but highly volatile and exhibits trends. This stands behind the volatility of financial asset returns and the patterns followed by asset prices time series (Shiller 1988 a, b, Le Roy & Porter 1981). The volatility of the incremental rate of profit and the consequent structural uncertainty of financial markets give rise to expectations that can alter the fundamentals and contrary to the postulations of the efficient market hypothesis, influence future prices and returns. The latter can lead to the divergence of actual from equilibrium prices for some time although fundamentals rule in the end. This is a brief outline of the 'reflexivity theory' introduced by the speculator and financial manager George Soros (Soros 2009). The latter can explain price dynamics and the gravitation around equilibrium paths in the context of the profit-based approach. These concepts and arguments will be elaborated in the next chapter. For now, we need to stress the following: 1) that in the fair game model investors are risk-neutral and not risk-averse as we have assumed so far, 2) that the definition of market efficiency in Samuelson is not necessarily the definition of efficiency in Fama. The last point was and to a certain extent still is a matter of heated debate within the mainstream with important theoretical and empirical repercussions.

More than half a century ago the equilibrium model which had just come out was the Sharpe – Lintner-Mossin version of the CAPM discussed in section 2.b above (Sharpe 1964, Lintner 1965, Mossin 1966). From an analytical standpoint, the CAPM does the job although its solution requires additional more restrictive assumptions on the structure of asset returns. As already discussed in section 2.b, in the CAPM, market returns are assumed to follow the normal distribution an assumption that is not

[66] The most adequate model is the Arrow – Debreu model. The reason is that it assumes that all 'states of nature' are known in advance and have a specific actual probability of occurrence. The same 'states of nature', or 'fundamental assets', can be associated also with a specific risk neutral probability of occurrence. These probabilities discounted by the risk-free rate can calculate the equilibrium prices as martingale equivalents. The latter implies that in equilibrium there are no arbitrage opportunities. Under the profit-based approach path dependent time series and investment decisions in real time constantly produce new ways and patterns of market adjustment and positions of profit or loss. The main reason is that capitalist competition alter expected and actual returns all the time. The latter implies also a different notion of dynamic market equilibrium where the time path of equilibrium prices or returns are the gravity center around which actual prices and returns fluctuate. The latter is the notion of 'turbulent arbitrage' I will present in the next chapter.

necessary for the derivation of the martingale model (Samuelson 1965, Mandelbrot 1966). To understand the difference, we need to go back to the introduction of these ideas in Bachelier (1900). The latter developed three stochastic models of asset pricing: one that suggested that current prices are an unbiased estimator of price in the future, a second where he assumed that future prices are independent of current prices, in other words, the random walk hypothesis, and finally a third which assumed that prices and returns follow a Gaussian random variable with zero mean and variance proportional to the number of future periods. The last model is the celebrated Brownian motion presented above and incorporated in the CAPM. Samuelson (1965, 1973) derived the martingale model from the first model of Bachelier. The solution of the CAPM relates to the third model. As presented in section 2.b, in the CAPM, asset returns are determined through the normally distributed return of the market portfolio and investors willingly undertake the risk.
This will become evident by elaborating CAPM prices as the discounted expected return less a correction for risk aversion. From equation 2.5, repeated below for easy reference, the expected return in the CAPM can be written as follows:

$$E(Rj) = Rf + \lfloor E(RM) - Rf \rfloor \cdot \beta_j \rightarrow \textit{from the definition of expected return we know}$$

$$Rj = \frac{\widetilde{C_{t+1}}}{P_t} - 1 \textit{ where } \widetilde{C_{t+1}} \textit{ denotes future uncertain cash flow and } P_t \textit{ current price}$$

$$\textit{taking expectations } E\left(\frac{\widetilde{C_{t+1}}}{P_t} - 1\right) = Rf + \lfloor E(RM) - Rf \rfloor \cdot \beta_j \rightarrow$$

$$\mathbf{2.26}\ \boldsymbol{P_t = \frac{\widetilde{C_{t+1}} - P_t \cdot \lfloor E(RM) - Rf \rfloor \cdot \beta_j}{1 + Rf}},$$

$$\textbf{\textit{and }} \boldsymbol{\psi = P_t \cdot \lfloor E(RM) - Rf \rfloor \cdot \beta_j} \textbf{\textit{ is the risk aversion correction term}}$$

As expected, the risk adjustment factor ψ depends on the correlation of asset returns with the market portfolio. For an exogenously given risk-free rate and known variance and next period expected return 2.26 is a martingale.
However, this is not a satisfactory solution. As argued by LeRoy (LeRoy 1989) the exogenous determination of expected return and variance and the fact that the risk premium is calculated from a single period utility maximization[67] exercise invalidates the results. This becomes evident when the one-period CAPM is extended to its intertemporal version. There the martingale properties are lost except under specific assumptions (LeRoy 1973, Lucas 1978). The reason is that the conditional expected return fluctuates over time as dividends change. In other words, dividends

[67] The quadratic utility function underlying the CAPM as we have shown (see section 2.a) is the equivalent of the assumption of the normal distribution of returns of the market portfolio.

are auto-correlated, and as a result, expected returns are auto-correlated as well. Therefore, future returns are partially forecastable something which contradicts the martingale model. Of course, this result would not hold if investors were assumed risk-neutral.

Moreover, the CAPM has poor empirical performance as elaborated in section 2.d above. This is one more reason for the dissatisfaction of mainstream theorists about the application of the CAPM in the foundation of the efficient market hypothesis. In any case, it should be expressly stated that risk aversion, although it induces some variability in required returns does not solve the empirical problems of mainstream models. The empirical shortcomings of DCF models elaborated by Shiller and LeRoy and Porter (Shiller 1988, LeRoy, and Porter 1981) and discussed in section 1.b of the present hold for all the basic models of mainstream asset pricing.

Despite the unanimous agreement on the poor empirical performance of both risk-neutral and risk-averse models of asset pricing, it is worth considering further the relation between risk aversion models and the assumption of efficient markets at the analytical level. The reason is that it identifies the important assumptions that distinguish the profit-based approach from modern investment theory.

As stated already there are cases where martingale properties (analytically) hold in a world of risk-averse investors without further qualification. Ohlson 1977 has shown that if dividend growth rates are serially independent and investors have constant non-zero relative risk aversion then expected returns are constant and the properties of the martingale model hold. In short for the martingale properties to hold in a world of risk-averse investors additional assumptions on the distribution of asset returns are required. These assumptions generally suggest that financial asset returns can be fully described by unchanging, objective conditional probability functions. In other words, calculable risk and risk aversion can be applied in financial market equilibrium if the ergodic axiom is assumed to hold.

The above can be considered in a more general formulation. This no other than the Lucas pure exchange model of (1978). A version of the Lukas framework is the Mehra & Prescott 1985 model presented in section 1c.2 of the previous chapter. Lucas presented a representative firm representative agent model where prices are in equilibrium when the following stochastic Euler equation holds:

2.26 $p_t \cdot U_t' = \frac{E(p_{t+1} + d_{t+1})}{(1+r)} \cdot U_{t+1}'$

From 2.26 it is clear that an investor is at optimum if any utility gain at present U_t' is equal to any utility loss in the next period U_{t+1}'. This is certainly true in the case of risk-neutral investors in a pure exchange economy. In that event equation, 2.26 becomes identical to equation 2.24 and prices are martingales. Nevertheless, in the case of risk-averse investors, there may be cases that prices become volatile. This can be explained analytically as a behavior of risk-averse investors seeking to smoothen their consumption streams over time. For investors to do this willingly prices must be remarkably high in times of economic prosperity to prevent excess saving and exceptionally low in times of economic contraction to prevent dissaving. The obvious question is whether price volatility and violation of the variance constants can be explained as a departure from the martingale model due to risk aversion? The answer volatility is too high to be explained by risk aversion (Singleton 1987).

The overall conclusion is that all versions of mainstream pricing models imply constant, stationary, or slowly varying required returns depending on the utility function applied and the probability distribution of the growth rates of dividends. This has raised reasonable concerns on Fama's definition of the efficient market hypothesis (LeRoy 1973, 1989, Lucas 1978). It has been shown, however, that Arrow-Debreu prices can be information efficient if transaction costs are negligible and there is a price for every financial asset for all 'states' of the world. This is the theory of complete markets (Ross 2004: 19). The association of information efficiency with the Arrow – Debreu equilibrium explains the limited volatility of prices and returns in all versions of neoclassical equilibrium applied to financial markets.

The unexplained volatility of stock prices presented in the works of Shiller, LeRoy, and Porter marked a turning point in mainstream finance. It was considered as evidence against all versions of information efficient prices. From the late 1980s onwards, neoclassical economists have been trying to explain the persistent diversion of asset prices from those calculated by mainstream models. These efforts have intensified following the financial panic of 2008 which led to the practical abandonment of the efficient market hypothesis. These references are outlined in the next section.

2g. The Present State in Mainstream Finance

This section will not present the current literature in mainstream finance in extent. It will emphasize the insights underlying this set of ideas. The reason is, that this literature offers mainly an explanation of why financial asset prices and returns do not follow the mainstream models presented so far without offering an alternative pricing theory. This is the main critique from the side of the profit-based approach to this set of ideas. From a different angle, this could be also the critique of the Nobel prize laureate Robert Lucas on his peers. In his 1978 paper cited above, Lucas states: '..there are innumerable ways for the economy to be out of equilibrium, so we must expect any treatment of out-of-equilibrium behavior to have considerable arbitrariness, not resolvable by economic reasoning' (Lucas 1978: 1437).

The categorization is based upon the main feature that underlies each theory and follows Tirole (2017: 307-321). This is helpful because it avoids confusion on mainstream notions that are similar but not the same.

2g.1. Rational Financial Bubbles

The idea that financial asset prices reflect their fundamental values lies at the heart of the efficient market hypothesis. Therefore, the particularly high prices of stocks or real estate can be seen as departures from the fundamental value resulting in 'bubbles'. Mainstream economists have associated aspects of the present crisis with real estate bubbles. But they do not stay there, they point out that sovereign defaults are usually preceded by real estate bubbles (Reinhart, and Rogoff 2011)[68].

Of course, the persistent appearance of bubbles is an integral part of behavioral finance (Shiller 2009). However, the 'behaviorist bubbles' are generated from the 'irrational behavior' of investors. Here we will consider the cases of financial bubbles generated although investors are 'rational' in the neoclassical sense since behavioral finance is discussed in section 2.d.4 above.

The source of the financial bubble is a difference between the interest rate and the rate of growth (Tirole 2017: 309). The real interest rate must be lower than the growth rate. The idea is that the steady-state equilibrium is inefficient since the economy saves too much given the prevailing rate of growth[69] (Tirole 1985, Phelps 1961). This means that part of the total savings is 'unproductive' in the sense that it is used to validate valueless assets or to increase the value of assets in an unjustified manner. For a positive equilibrium rate of return on capital (marginal product of capital) these savings create a maximum feasible bubble. The bubble either pushes interest rates towards the marginal product of capital and the economy converges towards an asymptotically bubbles equilibrium or to an equilibrium that sustains a bubble equal to the maximum feasible level[70]. The outcome depends on the initial

[68] The idea is that real estate bubbles lead to extended credit and when mortgagee's default this triggers a banking crisis which in turn leads to a public debt crisis.

[69] The equilibrium rate of growth is the rate of growth of population since the models have an underlying neoclassical production function exhibiting constant returns to scale.

[70] In this case the interest rate becomes equal to the growth rate and is greater than marginal product of capital.

conditions (Tirole 1985). For negative rates of return on capital, there exists a unique 'bubbly equilibrium'. In short, an inefficient economy can give rise to bubbles but in conditions of equilibrium.

Things become more interesting when rents are introduced in the story. Tirole (1985) has shown that a perfect foresight equilibrium with non-ex-ante capitalized rent creation has a constant interest rate and (an asymptotically) bubbly steady-state. The only condition for this analytical outcome is that the rate of interest must be less than the rate of growth.

The striking part of the theory is that this possible steady-state is the starting point for discussing the volatility of financial assets. It is stunning, to say the least, to attempt an explanation of volatility with a model where the fundamentals are constant. For example, LeRoy (1989), Shiller (2003), and others as well have implied that only variable fundamentals (required returns) can explain price volatility. This was the meaning of the discussion on efficient markets and risk aversion in the previous section. So, the question is how can rational bubble models contribute to this discussion?

The idea is that in an asymptotically bubbly steady-state with rents, although everything is steady including the bubble, the bubble composition can become the source of volatility. Tirole (1985), in an analytical example, assumes, that there exist two bubbles one for Gold and another for Stocks both of which are martingales, although their aggregate is deterministic. Volatility appears from 'bubble substitution' (Tirole 1985:1513). In other words, the substitution of gold for stocks and vice versa.

The next obvious question, of course, is how this substitution happens without any change in the fundamentals? Well, the answer is "...from factors irrelevant to the economy i.e., sunspots" (Tirole 1985: 1513). Amazingly, the whole analysis so far was devoted to supporting the conclusion that stock price volatility is attributable to factors irrelevant to the economy. One could raise questions regarding this reasoning especially if we remember that 'bubble substitution' takes place in perfect foresight dynamic equilibrium. However, for our discussion, the important part of the argument is that neoclassical equilibrium fundamentals remain relatively constant even in sub-optimal solutions that give rise to asset mispricing. This is the reason that, even in this case, volatility is explained from factors 'irrelevant to the economy' (Tirole 1985: 1513).

2g.2. Divergence Between Individual and Collective Interest

This idea originates from the classical political economy, especially Marx, and is also found in Keynes. It argues that the outcome of the actions of rational individuals may result in unfavorable collective interest. This resembles a flipside falling rate of profit argument in Marx. There as the capitalist strives for higher profits but this effort brings about a lower average rate of profit. Therefore, the individual motive contradict the collective class motive.

Mainstream economists cannot admit the existence of contradictions and conflict in market economies. For this reason, they reduce these phenomena to what they call 'negative externalities'. That is a cost affecting a party who did not choose to incur that cost. In our case, mainstream economists suggest that shareholders, employees, and taxpayers bear the cost of excessive risks undertaken by bankers and financiers. This way competition both between the corporate and the financial sector and inside the financial sector is reduced to 'agency problems' as I will outline below.

The negative externality that originates from excessive risk-taking by banks and financial institutions in general results from perfectly rational actions from the side of the party incurring the cost. For example, the actions of the CEO of Lehman Brothers[71] to keep purchasing more toxic asset-backed securities, when everybody knew of their toxicity, could be considered irrational by all accounts. This seems to be even more true for the institutions which kept lending Lehman to purchase those assets. However, the actions of both make perfect sense. The Lehman lenders were betting on a Federal government bailout whereas the borrowed funds helped Lehman to stay in business taking more risks when it had nothing else to lose. Of course, this sequence of actions harmed wage earners, shareholders, and taxpayers worldwide to say the least.

This rationale can become associated with financial asset pricing. Many people talk about the extremely low spread between the rate of the sovereign bonds the countries of the European South and that of the German bonds before 2009. They argue that people kept lending these countries on such low interest rates because they thought that the EU would intervene in the event of difficulty. Similar explanations underlie the recent decline in the yield of Greek bonds due to the 2020 unlimited purchase program of the ECB. On the same track but in a more formal economic fashion the book *The Chains of Finance* (Arjaliès *et al.* 2017) attempts to identify and evaluate the impact of financial intermediation on asset pricing. The most interesting argument in the book is that financial intermediation shortens the

[71] His name is Richard Fuld.

investment horizon through active fund management thereby increasing market volatility (Stravelakis 2017).

The hypertrophy of the financial sector is the only part of this line of thought that has produced some formal academic research papers. Hypertrophy is attributed to problems of agency like the ones outlined above. Academic studies (Philippon 2015, Philippon and Reshef 2012) confirm what we all know from experience, that financial intermediation increased from 1980-2006, and financial industry jobs enjoyed 50% salary increases from 1990-2006. Reasonably, but in sharp contrast to the reasoning under the efficient market hypothesis, mainstream economists (Tirole 2017: 314) attribute these phenomena to the excessive deregulation of the financial sector. Nevertheless, their explanation of the crisis on these grounds is short sited. They argue that deregulation and the anticipated state bailout encouraged the overextension of risk-taking from bankers and financial intermediaries. This, in turn, led to the mispricing of financial assets and eventually to the crisis of 2007.

It is a convenient explanation since under this reasoning mainstream economists can ignore variations in fundamentals once again. It is as if equilibrium prices and returns for commodities and financial assets remained the same, and mispricing resulted from people seeking a fat bonus without bearing the risk. Nevertheless, this type of reasoning is limited again by the fact that it cannot arrive at a theory of asset pricing. Equilibrium asset prices are the ones calculated by the traditional models and actual prices diverge from equilibrium prices. The latter is due to the agency problems outlined above. How can we determine actual prices under this rationale?

Moreover, mainstream pricing models failed empirical tests that took place before the deregulation of the financial sector that followed 1980 (see sections 2d.1-3). What was the problem back then? In short, persistent price discrepancies cannot be justified without taking account of variations in the fundamentals. Any reasoning that does not address this issue will remain arbitrary like the 'agency problem' theory outlined above.

2g.3. Collective Action - Financial Panics

Again, we have an argument originating from classical and Keynesian economics that takes a quite different meaning in the context of neoclassical economics. The 'Financial Instability Hypothesis' was presented to us by Hyman Minsky (1985) and certain of its elements originate from the works of Marx (Marx 1894, Ch. 22:245-6) and Keynes (1936: 151). It rests on the idea that banks lend money long term whereas their liabilities (deposits) are short term. So massive withdrawals of deposited money can create a panic that will force banks to 'fire sell' its assets to cover depositors. The latter is supposed to create a collapse in the prices of financial assets as well as direct effects on businesses who may see their loans called overnight.

For Minsky (1992), capitalism itself creates the conditions for financial panics. The financial system lends more speculative and Ponzi financial units in the progress of long periods of prosperity.[72] As the weight of the debt of these units increases relative to total loans the likelihood of units having to sell their assets to stay afloat increases as well. This means that a collapse in asset values becomes more and more probable.

For neoclassical economics financial panic is certainly not inherent. It is 'caused by a sudden shift in expectations, which could depend on almost anything' (Diamond and Dybvig 1983: 404). For neoclassical economists, a bank run has an equal impact if it originates from a mere rumor like the imaginary bank run in the tale *Mary Poppins*[73], or from an actual event indicating that a bank may indeed fail. The neoclassical economist is not primarily concerned with the reasons behind a bank run. Bank runs are initiated by 'commonly observed random variables', 'a bad earnings report, a negative government forecast, or even sunspots' (Diamon and Dybvig 1983: 410). For this reason, the risk of a bank run can be eliminated by a deposit contract that provides a form of capital controls when withdrawals exceed a certain percentage. The latter will discourage bank runs and fortify what Diamon and Dybvig (1985) call a 'non-bank-run equilibrium'.

There is also a second mainstream approach for the occurrence and impact of financial panics. A good part of these views is held by the former chairman of the FED Ben Bernanke (2010) and has been developed in a macroeconomic model in Gertler, Kiyotaki, and Prestipino (2014). The model is in the Neo-Keynesian tradition as stated by its authors. In this line of thought, a financial panic or crisis is ruled out for an economy operating at or around a steady-state equilibrium. For an economy in recession, that is followed by deteriorating bank balance sheets, however, small

[72] For the sake of completeness Minsky suggests also that monetary controls aiming to control inflation have the tendency to turn speculative units to Ponzi schemes. Speculative units can pay interest but not principal on their debt, Ponzi units, however, can pay neither principal nor interest on its loans from its operation.

[73] Recall that in the Walt Disney 1964 film, Mary Poppins was hired as a nanny by the family of a bank employee. One day he took his children to their father's place of work. There, in order to impress his employers, he said that his son wanted to open an account. The bank manager gave the boy a lecture about saving and investing and took his nickels and dimes to open an account. But the boy wanted to buy food for the birds with his money and not to open an account, so he started shouting "I want my money back". The other customers in the bank heard the boy shouting and thought that the bank was unable to meet its liabilities. So, they started to withdraw their money and an actual bank run took place.

shocks or even no shocks can generate a run with important consequences on asset prices.

For the pure neoclassical model (Diamond and Dybvig 1983) collective action leading to bank runs can be eliminated because it is generated by external random factors and not by fundamentals. The neo-Keynesian approach (Gertler, Kiyotaki, and Prestipino 2014) is more realistic. It acknowledges that the business cycle can weaken the bank balance sheets leading to financial bank runs.

Nevertheless, when it comes to asset pricing all these approaches suggest that financial panic is the cause of asset price deterioration which in turn affects business conditions. The profit-based approach argues that causality works the other way around. Deteriorating fundamentals lead to a decline in asset prices the latter weakens bank balance sheets leading to financial panic. This causality line is perfectly consistent with the fact that many times major capitalist crises initially appear in the financial sector. The reason is that adjustments between the corporate and the financial sector follow the incremental and not the average rate of profit and the incremental rate of profit is much more volatile. Whether a financial crisis will trigger a major capitalist crisis is a different matter relating to general conditions of profitability which follows the average rate of profit and reflects on what Marx calls the 'rate of profit of enterprise'[74]. These points will be elaborated in the next chapter.

Minsky's financial instability hypothesis is of course a different story. It is what Marxist and heterodox economists call a possibility crisis theory or a crisis trigger mechanism. It is a different trigger mechanism from the one I will present in the next chapter and is included in Stravelakis 2012,2014. However, the association of the availability of credit with profit expectations and his analysis of banks as capitalist enterprises and not simply 'intermediaries' are important elaborations of ideas originating from Marx.

2g.4 Market Frictions

This is certainly the most active line of thought in mainstream theory and elaborates on the idea of information asymmetry. It appeared in the bibliography in (1970) with the works of George Akerlof and its elaborations include the important contributions of Michael Spence and Joseph Stiglitz. Asymmetric information gained further acknowledgment when these three economists received jointly the Nobel prize in 2001 for their contributions to information theory.

[74] The difference between the rate of profit and the rate of interest.

Information asymmetry means that transactions take place between parties where one of them has more or better information than the other. If these parties engage in trades of products or assets that have different quality but sell (initially) at the same price, then the low-quality products will drive out the good products. In this case, prices will decline and in the extreme, the market freezes. The buyer believes that everything in the market is a 'lemon' and offers low prices that are not acceptable by the seller. It is the famous example of Akerlof for the market for used cars where asymmetric information[75] pushes the good cars out of the market leaving only the bad cars (lemons). In the case we have only two grades of cars in the market (good and lemons), we have no trades at all because the prices offered to the sellers are unacceptably low (Akerlof 1970). A market situation like the 'market for lemons' is referred to as an 'adverse selection'.

Situations of adverse selection in financial markets take the form of the principle-agent problem. The two parties (principal and agent) operate in an uncertain environment. The agent takes action(s) which the principal can follow only through the outcome. Usually, the 'agent' is the company or the bank executive(s), and the 'principle' the owner (employer) or the shareholder (Grossman and Hart 1983). The separation between ownership and management is favorable because this way the owner of a company shares his risk with other investors by selling part of the company stock through the stock – exchange. Consequently, productive investment expands, and social welfare increases with it (Arrow 1971).

The cited paper by Kenneth Arrow presents all the risk-sharing processes using the analog of an insurance contract which leaves both parties (insured and insurer) better off. But he also points out that insurance policies can alter the incentives of the parties involved. The insurer is not aware of the actions of the insured party and this can give rise to actions where one party harms the other. This practice is referred to in the literature as 'moral hazard' (Arrow 1971: 228).

Moral hazard places limitations to risk shifting through the market. For financial markets, this is due to the assumption that the principle can only observe the results of the actions of the agent. Our second reference the paper by Grossman and Hart (1983) argues that if "agent's preferences over income lotteries" (Grossman and Hart 1983: 7), where lotteries are uncertain income streams, 'are independent of the action [taken]' then there are cases of serious incentive problems from the agents'

[75] The information asymmetry exists because only the owner of a car is assumed to know whether it is a good car or a lemon.

side. These arise when people are not rewarded for what they do, or they do not bear the full cost of their actions.

In the case of the financial markets, we usually refer to the actions of agents not bearing the full cost of their actions. The following extract is from a statement of Warren Buffet in the 2002 annual report of Berkshire Hathaway and gives us a good example:

> Derivatives contracts are of varying duration, running sometimes to 20 or more years, […] But before a contract is settled, the counter-parties record profits and losses – often huge in amount – in their current earnings statements without so much as a penny changing hands. Reported earnings on derivatives are often wildly overstated. […] the parties to derivatives […] have enormous incentives to cheat in accounting for them. Those who trade derivatives are usually paid, in whole or part, on 'earnings' calculated by mark-to-market accounting […] [C]ontracts involving multiple reference items and distant settlement dates increase the opportunities for counterparties to use fanciful assumptions. The two parties to the contract might well use differing models allowing both to show substantial profits for many years. In extreme cases, mark-to-model degenerates into what I would call mark-to-myth.

Derivative traders are paid bonuses on current profits which are calculated on mark to market accounting, so they have a strong incentive to make a contract maturing on a distant date. This way they can manipulate upwards the current valuation since the bank Principles cannot follow up on their actions. Finally, they bare small or no risk since by the time the derivative will be settled, they may be working elsewhere, or they will have reached the age of retirement. Principles benefit of course from the valuation of the contracts because corporate accounting profits increase in the short - run. Nevertheless, the financial intermediary, its creditors, and maybe the financial system is undertaking risks it is not aware of. This line of thought can offer similar explanations to risks taken by bank executives before the current crisis like the examples of section 2g.2 above.

Spence (1973) has suggested that asymmetric information problems can be solved through signaling. That is the identification by the principal (in our case) of the appropriate signal that can fill his lack of information. However, it is unanimously accepted that when this type of signal is attempted to be identified at the microeconomic level it leads to multiple equilibria and arbitrary solutions. For example, an agent (employee) proposing a high observable investment plan can be signaling that he has an outside option (for example an employment option) but at the same time he can be bluffing to get a better contract. Spence (2010: 60) implicitly admits these limitations of 'signaling' when he states that the identification of bubbles is the appropriate signal for policymakers to take appropriate measures regarding credit expansion and/ or asset pricing. In other words, he admits that the signal can be identified only at the market level.

The second solution to information asymmetry is by applying the appropriate 'screening' procedures. This notion was elaborated mainly by Joseph Stiglitz (1975). Stiglitz's paper applied screening in the labor market. The potential employer adopts screening procedures to extract information about the quality of the potential employee. This is the main difference from signaling where the party lacking information is trying to receive the appropriate signal from his counterpart. Stiglitz's main argument is that:

> economies with imperfect information ... differ in fundamental ways from economies of perfect information. There may be, for instance, multiple equilibria in which one of the equilibria is Pareto inferior to another; the Pareto inferior equilibrium may involve too much or too little screening, or it may entail too little screening, or it may entail the wrong kind of screening. On the other hand, there may be situations where there exists no equilibrium (1975: 283).

The most interesting combination of this idea with 'signaling' is the one identifying situations of 'credit rationing'[76] in markets with imperfect information (Stiglitz, and Weiss 1981). The idea is that banks sort their potential borrowers by altering the interest rate and at the same time, they affect the actions of the borrower. In other words, banks use the interest rate as a 'screening' device. Corporations or households willing to pay a higher interest rate are considered a higher risk. At the same time, higher interest rates are supposed to push corporations towards investment projects with lower chances of success but higher potential returns in case they succeed. From the side of the bank, there exists a rate of interest that maximizes expected to return by assumption. This interest rate is not necessarily the one that matches supply and demand although it is the equilibrium interest rate. Similarly, to the excess demand equilibrium outlined above, imperfect information leading to interest rate screening can lead to situations of excess supply equilibrium.

Credit rationing can be used to theorize on conditions of disequilibrium in financial asset markets in general. The idea is that well-informed investors[77] are unable to act on their information to push the market in the right direction because they lack the

[76] Credit rationing means 1) that credit is granted to some households and corporations and denied to others, although they have identical observable characteristics, 2) corporations and households are denied credit at any interest rate because of restrictions in credit supply (Stiglitz and Weiss 19.

[77]In other words, investors that have received the appropriate signal.

required credit. This means that credit rationing places limits on arbitrage. The book and film *The Big Short* provide us with an incredibly good example (Lewis 2010). In the book a group of traders realize that the real estate is a bubble, mortgagees will fall back on their payments and the grades given to securities backed by these mortgages by rating agencies are not correct. Acting upon this information they sell the bubble sort. However, prices do not fall during the period of the short sell and they roll over their short position. The market again does not fall, and they roll over again, but each time their creditors are asking for more collateral because the short sellers are at a loss. In the end, they run out of money, they cannot roll over their position any longer, their creditors call their position at a loss and they go bankrupt.

One last piece of important literature needs to be outlined before we turn to the critique of ideas presented under the label of 'information asymmetry'. The discussion in the previous paragraph suggests that contrary to the postulations of Arbitrage Pricing Theory, arbitrage is costly. Moreover, arbitrage is limited. Therefore, what kind of information is reflected in financial asset prices? The paper of Grossman and Stiglitz (1980), briefly referred to in section 2.f.2 above attempts to answer this question. It includes a model with a risk - free and a risky asset. The returns on the risky asset vary randomly from period to period. The random total asset return is broken down into two (2) random components one observable at a cost and the other unobservable. In the market, there are two types of investors the informed investors who are aware of the observable part of the risky asset return, and the uninformed investors who only follow asset prices. Nevertheless, both investor sets have rational expectations. Contrary to the credit rationing scenario equilibrium involves a market-clearing price. The price is a function of the supply of the risky asset and the observable part of the asset return given the number of informed investors. In equilibrium, the expected utility of the informed and the uninformed are equal. In other words, whatever the extra gain received by the informed is paid as a cost for the acquisition of the information. The latter means also that equilibrium involves a certain number of informed and uninformed investors. Trades in this system incurs because of differences in beliefs between the informed and the uninformed investors. In rough analogy to the 'market for lemons,' the market is thinner (more illiquid) when all investors become informed and uninformed, respectively.[78]

[78] Like the market freeze incurred when all cars are considered lemons here transactions stop when all investors share the same beliefs.

Equilibrium exists if investors maximize a constant absolute risk aversion utility function and prices and returns are jointly normally distributed. The idea is that uninformed traders learn about the joined (normal) distribution of prices and returns or, in other words, that market-clearing prices contain information. The equilibrium price is a linear function of the observable part of returns and the noise. The knowledge of the joint distribution of prices and returns keeps information acquisition costs small and the existence of uninformed investors, who always prefer a free ride on other people's information, prevents the market from becoming fully informationally efficient.

Nevertheless, the most interesting property of the model is that if the information is perfect then no equilibrium exists (Grossman and Stiglitz 1980: 401). In the first case, if information is perfect (there is no noise), and there exist, several informed traders, then their information will pass over to prices, and the uninformed will become fully informed. Therefore, the informed trader acting as a 'prices taker' thinks that his information does not affect the informativeness of the system if he becomes uninformed. In other words, the existence of informed traders does not define a condition of equilibrium. Under the same rationale if all traders are uninformed then there is nothing to be learned from the prices and everybody will seek information. Finally, if all investors are perfectly informed then their asset demands will be very sensitive to their information set and their information will easily reveal the expected return to the uninformed. So, they will all seek to be uninformed to save the information cost.

The last reference indicates that the information asymmetry models are versions of the Lucas (1978) pure exchange model (Grossman and Stiglitz: 393) like Mehra and Prescott (1985) with the difference that it has two types of homogeneous agents (informed and uninformed) and not one. This means that the empirical problems of unexplained volatility and the equity risk premium puzzle remain. The reason is no other than the assumption of normally distributed asset prices and returns like in the CAPM. This implies that investment returns in the commodity sector follow the neoclassical equilibrium. It is an assumption shared by all the models presented in this chapter irrespective of their different assumptions and conclusions. The bottom line of this common ground is the very limited variability of asset required returns, which is also the main reason for the poor empirical performance of mainstream models. However, this particular model puzzles the reader for one more reason: why does perfect information come at a price? Grossman and Stiglitz have no explanation and state that informed traders are simply 'price takers'. If, however, the informed traders are not passive price takers then they will either accept that their information benefits the whole system and will keep paying for it or if they think it does not they will ask for the information for free. The internet is full of sites that offer information about financial assets for free. Corporations have analyses of their stock in their sites also for free and all this in a world where information is not perfect. But this is not because of its price but because of the structural uncertainty which underlies financial asset returns as we will see in the next chapter.

Conclusion

I could not find a better summary of the first two chapters of this project than the following extract from a (2018) paper of the neoclassical economist Costas Azariadis (2018: 1549).

> Financial markets bring to the table their own mysteries. The large equity premium, volatile equity prices, low returns on short-maturity public debt, and the identification of bubbles remain unfathomed questions that are unlikely to be resolved until we have better clues as to how markets discount streams of future income. Whose discount rates are reflected in the valuations we observe: the representative everyman's, that of a small group of wealthy investors, or nobody in particular?

Mainstream theorists admit that the problem of asset pricing models rests with the required rate of return and the party which controls this rate of return. This is the starting point of the profit-based approach as indicated in various instances so far. However, this elaboration will take us away from neoclassical equilibrium and the restriction it imposes on asset returns through perfect competition. As we saw (section 2.g.4) this property remains active even for models that acknowledge market frictions like asymmetric information and credit rationing. The latter proves that the critical issue of mainstream asset pricing is not related to information efficiency, its definition, and its properties. It relates to the assumption on investment returns underlying mainstream theory.

Perfect competition plays a crucial part in this outcome. As we saw in sections 2b -2f the return on a particular financial asset is not affected by the returns on other assets. However, even when diversions from mainstream equilibrium are considered (section 2g) they are attributed to factors relating to externalities and frictions and not the properties of the goods (commodity) equilibrium model. This is the reason that following 2008 mainstream theory took the focus away from asset pricing and attempts analytical explanations of the crisis itself as we saw in the last section.

However, this analysis cannot arrive at an alternative pricing theory. The profit-based approach, on the contrary, arrives at a clear and testable pricing theory as we will see in the next two chapters.

Chapter 3
The profit-based approach Theory and Implications

Introduction

In the first two chapters, we discussed the basic assumptions of mainstream investment and finance theory. We saw that mainstream theory concludes the required rates of return for financial assets are constant or slowly varying. This assumption reflects the properties of neoclassical equilibrium. The theory of perfect competition plays a major part in this outcome. However, it is precisely these constant or slowly varying rates of return that are 'responsible' for the empirical failure of mainstream models. We saw this in a broad review of empirical tests of DCF models (chapter 1), as well as of mainstream asset pricing models (chapter 2). The crisis of 2008 made these analytical shortcomings and empirical failures even more apparent. Mainstream theory practically abandoned the efficient market hypothesis that underlies these models and turned to behavioral finance, as well as, to problems like 'moral-hazard' to explain the divergence between actual prices and theoretical models. Nevertheless, the application and elaboration of these arguments have failed so far to produce a new model that explains the actual movement of financial asset prices. This comes as no surprise; modelling the systematic divergence of actual prices from those anticipated by the underlying theory is a difficult task to start with. Moreover, it poses further methodological and theoretical questions. Neoclassical economists agree that a Walrasian general equilibrium will hold only in a world where 'asymmetric information' is confined to a single market. However, it is difficult to imagine how persistent discrepancies in stock market returns, for example, will be restricted in the stock market alone. If stock market returns are higher, for instance, from the equilibrium values for long, this will lead to the inflow of capital in the stock market that will distort prices in the other markets as well.

As we saw in the previous chapter, these theoretical issues have triggered broader academic investigations in orthodox economics. The most popular line of research explores the appropriate tools to design efficient markets. In other words, they are looking for a market institutional framework that will remove any negative externalities and will lead to an equilibrium of similar properties to that of perfectly competitive markets (Roth & Wilson 2019). At the same time, these institutions will "reconcile, as far as possible, the interests of the individual with the general interest" (Tirole 2017: 3). However, in all versions, an efficient solution exists "when competition is sufficient to justify traders' price-taking behavior in response to prevailing equilibrium prices" (Roth & Wilson 2019). In short, mainstream research looks for a world where competition is, or functions, like 'perfect competition'. This is the reason why the theory of competition is the starting point of the critique of the profit-based approach to mainstream theory.

In the classical/Marxian/Schumpeterian context competition is a war fought by the cheapening of commodities. As elaborated below this explains why the required rate of return of financial assets is expected to be highly volatile. Moreover, this same rate of return is the regulator of the mobility of capital between sectors. The latter means that the 'profit-based approach' shares the premise that capital mobility will tend to equalize returns between the corporate and financial sectors. However, contrary to the postulates of modern investment theory this is a turbulent process where the volatility of the required rate of return constantly creates new positions of risky arbitrage. In the case of stocks, this establishes a tendency of equalization of stock returns with a particular profit rate, while for loan and bond rates it means that their required returns will remain below profit rates most times. Finally, for derivatives and asset-backed securities, this means systematic mispricing. The erroneous assumptions on the probability distribution of returns of the underlying asset affect the applied mainstream model of derivative pricing which systematically diverges from the actual value at maturity. This is the reason that outstanding derivative contracts range from 650-950 trillion dollars per quarter as reported by the BIS. They reflect mainly rolled over positions waiting for a better price, or for a better time, for the realization of the loss.

The profit-based approach develops from the insights underlying the social relations of capitalist production and their manifestation through 'real competition' in Marx. For this reason, the exposition begins with a brief presentation of rates of return in the Marxist political economy.

3a. Profit Rates, Capitalist Competition, and Capital Mobility: An Outline

In Marx's economics, the rate of profit and its dynamics are the key variable of capitalist economies. It determines growth, employment, and affects income distribution. The idea is that capitalism is driven by an unsaturated appetite for profit which is ultimately regulated by the rate of profit. Here we will outline certain parts of the argument for the sake of clarity and elaborate on others in order to arrive at its application in asset pricing and finance.

The initial question is: What makes the rate of profit so important compared to other measures of profitability? For Marx, the rate of profit and its dynamics reflect the conflict of capital with labor in capitalist production. The conflict manifests itself in the continuous tendency of mechanization of production. In other words, capitalists intensify the exploitation of labor by implementing more mechanized methods. Although these techniques have lower unit production costs, they involve higher investment costs, "the increase in productive power [of labor] must be paid for by capital itself, is not free of charge" as Marx states (Marx 1973: 694). This leads to a higher value of machinery and raw materials per worker. Marx names this ratio: the 'technical composition of capital'. If the 'technical composition of capital' increases, its ratio with the value of labor power in the base year will increase as well. Marx calls the latter ratio the 'organic composition of capital' (Fine and Harris 1976, Weeks 1981). The higher investment costs (the higher ratio of fixed capital per unit of output) ensure that the increasing organic composition of capital will dominate the decline in the value of means of production expended in the production process (Patten 1971, Weston & Brigham 1982).[79] This result ensures that a rising organic composition of capital will lead to an increasing ratio of constant (value of machinery and materials) to variable capital (value of labor power), or the 'value composition of capital' in Marx's terminology (Shaikh 1986). As we will see from the equations here below, a rising value composition of capital or a rising capital-output ratio is a sufficient condition for the falling tendency of the rate of profit expressed in value and monetary terms, respectively.

$$3.1\ r = \frac{s}{C_c + v} = \frac{\frac{s}{v}}{\frac{C_c}{v} + 1}$$

$where: r = profit\ rate, s = surplus\ valus, v = variable\ capital, C_c = constant\ capital = c(flow) + c(stock)$

$$3.1'\ r = \frac{s}{C} = \frac{\frac{s}{l}}{\frac{C}{l}}$$

$where\ C = c(flow) + c(stock) + v = C_c + v, and\ l = c(flow) + v + s$

$$3.2\ r = \frac{P}{K} = \frac{Q}{K} \cdot \frac{P}{Q}$$

$where\ P = Profits, K = Capital\ and\ Q\ is\ output$

[79] Weston and Brigham is a well-known mainstream textbook in financial management. It has undergone 13 editions the last one in 2011. The reason it is referred here is that the authors are quite certain that superior techniques will involve a higher investment cost that will dominate the gains in production costs.

Equation 3.1 is the function of the rate of profit in value terms. The last form on the right-hand side shows the measure as the ratio of the rate of surplus-value $\frac{s}{v}$ to the value composition of capital $\frac{c_c}{v}$ At the end of the chapter the various Marxist notions on capital composition are presented in some detail in Appendix 1. The rate of surplus-value is expected to rise since more productive techniques are expected to increase the exploitation of labor, but the same is true of the ratio (c/v) as discussed in the previous paragraph. Important scholars (Sweezy 1942 Ch.6, Robinson 1966) have argued that because the rate of profit tends to increase due to the rising rate of surplus-value and decline due to the rising value composition of capital its overall dynamics is indeterminate. However, their argument does not take into account the fact that, contrary to the value composition of capital, the rate of surplus-value cannot rise indefinitely. As Rosdolsky (1977, Chs. 16. 17, 26 and part V, appendix) pointed out the working day is limited and a part of it is always required for the reproduction of the working class. Therefore, there is a limit to the increase in the rate of surplus-value (s/v).

Equation 3.1' makes this point more evident. The numerator (s/l) is the ratio of surplus-value (s) to total produced value (l=c(flow) + v + s). This ratio has a limit of 1 which reflects the unrealistic case where all produced value is appropriated by capitalists as surplus value. The denominator (C/l) is the ratio of total capital advanced (the sum of capital stock, the consumption of materials, and the depreciation of constant capital in the production period) to the total value produced. In Marx's terminology, this ratio is called the 'materialized composition of capital'. It has been proven by Shaikh (1986) that C/l increases without limit when the organic composition rises together with an increase of fixed capital per unit of output. Therefore, the overall dynamics is not indeterminate but indicates a falling tendency of the rate of profit, irrespective of the increase in the rate of surplus-value.

This result is expressed in monetary terms in equation 3.2, which presents the rate of profit as the ratio of profits (P) to total capital advanced (K). The second term on the right-hand side decomposes the ratio to two elements: the output capital ratio (Q/K) and the profit share (P/Q). The former is the reciprocal of the materialized composition of capital (C/l) in monetary form, the latter (P/Q) is the monetary expression of the ratio of surplus-value to the total value (s/l). Obviously, the profit share cannot become greater than unity, while the ratio (Q/K), which is also a monetary expression of the maximum rate of profit, is expected to fall without limit provided that the materialized composition of capital increases.

The foregoing has outlined the major consequence of the mechanization of production in capitalism, but it has left out the process through which it is realized. This is important for the argument since as Marx stated: the falling rate of profit is "one of the most striking phenomena of modern production" (Marx 1973: 481). It is indeed striking to argue that the strive of individual capitalists for greater profits ends against their will to a lower rate of profit. Therefore, the theory must explain not only *why*, but also *how* this happens. Before we move to this, however, it should be noted that the dynamics of the rate of profit is not monotonically declining in Marx. The reason is that the system has built in processes that delay or even reverse for some time the dominant declining tendency. These are the famous 'countervailing tendencies' (Marx 1894: 165-171). Certain tendencies are discussed in some extend in section 3g.1 below.

Returning to our exposition, in the early 1960s, it was formally proven that the realization of a lower average rate of profit requires that capitalists and capitalist corporations will implement techniques with a lower rate of profit at the prevailing price. It is the celebrated Okishio theorem (Okishio 1961). The Japanese Marxist Nobuo Okishio to whom we owe the 'theorem' thought that it made no sense for capitalists to adopt lower profit rate techniques. He assumed, however, a world where capitalist competition was reduced to the neoclassical notion of 'perfect competition'. Indeed, if capitalist corporations are passive 'price takers' there is no reason to adopt a technique that involves a lower rate of profit. Nevertheless, the notion of competition in classical political economy and Marx has little or nothing to do with the neoclassical notion of perfect competition. In Marx capitalist competition is war "fought by the cheapening of commodities" (Marx 1867: 777). It is a process where companies in the same industry constantly introduce new products and implement more productive techniques. Their main objective is to achieve lower unit production costs, reduce prices, and penetrate the market share of their competitors. However, as the limits of existing knowledge and technology are reached the new techniques call forth ever-smaller reductions in unit production costs. The latter implies lower transitional profit rates for lower-cost techniques. Capitalist competition, in turn, forces corporations to adopt these techniques to survive the battle of competition.

To conclude our outline of the argument in Marx we need to specify how a lower transitory profit rate technique leads to lower industry and economy rates of profit. For the different industry profit rates, the theory assumes that the price of the most efficient producer becomes the industry price. This is not surprising since the most efficient producer is expected to cut prices to penetrate the market share of his competitors. The other corporations of the industry will either follow or go out of business. For this reason, the most efficient capital is referred to as the 'regulating capital' and its selling price as the 'regulating price'. Thereafter the new 'regulating profit rate' fuses in the whole economy through capital mobility. Investments will accelerate towards the industries with higher (regulating) profit rates. As a result, their capacity will rise, and their profit rate will decline towards the new average regulating rate. Nevertheless, the whole process is one of conflict where rates of return tend to become differentiated through competition in the same industry and equalized through competition between industries. In other words, the new 'prices of production' are a gravity center around which actual market prices constantly fluctuate.

The question of profit rate equalization, however, needs further attention. Since the price of production of the most efficient capital is the regulating price and its profit rate the normal profit rate, then equalization takes place around profit rates which are different from the average profit rate. Moreover, investment grows to meet increasing demand, therefore when talking about investment acceleration the theory refers to investment growth rates over the growth rate of the economy. The above means that it is the rate of profit of new investments which attracts funds at a lesser or greater rate than the average rate of growth. For this reason, it is the rate of profit on new investment, the 'incremental rate of profit' as we call it, which tends to become equalized between the various industries through capital mobility.

From the previous discussion, it is evident that the average (normal capacity utilization) rate of profit changes at a slow pace. Its downward tendency comes mainly from technical change and its volatility depends on fluctuations in capacity utilization which are associated with the ten-year cycle. The incremental rate of profit, on the other hand, is a highly volatile measure. It reflects the conditions of capitalist competition which constantly produce variations in prices, changes in demand, and productive capacity, as well as transfers of value between sectors. For example, relative prices play a part of their own on total profit. The latter can differ from fundamental profit due to transfers of value within the circuit of capital or between the circuit of capital and the circuit of revenue.[80]

These elaborations are the starting point of the profit-based approach. The idea is that variations in the incremental rate of profit will trigger capital mobility not only within the commodity/ corporate sector, as outlined above, but also between the corporate and the financial sector. In other words, the equalization of rates of return takes place for the whole economy. This means, of course, that because capital is expected to move along various applications the incremental rate of profit will serve as the approximation of the general (regulating) rate of profit. In other words, the opportunity cost foregone when a corporate or a financial investment is undertaken. Is this idea present in Marx's theory of Money and Finance? What are its main implications? Can we apply it to arrive at a theory of asset pricing? These are the questions that will be addressed at the analytical level in the remaining chapter with the emphasis placed on asset pricing.

3b Financial Capital, Profit Equalization, and Interest rate Determination in Marx

The question of whether financial capital participates in the profit equalization process in Marx is not answered straightforwardly in Third Volume of *Capital* (Marx 1894). On the contrary, the exposition has gaps and possible contradictions. In the introduction to the Third Volume, Engels pointed out that section V[81] (Marx 1894: 230-457) posed the "greatest difficulty" because "we had no finished draft, not even a scheme whose outlines might have been filled out, but only the beginning of an elaboration-often just a disorderly mass of notes, comments and extracts." (Marx 1894: page 5 of the introduction). Therefore, the arguments presented here below are possible solutions to an analytical gap and not interpretations of an argument already developed by Marx, at least in part. In order, however, to arrive at a sound solution, we need to consider the outline provided by the whole of Marx's work and I try to follow this guideline.

Marxist economists are puzzled by the fact that in section IV of *Capital* Volume III Marx argues that commercial capital and 'money dealing capital' (MDC), the two categories that comprise 'merchants' capital', will earn the regulating rate of profit,

[80] M-C-M' is the circuit of capital where money is advanced to make more money and C-M-C is the circuit or income where commodities are sold for money and then used to purchase commodities of equal value. This is a way of understanding the impact of what Marx calls 'profit upon alienation' and its association with profit on production.

[81] The section analyzes interest, the interest-bearing capital (IBS) and the division of profit to interest and 'profit of enterprise'.

although they do not participate in the creation of surplus value. The reason is that in the next section (section V) no express reference about equalization of returns is made regarding an analytical category with similar characteristics (regarding the creation of surplus value) to 'merchants' capital' that of the 'Interest-Bearing Capital' (IBC).[82]

Before we move to the analysis a few words about the analytical categories are appropriate. The 'money dealing capital' (MDC) is the portion of capital remaining in monetary form to settle payments that incur in the process of production and commodity circulation. It refers to the function of present-day banks in settling daily payments, executing money transfers, issuing letters of guarantee for important transactions, and the bookkeeping of the corporate 'cash equivalents'. The interest-bearing capital (IBC), on the other hand, involves capital that does not remain in monetary form, its purpose is to be lent out to the industrial capitalist to finance fixed and circulating investment and, finally, to be returned with interest. In short, it is credit capital, a *sui generis* form of commodity (Marx 1894: 230).

It should be noted that in Marx's time banking and money-dealing were to a great extend separate activities. London in the second half of the 19th century was filled with Money Dealers that operated on the side of Banks. The former were mostly facilitators for businesses (Bagehot 1873: 50). In contemporary finance, the functions of MDC and IBC are performed mostly by banks. In this context, very few corporations will use a different bank for their money dealing operations, while borrowing from a different bank (unless their relation becomes troubled). When banks calculate the profitability of a customer, especially of a corporate customer, they consider the total revenue he brings to the bank. A customer generating high revenue from money dealing operations has an advantage when negotiating the interest rate on his loan. This means that the methodology of determining the rate of interest or the equalization between the returns of the corporate and the financial sector by dealing separately with each analytical category is not truly relevant in nowadays finance. Nevertheless, I will stick to it because this way it is easier to follow the different analytical arguments made by Marxist economists on these important issues.

When discussing merchant's capital in section IV of *The Capital Volume* III, Marx makes the following argument:

---

[82] At a different part of section V Marx refers to the Interest-Bearing Capital (IBS) as the 'twin brother, [of] merchant's capital' (Marx 1894a: 443).

> Should merchant's capital yield a higher percentage of average profit than industrial capital, then a portion of the latter would transform itself into merchant's capital. Should it yield a lower average profit, then the converse would result. A portion of the merchant's capital would then be transformed into industrial capital' (Marx 1894a: 195).

This means that MDC enters the profit equalization process through capital mobility.

In the next section (section V Chapter 22) the following famous extract appears:

> The average rate of interest prevailing in a certain country – as distinct from the continually fluctuating market rates – cannot be determined by any law. In this sphere, there is no such thing as a natural rate of interest in the sense in which economists speak of a natural rate of profit and a natural rate of wages (Marx 1894a: 246).

Marxist scholars were reasonably puzzled by reading these two extracts together and attempted to offer explanations. For one set of approaches, (Fine 1985-86, Lapavitsas 1997) these two passages read together meant there is no equalization of returns between the corporate and the financial sector, at least for the category of 'Interest-Bearing Capital' (IBC). Although their reasoning is different these references share one premise, that, if such an equalization existed, this would mean that the rate of interest and the rate of profit will become equal. The following quote by Ben Fine (1985-86) is revealing:

> It would be quite exceptionable for the rate of interest to be … represented by a normal rate of profit on capital advanced. For this would require that competition within the fraction of IBC be as intense as across the sectors of industrial capital. …This is not to deny the tendency towards uniformity in rates of interest… [T]he uniformity of the 'commodity' [i.e., loanable capital-NS] involved, in contrast to the dull movement by which the rate of profit is equalized across sectors … reflects a structural separation between the two fractions [Industrial and Interest-Bearing Capital, NS] and limits the mobility between them. (Fine 1985-86: 399-400)

The extract indicates that the mobility of capital between the Interest-Bearing Capital (IBC) and the commodity sector is limited and it is for this reason that the rate of interest does not tend to become equal to the rate of profit. In contrast, the unlimited mobility between the industrial and the merchant sector makes a different analytical category, that of the Money-Dealing Capital (MDC), earn the rate of profit.[83]

One thing that will become clear here below is that for the profit-based approach, with unlimited capital mobility, the equalization of returns between the industrial and the financial sector (including IBC) does not imply an equalization between the rate of profit and the rate of interest (Shaikh 2016: 448, Stravelakis 2012). Moreover, the equalization process does not imply any notion of a 'natural' rate of interest neither in the classical sense of the 'natural prices' (Marx 1865: 49), nor in the neoclassical concept of the 'natural rate of interest' (Böhm-Bawerk 1890, Wicksell 1936). Keynes initially accepted the notion of a 'natural rate of interest' in the *Treatise on Money* (Keynes 1930: 139). In his subsequent writings, however, he changed his position. Before we move to this discussion, however, the second approach arguing in favor of the non-equalization of returns between industrial and Interest-Bearing Capital (Lapavitsas 1997, Itoh and Lapavitsas 1999) needs to be outlined.

In a paper written in 1997 Costas Lapavitsas explains the non-equalization between industrial capital and the IBC by the peculiarities of the latter. Nevertheless, his reasoning is different. He does not place the emphasis on the terms of competition between industrial and interest-bearing capital and, more generally, on the relation between money and functioning (industrial) capitalists like Ben Fine. The reason for the difference between the interest and the profit rate comes from "the structurally different location of industrial and interest-bearing capital relative to the circuit of the total social capital' (Lapavitsas 1997: 105).[84] He argues that IBC is formed from idle sums of monetary capital but also the savings of workers and other social classes that are transformed into IBC by the credit system. The transformation, however, implies, in his view, that these sums become IBC outside the process of capital accumulation although they result from it and return to it as loaned facilities.

[83] Lapavitsas (1997) has the same understanding of the paper by Fine he writes: "Harris (1981) and Fine (1985--86) suggest that a systematic difference between the rate of interest and the rate of profit might arise from the existence of barriers between financial and industrial capitalists, treated as fractions of the capitalist class." (1997: 105)

[84] Although, it is not crucial for the discussion herein it should be noted in passing that for Marx the dissociation of certain portions of capital from the rest does not prevent the participation of these portions in the equalization of the rate of profit. For example, as Marx points out, the Money Dealing Capital (MDC) is: 'A definite part of the total capital [that] dissociates itself from the rest and stands apart in the form of money-capital…' (Marx 1894a: 216). The dissociation of MDC from the remaining capital does not prevent it from participating in the equalization of the rate of profit.

Therefore, "[d]espite the absence of barriers between the two areas, the mobility of capital cannot lead to the equalization of the rate of profit and the rate of interest" (Lapavitsas 1997:105). Although, this could mean, in a similar fashion to the argument presented here, that the equalization of returns between industrial and interest-bearing capital does not mean an equalization between the rate of profit and the rate of interest, this is not the case. In a more complete work, that with Makoto Itoh (Itoh and Lapavitsas 1999), IBC is expressly exempted from the equalization of the rate of profit (Itoh and Lapavitsas 1999: 61), although they accept that banking capital participates in the equalization of profit rates (*ibid*.: 95-96). They suggest that IBC is exempted because capitalists control both the supply and demand for loanable funds (*ibid*.: 97-98).

This last point of Itoh and Lapavitsas reveals that the problem of this approach is mainly methodological. To put it differently, it is substantially different from the methodology of Marx in the three volumes of *Capital*. In his monumental work, *The Making of Marx's Capital* Roman Rosdolsky (1977) explained that the first two volumes of The Capital involve 'capital in general' whereas the third volume involves 'competition' and 'credit', in other words, 'many capitals'. When Marx talks of 'capital in general' he 'excludes a study of competition and the credit system' (Rosdolsky 1977: 41, Marx to Kugelman 28/12/1862). When it comes to credit, he states that "capital appears in relation to the individual capitals as a general element" (Marx to Engels 2/4/1858). This means that when Marx talks about credit, he refers to the movement of "real capitals-capitals in concrete reality" (Rosdolsky 1977: 41) and not in the capitalist class in general like in Itoh and Lapavitsas.[85] In short, to abstract from banks and financial institutions and their actual competition with industrial/ corporate capitals and between themselves does not reflect Marx's methodology in dealing with credit.

The practical result is that the rate of interest remains indeterminate in this line of thought. Both the relative independence of IBC from capital accumulation (Lapavitsas) and the limitations in the mobility between the two 'fractions' of capital (Fine) cannot lead to a theory that determines the rate of interest. This has obvious repercussions for the Marxian theory of asset pricing as well as the theory of crisis as we see shortly.

[85] In his earlier work Lapavitsas is more explicit on the matter when he states that: 'At the same time, however, the theoretical underpinnings of radical analyses of credit and finance have not been sufficiently differentiated from those of mainstream theory, particularly from the methodological individualism that underlies concepts such as demand and supply of loans.' (Lapavitsas 1997: 85)

3c The Determination of the Rate of Interest

The indeterminacy identified above is removed if we assume that IBC enters the profit rate equalization process like MDC. This means that interest rate determination involves real capitals and not analytical categories in general as discussed so far. The way of doing this is by extending the analysis of Marx in *The Capital* Vol. III, Chapter 17 (Panico 1988: 88-92, Fine 1985-86: 391). The scheme suggests that the industrial rate of profit is reduced by the capital advanced by the commercial capitalist and the banker for the Money Dealing Capital. Sticking to the equalization of the rate of return between the corporate and the banking sector and replacing MDC with IBC brings the following result:

3.3 $r_1 = \dfrac{S}{C+V+R}$ *or in monetary terms* 3.3′ $r_1 = \dfrac{P}{K+R}$

3.4 $Q = C + V + S$ *or in money* $Q = W + Mat + DEP + P$

3.5 $C + V + (C + V + R) \cdot r_1 = Q$ *since* $(C + V + R) \cdot r_1 = S$ *or in money* $(K + R) \cdot r_1 = P$

Where *C*, *V*, *S* is constant capital, variable capital, and surplus value respectively as in equation 3.1. The difference between 3.1 and 3.3 is mainly the variable *R* which represents bank reserves. Similarly, 3.3' is the same as 3.2 with the difference of bank reserves *R*. In the remainder, I will use the monetary form (3.3') assuming that value and monetary aggregates are indistinguishable (Shaikh 1984b, Bellofiore 2001: 369). Total loanable funds minus reserves is the IBC which is transformed into credit by banks.[86] The reason that banking capital is reduced to reserves *R* is that I have abstracted from bank operating costs and have assumed that banks have no constant fixed capital (buildings, desks, computers, etc.). In other words, reserves that earn no interest is the only cost of banks at this level of abstraction. The participation of reserves *R* reduces the profit rate although it leaves surplus value the same. Equation 3.4 tells us that the value of total output (*Q*) is equal to (*C+V+S*) and in monetary terms to wages *W*, materials *Mat*, depreciation *DEP* and profits P_t.

[86] This is the definition used by Marx. The following extract that refers to the minimization of MDC reserves is characteristic: 'These funds are thus converted into loanable money-capital. In this way, the reserve fund of the commercial world, because it is concentrated in a common treasury, is reduced to its necessary minimum, and a portion of the money-capital which would otherwise have to lie slumbering as a reserve fund, is loaned out and serves as interest-bearing capital. In the second place, the loanable capital of the banks is formed by the deposits of money-capitalists who entrust them with the business of loaning them out.' (Marx 1894a: 277)

Using 3.4 in 3.5 we arrive at an equilibrium where banks and industrial capital earn the same rate of return r_1.

Assuming further that banks take only zero interest demand deposits and offer a single type of loans the following relations hold:

3.6 $P_{B_t} = i_t \cdot L_t$

3.7 $K_{B_t} = R_t$

3.8 $r_{1_t} = r_{B_t} = i_t \cdot \frac{L_t}{R_t}$ or $i_t = r_{1_t} \cdot \frac{R_t}{L_t}$

Equation 3.6 - 3.8 are presented in various versions in Shaikh (2016: 447-452). Equation 3.6 says that banking profit P_{B_t} is equal to interest on loans $(i_t \cdot L_t)$, 3.7 that banking capital K_{B_t} is equal to the bank (opportunity) cost which at this level of abstraction consists only of reserves R_t. Finally, equation 3.8 suggests that banking capital and industrial capital returns become equalized through capital mobility. This equalization reflects the equalization of returns between regulating banking capitals and regulating industrial capitals in the context of capitalist competition outlined in the previous section (3.1). In other words, the rate of interest defined by 3.8 is the rate of interest charged by banks on prime customers. It should be noted that regulating banking capitals exist even when we abstract from banking operating costs since banks have different capabilities in accessing funds as well as different loan portfolios.

It is clear, that the equalization of returns does not lead to an equalization of the rate of interest and the rate of profit as implied in Fine (1985-86), Lapavitsas (1997), Itoh and Lapavitsas (1999). Banks are expected to lend a multiple of their reserves at least in normal periods. Therefore, the interest rate will be less than the profit rate in most cases as anticipated by Marx. Furthermore, the difference between the interest and the profit rate is not due to risk as in mainstream theory, presented in various models in the first two chapters, but to a structural factor. Therefore, the above formulation is free of the shortcomings referred to as the 'equity risk premium puzzle' and discussed in detail in chapter 1 (section 1c.2) (Mehra and Prescott 1985).

Before we move further certain clarifications are required for this definition. Equation 3.8 represents at this level of abstraction (i.e., in the absence of the bank operating costs and zero deposit interest rates) the bank rate of return. The numerator is the bank profit (which is equal to interest income $i_t \cdot L_t$ in the absence of costs) and the denominator the only (opportunity) cost which is no other than the reserves R_t. In this context the interest rate is a cost based 'price' of finance. This principle underlies the profit-based approach. Below (equation 3.13) I will show that reserves are associated to the ratio of net corporate profits to total gross profits $y_t = \frac{NP_t}{P_t}$. The idea is that if companies keep most of their gross profit, these funds will return and remain as deposit in the bank. It is the average deposit balance which is so important in modern banking. Therefore, reserves do not come naturally to banks, they reflect rather the underlying conditions of profitability and growth as elaborated in section 3.4. Moreover, a high average deposit implies a higher turnover ratio for an investment which results at a lower rate of interest charged by the bank. In section 3.5 the various amounts of reserves required for loans of similar risk, but different duration (expected investment turnover) is used to determine the term structure of interest rates.

Despite its simplicity equation 3.8 summarizes additional important aspects of modern banking. It can be elaborated to read as follows: $i_t = r_{1_t} \cdot \frac{R_t}{L_t} = r_{1_t} \cdot \frac{R_t}{DEP_t} \cdot \frac{DEP_t}{L_t}$. The last term on the right-hand side ($\frac{DEP_t}{L_t}$) is the reciprocal of the ratio of deposits to loans. In banking the latter is a measure of the bank's ability to cover loan losses and withdrawals by its customers. This means that our formulation incorporates potential NPL losses in the interest rate through the deposit to loan ratio. If banks must keep a high $\frac{DEP_t}{L_t}$ to cover for potential NPL losses this means they will charge all their customers (including prime customers) a higher interest rate.[87]

Finally, if we assume that bank operating costs and capital expenditures are a function of their lending capacity and their depository base equation 3.8 can be considered a good approximation of a cost- based interest rate.

---

[87] The ratio of reserves to deposits $\frac{R_t}{DEP_t}$ is also an important measure. It reflects the banks ability to cover mass withdrawals by its depositors.

The question is whether this formulation implies a 'natural rate of interest' and whether under this rationale certain 'laws' that underlie the average rate of interest. In short, the question is if it contradicts the extract from section V of *The Capital* Vol. III quoted in the previous section (Marx 1894: 246). If we assume that there exists a desired ratio $\frac{R_t}{L_t}$ then indeed equation 3.8 can be considered as a description of a 'natural rate of interest' proportional to the rate of profit. A notion found, under different reasoning, in Smith (1976 I.ix), Ricardo (1951: 363) and Mill (1874, Essay IV: 90–119).

Shaikh (2016) answers the issue by suggesting that any notion of a 'natural rate of interest' is lost if constant banking capital and bank operating costs are introduced in the picture (2016: 449-450). His idea can be followed if we modify the banking profit equations (3.6-3.8) as follows (all notation appearing also in equations 3.6-3.8 have the same meaning as above):

3.9 $P_{B_t} = i_t \cdot L_t - p_t \cdot ucr^D \cdot D_t - p_t \cdot ucr^L \cdot L_t$

where p_t *is the price level*, D_t *is demand deposits, and* ucr^D, ucr^L *are real deposit and loan unit costs*

3.10 $K_{B_t} = R_t + p_t \cdot K_{Bf_t} \cdot L_t$

where K_{Bf_t} *is the real cost of fixed capital per loan (at normal capacity)*

$$3.11\ r_{1_t} = r_{B_t} = \frac{\left(i_t - p_t \cdot ucr^D \cdot \frac{D_t}{L_t} - p_t \cdot ucr^L\right)}{\left(\frac{R_t}{L_t} + p_t \cdot K_{Bf_t}\right)}$$

$$\rightarrow i_t = r_{1_t} \cdot \left(\frac{R_t}{L_t} + p_t \cdot K_{Bf_t}\right) + p_t \cdot \left(ucr^D \cdot \frac{D_t}{L_t} - ucr^L\right)$$

Equation 3.11 indicates that the interest rate depends on the general regulating profit rate r_{1_t}, through the process of equalization, but also on the price level p_t. Marx was aware of the findings of Tooke that indicated that the price level affects the interest rate. The latter is evident from his extensive references to the debate between the 'Banking' and the 'Currency' school in *Capital* Vol. III[88] (Marx Capital Vol. III 1894 Ch. 28). In this regard, equation 3.11 indicates that there is no contradiction in Marx's arguments on the rate of interest and provides a direct analytical explanation of what would be called by Keynes (1930: 198) the 'Gibson Paradox'.

The most important part of this reasoning, however, is that it proves that there is no natural interest rate. From equation 3.11 it is evident that there is a different interest rate for each price level.[89] At the same time, 3.11 is a reconciliation between the two aspects of Marx's theory of the interest rate since it associates the latter with both the rate of profit and the price level. At the analytical level, this type of reasoning brings together his theory of endogenous money (Marx *Capital* Vol. I 1867: 188-227) with the theory of interest and credit. Because in this environment causality runs from prices to money and not the other way around as in the quantity theory.

But there is a second important question of analytical and practical interest in section V of The *Capital* Vol. III, that needs to be addressed. The extract that follows will bring this issue forward:

> There is no reason at all why the average conditions of competition, of equilibrium between lender and borrower, should give the lender an interest of 3, 4, 5 per cent, etc. on his capital, or alternatively a certain percentage, 20 per cent or 50 per cent, of the gross profit. Where, as here, it is competition as such that decides, the determination is inherently accidental, purely empirical, and only pedantry or fantasy can seek to present this accident as something necessary. [...] Custom, legal tradition, etc. are just as much involved in the determination of the average rate of interest as is competition itself, in so far as this average rate exists not only as an

---

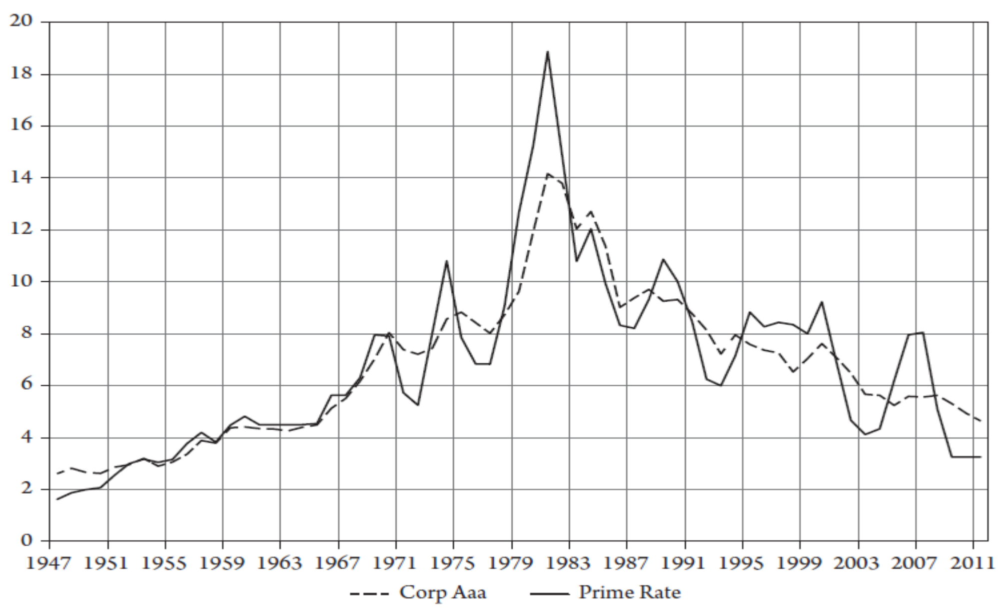
[88] In the mid-19th century England, there was a furious debate between an early version of quantity theorists (the currency school) and certain proponents of the endogenous money approach (the banking school). The main issue of the confrontation was whether there was a need to restrict the circulation of bank notes. The currency school suggested in favor of restrictions in bank notes whereas the banking school argued for the opposite. In the end the currency school prevailed imposing a regulatory legislation known as the Peel Act (1844) named after the British PM Sir Robert Peel. Marx mocked the Peel Act from the first instance through his column in *New York Herald Tribune* (Stravelakis and Tziantzi 2018: 195-2013). He pointed out that its restrictions were not required during times of normal accumulation and was withdrawn when the crisis broke out to prevent economic collapse. His views stand close to those of the banking school although his approach on money is original.

[89] To a certain extent this type of reasoning is similar to the structure of the argument on the natural rate of interest in Keynes. In the *Treatise on Money*, Keynes defines the natural rate of interest as that corresponding to the equality of savings to investment at full employment output. (Keynes 1930:139). But he subsequently defines the natural rate only in terms of the equality of savings and investment, in which case there is a natural rate of interest corresponding to every given level of employment (Keynes 1930: 447).

average number but as an actual magnitude. [...] From what has already been developed, it follows that there is no 'natural ' rate of interest. (Marx 1894: 485-487).

This reasoning goes beyond the rejection of the natural rate of interest through variations in the price level. It suggests that the variability of the rate of interest will be much greater and will depend on competition as well as customs, and juristic tradition. In other words, there is no fixed average ratio of interest to profits. Moreover, looking for such a fixed average ratio is 'pedantry and fantasy'. This is an insight quite relevant to 20th–21st century finance. The chart that follows (Figure 3.1) presents the time series of the loan (prime rate) and Aaa bond interest rates in the US from 1947 until recently (Shaikh 2016: 463). The data comes from the database of the Federal Reserve Bank of St Louis. In Figure 3.10 below I will use the same data to show the relation between the loan rate and the bond rate.

Figure 3.1
Bank Loan Rate of Interest and Corporate Bond Yield



Source: Shaikh 2016 Fig. 10.2, p. 463

Both interest rates have a clear upward trend from the end of the war to the beginning of the neoliberal era and a downward trend afterward. Moreover, during periods of capitalist crises like in the 1970s, the abandonment of the gold standard in 1971, the Asian crisis in 1999, and the global financial crisis of 2007-2008 interest rates have a spike motion without reversing the longer-term trend. If someone wanted to comment on the evolution of interest rates, he would say that the most important factor in the movement appears to be the deregulation of the financial markets following 1980.

Returning to equation 3.8 such trend and variability of the interest rate can be justified only from a combination of the incremental rate of profit volatility (r_{1_t}) and the volatility of the ratio $\left(\frac{R_t}{L_t}\right)$. The ratio involves reserves (R_t) which are dependent upon monetary policy since banks will keep fewer reserves against a given amount of loans in an environment of accommodating monetary policy rather than in an environment of tight monetary rules. This influences, besides other issues, the equalized profit rates and their volatility as indicated by equation 3.3. However, the ratio has a second factor; the amount of borrowing which depends on the competition of borrowers and lenders at the prevailing economic conditions. Therefore, the rate of interest resulting from the multiple of two highly volatile ratios (the incremental rate of profit and the ratio of reserves to loans) may appear not to obey any law although it brings rough equality of returns between the banking and the industrial capital. In other words, equalization of returns does not necessarily mean that there must exist a stable 'gravity center' for the interest rate at the average conditions of competition in the absence of banking costs.

Shaikh, whom we have followed in this derivation, so far considers this as a contradiction of the argument in Marx. He suggests that in the last extract (Marx 1894: 485-487), Marx, abstracts from the conditions of production, costs, and capital invested, in the same way that neoclassical economists abstract from production in presenting models of pure exchange (Shaikh 2016: 479). There is, however, an extract from Marx which indicates that he had made no such abstraction:

> As far as the determination of the rate of interest is concerned, Ramsay says it "depends partly upon the rate of gross profits, partly on the proportion in which these are separated into. Profits of capital and those of enterprise. This proportion again depends upon the competition between the lenders of capital and the borrowers; which competition is influenced, through by no. means entirely regulated, by the rate of gross profit expected to be realized" (Marx 1894: 484).

Although this is an extract from George Ramsay (1836: 206-207),[90] it is compatible not only with a monetary rate of interest but also with the process of the

[90] Although the Scottish economist of the 19th century, George Ramsay, is almost forgotten nowadays, he was very influential in his time and his main work *Essay on the Distribution of Wealth*

equalization of rates of return discussed above. The anticipated 'rate of gross profits' is no other than the general (regulating) rate of profit discussed above in various instances. It is this rate that regulates the mobility of capital between the industrial and financial sectors and at the same time a good part of the competition between borrowers and lenders. Its inclusion in Marx's notes on the rate of interest indicates that the equalization of returns between the banking and the corporate sector was always in the background of his elaborations. Nevertheless, he acknowledges that there are factors that do not affect only profitability but also the availability of funds. These factors play a part in the distribution of profits of capital and 'profits of enterprise'. For example, an accommodating monetary policy will reduce reserves (R_t). This on one hand will increase the regulating rate of profit (equation 3.3) and on the other will reduce the $\left(\frac{R_t}{L_t}\right)$ ratio. The higher profit rate will tend to increase the rate of interest while the lower reserve to loan ratio will tend to reduce it (equation 3.8), the overall result on the interest rate is not easy to assess.

This is the reason that the extract from Ramsay is followed by an extract from Massie (1750: 27) that reads as follows: "The only thing which any man can be in doubt about on this occasion, is, what proportion of these profits do of right belong to the borrower, and what to the lender". (Marx 1894: 484-485)

Therefore, we can conclude that a highly volatile rate of interest will, nevertheless, tend to equalize returns between the corporate and the banking capital. These adjustments are influenced by profitability directly and through competition, the price level but also by institutional factors that influence the availability of loanable funds. The overall result of the simultaneous operation of these factors on the rate of interest explains why there is no such thing as a 'natural rate of interest'. Marx's reference to the operation of institutional factors, customs, and juristic tradition has

---

was highly regarded. His name appears 11 times in *The Capital Vol. III* in almost all cases to enforce Marx's own arguments. Specifically, in *Vol. III* (1894: 129) Marx cites Ramsay to comment on his position that profit cannot come from exchange. Ramsay is criticized only in a footnote (1894: 391*n*38) for confusing merchant's capital with transportation. However, Marx treats the extensive quotations from Ramsay as guidance when dealing with the distribution of profit between interest and profit of enterprise (1894: 485-487). He seems to appreciate the fact that although Ramsay accepts the central role of profit in the competition between borrowers and lenders, he acknowledges also that additional aspects play a part in the distribution of gross profit. These are the centralization of savings of all classes and their transformation to loanable funds through the credit system, and the degree of economic development which he associates with the appearance and growth of a class of rentiers. The latter point is considered by Marx in his fragmental references to the stock exchange presented in section 3g.1. below as a countervailing tendency to the decline in the rate of profit. Overall, Ramsay's views on interest and profit are considered by Marx with a favourable eye similarly to his attitude towards Tooke and Fullarton on the relation of interest rates with prices which have received greater attention in the literature.

been misunderstood in my opinion. Some scholars (Fine, Lapavitsas, Itoh) considered it an indication that IBC does not participate in the profit equalization process. Shaikh, although proposing a different solution, also considered it contradictory to the argument on equalization. However, Marx's references to Ramsay and Massie indicate that Marx, most probably, anticipated an equalization of returns irrespective of the influence of additional factors on the rate of interest. The reason is that policy and institutional changes, as well as custom and juristic traditions, also affect the regulating rate of profit around which equalization takes place as indicated by equation 3.3. Despite the last point of criticism, Shaikh's proposed solution presented in equations 3.8 and 3.11 consolidates most of the insights presented in the notes that comprise section V of *The Capital* Vol. III.

The equation of the rate of interest (3.8) can be elaborated further. In a paper published in (2012), I have argued, abstracting from changes in monetary policy and institutional factors in general, that the rate of interest can be presented as the difference of the regulating rate of profit from the share of corporate profits. This can be written as follows:

3.12 $i_t = r_{1_t} - a \cdot y_t$

$where\ r_{1_t}\ is\ the\ general\ regulating\ rate\ of\ profit,$

$parameter\ a\ summarizes\ the\ current\ institutional\ and\ policy\ environment$

$and\ y_t = \frac{NP_t}{P_t}\ where\ NP_t\ is\ net\ corporate\ profits\ and\ P_t\ gross\ profits$

Combining 3.8 and 3.12 and assuming that $r_{1_t} = r_{b_t}$ then we arrive at the following relation:

$$r_{1_t} \cdot \frac{R_t}{L_t} = r_{1_t} - a \cdot y_t \rightarrow a \cdot y_t = r_{1_t} \cdot \frac{L_t - R_t}{L_t}$$

$from$ 3.12 $we\ find\ that\ y_{max} = \frac{r_{1_t}}{a}\ since\ for\ this\ value\ i_t = 0\ and\ we\ get$

3.13 $\frac{y_t}{y_{max}} = \frac{L_t - R_t}{L_t}$

Equation 3.13 offers a complete determination of the interest rate assuming a stable institutional environment. If corporations keep the maximum of the gross profit, then 3.13 tells us that banks will keep no reserves and interest rates will drop to zero. If corporations pay out the whole gross profit $(y_t = 0)$ banks will lend out an amount equal to their reserves, euro for euro. In that case, the rate of interest will be equal to the regulating rate of profit. Finally, if corporate net profits turn negative $(y_t < 0)$ then banks will lend amounts smaller than their reserves and the lending rate will exceed the profit rate.

This formulation can be presented as a risk sharing process between borrowers and lenders. That is as a bilateral contract that maximizes corporate profitability given the underlying rate of profit. In this context the interest rate appears as the solution of an overdetermined model where the equation of the profit of enterprise is the objective function (it can be understood also as a demand function for new loans). The bank minimum profitability and the interest rate being less than the profit rate are the restrictions. In this context the gross rate of profit participates in the bargaining between corporations and banks as argued above. The only problems are that the rate of return is not equalized between corporations and banks and the static formulation of the model. Nevertheless, if we wish to transform equation 3.13 to a monetary policy tool a formulation along these lines is indicative.

Equations 3.12 and 3.13 are equivalent to 3.8 with the difference that it also introduces a form of competitive behavior. When corporations keep most of their gross profits, in other words, interest payments and other transfers are limited, banks are eager to extend their balance sheets without accumulating additional reserves and interest rates remain low. Nevertheless, when corporations pay to banks important parts of their gross profits banks react by accumulating additional reserves, their cost increases and this pushes up interest rates.

In the next section (section 3.4) I will present a dynamic model where the rate of profit of enterprise determines growth and the interest rate is determined from the competition between borrowers and lenders along the lines of equation 3.13. The idea is that low net corporate profitability induces banks to increase the reserve/loan ratio and the interest rate. This reduces corporate profitability and the required rate of profit (equation 3.3). However, in this case certain corporate funds will remain idle in the form of bank deposits. If this increases bank liquidity (i.e. the loan/ deposit ratio drops) then interest rates will drop, and growth will resume. Nevertheless, if the rate of profit is too low bank liquidity will not rise (the average deposit balances will remain low) and the interest rates will increase further. The interesting thing is that the mobility of capital equalizes corporate and bank returns along the phases of the business cycle. It is only in a depression that the two rates systematically diverge.

3d Capital Accumulation – Crisis and The Rate of Profit of Enterprise

Most of the preceding discussion refers to the contents of *The Capital* Vol. III chapter 22 (Marx 1894: 480-492). The following chapter (chapter 23) is titled 'Interest and Profit of Enterprise'. The idea presented in the latter is that the formation of IBC and the mass use of credit in capitalism leads to a qualitative transformation. Irrespective of whether an industrial capitalist works with borrowed funds or his capital he separates the return (profit) on 'capital' and the return from putting that capital to work. The profit on capital is the interest this capital earns if it is lent out to a 'functioning'[91] capitalist. The return for the functioning capitalist is described by the German word *Unternehmergewinn* (profit of enterprise) (Marx 1894: 496). Under the same rationale, the rate of return on capital is the rate of interest and the rate of profit of enterprise the difference between the rate of profit and the rate of interest (r-i).

The qualitative difference imposed leads to the acknowledgment that the rate of profit of enterprise is the crucial variable for capital accumulation. In Marx's view, and to a great extend in actual life, capitalists have been trained to consider the interest rate as a benchmark when making investment decisions. Irrespective of whether they need to borrow funds for the investment; the anticipated return compared to the interest rate is the primary criterion in investment decisions. This is the reason why Marx expects the interest rate to be less than the profit rate. Of course, the rate of profit of enterprise must be positive for firms to be viable anyway but this is only the starting point of Marx's analysis.

To explore how this idea works together with the theory of the interest rate outlined in the previous section, I developed a dynamic model (Stravelakis 2012) with the following assumptions[92] (all repeated notation has the same meaning as above):

$$3.14 \quad \frac{K_t - K_{t-1}}{K_{t-1}} = s_t \cdot \left(r_{1_t} - i_t\right) \text{ where } s_t \text{ is the rate of savings out of industrial profit}$$

[91] The word 'functioning' for capitalists is used by Marx to include together industrial and commercial capitalists.

[92] In the initial model (Stravelakis 2012) I did not expressly introduce a different regulating rate of profit r_{1_t}. In this sense the resent model is more complete and closer to an overall theory of financial asset pricing.

$$3.15\ r_{1_t} = constant. This\ means\ that\ r = \frac{P_t}{K_{t-1}}\ constant\ and\ z = \frac{R_t}{K_t}\ constant \rightarrow r_1 = \frac{1}{1+z} \cdot r$$

$$3.16\ \ i_t = r_{1_t} - a \cdot y_t\ the\ same\ as\ in\ equation\ 3.12\ section\ 3.2$$

$$3.17\ \ s_t = \frac{i_t}{r_{1_t}}\ the\ rate\ of\ savings\ of\ the\ industrial\ capital$$

$$3.18\ \ y_t = \frac{NP_t}{P_t}, NP_t = P_t - i_t \cdot L_t \rightarrow y_t = 1 - i_t \cdot \frac{L_t}{P_t}$$

The model pictures a world of industrial corporations and banks, where banks receive zero-interest deposits and offer a single type of corporate loan. Starting from the end, 3.18 is simply a definition it says that the share of industrial profit out of total profit is equal to gross profit (P_t) minus interest payments $(i_t \cdot L_t)$. This means that we abstract from administrative expenses and commercial costs and non-productive corporate costs except for interest payments.

Equation 3.14 is the growth equation which says that the rate of growth depends on the rate of savings (s_t) and the rate of profit of enterprise $(r_{1_t} - i_t)$. The equation indicates that investment $(K_t - K_{t-1})$ will equal savings in the case the rate of interest equals zero $(a \cdot y_t = r_1)$. This becomes evident by substituting 3.16 in 3.14

$$3.19. \frac{K_t - K_{t-1}}{K_{t-1}} = s_t \cdot a \cdot y_t \rightarrow . \frac{K_t - K_{t-1}}{K_{t-1}} = s_t \cdot r_{1_t}$$

$$\rightarrow if\ r_{1_t} = r\ \ because\ i_t = 0\ and\ K_t - K_{t-1} = I_t = s_t \cdot r \cdot K_{t-1}$$

$$\rightarrow I_t = s_t \cdot P_t\ and\ I_t\ is\ corporate\ investment\ in\ the\ current\ period$$

Of course, this is not a realistic case, not only because the rate of interest is equal to zero but also, because in this case the rate of savings (s_t) is also zero as indicated by equation 3.17. In the context of this model, the normal rate of accumulation is supported by a positive stable rate of excess demand that enhances growth together with savings. This is indicated by the following elaboration of equation 3.19:

$$3.20\ \ \frac{K_t - K_{t-1}}{K_{t-1}} = s_t \cdot a \cdot y_t \rightarrow K_t - K_{t-1} = s_t \cdot \frac{a}{r_t} \cdot y_t \cdot P_t = s_t \cdot \frac{a}{r_t} \cdot NP_t$$

$$\rightarrow I_t = s_t \cdot NP_t\ only\ if\ r_t = r = a$$

One basic assumption of the model is that the structural parameter (a) is greater than the gross industrial rate of profit r for reasons I will explain shortly. For now, we need to point out that $a > r$ indicates that investment will always be greater than savings for positive net corporate profits and interest rates. Having assumed (equation 3.14) that only industrial capitalists save in the form of corporate retained earnings, then new borrowing will equal the difference of investment (I_t) from savings $(s_t \cdot NP_t)$. In this case, the equation of excess demand that mirrors finance will look as follows:

$$3.21\ E_t = L_{t+1} - L_t = (K_t - K_{t-1}) - s_t \cdot NP_t$$
$$\rightarrow L_{t+1} - L_t = \left(\frac{a}{r_t} - 1\right) \cdot s_t \cdot NP_t$$

Taking a moment of reflection on 3.21 we can give some reasoning on the anticipated value of the structural parameter a. Following Marx, I will assume that the velocity of circulation of money depends on credit (Marx 1894: 566-567). On these grounds, I assume that the velocity is a linear function of the rate of profit of enterprise of the following form.

$$3.22\ y_t = \frac{1}{\theta} \cdot (v_t - v_{min}) \rightarrow \alpha = \frac{1}{\theta}$$

Given that the Fisher velocity v_t is much greater than unity, whereas $y_t \leq 1$ means that the structural parameter α will be greater than unity. The latter is greater than any calculated value of the gross, average, or regulating (incremental) rate of profit.

To keep the dynamics as simple as possible, I have assumed that the regulating rate of profit (r_1) is constant (data for the model) something which implies that the industrial profit (r) is constant and a linear function of the regulating rate. The latter means that the ratio of industrial to banking (IBC) capital is fixed. These relations are briefly elaborated in equation 3.15. In this case, if $(a > r)$, 3.21 indicates that an amount of new borrowing reflecting excess demand will enhance investment and growth.

Equation 3.17 on the rate of savings also requires certain clarifications. The rate of savings is not constant. Equation 3.17 indicates that corporations will retain a

greater portion of their profit if the interest rate increases. The idea is that corporations will cut back on their distribution policy as the first reaction against declining profitability which in this model comes from interest rate increases.
Although equation 3.16 was discussed in the previous section it can be elaborated further under the model assumptions. First, we can shed further light on the discussion on the IBC - industrial capital equalization process, and the existence of a natural rate of interest by introducing the model assumptions in equation 3.8 of the previous section.

$$3.23\ \textit{the original equation}\ (3.8)\ \textit{is}\ r_{1_t} = r_{B_t} = i_t \cdot \frac{L_t}{R_t}\ \textit{or}\ i_t = r_{1_t} \cdot \frac{R_t}{L_t}$$

$$\textit{under the model assumption this can be written:}\ i_t = r_1 \cdot \frac{R_t}{L_t} = r_1 \cdot \frac{R_t}{K_t} \cdot \frac{K_t}{L_t}$$

$$\textit{from equation}\ 3.15\ \textit{it follows}\ i_t = z \cdot r_1 \cdot \frac{K_t}{L_t} = (r - r_1) \cdot \frac{K_t}{L_t}$$

Equation 3.23 indicates that for any ratio of reserves to industrial capital (denoted here by z) we will have a different rate of interest. This is because $z \cdot r_1$ is equal to the difference between the gross and the regulating rate of profit $(r - r_1)$. The above indicates that an additional factor (besides prices) that justifies a monetary rate of interest in Marx is that the average and the regulating rate of profit are not the same.
In the context of the model interest rate adjustment happen through the leverage ratio $\frac{K_t}{L_t}$. It will become evident, from the dynamics that the ratio may follow chaotic patterns indicating that a 'natural rate of interest' is not the case even with constant profit rates. The above, however, does not prevent the rough equalization between IBC (in the sense of the banking rate of return) and corporate returns.
By elaborating on equation 3.16 we will arrive at similar results that also indicate an important property of the model. That under certain parameter values it produces conditions of normal accumulation and under different values, it results in depression.

$$3.24\ \textit{if}\ i = 0,\ \textit{then}\ y = y_{max} = \frac{r_1}{a}$$

$$\rightarrow i_t = r_1 - r_1 \cdot \frac{y_t}{y_{max}}\ \textit{since}\ y_t = 1 - \frac{i_t \cdot L_t}{P_t}$$

$$\rightarrow i_t \cdot y_{max} = r_1 \cdot \left(y_{max} - 1 + i_t \frac{L_t}{P_t}\right) \rightarrow i_t \cdot \left(y_{max} - \frac{r_1}{r} \cdot \frac{L_t}{K_{t-1}}\right) = r_1 \cdot (y_{max} - 1)$$

$$\rightarrow i_t = r_1 \cdot \frac{(y_{max} - 1)}{\left(y_{max} - \frac{1}{1+z} \cdot \frac{L_t}{K_{t-1}}\right)} = r_1 \cdot \frac{\left(\frac{r}{a} - (1+z)\right)}{\left(\frac{r}{a} - \frac{L_t}{K_{t-1}}\right)}$$

Equation 3.24 tells us that the rate of interest is a positive function of the regulating rate of profit (r_1), the leverage ratio $\left(\frac{L_t}{K_{t-1}}\right)$ and a positive function of the ratio of banking to corporate capital $z = \frac{B_t}{K_t}$. A set of factors already discussed. When the leverage ratio $\left(\frac{L_t}{K_{t-1}}\right)$ increases to become equal to $(1+z)$ the rate of interest will become equal to the regulating rate of profit $(r_1)$and the rate of profit of enterprise $(r_1 - i_t)$ becomes zero. This implies a depression since we either have a big amount of losses financed through debt or a situation of low-capacity utilization associated with high outstanding debt. The latter case is closer to the dynamics of the model we will explore shortly.

If we assume that total capital advanced is equal to the sum of debt plus equity. Total utilized capital (K_t) can be less, equal, or greater than (in the case of use over the normal working day) to the accounting value of debt plus equity. Under this rationale capacity utilization is defined as follows:

3.25 $u_t = \frac{K_t}{L_{t+1} + EQ_t}$

$and\ u_t = capacity\ utilization, EQ_t = corporate\ equity$

In the case of $K_t = \frac{1}{1+z} \cdot L_t$ 3.24 will take the following form:

3.26 $u_t = \frac{L_{t+1}}{(1+z) \cdot (L_{t+1} + EQ_t)} < 1$

Under these assumptions, the model is solvable. The solution is derived in Appendix 2 and is summarized in the following equation:

3.27 $$(y_{t+1} - y_t) = \frac{1}{r_1 \cdot (a - r_1)} \cdot \left(\left(\frac{a}{(1+z) \cdot r_1} - 2\right) \cdot (r_1 - a \cdot y_t) - (a - r_1)\right) \cdot (r_1 - a \cdot y_t)^2 \cdot y_t$$

This is a four-degree non-linear difference equation of y_t depending on the gross profit rate r, the regulating profit rate r_1 and the structural parameters z, a. It determines the rate of growth and the rate of interest through the share of industrial profit out of total profit. The equation has three initial roots/solutions. One for $y_1 = 0$ which means that $i = r_1$ and represents a depression as indicated above. A double solution for $y_2 = y_{max} = \frac{r_1}{a} \rightarrow i = 0$, and a third solution for $y_3 = -\frac{(r+a\cdot z)}{(a-2\cdot r)} \cdot y_{max}$. The last root suggests a positive equilibrium share of industrial profit $y_3 > 0$ if $(r > \frac{1}{2} \cdot a)$ and if the equilibrium share is negative then the opposite holds. A positive corporate profit share $y_3 > 0$ is associated with a positive normal rate of interest for $a > r_1$ which implies a positive rate of profit of enterprise. In short, it pictures a state of normal accumulation. A low-profit rate, however, $(r < \frac{1}{2} \cdot a)$ pulls the economy towards a negative growth trend which is associated with an interest rate that exceeds the profit rate and a negative rate of profit of enterprise. Although this is a tempting solution it is unstable as we will see next.

The investigation of the stability of the primary roots (y_1, y_2, y_3) will reveal not only the conditions for economic depression but also a set of secondary roots associated with states of normal accumulation (positive growth) associated with circular and chaotic interest rate fluctuations.

The first derivative of 3.17 is the following:

3.28 $$\frac{dy_{t_1}}{y_t} = \frac{1}{r_1 \cdot (a - r_1)} \cdot \{Z_t \cdot i_t^2 - a \cdot \left(\frac{a}{(1+z)\cdot r_1} - 2\right) \cdot i_t^2 \cdot y_t - 2 \cdot a \cdot i_t \cdot Z_t \cdot y_t\}$$

$$and\ Z_t = \left(\frac{a}{(1+z)\cdot r_1} - 2\right) \cdot (r_1 - a \cdot y_t) - (a - r_1),\ i_t = r_1 - a \cdot y_t$$

Substituting the initial roots

For $y_1 = 0 \rightarrow \frac{dy_t}{y_1} = -\frac{r_1}{(a-r_1)} \cdot \left(\frac{z}{(1+z)} \cdot a + r_1\right) < 0\ for\ a > r_1$ therefore for the solution to be stable, the following inequality must hold: $-\frac{r_1}{(a-r_1)} \cdot \left(\frac{z}{(1+z)} \cdot a + r_1\right) > -2$. The inequality holds for (see appendix 1):

3.29 $$\frac{r \cdot (r_1 + 2)}{[(2 \cdot (1+z) - (r - r_1)]} < a$$

The stability condition indicates that the system drifts to depression when profit rates are sufficiently low and the ratio of financial (IBC) to industrial capital (K) is high. It is a finding with important analytical and policy implications. Inequality 3.29 indicates that a high ratio of financial to industrial capital (z) pushes the system to stagnation. This explains the present situation of the world economy where, despite the trillions that have been advanced from the state and central banks to the financial sector, growth is anemic and the spreads between bond and loan rates are excessively big. The model indicates that the main factor that can bring the economy out of stagnation is a higher gross rate of industrial profit (r).

For $y_2 = \frac{r}{a} \rightarrow \frac{dy_{t_2}}{y_2} = 0$ This is not an economically meaningful solution since both the interest rate and the rate of savings are zero.

For

$$y_3 = -\frac{(r+a\cdot z)}{(a-2\cdot r)} \cdot y_{max} \rightarrow \frac{dy_{t_3}}{y_3} = \frac{1}{(a-r_1)} \cdot \left(\frac{a}{(1+z)\cdot r_1} - 2\right) \cdot r_1^2 \left(1 + \frac{(r+a\cdot z)}{(a-2\cdot r)}\right)^2 \cdot \frac{(r+a\cdot z)}{(a-2\cdot r)} > 0 \; for \; a > r_1.$$

Therefore, the solution is unstable.

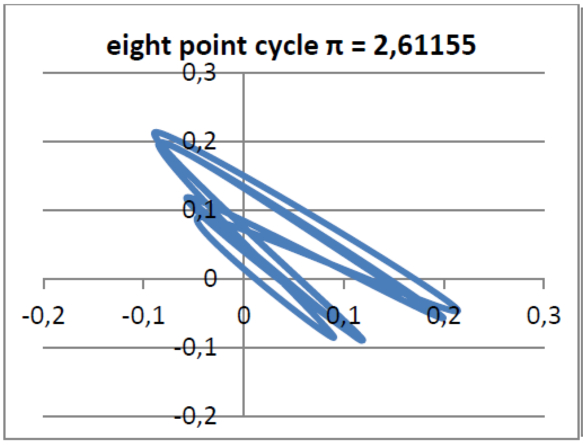
It is clear from the above that the only solution which is both economically meaningful and stable is $y_1 = 0$. The question is if there is a range of parameter values resulting from equation 3.27? Indeed, for higher values of r and appropriate values of z that reverse the direction of inequality 3.29, there exists a whole set of circular and chaotic growth trends depending on parameter values and initial conditions. The dynamics can be approximated by a second-degree nonlinear difference equation of the form (Stravelakis 2012, Brigs 2001, Feigenbaum 1980):

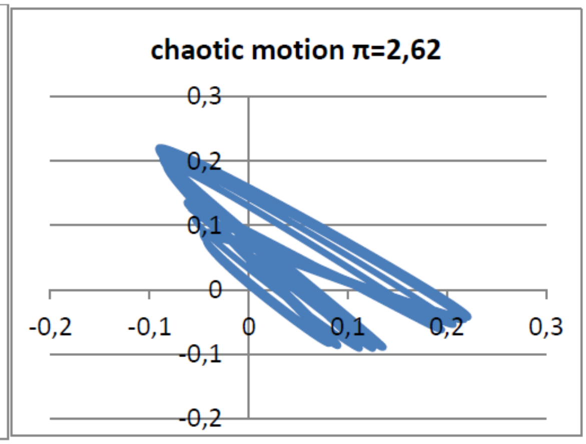
$$3.30 \quad y_{t+1} = \sigma + \mu \cdot y_t^2$$

$$and \; \mu = \frac{1}{2} \cdot \frac{r_1}{(a-r_1)} \cdot \left(\frac{z}{(1+z)} \cdot a + r_1\right), \pi = 2 \cdot \mu, \delta = \frac{\pi_t - \pi_{t-1}}{\pi_{t+1} - \pi_t} = 4.6692$$

Using the Feigenbaum constant δ the dynamics of equation 3.30 can be fully explored (Stravelakis 2012). Here I will present only certain indicative simulations of y_{t+1}. The simulations indicate different values of the rate of interest (Figures 3.2, 3.3)

Figure 3.2 **Figure 3.3**





Figures 3.2 and 3.3 are phase diagrams of y_{t+1} (vertical axis) against y_t. The figures indicate that small changes in the complex parameter μ create substantial changes in the patterns of variation of the share of corporate profits y_t and consequently the rate of interest i_t. Nevertheless, returns for corporations and banks become equalized around the regulating rate of profit r_1 (equation 3.14, 3.23). In this regard, the model outlined herein offers a reconciliation of various insights presented in section V of *The Capital* Vol. III. Of course, this is a solution and not an interpretation of the references on the rate of interest in the third volume of *The Capital*. The advantage of this interpretation is that it offers a determination of the rate of interest that justifies Marx's quote that the latter "exists not merely as an average, but rather as actual magnitude" (Marx 1894: 486). So far this quote together with similar references has led scholars to suggest either that returns do not become equalized, or that equalization results only in the context of a Sraffian model where the rate of interest serves as the 'price of production' of the banking sector. In the first case, the rate of interest remains indeterminate in the second the variability of loan rates is not justified by the determining factors (the regulating rate of profit and the price level).

The analytical relevance of the model is not limited to the rate of interest. It also suggests an explanation for short-term fluctuations and at the same time a trigger mechanism for depressions. The latter is in line with the insights of Marx in *The Capital* Vol. III where he states that "a rise in interest [not a decline in the rate of profit-NS] comes between prosperity and its collapse, while maximum interest up to extreme usury corresponds to a period of crisis" (Marx 1894: 482. This insight is quite relevant since Figure 3.1 indicates that loan rates surged during the depressions that marked the second half of the 20th century and the crisis that began in 2008. Nevertheless, Marx was well aware that crises are due to production and profitability and not the result of financial turmoil. The extract from *The Theories of Surplus* Value cited by Henryk Grossman (Grossman 1929; 1992: 28) leaves little doubt about that.

'In investigating why the general *possibility* of crisis turns into a *real* crisis, in investigating the *conditions* of crisis, it is therefore quite superfluous to concern oneself with the *forms* of crisis which arise out of money as *means of payment* [credit— HG]). This is precisely why economists like to suggest that this *obvious* form is the *cause* of crises.' (Marx 1969: 514-515, original emphasis)

The model outlined above resolves how interest rates react to profitability. As we saw the rate of profit does not affect only the rate of interest directly but also the competition between borrowers and lenders. The latter is indicated in the extract by Ramsay (1836: 206-207) quoted by Marx and cited in the previous section. This explains why interest rates rise in periods of prosperity but reach their maximum in periods of crisis. Both results appear in the different solutions of the model. Interest rates increase at the upper phase of the business cycle in times of normal accumulation (Figures 3.2, 3.3) but surge, becoming equal to the rate of profit when the industrial profit rate is sufficiently low (inequality 3.29). The main factor that brings different results is the gross industrial rate of profit.

These are not theoretical issues. In the current crisis, certain heterodox scholars argued that it is not a depression in the Marxist sense, but a different type of crisis resulting from the 'financialization' of capital (Lapavitsas 2009, Magdoff and Foster 2014).[93] Although, the reasoning is significantly different in the various financialization theories, they all share the premise that the cause of the 2007-2008 crisis lies in the financial sector. This argument gained support from the fact that average profit rates were relatively stable and not declining during the neoliberal era (Shaikh 2011).

[93] The references are indicative. Tomé (2011) has produced an exceptionally good survey of most financialization theories as crisis theories.

By considering the gross rate of profit as the key parameter, the model outlined above separates the cause from the trigger of a crisis. If a surge in the interest rate results from a low rate of profit (inequality 3.29) then financial turmoil is a mere trigger of a slower process underlying the profit rate outlined in section 3.1. Moreover, the model indicates that the average profit rate need not fall sharply before a depression although it must be sufficiently low for a considerable time. In this regard, it explains analytically the present depression as a Marxist type of crisis resulting from the rate of profit and does so by pricing financial assets, at this stage of corporate loans.

In the following, the idea of the rough equalization of returns will be extended to explain the term structure of interest rates, the price of stocks, and the (mis)pricing of derivative and asset-backed securities. The model outlined in this section will be modified to elaborate on these matters especially regarding the triggering of economic crises.

3e The Term Structure of Interest Rates

Although we did not refer to it to a great extent in chapter 2 the term structure of interest rates also poses a problem for mainstream theory. Azariadis (2018) considers the low returns on short term maturity public debt as one of the puzzles faced by mainstream theory. It is a matter of the same nature as the 'equity risk premium puzzle'. In mainstream theory, financial firms are not treated as capitalist corporations therefore the different costs associated with issuing debt with different maturities are not considered. So, any price differential is attributed to notions like risk and expectations which mostly fail empirical testing. On the opposite side, certain heterodox approaches from the Marxian and Post-Keynesian tradition fully reject the market determination of interest rates. Some consider the determination of interest rates purely conventional (Lapavitsas 1997, Rogers 1989: 268). Others determine interest rates from a mark-up on costs which they attribute to banking monopoly power. In the latter case, the usual assumption is that the central bank sets the interest rate and commercial banks set the spread as a mark-up on their cost (Moore 1988: 258, Fontana 2003: 9)

In the previous sections, we determined interest rates differently. In our determination profitability, banking costs, competition, as well as institutional and policy factors are significant in interest rate determination. This approach, especially that relating to cost differentials can be extended to the determination of the term structure of interest rates. Cost differentials incur due to different amounts of reserves engaged when banks undertake longer-term debt, but also from the difference in the direct banking costs involving the follow-up and handling of debt of different nature and maturity. I will examine this rationale for fixed income financial assets of different maturities.

I will keep the level of abstraction of the model presented in the previous section. Banks will offer a second loan with a double duration from the one already considered. I assume that regulating banking capitals have two sections. Section 1 offers the original (short term loan) loan and section 2 offers the new type of (longer-term) loans. The profit rate between the two sections tends to become equalized and I abstract from direct banking costs. Therefore, the interest rate equations are the following:

$$3.31\ r_1 = i_{1_1} \cdot \frac{L_{t1}}{R_{t1}}, and\ \ 3.32\ \ r_1 = i_{2_t} \cdot \frac{L_{t2}}{R_{t2}}$$

$$\rightarrow 3.33\ i_{2_t} = i_{1_t} \cdot \frac{L_{t1}}{R_{t1}} \cdot \frac{R_{t2}}{L_{t2}}$$

$$where\ i_{t_1}, i_{t_2}\ the\ short\ and\ long\ term\ interest\ rates, and\ \frac{L_{t1}}{R_{t1}}, \frac{L_{t2}}{R_{t2}}\ the\ relevant\ loan\ reserve\ ratios$$

Remembering the transformation performed in equation 3.12 we can write the following relations:

$$\frac{L_{t1}}{R_{t1}} = \left(1 - \frac{a_1}{r_1} \cdot y_t\right) = 1 - \frac{y_t}{y_{\max 1}}, \qquad \frac{L_{t2}}{R_{t2}} = \left(1 - \frac{a_2}{r_2} \cdot y_t\right) = 1 - \frac{y_t}{y_{\max 2}}$$

$$3.34\ i_{2_t} = i_{t_1} \cdot \frac{\left(1 - \frac{y_t}{y_{\max 1}}\right)}{\left(1 - \frac{y_t}{y_{\max 2}}\right)}$$

$$and, if\ a_1 > a_2\ then:\ \boldsymbol{i_{2_t}} > \boldsymbol{i_{1_t}}\ for\ y_t > 0,\ \boldsymbol{i_{2_t}} = \boldsymbol{i_{1_t}}\ for\ y_t = 0, and\ \boldsymbol{i_{2_t}} < \boldsymbol{i_{1_t}}\ for\ y_t < 0$$

Equation 3.34 can take infinite substitutions for fixed income financial assets with different maturities. If we consider that generally $y_t > 0$ reflects periods of normal accumulation, then we can construct a positively sloped yield curve. The slope depends on the parameters $a_1, a_2\ etc.$ (I will turn to their economic meaning below). Figures 3.4 and 3.5 picks a set of curves appearing in a certain period for $y > 0, y < 0$ respectively.

Figure 3.4

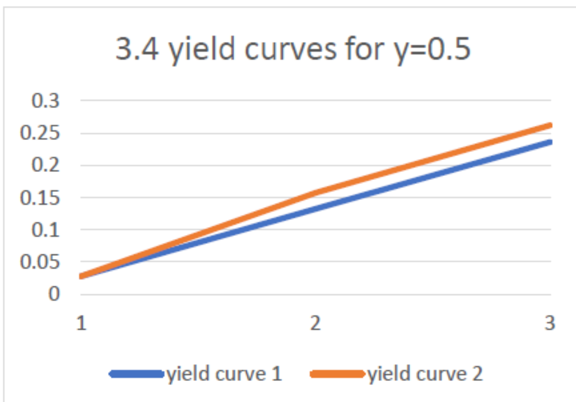
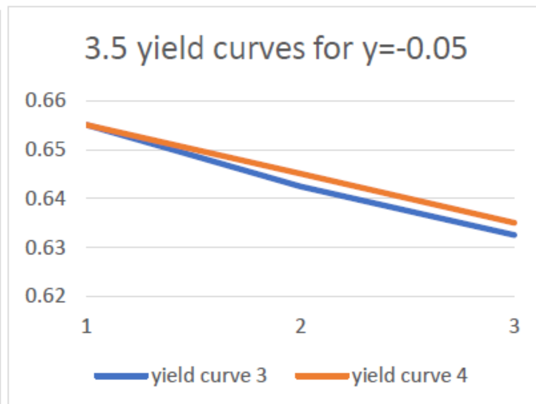


Figure 3.5



There are two sets of a_s in Figure 3.4. Both result in two positively sloped yield curves with the same basic interest rate i_{1_t} because $y_t = 50\%$ in both calculations. The lower a_s result in a steeper curve (yield curve 2) indicating higher yield spreads. When we calculate the same curves for a negative y_t (a corporate loss) both curves turn negative indicating that short-term fixed income asset returns are higher than the long-term (Figure 3.5). This is an interesting property. During depressions and financial turbulence, short-term interest rates are higher (for some time) than the long-term ones. Figure 3.6 is an example of such a case on the vertical axis we have bond yields and on the horizontal axis their respective maturities. Although, we would expect the curves to be positively sloped the opposite happens. Due to financial turmoil long-term debt has lower yield than short term debt.

Figure 3.6

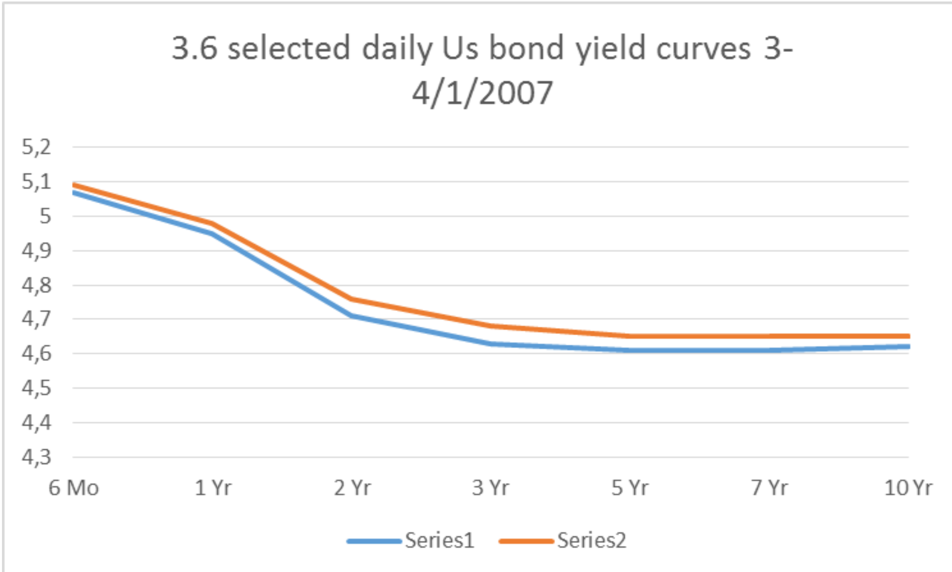
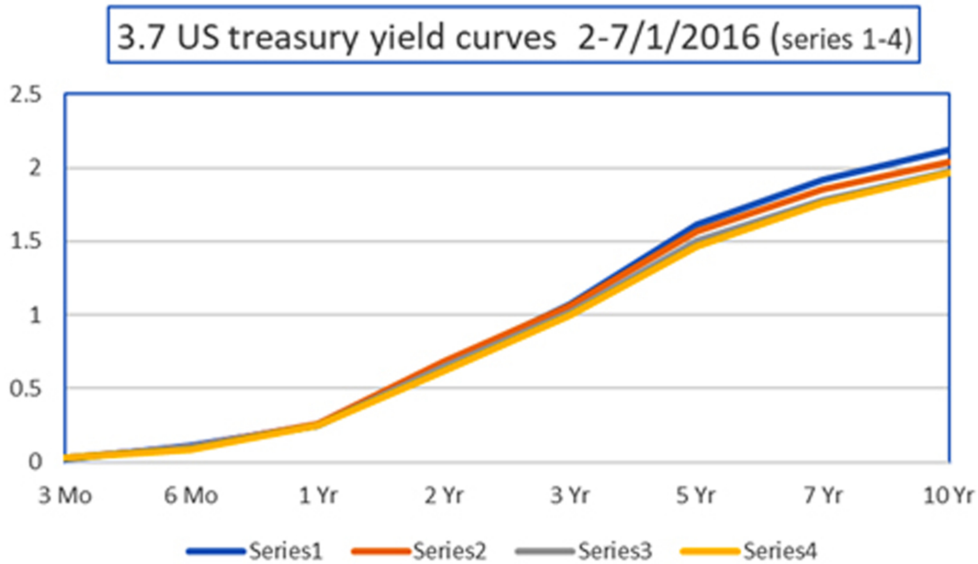


Figure 3.6 shows the official daily US treasury bond yields on the 3rd and 4th January 2007, similar patterns we experience throughout 2007 and during a good part of 2008. The horizontal axis shows the maturities (from 6 months to 10 years) and the vertical axis the corresponding yields. You will note that the slope is negative which means that the 10year bond has a yield of 4.7% whereas the 6-month T-bill a yield of 5.2%. In general, the yield curves take various shapes even when they are positively sloped. This is indicated in the daily shapes of the yield curves that I present in Figure 3.7.

Figure 3.7



In this regard, the strong variation implied by the presence of the variable y_t in equation 3.34 is an additional property of the model. It indicates that even if equal returns between the corporate and the financial sector prevail the shape and slope of the yield curve are expected to be highly volatile. Moreover, both the volatility and the slope of the yield curve result from structural elements and not risk and expectations like in mainstream theory.

The alternative would be to assume following Shaikh (2016: 453) that there exists a desired ratio $\frac{L_{t_2}}{R_{t_2}}$. In this case, the following equation holds in equilibrium:

3.35 $i_2 = p \cdot (ucr_2^D \cdot \frac{L_2}{R_2} + ucr_2^L) + i_1 \cdot \frac{D_2}{L_2} + r_1 \cdot p \cdot kr_{B2}^f + r_1 \cdot \frac{L_2}{R_2}$

The equation is similar to equation 3.11 with the difference that now the short-term rate of interest enters as a cost factor in the determination of the longer-term rate i_2. The idea is that i_1, i_2 are normal interest rates around which market rates will gravitate under stable prices. Equation 3.35, like equation 3.34, has the property of dissociating the shape of the yield curve from risk and expectations. The positive slope of the curve results from structural factors. However, this arrangement does not consider the excessive variability of the yield curve especially in times of crisis and financial turbulence. So, I will stick to my arrangement as in equation 3.34.

Before we move on, we need to define the structural parameters $a_1, a_2\ etc$. In the previous section, the parameter was part of a linear relationship between the rate of profit of enterprise and the velocity of circulation (Equation 3.22). The idea comes from Marx where the velocity of circulation is a positive function of credit. In the case of multiple assets with multiple interest rates, we will have multiple rates of profit of enterprise each associated with a different rate of interest (assuming that banking rates of return are equalized among the different assets). Therefore, equation 3.22 can be rewritten as follows:

3.36 $$\left(v_{1_t} - v_{min}\right) = \left(r_1 - i_{1_t}\right) = a_1 \cdot y_t$$

$$\vdots$$

$$\left(v_{n_t} - v_{min}\right) = \left(r_1 - i_{n_t}\right) = a_n \cdot y_t$$

The idea in equation 3.36 is that each different maturity fixed income financial asset is associated with a different rate of profit of enterprise. The latter corresponds to a velocity of circulation v_i which is a positive function of the parameter a_i. In other words, the shorter the debt maturity the greater its impact on the velocity of circulation. This is reasonable since short term debt usually finances working capital needs that have a faster turnover in times of normal accumulation. The latter justifies a higher profit of enterprise since short term debt will have lower reserves requirements. This advantage turns into a disadvantage in times of crisis. Corporations seeking short-term debt in a crisis either wish simply to meet payments and thus stay in business, or they maximize profits in full capacity utilization. In both cases, this implies that these firms will experience losses. Therefore, from equation 3.34 short-term interest rates will rise faster than long-term rates. Consequently, the velocity of circulation is expected to decline since banks and the public seeks higher reserves. However, both in normal accumulation and crisis the shape and the slope of the yield curve depends on structural and cost factors and not risk, and expectations like in mainstream theory. Finally, the a appearing in equation 3.16 (section 3.4) is the average a resulting from an equation set like 3.36. This average a is the parameter that of the linear equation that associates the share pf corporate profit y_t to the average velocity v_{1_t}.

Despite the previous discussion, expectations play a part in the profit-based approach. The difference between the average and the regulating rate of profit supports a particular expectations theory that offers insight into the operation of the financial markets. To this, we will turn next.

3f. Expectations and Financial Arbitrage – The Reflexivity Theory of George Soros

The analysis conducted so far indicates that both interest rates and yield spreads are expected to exhibit high volatility in the context of the profit-based approach. The main underlying reason is that the regulating rate of profit and the average industrial rate of profit are not the same. This is a particularity of the profit-based approach coming directly from the classical theory of competition and its application by Marx. In neoclassical and neo-Ricardian economics, the price of capital adjusts, and all capitals earn the average rate of profit. As we saw in section 3.1 this is not the case in classical political economy and Marx where we anticipate that only the rate of return of the regulating capitals tends to become equalized. The latter is different from the average rate because new products and techniques are persistently applied. But there is more in this because equalization of returns is reached through the mobility of capital, it is the rate of return on new investments (the incremental rate of profit) that plays the crucial part in this process. We will see shortly that this measure also approximates the definition of the regulating rate of profit of equation 3.3, 3.3'. This means that the incremental rate of profit is expected to be persistently different from the average industrial rate, and indeed it is.

As indicated by equation 3.23, the difference between the average and the regulating rate of profit induces strong variability in interest rates. The latter passes to yield spreads as indicated in equation 3.34, and as we will see shortly is also reflected on the returns of stocks and bonds. All this even though throughout our analysis I have assumed that returns between the industrial and the financial sector are equalized.

But things do not stop there, from equations 3.3, 3.3' we saw that bank reserves R_t enter in the determination of the regulating rate of profit r_1. This means that changes in monetary policy and expectations may alter the profit rate (the fundamentals) around which this equalization takes place. In this world, it is unreasonable to consider equilibrium as a point of rest. On the contrary, it points at a turbulent process where actual rates of return and consequently market interest rates will deviate from the fundamental values also altering the fundamentals themselves.

Nevertheless, equations 3.3, 3.23, and 3.34 pose a limit to the extent and the duration of such disequilibrium dynamics. For example, positive expectations about the future will reduce or keep constant the amount of reserves R_t. This will increase the regulating rate of profit r_1 more than the rate of interest on loans94. This will bring an increase in the 'rate of profit of enterprise' that will boost growth and expectations further leading to a speculative rally around bonds or interest rate spreads.

Up to this point expectations represent a self-validating process. Bankers believe that the economy is going to do better they keep lower reserves, and the economy does better because of their initial expectations. However, at some point, the regulating rate of profit will tend to approach the average rate of profit (equation 3.23). At that point, expectations cannot boost the rate of profit further and the rate of interest will now depend on the leverage ratio $\frac{L_t}{K_{t-1}}$ (equation 3.24). If the average industrial rate of profit is sufficiently high, then a simple correction will happen interest rates will increase debt will be tempered and the rate of growth will fall towards sustainable levels. But if the average rate of profit is below a certain limit (inequality 3.29) then interest rates surge the rate of profit of enterprise will turn zero and stagnation prevails. In short, fundamentals have relative autonomy and for this reason, expectations cannot be self-fulfilling. In other words, there are inherent limits to speculative rallies.

Surprisingly, an expectation theory that encompasses these properties was not introduced by Marxist or heterodox economists, but by the investor and speculator George Soros (1994, 2009, 2013). Anwar Shaikh (2010, 2014, 2016) brought this theory to our attention and developed it further. He points out that Soros' theory suggests that: '1) expectations affect actual prices, 2) actual prices can affect fundamentals and 3) expectations are in turn influenced by the behavior of actual prices and fundamental prices' (Shaikh 2016: 446). It is a theory that incorporates all aspects of the example of the previous paragraph.

The obvious question is 'what are the underlying behavioral patterns?' Or in Soros' own words his 'decision-making process' (Soros 1994). The starting point of the theory is that financial markets cannot discount the future correctly because they 'shape it'. Decisions are made by both a passive relationship with reality (cognitive

[94] Keep in mind that the latter depends also on the ratio of reserves to loans $\frac{R_t}{L_t}$ (equation 3.23) that is expected to decline.

function) and an active relation (participating function). The interaction between these two functions is called 'reflexivity'. This word gave the name to the theory (reflexivity theory). The idea is that reflexivity is an unending process where reality shapes people's thinking and people, in turn, shape reality. Although people's perceptions and reality can come close, they never become identical. The reason is what Soros calls 'participants bias'. Participant bias gives an element of indeterminacy mainly because market participants do not share identical views regarding economic facts and conditions. This makes the whole process unpredictable. In other words, although the random walk hypothesis does not apply to this model, the knowledge gained from it cannot make people rich by predicting future prices. Nevertheless, judging from the personal finances of George Soros, it can be useful.

The critical factor of the theory is that 'participant's bias' can change the fundamentals which determine asset prices as indicated in our example. In a different fashion from the example outlined above, where the regulating profit rate r_1 is inflated from the relatively small amount of reserves held by banks, Soros (1994) presents the case of 'equity leveraging'. In short, equity leveraging refers to a situation where corporations use inflated expectations about future earnings per share to issue new overpriced stocks. The overpriced stocks in turn validate the expectations of increasing earnings per share for some time if they are used, for example, to reduce corporate debt95. This way participants' bias makes expectations a self-validating process. All the examples discussed so far indicate that fundamentals can be influenced by expectations either through a fallacy like in the case of 'equity leveraging' or by banks seeking to increase their profits by expanding their balance sheet. In other words, 'personal bias' can take many forms.

Reasonably, the self-validating capacity gives rise to a speculative boom that pushes prices away from fundamental values even if increased prices can keep altering fundamentals for some time. In other words, fundamentals cannot follow expectations forever and this way booms are followed by busts.

On these grounds, Soros indicates another important matter about reflexivity. He suggests that reflexivity is not another way of looking at things, but a different way

[95] A simple example. A company has a debt of 100 currency units for which it pays an interest of 10 units. It has 10 common stocks issued and a net profit of 5 units. Therefore, its current earnings per share is 0.5 currency units (5/10). If all other factors remain the same with the difference that the company pays out its debt from the proceeds of the of issue of share capital, then it has a net profit of 15 units (assuming there are no income taxes involved) and the earnings per share will be 0.75 units (15/20). Therefore, the share capital increase with the expectation of higher earnings per share validates itself.

events unfold. If reflexivity theory holds, then the efficient market hypothesis where prices can deviate from equilibrium values only randomly is invalidated. Here deviations are path-dependent both in the boom but also in the bust. The key to this outcome is the effect of expectations on fundamentals which leads to path-dependent asset prices. This point is expressly rejected by rational expectations theory where expectations cannot affect equilibrium prices and therefore actual prices are not path-dependent. For reflexivity theory, the time path of asset prices is non-ergodic contrary to the assumptions of intertemporal equilibrium models that underlie mainstream asset pricing (Davidson 1991, see also chapter 2 sections 2e and 2f).

It is important to note that the behavioral patterns described in this section require the mobilization of considerable funds. The control over the fundamentals during the period of the speculative boom but also the correction or the bust that follows it requires the investment and withdrawal of big amounts of funds. This justifies the statement of the profit-based approach that financial capital controls financial asset returns. Finally, the 'participants' bias', understood as the difference of opinion between market participants indicates that arbitrage is a permanent but risky element of the financial markets. This is the notion of turbulent arbitrage (Shaikh 1997) briefly outlined together with these points in the first two chapters.

Based on this framework I will move on to price stocks and bonds. But before this, it is worth fully clarifying the relation of reflexivity theory to the classical and neoclassical notions of equilibrium (Mueller 1986: 8). This is an important point since Soros throughout his writings understands equilibrium only in the neoclassical sense of the point of rest. The latter explains why he considers the conditions in the financial markets as a permanent disequilibrium. The formulation of Soros' ideas by Shaikh (2010) will prove helpful in this regard.

Shaikh (2010) has shown that for any asset the interaction between actual prices, expected prices, and fundamental prices can result in the gravitation of actual prices around the time path of fundamental prices. In this regard, he presented the following dynamic model which I modified for the interest rate although it applies to any financial asset price.

3.37 $$\frac{di}{dt} = \delta \cdot (i^e - i), \qquad \delta > 0$$

3.38 $$\frac{di^*}{dt} = \beta \cdot (i - i^*), \qquad \beta > 0$$

3.39 $\frac{di^e}{dt} = -\gamma_1 \cdot (i^e - i) - \gamma_2 \cdot (\iota - \iota^*)^3 , \qquad \gamma_1, \gamma_2 > 0$

$where\ i^e\ is\ the\ expected\ interest\ rate, i^*\ the\ equilibrium\ or\ fundamental\ interest\ rate$

Differential equations 3.37-3.39 constitute a three-equation non-linear system. The first equation (3.37) says that if expected interest rates i^e are greater than the actual rate i, then actual interest rates will rise. The second equation (3.38) suggests that if actual interest rates are greater than the 'fundamental interest rate' i^*, then fundamental interest rates will increase. These equations reflect the first two assumptions of reflexivity theory (mentioned under 1), 2) above). The third equation (3.39) relates to the third assumption of the theory (mentioned under 3) above). It indicates that expected interest rates that exceed the actual, and actual interest rates that exceed the fundamental will have a negative impact on the time derivative of expected rates $\frac{di^e}{dt} < 0$. In other words, equation 3.39 suggests that investors will expect the interest rate to move eventual towards the 'fundamental value'.

The system can be reduced to a two 2 x 2 differential equation system by subtracting 3.37 from 3.39 and 3.38, respectively.

3.40 subtracting 3.37 from 3.39 $\frac{d\varphi^e}{dt} = \frac{di^e}{dt} - \frac{di}{dt} = -(\gamma_1 + \delta) \cdot \varphi^e - \gamma_2 \cdot \varphi^{*3}$

3.41 $substracting$ 3.38$from$ 3.37 $\frac{d\varphi^*}{d_t} = \left(\frac{di}{dt} - \frac{di^*}{dt}\right) = \delta \cdot \varphi^e - \beta \cdot \varphi^*$

Differential equations 3.40 and 3.31 have a solution for $\varphi^*\ and\ \varphi^e$ both equal to zero. the solution means that actual, expected, and fundamental values become equal in equilibrium. The solution is stable as shown by the Jacobean.

3.42 $J_{0,0} = \begin{bmatrix} -(\gamma_1 + \delta) & 0 \\ \delta & -\beta \end{bmatrix} \rightarrow trace\ T = -(\gamma_1 + \delta) - \beta < 0\ and\ DET = -(\gamma_1 + \delta) \cdot (-\beta) > 0$

The system pictures a situation where the time paths of actual and expected prices will fluctuate around the time path of the fundamental values. The above indicates that the theory presented by Soros and elaborated herein is different from behavioral finance theories where persistent 'irrational exuberance' prevails (see chapter 2 section 2.d.4). This explains also why the profit-based approach directly applies fundamentals for stock pricing as we will discuss next.

3g Competition and Stock Pricing

Although this project was never confined to the pricing of stocks both the critique on mainstream theory and the small references to the profit-based approach presented in the first two chapters was centred around stocks. Having discussed the interest rate theory, and the formation of expectations we can now address the issues of stock pricing directly. However, it should be clear that the profit-based approach is an overall theory of asset pricing since profitability and equalization of returns between the different categories of capital apply for all types of financial assets although their pricing is different. As we will see stocks are priced differently from bonds and fixed income assets in general, although the same principles are applied for the pricing of all the categories of financial assets considered herein.

Stocks represent ownership of a portion of a company. In this regard they represent capital. Therefore, it is reasonable that the return on a stock index should reflect the return on both industrial capital and financial capital since we expect returns to be equalized. This assumption is in line with the discussion in the previous section on reflexivity theory but also the determination of the rate of interest in sections (3.2 and 3.3). In short, arbitrage should tend to equalize the rate of return on stocks with the rate of corporate returns. As we have seen already in the first two chapters this is the position of mainstream theory as well. For this reason, the crucial questions are: 1) which is the appropriate rate of return around which the equalization will take place? And 2) who regulates this rate of return?

In chapter 1 we defined the required rate of return as the rate of profit on new investment. I repeat the applied definition (equation 1.33) for easy reference.

$$3.43\ (1.33)\quad Irop_t = \frac{P_t - P_{t-1}}{I_{t-1}}$$

The idea is that changes in gross profitability, $P_t - P_{t-1}$, are due to the most recent investment (denoted by I_{t-1}). Consequently, the 'incremental rate of profit' (denoted by $Irop_t$) is their ratio. In section 3.1 I argued that it this around this rate that industrial capital returns are equalized. There exists considerable empirical work coming from different databases confirming this (Mueller 1986: 8; Botwinick 1993 ch.5; Shaikh 1998b, Christodoulopoulos 1995; Tsoulfidis and Tsaliki 2005). Therefore, we can consider this as the appropriate measure around which equalization takes place. Nevertheless, when we discussed the equalization between the industrial and the banking capital, I suggested that the profit rate presented in equation 3.3, 3.3' is the regulating rate of profit. Are these definitions equivalent?

As stated already in section 3.3 above, when working with aggregates, money, and value measures are practically indistinguishable (Shaikh 1984b, Bellofiore 2001: 369). Therefore, we will repeat equation 3.3' which reads as follows:

$$3.44\ r_{1_t} = \frac{P_t}{K_{t-1} + R_{t-1}}$$

Equation 3.44 is the same in concept as equation 3.3' with the difference of the time subscripts which state that (industrial and IBC) capital is advanced, and profits are realized at the end of the production period. Moreover, R_{t-1} represents now not only bank reserves but the total of financial capital engaged both in supporting bank lending and the purchase of stocks. In short, gross industrial profit P_t is normalized by the total of industrial capital (K_{t-1}) and the total financial capital reserves (R_{t-1}) at the present level of abstraction. To investigate whether $Irop_t$ can serve as an approximation of r_{1t} we can look at the economic meaning of this condition. We can also consider the comparison of actual data and the relation of the time series of r, r_1, and $Irop$. Both investigations will lead to important insights.

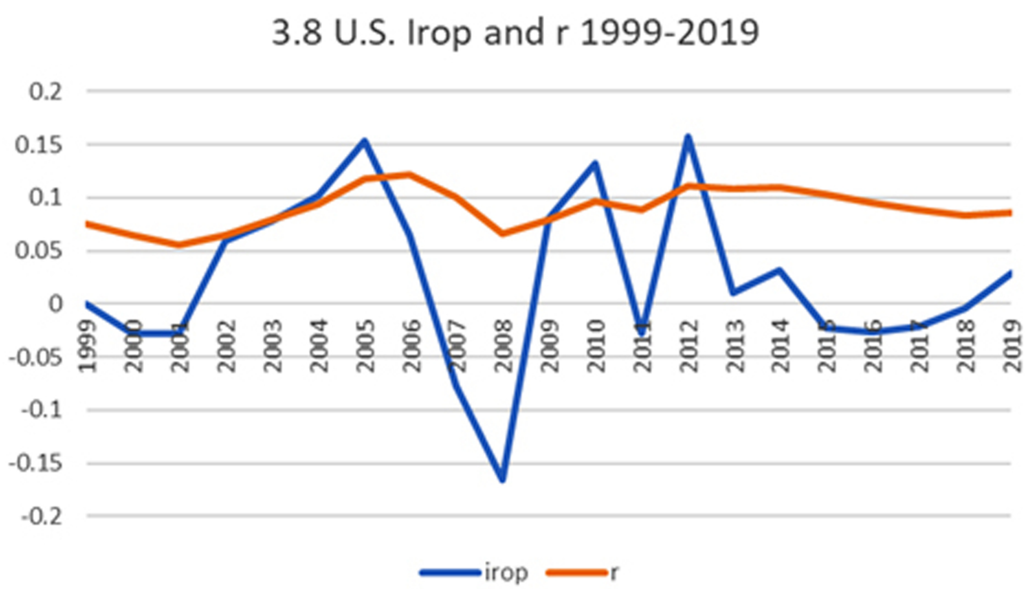
First, it is not difficult to understand that the gross average rate of profit r is strongly associated with the incremental rate $Irop$. Recent empirical work, with Japanese data, has shown that the two rates move in an intertwined way (Tsoulfidis, Alexiou, and Parthenidis 2015). Below we will reconfirm (under different methodology) these findings with US data. If on top of this we retain the assumption that the ratio of industrial to financial capital remains roughly constant, in analogy to equation

3.15 then this association holds also for the regulating capital r_1. Nevertheless, given that r_1, r have the same numerator, and industrial capital is vastly greater than financial capital, we can conclude that r_1 is strongly associated with r.

For some unknown reason, these relations (equations 3.43, 3.44) have not been expressly discussed (at least to my knowledge) as equivalent formulations of the equalization process between the corporate and the financial sector. In the elaboration presented herein, the formulation presented by equation 3.44 explains the determination of the interest rate and interest rate spreads. At the same time, the $Irop$ formulation is convenient for pricing stocks and stock market indexes since it is the profit rate around which corporate returns tend to become equalized. The two read together clarify why the tendency of equalization of corporate returns also includes the equalization between the corporate and the financial sector.

Keeping in mind that full and permanent equalization between corporate and financial returns is the exception rather than the rule in our context, the relations discussed above are confirmed by actual data as shown in Figure 3.8.

Figure 3.8



The figure compares the incremental rate of profit (blue line), with the average gross corporate rate of profit (brown line). Both measures were calculated from US data for the incremental rate following the methodology of Shaikh (1997). I calculated gross profits by adding financial and non-financial corporate profits from table 6.16 D. of the *U.S. Bureau of Economic Analysis* (BEA) accounts[96] (lines 10,13), and corporate investment from line 1 table 5.3.5 of the BEA accounts. (**BEA**)[97] With this data in hand equation, 3.43 was calculated. To calculate the gross average rate of profit the corporate non-residential net fixed assets (line 17 of table 4.1 BEA accounts) were added to residential net fixed assets (sum of lines 31-40 net residential assets spreadsheet prepared by BEA from table 5.10). Thereafter the ratio $r = \frac{P}{K_t - 1}$ was calculated. The figure indicates that contrary to the average gross profit rate the incremental rate is much more volatile.[98] Moreover, on numerous occasions, like in 2007 and following 2013 a decline in the average rate of profit is preceded by a sharp decline in the incremental rate of profit. This property explains the triggering mechanism of major depressions from the stock exchange although their actual cause lies in production and profitability.

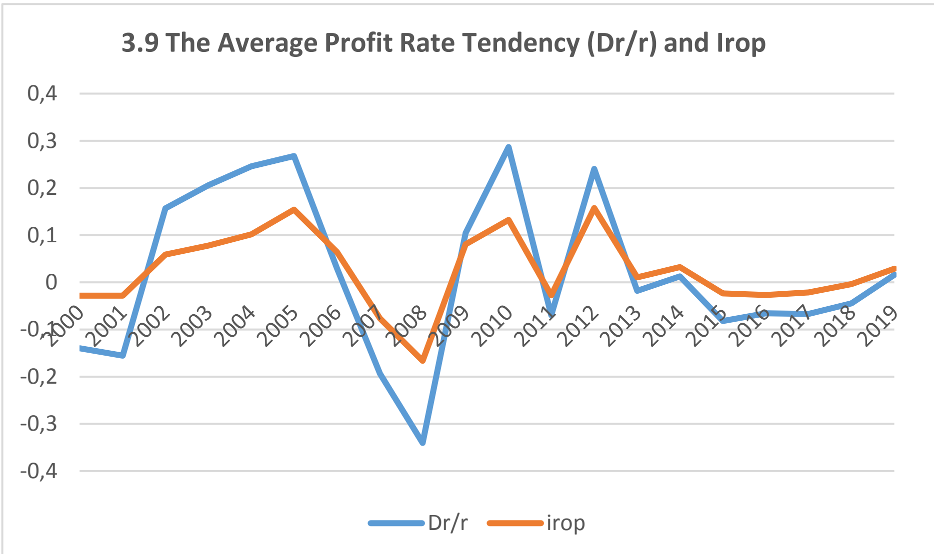
But the association between the incremental and the average rate of profit will become apparent if we compare the rate of growth of the average rate of profit with the incremental rate of profit. this appears in Figure 3.9 that follows.

[96] The official reference of the Bureau of Economic Analysis accounts is: 'Table 6.16D. Corporate Profits by Industry [Billions of dollars] Seasonally adjusted at annual rates. Last Revised on November 25, 2020", See Data Sources and Tables.

[97] Official Reference: Table 5.3.5. Private Fixed Investment by Type (Billions of dollars] Seasonally adjusted at annual rates Last Revised on November 25, 2020

[98] In chapter 4 we will see that the standard deviation of the incremental rate of profit (IROP) from 1948-2019 is roughly 12% almost equal to the standard deviation of the S&P 500. The standard deviation of average rate of profit is no more than 4% during the same interval.

Figure 3.9



The chart shows the rate of growth of the average profit rate against the incremental measure for U.S. data from 2000-2019. The correlation between the two variables is extremely close. The R^2 between the two is around 94%. The whole set of relations simply tells us that the dynamics of the rate of profit depend heavily on the rate of profit on new investment. Similar correlations can be expected to hold between *Irop* and r_1. Moreover, given that $r_1 < r$ this means that r_1 is expected to be the gravity center around which *Irop* fluctuates.[99]

The application of the *Irop* as the regulating rate of profit has important advantages. In the context of the classical/ Marxian theory of competition, we can obtain a good grasp of the anticipated volatility of this ratio. Contrary to perfect competition, in the classical theory of competition, the relentless introduction of new products and the persistent application of new techniques tend to differentiate the profit rate within the same industry. Moreover, current profitability reflects transitory factors not limited to business cycle effects. This means that the incremental rate of profit will constantly vary and will never converge towards the average rate of profit. This

[99] Keep in mind that $\dot r = \frac{\dot P}{K} - \frac{\dot K}{K}\cdot r = \frac{\dot P}{\dot K}\cdot\frac{\dot K}{K} - \frac{\dot K}{K}\cdot r = \left(\frac{\dot P}{\dot K} - r\right)\cdot\frac{\dot K}{K} = (Irop - r)\cdot\frac{\dot K}{K}$ the $\dot{}$ denoting time derivatives. This form explains the correlation between $Irop$ and $\frac{\dot r}{r}$. It explains also that the latter is more volatile since it incorporates not only the volatility of the former but also the volatility of the growth rate $\frac{\dot K}{K}$.

gives rise to what Shaikh (1997) calls 'turbulent arbitrage'. It is a notion we elaborated upon in the previous section when discussing Soros' 'reflexivity theory'. Turbulent arbitrage represents permanent conditions of risky arbitrage where positions of probable mispricing constantly appear giving rise to disequilibrium dynamics that can influence fundamentals as discussed already (section 3.6). This reflects the reality of the stock exchanges around the world where expected and actual prices endlessly fluctuate around the time path of their fundamental values (equations 3.37-3.42 above). Moreover, this nature of investment decisions, whether triggering disequilibrium dynamics or tempering them through capital mobility between the corporate and the financial sector, cannot be performed with just any amount of available capital, it requires control over sufficient funds. In other words, financial capital regulates the stock market rate of return.

In the next chapter (chapter 4), we will test this theory of asset pricing by comparing asset prices and returns directly to the fundamentals as indicated by equation 1.34 repeated below for easy reference:

3.45 1.34 $P_{rt}{}^{w} = Pr_{t-1} \cdot [1 + (rror_t - divy_t)]$

$where\ P_r{}^w = \text{the warranted } stock \text{ price}, \text{Pr} = the\ actual\ stock\ index\ price,$
$rror_t = Irop_t + i_t\ and\ divy_t = the\ dividend\ yield$

This property of the profit-based approach comes directly from the Marxian theory of competition and the anticipated volatility of the fundamentals. It is the opposite of mainstream theory that anticipates equality between the average and the incremental rate of profit something which implies limited volatility in the underlying fundamentals. The latter is indicated also in Figure 3.8. As we saw in the first two chapters this is the main reason for the empirical shortcomings of mainstream asset pricing models.

3g.1. Marx on the Stock Exchange

The elaborations outlined above, like in the case of the rate of interest, serve as a reconciliation of the various references of Marx to the stock exchange in *The Capital* Vol. III. However, the profit-based approach can be associated with a good part of the notes presented in chapter 27 (Marx 1894a: 315-319).[100] There Marx argues that the '[f]ormation of stock companies' (Marx 1894a: 315) is the result of the credit system in capitalism. The idea is that credit makes possible the separation of the function of capital from the ownership of capital. In the case of stock companies, credit plays the part of offering to a capitalist the means of working with other peoples' money that is not necessarily borrowed money. In this regard, Marx cites Tooke from the *Inquiry into the Currency Principle* where the latter states:

> A person having the reputation of capital enough for his regular business, and enjoying good credit in his trade, if he takes a sanguine view of the prospect of a rise of price of the article in which he deals, and is favored by circumstances in the outset and progress of his speculation, may effect purchases to an extent perfectly enormous compared with his capital (Tooke 1844: 136)

The extract describes a situation like those that initiate a speculative boom in the examples of Soros on 'reflexivity theory' discussed in the previous section. This becomes even more so if we consider that in the 19th-century people bought shares mainly at issue since corporate listings were massive (Rutterford 2004). Someone with a good reputation in the market could sell an expectation which, due to his reputation and credit, turned the expectation into a self-validating process for some time. In this context, Marx understands stock exchange speculation as the means of expropriation of 'social property by few' (Marx 1894a: 317). This is the reason he states:

> property here exists in the form of stock, its movement and transfer become purely a result of gambling on the stock exchange, where the little fish are swallowed by the sharks and the lambs by the stock-exchange wolves. (Marx 1894a: 317)

---

[100] There are also fragmental references in chapters 29 and 30 (Marx 1894a: 333-342, 343-355). However, the latter represent a valuation of stocks similar to the valuation of preferred stock in mainstream theory. That is by dividing the yield to the rate of interest. Marx is aware that both profits and interest rates are highly volatile. So, he claims that this valuation turns stocks to 'fictitious capital' (Marx 1894a: 334), because it assumes that current profits will prevail in the future. From the discussion in chapter 1 herein we know that this type of valuation is not relevant. In the Marxist context, due to the dynamics of the rate of interest it is limited to the conclusion that stock prices fall at the beginning of the crisis (when interest rates are at their peak) and feverish speculation appears at the end of a crisis or at the depression phase (when interest rates are low) (Grossman 1929: 63). Nevertheless, even in this context Marx associates stock prices with profitability (Marx 1894a: 354). As indicated already (Figures 3.8, 3.9) following the incremental rate of profit offers a much richer and complete analytical and empirical investigation of stock pricing and volatility. Finally, Engels refers to the stock exchange in his supplement in *Vol III* (Marx 1894a: 644-645). However, his contribution does not discuss stock pricing, but the developments related to the stock exchange following 1865 when, as reported by Engels, Marx's notes were written.

This statement can hold only in a world of uncertainty where financial capital controls stock returns as suggested by the profit-based approach. Keep in mind that most of these notes were written around 1865. That is in the aftermath of the collapse of British railway stocks that triggered the crisis of 1848 and the beginning of the downfall of the French investment bank Credit Mobilier in 1857 which injected turmoil in the Paris Stock Exchange (Stravelakis 2018). In short, Marx did not lack experiences from episodes of financial turbulence (Stravelakis and Tziantzi 2019).

In Vol. III Chapter 27 Marx also refers to stock returns. He states the following:

> 'Even if the dividends which they [the stockholders -NS] receive include the interest and the profit of enterprise, i.e., the total profit [there are no interest payments or managerial costs here-NS] […], this total profit is henceforth received … as mere compensation for owning capital' (Marx 1894a: 315)

Although he places the emphasis on the separation of ownership from function in joint-stock companies, the first part of the extract indicates that stock returns do not include only interest but also at least a portion of the profit of enterprise. The reference to dividends and dividend yields as an indication of stock returns has to do with the time the book was written. For example, the Credit Mobilier, even in the times just before it run into trouble in 1857, offered a dividend yield of 22%. To put it differently, corporations in the second half of the 19th century paid almost constant dividends irrespective of the phase of the business cycle. Therefore, in Marx's time, a reduction of dividends was an indication that a company was running into trouble. It gave the same signal to the market that a sharp reduction in earnings per share (EPS) gives nowadays.[101] This means that Marx's reference to dividends points to a theory of stock pricing where stock returns follow corporate profit fundamentals. It is not a theory that ignores corporate earnings in general and treats stocks similarly to bonds. Moreover, he expects the whole process to be turbulent since he anticipates that high dividend yields cannot last forever. A vision close to the developments of the profit-based approach especially if EPS is considered as the key fundamental. It is worth noting that in certain empirical calculations performed in the next chapter I will use EPS as a proxy of the incremental rate of profit. George

[101] It is indicative that the top 'railway promoter' in the mid-19th century England George Hudson did not hesitate to pay dividend out of company capital to induce shareholders to hold the stock. At the same time, he manipulated the books to boost profits that were actually very low.

Soros has stated (1994) that he uses EPS as the basic fundamental in his stock valuations.

Nevertheless, Marx's reference that the stock exchange "gives rise to monopoly in certain spheres and hence provokes state intervention" (Marx 1894: 316), as well as that it will reproduce "a new financial aristocracy" (*ibid*.) gave rise to a whole set of ideas in Marxist economics which had little or nothing to do with Marx's argument. One is almost certain that Rudolf Hilferding (1910) developed a good part of his ideas about 'Finance Capital'[102] from these few pages of notes that comprise Chapters 27-30. Even recent financialization theories referring to a stratum of rentiers that have allegedly taken over the capitalist mode of production (Tome 2011, Lapavitsas 2009)[103] draw from these sections of Marx's writings.

I argue that what Marx meant is something completely different. This will become evident from what follows. I will begin with an extract that precedes by a few lines Marx's reference to monopoly, financial aristocracy, and capital concentration. It says the following:

> Since profit here assumes the pure form of interest, undertakings of this sort are still possible if they yield bare interest, and this is one of the causes, stemming the fall of the general rate of profit, since such undertakings, in which the ratio of constant capital to the variable is so enormous, do not necessarily enter into the equalisation of the general rate of profit. (Marx 1894a: 316)

The part that reveals what he has in mind is the one that suggests that these undertakings stem (stalk) 'the fall in the general rate of profit'. It gives a hint to look in *The Capital*, Vol. III Chapter 14 on the 'countervailing influences' for clarifications on this mysterious reference. There we find counteracting influence VI which states:

[102] Finance Capital in Hilferding is the amalgamation of industrial and financial capital that allegedly emerged from concentration and centralization of capital through the stock exchange. Although the stock exchange accelerates the concentration of capital this is certainly not the argument in Marx even in these few pages of scattered notes in *The Capital Vol. III* Chapter 27.

[103] Lapavitsas is quite clear about this:

> Much of the literature on financialization assumes (sometimes tacitly) that the ascendancy of the idle rentier characterises contemporary capitalism [...] This is at heart a Keynesian approach arguing that the rentier slows down the rhythm of accumulation either by depriving the active capitalist of funds, or by raising interest rates. Analysis of the rentier can be found in Marxist political economy, with the occasional reference coming directly from Marx (Lapavitsas 2009: 141)

> *VI. The Increase of Stock Capital*
> The foregoing five points may still be supplemented by the following, which, however, cannot be more fully treated for the present. With the progress of capitalist production, which goes hand in hand with accelerated accumulation, a portion of capital is calculated and applied only as interest-bearing capital. Not in the sense in which every capitalist who lends out capital is satisfied with interest, while the industrial capitalist pockets the investor's profit. This has no bearing on the level of the general rate of profit, because for the latter profit = interest + profit of all kinds + ground rent, the division into these particular categories being immaterial to it. But in the sense that these capitals, although invested in large productive enterprises, yield only large or small amounts of interest, so-called dividends, after all costs have been deducted. In railways, for instance. These do not therefore go into levelling the general rate of profit, because they yield a lower than average rate of profit. If they did enter into it, the general rate of profit would fall much lower. Theoretically, they may be included in the calculation, and the result would then be a lower rate of profit than the seemingly existing rate, which is decisive for the capitalists; it would be lower, because the constant capital particularly in these enterprises is largest in its relation to the variable capital. (Marx 1894a: 169-170)

The two extracts are connected. The latest extract (Chapter 14) indicates that Marx had the 'railway' in the back of his head when talking about the stock market and monopoly. But the railway example does not point to the powerful monopolies of Hilferding, and Sweezy but an industry hampered by low profit, speculation, and fraud. The British railway was not making sufficient profit not only in 1848, when its stock collapsed triggering a major capitalist crisis but also in 1870 (Irving 1978). Marx's view on the industry appears in a letter written in 1881 and is express and indicative:

> 'The ruling magnates amongst the different railway-nets directors contract not only – progressively – new loans in order to enlarge their network, i.e., the ' territory,' where they rule as absolute monarchs, but they enlarge their respective networks in order to have new pretexts for engaging in new loans which enable them to pay the interest due to the holders of obligations, preferential shares, etc., and also from time to time to throw a sop to the much ill-used common shareholders in the shape of somewhat increased dividends. This pleasant method must one day, or another terminate in an ugly catastrophe.' (Marx to Danielson 19/2/1881)

Marx claims that the corporate fundamentals of the railroad industry (in our case the dividend yield) could not be manipulated through leverage forever. The low profitability of the railway resulting from 'constant capital' being the 'largest in its relation to variable capital' was expected to take over leading to an 'ugly catastrophe'.

The extracts discussed so far are revealing in many respects. On one hand, Marx is confident that stock markets operate in a way like the one described by ‘reflexivity theory’. Expectations can affect prices and fundamentals for some time but fundamentals in the end rule. The key fundamental is a measure close to the earnings per share which depends on the corporate rate of profit. In his time corporate earnings were mostly distributed as dividends and this is the reason, he repeatedly refers to dividends and dividend yields.

Although Marx is quite clear that corporate profitability will affect stock returns, he is not clear about whether financial capital which he considers as part of the Interest-Bearing Capital will enter the equalization process. At the beginning of the extract from Chapter 14, he suggests that the portion of IBC that purchases stocks will earn a lower than the gross average rate of profit (in the sense that $r_1 < r$ see eq. 3.44 above). For this reason, it does not enter the equalization process. This implies that he expects that profit equalization in the corporate sector will take place around the average rate of profit, something that is not confirmed empirically (Mueller 1986: 8; Botwinick 1993: Ch.5; Shaikh 1998b, Christodoulopoulos 1995; Tsoulfidis and Tsaliki 2005). Then in the spirit of the relation described by equation 3.44, he suggests that these funds could enter ‘theoretically’ in the equalization process. But this would be meaningless for the capitalist because listed companies, like the railway, are low-profit rate companies therefore their rate of profit is not ‘decisive’ for capital mobility. This is the meaning of Marx’s position that “such undertakings… do not necessarily enter into the equalisation of the general rate of profit.” (Marx 1894a: 316)

In conclusion, Marx believed that financial (stock market) capital functions like a ‘countervailing tendency’ by settling for a lower than the gross average rate of profit. The reason is that this way high organic composition companies are exempted from the profit equalization process. This also justifies his statement that ‘state intervention’ is required. He means that these companies will sooner or later require state support like ‘too big to fail’ corporations and banks nowadays.

However, it is not only low-profit rate companies that are listed in stock exchanges. Moreover, equalization of returns both in the industrial sector but also between the industrial and the financial sector takes place around the incremental and not the average rate of profit. As we saw in Figure 3.8 the incremental rate of profit remains mostly below the average rate and is expected to gravitate around the regulating rate of profit r_1.

Irop is expected to push the average rate of profit downwards. Nevertheless, it functions as a countervailing tendency at the same time. The reason is that it attracts funds that settle for a return that is mostly below the average profit rate. If these monies were actively invested in production, then the average profit rate would fall at an accelerated pace. In this regard the solution proposed in Shaikh (1997) provides a reconciliation between 1) Marx's notion that IBC capital is a 'countervailing tendency' for the falling rate of profit and 2) the equalization of returns between the corporate and the financial sector.

3h Bond Pricing

The difference in the pricing of stocks, bonds, and loans is a key feature of the profit-based approach. The reason is that the equalization of returns between financial and industrial capital implies that equity returns will tend to become equal to the regulating rate of profit whereas loan and bond interest rates will remain below that rate. We have shown (sections 3.3, 3.7) how this happens in the case of loans and stocks and we will now turn to bonds. This latter feature is important because in mainstream asset pricing government bond rates are considered as the 'risk-free rate'. A notion that implies that in a world with no risk the profit rate and the interest rate will be equal. We have seen the analytical and empirical shortcomings of this approach in the first two chapters when discussing Dividend Cash Flow models in general, the 'martingale model' in particular, and the 'equity risk premium puzzle'. Moreover, recent research on income distribution (Piketty 2014) estimates the rate of profit from long term bond rates and finds that it was 5% and remains constant on average (Stravelakis 2020). A misleading position. Below I will present the solution proposed by the profit-based approach regarding bonds.

The usual approach taken in these cases is to attempt to price the two extreme categories of bonds. Namely *Consols* and *Zero-Coupon bonds*. Consols are bonds with infinite maturity. They pay interest and principal in perpetuity. Zero-coupon bonds at the opposite end pay interest in advance as a discount on the nominal value of the bond.[104] In between these two extremes, there is a whole set of bonds that pay

[104] For example, zero coupon bond with a nominal value of 100 and an interest rate of 10% will sell at 90 and pay 100 at maturity.

various coupons in different income streams. Moreover, bonds are tradable in secondary markets therefore from period to period current bond yields as well as the yield to maturity fluctuate105. Finally, the present-day bond market poses a challenge to bond pricing theories. The vast programs of asset purchases by central banks have led even to negative ten-year bond yields in some European countries sovereign debt, whereas positive bond rates are extremely low (below 1%).

Let us begin by stating the well-known convenient formulas for pricing Consols and Zero-coupon Bonds.

3.46 $i_{b0_t} = \frac{FV - Pr_{b_{t-1}}}{Pr_{b_{t-1}}}$

3.47 $i_{bper_t} = \frac{cp}{Pr_{per_{t-1}}}$

Equation 3.46 determines the interest rate i_{b0_t} of a one-period zero-coupon bond. The formula tells us that the rate of interest is equal to the difference of the face value FV of the bond minus the bond price $Pr_{b_{t-1}}$. Equation 3.37 determines the interest rate $i_{bper}$of a perpetual bond (or a very long-term bond). The idea that the interest rate is equal to the constant coupon payment cp divided by the price of the bond in the previous period $Pr_{per_{t-1}}$.

If we assume that competition equalizes the yields to maturity irrespective of the coupon and the income stream (Shaikh 2016: 457) then every bond of similar risk, maturity, and payment dates will have an almost equal price (Altman and Mc Kinney 1987: 12-24).

Besides the yield to maturity, we can define also the one-period bond return as the sum of coupon and capital gain. For zero-coupon bonds and perpetuities these are defined as follows:

3.48 $r_{b0_t} \equiv \frac{FV - Pr_{b_{t-1}}}{Pr_{b_{t-1}}} \equiv i_{b0_t}$

[105] The yield to maturity is the (constant) interest rate that discounts future payments to maturity, making them equal at present value with the observed bond price.

$$3.49\ r_{bper_t} = \frac{Pr_{per_t} - Pr_{per_{t-1}} + cp}{Pr_{per_{t-1}}}, let\ Pr_{per_t} \approx \frac{cp}{i_{bper_t}} \rightarrow$$

$$\rightarrow r_{bper_t} \approx i_{bper_t} + \frac{Pr_{per_t}}{Pr_{per_{t-1}}} - 1 = i_{bper_t} + \frac{\frac{Pr_{per_t}}{cp}}{\frac{Pr_{per_{t-1}}}{cp}} - 1 = i_{bper_t} \cdot \left(1 + \frac{1}{i_{bper_{t-1}}}\right) - 1$$

Equation 3.48 is the one-period return r_{b0_t} of the one period zero-coupon bond. Because it is one period the rate of return can be no other than the current interest rate i_{b0_t}. At the other extreme the one-period return r_{bper_t} of the perpetual bond is given by equation 3.49. It says that the rate of return is equal to the current interest i_{bper_t} multiplied by the reciprocal of last period interest rate $i_{bper_{t-1}}$.

The key assumption that underlies this argument is that arbitrage brings together lending and bond rates with the same risk, maturity, and payment dates. This means that the loan interest rates that we defined in section 3.4 and developed in the definition of the yield curve in section 3.5 are used as inputs in defining bond rates as follows:

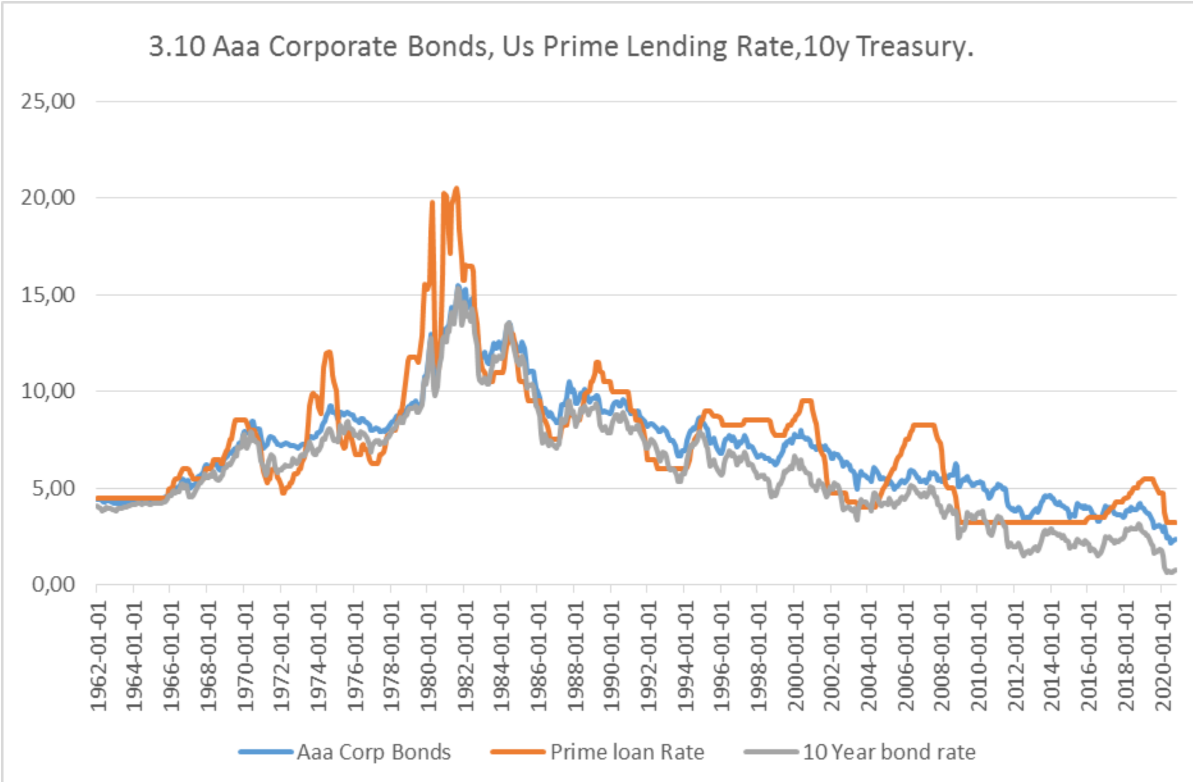
$$3.50\ i_{b0_t} = i_{1_t}, where\ i_{1_t}\ is\ the\ short\ term\ lending\ rate\ in\ equation\ 3.36$$

$$3.51\ i_{bper_t} = i_{n_t}, wher\ i_{n_t}\ the\ long\ term\ rate\ from\ equation\ 3.36$$

We could perform a set of simulations using our calculated interest rates basis equation 3.27 since the application of equations 3.50, 3.51 also determines equations 3.48, 3,49, and in turn 3.46, 3.47. However, it is better to work with actual data. Figure 3.10 compares the time series of the prime loan rate, the rate on Aaa corporate bonds, and the ten-year US treasury bond rates. All the data comes from the database of the Federal Reserve Bank of St Lewis106.

[106] Actually, this is the same as Figure 3.1 save for the 10y bond data and the fact that data frequency here is monthly whereas in Figure 3.1 it is yearly.

Figure 3.10



Loan rates to top banking borrowers (prime rate) tend to become equalized with the rates of Aaa corporate bonds. Only in periods of crisis like the collapse of the Bretton Woods in 1971 the burst of the inflationary bubble in the late 1970s early 1980s and the crises of 1999 and 2007 the two rates diverge. Nevertheless, the loan rate returns to a state of rough equalization with bond rates following these times. Moreover, the Aaa corporate bonds remain also close to the 10year US treasury bond. It is only after the strong intervention by the central banks following 2007 that a wedge appears between the two rates. But even then, they continue to move together. In short bond rates for regulating capitals tend to follow the loan rates on regulating capitals. The latter confirms that bond rates follow loan interest rates and not the profit rate as argued by mainstream theory. To put it differently, for the profit-based approach causality runs from loan to bond rate whereas in mainstream theory it is the other way around.

Before we move on, we need to consider one last point. Marx treats bonds, especially sovereign bonds as 'fictitious capital'107. This is clear from *Capital* Vol. III, Chapters 25 and 30. (Marx 1894a: 274-293, 343-355). Marx argues that any amount loaned to the state is 'never intended to be expended as capital' (1894a: 334) and in this regard never becomes a self-preserving value. Therefore, it is not capital like a loan or a corporate bond but a mere financial claim that is expected to be settled from incomes that have not been realized yet. In short, it is a 'fictitious' capital. Although fictitious capital has 'its own laws of motion' (*ibid*.) Marx argues that it obeys the laws of capital accumulation. He states:

> It follows from the above that commodity-capital, during crises and during periods of business depression in general, loses to a large extent its capacity to represent potential money-capital. The same is true of fictitious capital, interest-bearing paper, in so far as it circulates on the stock exchange as money-capital. Its price falls with rising interest. It falls, furthermore, as a result of the general shortage of credit, which compels its owners to dump it in large quantities on the market in order to secure money. (Marx 1894a: 354)

This is not the case for the modern financialization theory. Certain theorists suggest that IBC obtains autonomy from the laws of capital accumulation (Lapavitsas 1997) while others suggest that it is fictitious capital that becomes self-contained (Hudson 2010).

Marx is quite explicit in stating that the various categories of financial capital are in the end subordinate to the conditions of capital accumulation and growth. Nevertheless, he is not equally explicit in pointing out that it is through the equalization of returns that this 'subordination' takes place. The latter is the main contribution of the profit-based approach to the argument in Marx. This will become clear in the next section where we will discuss the main contemporary categories of fictitious capital that of derivatives and asset-backed securities.

3i Derivatives and asset-backed securities

The times of Marx were quite rich in financial crisis episodes. Marx witnessed the times of the 'railway kings', investment banking and the 'Credit Mobilier', the excessive use and trading of bonds and promissory notes. He also witnessed the important debate between the banking and the currency school in mid- 19th century

[107] Fictitious capital does not include only sovereign debt but also bills of exchange and other form of fictitious credit like post-dated checks in contemporary Greece. However, the most popular form of fictitious capital in contemporary capitalism is derivatives as we will see in the next section.

England that led to one of the first monetary regulation acts 'the Peel act' that established the Bank of England and to an extend contemporary central banking. Finally, Marx was aware of the political impact of finance in his articles for the Herald-Tribune but also in The Capital.[108] He knew in detail the history and political effects of the efforts of the Duke of Orleans with the Scottish economist and banker John Law to turn the liabilities of the young Louis XV to liabilities of the central bank, the 'Banque Générale' as it was called in 1716 (Marx July 11th, 1858; in Stravelakis and Tziantzi 2018). A story so old and at the same time so new since it resembles the excessive purchases of government bonds by central banks nowadays. But Marx did not stop there. He explained political events, like the 1830 revolution in France that gave the power to the House of Orléans, from the confrontations between different parts of the bourgeois class, especially amongst industrial capitalists, and bankers. We all remember how the pamphlet *The Class Struggle in France* (Marx 1850; 1969) begins:

> 'After the July Revolution [of 1830], when the liberal banker Laffitte led his compère, the Duke of Orléans, in triumph to the Hôtel de Ville, he let fall the words: 'From now on the bankers will rule'. Laffitte had betrayed the secret of the revolution. (Marx 1850: 1)

I could go on laying down examples and references from various parts of Marx's work, but this is not my purpose. This small account of references and economic events serves as an introductory note because it points out that a good part of what present-day theorists consider as novel phenomena of contemporary capitalism are as old as capitalism itself.

Nevertheless, there is a category of financial assets that do not appear in Marx: derivatives. Below, a brief outline of some types of derivative contracts and their pricing models are presented. Then I move to argue that the analytical category of fictitious capital provides an adequate background for its analysis and comprehension. The argument is that, although systematically mispriced, derivatives and asset-backed securities are also subordinate to the laws of capital accumulation.

[108] It is characteristic that *Vol III* Chapter 27 that refers to stock exchange ends with the following quote: 'The two characteristics immanent in the credit system are, on the one hand, to develop the incentive of capitalist production…., to the purest and most colossal form of gambling and swindling, and to reduce more and more the number of the few who exploit the social wealth; on the other hand, to constitute the form of transition to a new mode of production. It is this ambiguous nature, which endows the principal spokesmen of credit from Law to Isaac Péreire with the pleasant character mixture of swindler and prophet.' (Marx 1894a: 318)

The main reason is that the underlying assets on which they are built follow these laws as outlined above. But things do not stop there we will see that derivatives facilitate the execution of self-fulfilling patterns like those described by 'reflexivity theory' on the underlying assets. A similar rationale underlies the dynamics of asset-backed securities. This discussion will conclude financial asset pricing under the profit-based approach and will bring forth the topical debate over financial regulation that concludes this chapter.

3i.1. A short historical background

Although they do not appear in Classical Political Economy some people argue that derivatives are older than capitalism. In an interesting economic history discussion paper, Weber (2008) reports that derivative contracts for the delivery of goods in future dates existed in Mesopotamia, Ancient Greece,[109] and Rome. In modern times, derivative contracts on securities were traded over the counter in 18th century Amsterdam, although the transaction was based on reputation since no legal enforcement was possible on those contracts. Similarly, Sir John Barnard's Act, the major regulatory act on securities trading in 18th century Britain (Harrison 2003) extended the non-enforcement practice of the Dutch to the British Isles. This was the practice in France as well. In short, derivatives contracts on securities existed in the 18th and most of the 19th century but were practically illegal. This did not prevent Proudhon (1857) from writing a manual on derivative contract trading and proposing a regulatory framework.[110] To give the tone of those times Proudhon writes that the government of Louis-Philippe – the Duke of Orleans Marx refers to in the previous extract from the *Class Struggle in France* – tolerated derivative trading in coffee shops and alleys but in 1849 the police cleared the usual places of gathering from derivative traders. It seems that derivative contract traders were operating like present-day bookies for illegal bets.

The breakthrough with derivatives pricing took place around 1873. During that year, profit charts appeared in the work of Henri Lefèvre (1873) a French economist that

[109] Some people consider the story Aristotle (*Politics* 1259a5-20) wrote about Thales of Miletus as an example of one of the first derivative like contracts. The story is that Thales predicted that the olive crop that year would be good and for this reason well before the time of olive picking, he rented by paying a small advance all the oil presses in Miletus and Chios. When his prediction proved right, he charged a high price for processing the olives and made good money. This, however, is more a case of 'cornering the market' (Aristotle speaks of monopoly (*μονοπωλία*)), a point that has been made by Andreas M. Andreades in his book on ancient Greek public finance (Andreades 1933: 179).

[110] Proudhon wrote the manual because he needed money. This is proved by the fact that first two editions of the book were anonymous, and his name appeared only in the third edition.

had worked as secretary of Baron Rothchild for some years. The graphs presented the potential payoff of at least a long forward, a long call option, and a long call together with a long put option. Soon more profit charts appeared in a book by James Moser[111] (1875; Schmidt (2009)). However, the real breakthrough was the presentation of the derivative contract by a single profit chart in the dissertation of Louis Bachelier (1900).

The definitions provided by Bachelier did not have an immediate impact. Various attempts to trade derivative contracts continued in the 20th century but were never considered a fully legal, legitimate, and regulated trade. The pattern was that trade over some contract was initiated, it became popular and at some point, then due to a crisis or mere speculation, it gave rise to all sorts of claims and legal disputes. In the end, trade was banned by some form of legislation. It was only in the 1970s with the establishment of the Chicago Board Options Exchange and the International Money Market divisions of settlement banks (CMEs) that the trade was legitimized.

However, holding a seat in an organized derivatives market was not for everybody. Derivatives remained a game for a few for many years. They reached corporations and the public during the neoliberal era. Moreover, and more importantly, they gave rise to a new type of financial intermediaries intricately connected with banks, the Hedge Funds. Financial deregulation gave a huge boost to a whole generation of OTC derivatives like forward contracts and Credit Default Swaps but also structured derivatives. The latter is a combination of 'options' with bonds stocks and other primary assets. The promotion of derivatives was facilitated further by the general application of pricing models for Forwards and Options.

The 'law of one price' provided the formulas for the pricing of Forwards and the Black – Scholes model (1973) gave a price for Options. Banks were now capable to price their new 'products' with formulas publicly available and sell them mainly to financial intermediaries, corporations, and private banking customers. This was not simply a matter of convincing the customer that the assets were 'fairly priced'. The pricing models offered a way of financing the market with credit. This was not just any credit but fictitious credit. Banks introduced a new kind of credit line the 'derivative line', which enabled the customer to purchase a notional amount of

[111] Moser was German and his book had practical use as well. Following the unification of Germany in 1871 derivative contract issue and trading were not illegal but the result of case by case court decision.

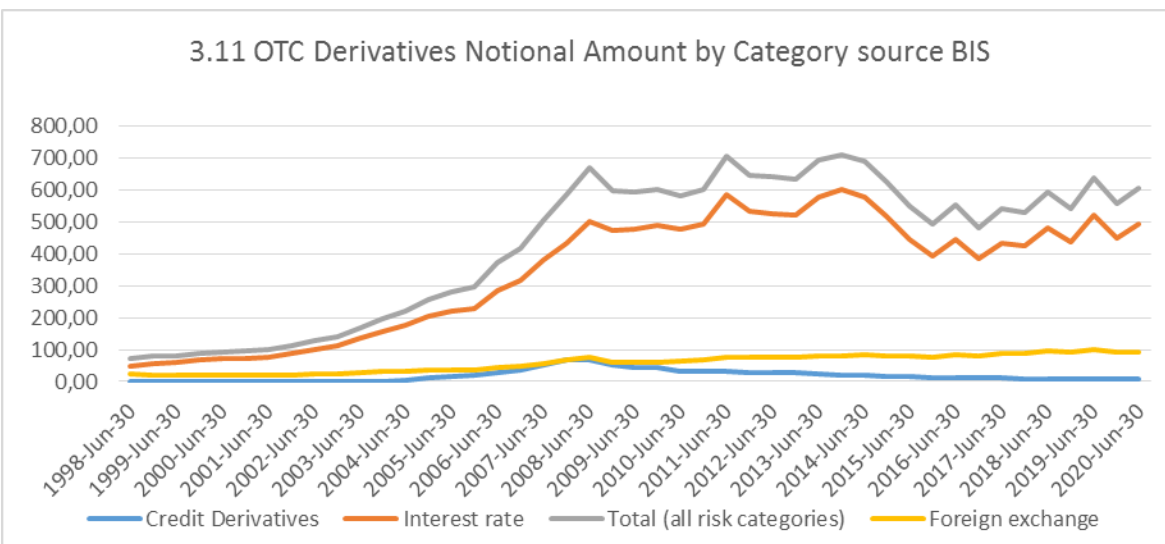
derivatives putting up almost no money. This was done as follows. In the spirit of mainstream options pricing, a certain (implied) volatility was assigned to each contract. For example, the exchange rate Forwards had an implied volatility of 20%, this meant that the bank assumed that the maximum loss on the forward would not exceed 20% of the notional value. In other words, the price would not diverge more than 20% from the derivative strike price. Then, based on his credit profile, the customer was assigned an amount of derivative line. For a line of 1 million, for example, someone could buy exchange rate Forwards with a notional value of up to 5 million (1/0,2=5). However, if things went bad this did not mean that the line would finance the loss but one of the following would happen: 1) The bank would buy the contract back at a loss and the customer would pay for the loss, 2) The bank would turn the fictitious derivative line into an actual credit line and the customer would pay for the loss with borrowed money, 3) The bank would extend the 'derivative line' so that the customer could roll-over his position.

This was/ is the transmission mechanism that initiated speculative streams, in the reflexivity theory context, for all sort of underlying financial assets but also the way market corrections take place. Contrary to the arguments of mainstream theory, derivatives are systematically mispriced and for this reason, cannot be used to reduce risk and securitize financial investments. Below we will show that a similar rationale applies to asset back securities. This is not only the position of Warren Buffet as we saw in chapter 2 section 2.g.4 but also George Soros. The latter has stated with humor: 'I take … a jaundiced view of derivative instruments which are based on what I consider a fundamentally flawed principle.' (1994). Regretfully, certain financialization economists and social scientists (Bryant et. al. 2008) consider mainstream derivative pricing sound and introducing the 'commodification of risk' (2008: 459) to contemporary capitalism.

To give a hint on the speculative practices mentioned above consider the following words from the abstract of the classical paper by Fischer Black and Myron Scholes (1973: 637): "If options are correctly priced in the market, it should not be possible to make profits from creating portfolios of long and short positions in options and their underlying stocks." If on the contrary options and derivatives, in general, are systematically mispriced, as argued here, this gives rise to persistent speculative positions that are explored in different ways by financial capitals. The Long-Term Capital Management (LTCM) hedge fund established in 1994 by John Meriwether, where Myron Scholes was a member of the board, is a good example. It invested in bonds by going long on the future price and short in the spot market. For Meriwether, this meant certain profit since the two prices were expected to converge. This implied of course that futures were correctly priced. It implied also that a well-behaved upward sloped yield curve like in Figures 3.4 and 3.7 above would hold in all circumstances. As we saw in Figures 3.5 and 3.6 this is not the case in a crisis. For this reason, LTCM run into trouble and was liquidated in the crisis of 1998/9. The story is beautifully presented in Roger Lowenstein's book When Genius Failed: The Rise and Fall of Long-Term Capital Management (2000).

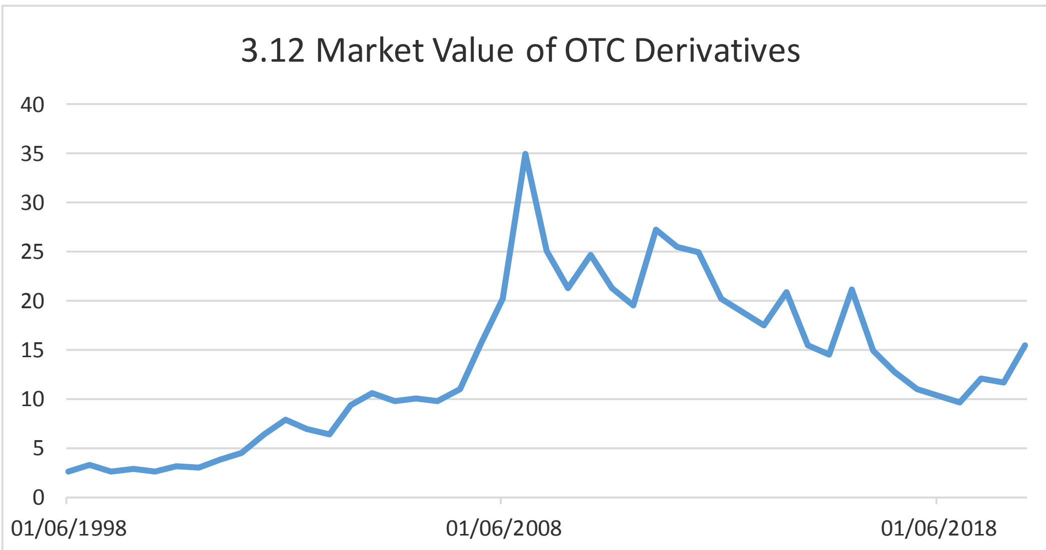
In short, speculative strategies combining primary financial assets with derivatives appeared across the board and OTC derivatives surged. Huge notional amounts are contracted indicating that the application of derivatives has nothing to do with securitizing risk in most of the contracts.

Figure 3.11



The data source for Figure 3.11 is the Bank of International Settlements (BIS). It pictures the times series of the notional amounts of the basic categories of OTC derivatives a well as their total from June 1988 to June 2020. The amounts are in trillions of USD. We can see that OTC derivatives from something just over 1 trillion USD in 1988 reached 700 trillion USD in 2014 and currently stand around 600 trillion. Of course, the aggregate amount involves notional values. That is the amount settled by these contracts. To calculate the risk involved in these transactions the BIS uses a second statistic called 'market value'. Since there is no market quotation for these derivatives the 'market value' involves 'mark to market valuations'. The amounts are again in trillions of USD.

Figure 3.12



Again, the data is indicative. The total market value of these derivatives increases from almost 2 trillion USD in 1998 to 35 trillion in 2008 (the beginning of the current crisis). Then it dropped until 2019 surging again in the current year and reaching an amount of around 15 trillion. Figure 3.12 is an indication that fictitious derivative capital is subordinate to the dynamics of capital accumulation as suggested by Marx. Therefore, the financialization theorists' idea that fictitious capital has gained autonomy from the laws of capital accumulation (Bryant et. al. 2008, Lapavitsas 2009) does not seem to hold for its main category that of derivatives.

To understand the argument outlined above we will present some basic categories of derivative contracts. I will show analytically how these dynamics prevail from and despite their systematic mispricing.

3i.2 Pricing Equity Forwards and Options

Mainstream economists suggest that trading of derivative contracts improves 'efficiency' for the underlying asset market, by broadening the portfolio selection perspectives and reducing transaction costs (Pyle 1993). As indicated from the data laid out above this is not the case. Moreover, relatively recent studies (Avellaneda & Cont 2011) indicate that almost 90% of equity OTC derivative contracts take place between dealers and only 10% between dealers and 'end users'. The latter, together with the preceding data, indicates that most derivative transactions do not involve hedging, but mere speculation performed by hedge funds. As I noted in the previous section the immense expansion of derivative contracts required also a formula for pricing these assets. It is not an exaggeration to state that mainstream derivative valuation formulas played a part of their own for this outcome. This is acknowledged by some scholars. Yanis Varoufakis for instance wrote early in the crisis that "economic formalism… is complicit in this crime against humanity"[112] (2009: 40).

The reason is that by applying the mainstream formulas derivatives are systematically mispriced. The mispricing results from the assumptions of the mainstream theory on the price and dynamics of the underlying asset. In other words, derivatives are priced under the same assumptions on asset prices and returns that we have criticized so far. But derivatives have a peculiarity compared to primary assets their strike price is artificially determined from mainstream models. If someone calls a bank asking for the 'strike price' of a yearly forward on an equity index the reply will be the result of the Forward formula that looks as follows:

$$3.52\ F_1 = \left(1 + r_f\right) \cdot Pr_0 - DIV_1 \cdot \left(1 + r_f\right),$$

$$where\ F\ the\ forward\ price, r_f\ is\ the\ so\ called\ risk\ free\ rate$$

Equation 3.52 is a version of the martingale formula. It assumes that we are in an efficient market where the required rate of return is the return of the risk-neutral investor. To put it differently, the formula is constructed on the assumption that the return in a fully hedged position where an investor is long on the forward and short on the asset cannot be other than the risk-free rate r_f. On these grounds, no one in the current market would believe that the price of the equity and the equity index would be the forward strike price at maturity. Moreover, no one would take a fully hedged position in equities to make the rate of some AAA bond, he can buy the bond directly and save himself the trouble.

[112] By 'crime against humanity' Varoufakis refers to the failure of the subprime market in 2007.

However, forwards like this one for various notional values are contracted every day and the question is why? The only reasonable answer is that someone believes that the market is mispriced, and the forward simply provides them with a fixed future price. This is the assumption on which Macro Hedge Funds operate. They speculate on big fluctuations in asset prices (in our context equity and equity derivative prices) assuming that it reflects a discrepancy between the market and the underlying fundamentals. By exploiting the discrepancy, the hedge fund anticipates extraordinary profits. Of course, this can imply that the normality assumption holds for equity returns as some hedge fund managers suggest (Nicholas 2008). More specifically, certain funds go after assets with returns falling more than one standard deviation away from the mean. In their view, this reflects potential mis
-pricing, since from the properties of the normal distribution 85% of asset returns should fall within one standard deviation from the mean. Furthermore, if asset returns are 'normally distributed' this implies also that the underlying fundamentals are roughly stable as well. Therefore, any diversion will generate an opposite movement since it comes from random occurrences. The reliance on the normality assumption was the reason many macro hedge funds failed in the period of the financial crisis.

The assumption that financial asset returns are normally distributed underlies the Black-Scholes option pricing model as well. It is a consequence of constant volatility assumption and enables the application of 'derivative lines' as discussed in the previous section. Of course, before we get to the derivative credit lines, this assumption is required to arrive at the famous option pricing formula of the model which is the following:

3.53 $C(Pr_t, t) = N(d_1) \cdot Pr_t - N(d_2) \cdot PV(F)$

$$and\ d_1 = \frac{1}{\sigma \cdot \sqrt{T-t}} \cdot \left[\log\left(\frac{Pr_t}{F}\right) + \left(r_f + \frac{\sigma^2}{2}\right) \cdot (T-t)\right]$$

$$d_2 = d_1 - \sigma \cdot \sqrt{T-t}$$

$$PV(F) = F \cdot e^{-r_f \cdot (T-t)}$$

Equation 3.53 tells us that the value of a European call option of a stock that pays no dividend is given by the current price of the underlying asset Pr_t, the present value of the strike price $PV(F)$ and two cumulative distribution functions of the standard normal distribution $N(d_1)$, $N(d_2)$. The model assumes a constant risk-free interest rate r_f and constant volatility of returns σ. It is based on the random walk assumption for asset prices and not the softer martingale version we discussed in Chapter 2 concerning the Samuelson martingale model (1964). In their classic paper, Black and Scholes (1973) are quite categoric in stating that no finite pricing formula can appear under more loose assumptions (Black and Scholes 1973: 639-640).

However, everyone knows that stock returns do not follow the normal distribution. I have shown elsewhere (Stravelakis 2014) that this can be shown analytically even under the more restrictive assumptions. For this reason, I modified the model presented in section 3.4 to follow the following growth equation (the notation is the same as above)

3.54 $$\frac{K_t - K_{t-1}}{K_{t-1}} = s \cdot r_1 \cdot \frac{y_t}{y_{max}}$$

3.54 is a version of the Cambridge growth equation (Pasinetti1963) but under the rationale, it appears in *The Capital*, Vol. II, *i.e.*, the reinvestment of the surplus in expanded reproduction. But there are additional peculiarities in this growth equation. First, it depends on the net rate of profit since with the assumption $r_1 = \frac{1}{1+z} \cdot r \rightarrow r_1 \cdot y_t = \frac{1}{1+z} \cdot r \cdot y_t = \frac{1}{1+z} \cdot \frac{NP_t}{K_{t-1}}$. Second, although the rate of interest is treated as data in the model[113] y_{max} is an excess demand factor since it is assumed equal to $\frac{a}{r}$. In this context, it is proved (Stravelakis 2014) $\frac{a}{r} = \frac{K}{EQ}$, in other words, the leverage ratio. Substituting these relations in 3.54 we arrive at the following relation

3.55 $$\frac{K_t - K_{t-1}}{K_{t-1}} = s \cdot \frac{a}{r} \cdot \frac{1}{1+z} \cdot \frac{NP_t}{K_{t-1}} = \frac{1}{1+z} \cdot \frac{K_{t-1}}{EQ_{t-1}} \cdot \frac{s \cdot NP_t}{K_{t-1}} = \frac{1}{1+z} \cdot ROE_t$$

3.55 tells us that the rate of growth is a function of the net return on corporate equity $ROE_t = \frac{s \cdot NP_t}{EQ_{t-1}}$. I assume as above (section 3.4) that new borrowing is equal to

[113] In other words, the assumption of 3.16 is not included in this version of the model.

the difference of investment from savings the model reduces to the following nonlinear difference equation:

$$3.56 \quad ROE_{t+1} = \left(1 - \frac{1}{i^2 \cdot \varphi} \cdot ROE_t\right) \cdot ROE_t$$

In 3.56 φ is a composite parameter depending on the rate of profit. The equation is the simplest form of chaotic difference equation known in the mathematical literature as the logistic map. In the present case if the gross rate of profit r and the interest rate i are low so that the parameter $\varphi > 4$ then the system collapses. In the other case, it exhibits mostly circular or chaotic growth. Two cases one of chaotic growth and one of collapse are picked in the simulation charts that follow:

Figure 3.13

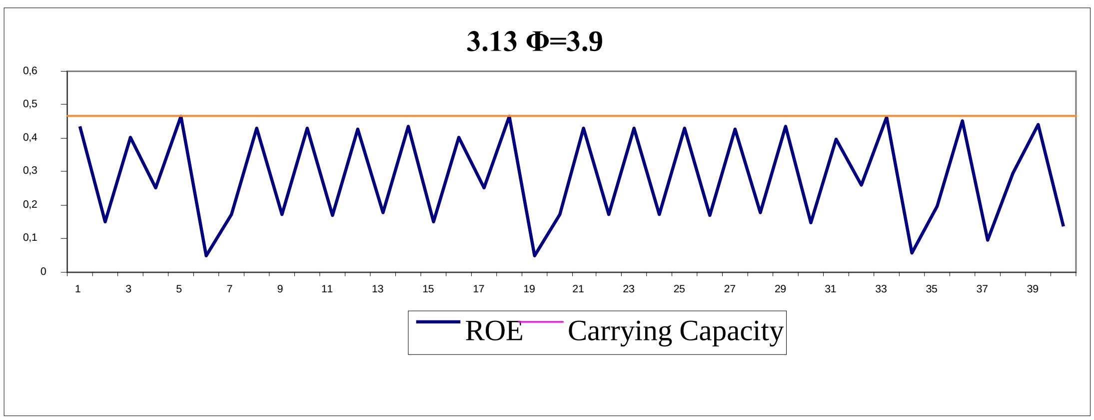
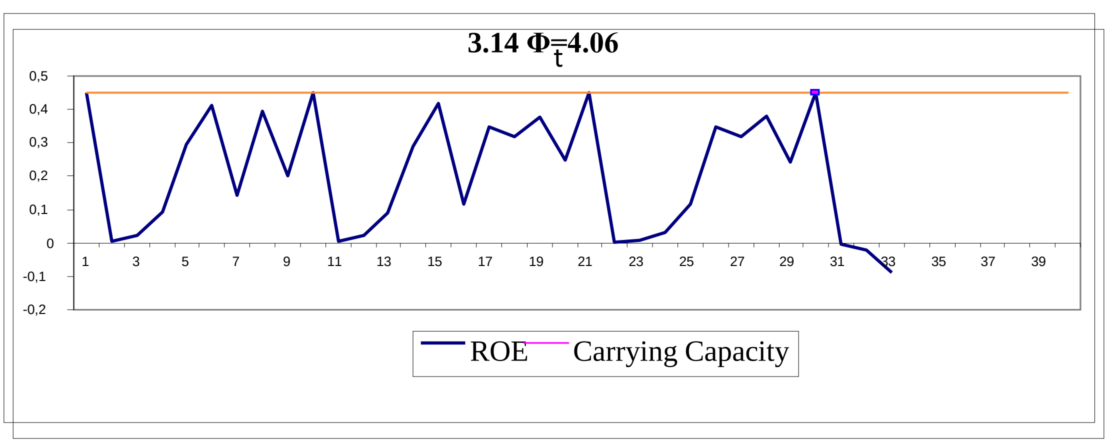


Figure 3.14



The logistic map comes from biology it refers to the growth rate of a population relative to its means of subsistence. The analogy here is that the system can carry a particular amount of credit. If credit expressed as the return on equity at a particular rate of profit exceeds a specific amount, then the system collapses. these scenarios are picked by simulation 3.13, 3.14 which refer to equation 3.56. In 3.13 with $\varphi = 3.9$ we have a situation of chaotic growth with severe fluctuations. However, the system operates below its 'carrying capacity' limit, presented by the red line, and growth continues. In the second case (Figure 3.14, φ=4.06) the system experiences severe fluctuations and after 30 periods it exceeds 'carrying capacity'. The latter triggers a breakdown. In the paper (Stravelakis 2014) I have shown that profit maximization through return on equity maximization pushes the system to its limits and leads to collapse.

This model stands in contrast to the so-called Modigliani–Miller theorem (Modigliani and Miller 1958). In the latter, the conclusion is that (in the absence of taxes) capital structure plays no part in corporate valuation. The idea is that corporate value is equal to debt plus equity therefore the anticipated or actual rate of return is not dependent on whether an investment is financed via debt or equity. This result depends on a second assumption of the Modigliani and Miller paper, that in the presence of risk, that is when the expected rate of return (cost of capital) is different from the bond rate, corporations are market-value maximizers rather than profit maximizers[114]. If firms were interested in the maximization of their profits, then the capital structure would certainly matter to them since it influences corporate net profits. The model assumes on top of this that there exist homogeneous categories of stocks (perfect substitutes), constant required returns (cost of capital), and perfect capital markets i.e., equal required returns among the stocks that comprise the group. In this context, investors will see any difference in returns between levered and non-levered companies as an arbitrage opportunity. Either through personal

[114] This is clear from the following extract:

> These lines represent, in effect, attempts to extrapolate to the world of uncertainty each of the two criteria-profit maximization and market value maximization-which were seen to have equivalent implications in the special case of certainty. With the recognition of uncertainty this equivalence vanishes. In fact, the profit maximization criterion is no longer even well defined. Under uncertainty there corresponds to each decision of the firm not a unique profit outcome, but a plurality of mutually exclusive outcomes which can at best be described by a subjective probability distribution. The profit outcome, in short, has become a random variable and as such its maximization no longer has an operational meaning. Nor can this difficulty generally be disposed of by using the mathematical expectation of profits as the variable to be maximized. (Modigliani and Miller 1958: 263)

borrowing or by 'undoing leverage' (Modigliani and Miller 1958: 270) returns will become equalized irrespective of the capital structure of the corporations participating in the homogeneous category of stocks.

The first point to be made is that in the Modigliani and Miller theorem equalization takes place around the average rate of return which is assumed equal to the incremental by assumption. But the most important part is that this rate is assumed constant. In the profit-based approach where corporations in the same industry are different, as elaborated in section 3.1, therefore, it is impossible to find stocks that are perfect 'substitutes'. Only regulating capitals in each industry could be considered 'substitutes' but they are far from 'perfect'. As I have noted already in various instances, for the classical theory of competition, equalization is a rough and turbulent process where regulating capitals themselves are displaced by other corporations introducing new products and applying new techniques. In other words, the assumption of constant returns cannot hold in the profit-based approach context even if markets were perfect in all other respects.

The assumption of constant returns does not hold even under the restrictive assumptions of the model I outlined above. The association of the new debt with excess demand (like in equation 3.21 above) has important implications for short term profitability even in an environment of a constant regulating rate of profit r_1 and interest rate i. As borrowing increases so does capacity utilization and this increases short-term profitability. In the paper under discussion (Stravelakis 2014) I used the following equation for the stock market net required rate of return.

3.57 $rror_t = r_1 \cdot u_t - irf_t$

3.58a $u_t = \frac{i \cdot \alpha}{r \cdot \alpha \cdot (1 - y_{t+1}) + r \cdot i}$, 3.58b $irf_t = i - \sigma_t^2(g_t)$

3.59 $Pr_t^W = (1 + rror_t) \cdot Pr_{t-1}$

Equation 3.57 gives the net required rate of return $rror_t$ which is equal to the product of regulating profit rate r_1 times capacity utilization u_t minus the risk-free rate irf_t. The latter is equal to the constant loan rate i minus the yearly standard deviation of output growth $\sigma_t^2(g_t)$(eq. 3.58b). Capacity utilization (equation 3.58a) is derived from equation 3.25 above (section 3.4). The equation tells us that capacity utilization is a positive nonlinear function of the share of the next period corporate profits y_{t+1}. The idea is that accelerated investment will bring higher capacity utilization and higher profit in the next period. This is the reason high-capacity utilization increases the required rate of return as indicated by equation 3.57 since it brings positive expectations about next period profits. I have subtracted the standard deviation of growth from the rate of interest (eq. 3.38b) because it is an additional factor of risk. If the standard deviation is high this means that the interest income will be possibly reduced because of defaults and the effective interest rate will be less than i. Finally, equation 3.59 is a version of equation 3.45 in section 3.7. It says that the warranted price is a function of the required rate of return and last period price Pr_{t-1}.

I have simulated equation 3.57 against the time path of growth picked in Figure 3.14 and the simulation appears in the next chart. Both time series were calculated with the parameter φ=4.06. The latter dominates the simulation dynamics. The stock market returns collapse earlier than the growth rate because 3.58α is calculated basis $y_{t+1}$and not ROE_t.

Figure 3.15

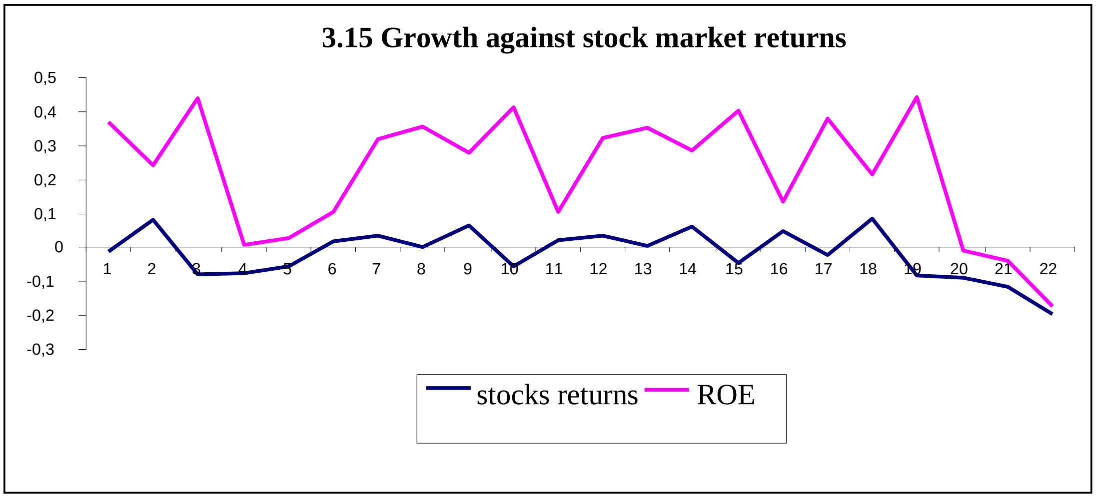
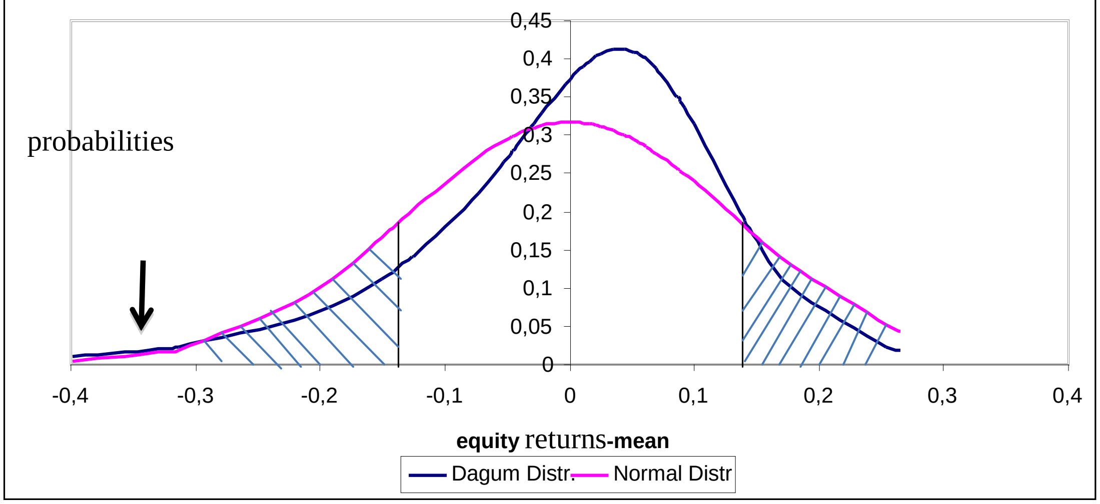


Figure 3.15 provides some interesting analytical insights. It shows that although net stock returns follow the pattern of the simulated growth path, they precede growth fluctuations. The reason is the anticipated fluctuations in profitability coming from capacity utilization. This is an additional analytical explanation indicating that stock market fluctuations can precede severe fluctuations in growth without causing them. Moreover, although the growth rate determines the rate of return in the stock exchange in this context the Pearson coefficient is low. This finding will prove useful in empirical work in the next chapter.

The most interesting finding, however, appears in Figure 3.16 that follows. It presents the normal probability distribution that fits the simulation data (purple line) together with the best-fitted distribution (blue line).

Figure 3.16



The distribution best fitting the data (blue line) is a four-parameter Dagum distribution (Dagum 1975). Returns on the horizontal axis are differences from the mean and probabilities appear on the vertical axis. The two shaded regions picture the areas of possible interest for hedge funds. If the stock has return values in the left-hand side shaded area, the hedge fund builds long forward positions and/or purchases call options. In the same fashion short forward positions and/or put options are appropriate for returns in the shaded area on the right-hand side115. However, the risk is miscalculated on both occasions. The most important miscalculation appears in the left-hand side tail of the two distributions marked by the black arrow in Figure 3.16 The actual return distribution (blue line) has a long tail where finite probabilities appear for very low returns whereas in the assumed normal distribution (purple line) this probability is practically zero. Hedge funds assuming normally distributed returns will take long derivative positions at this level of returns anticipating a strong recovery. Instead, they may witness a market collapse. Banks experiencing a deterioration of their depository base, during a period of financial turmoil, are reluctant to finance such big losses. These were roughly the circumstances that led many hedge funds, especially macro hedge funds, to bankruptcy in the period of the financial crisis. This explains also why both forward strike prices and option derivatives values calculated from equations 3.52 and 3.53 are systematically mispriced since they both rely on normally distributed returns.

[115] This is by no means an exhaustion of potential hedge fund strategies but only a simplistic example. However, we can safely claim that almost every macro hedge fund strategy is vulnerable to extreme negative returns.

Economists and market professionals have identified similar patterns in actual asset return data. They used these findings to make a case for the causes of the current depression. The financial analyst Nicholas Taleb (2007) argued that underestimation in the likelihood of extreme surprise events, 'black swans' in his terminology, is responsible for the meltdown. Heterodox economists argue that 'financialization' is the child of neo-liberal ideology (Fine 2011) which reached a climax in the first years of the new century. During those times, the theory of self – regulated markets, i.e. markets which could calculate risks correctly, thereby self-constraining any excesses justified complete deregulation of the financial markets. Under this reasoning, deregulated financial institutions undertook extensive derivative positions generating greater losses than the underlying asset price reduction. This resulted in depression. In other words, according to these theories, the depression was caused by the financial crisis spillover. What the argument misses is that excessive impairment of 'fictitious capital', for example, the market value of derivative contracts (Figure 3.12), reflects a breakdown in the valorization of real capital as argued here and elaborated in the simulation I have presented so far. Similar analytical reasoning can be applied to asset-backed securities as we will see next.

3i.3. Asset-Backed Securities

Finally, we will consider asset-backed securities valuation since the collapse of the mortgage-backed securities market triggered the current depression. Although these assets entered our everyday vocabulary following the subprime market collapse, they are by no means new. U.S. government-owned or government-sponsored enterprises with a history going back to the years of the great depression have been issuing this type of securities for decades. For government agencies (Government National Mortgage Association, or Ginnie Mae) and government-sponsored agencies (Federal National Mortgage Association or Fannie Mae and Federal Home Loan Mortgage Corporation, or Freddie Mac) securities rated triple-A (AAA) were issued, since markets consider(ed) these assets backed by the U.S. government. This is the 'prime' mortgage-backed securities market. But as bank liquidity grew banks turned a good part of this liquidity to consumer lending. Lower quality mortgages were turned into 'collateralized debt obligations' (CDOs). The latter instituted the 'subprime' mortgage-backed securities market which triggered the depression. As interest rates were suppressed to historical lows from 1980 onwards mortgage-backed securities gradually assumed the biggest part of bond markets. The reason is simple they offered a premium over corporate and sovereign bonds of the same rating, the premium representing compensation against the uncertainty of mortgage refinance. Consequently, as interest rates declined, and the likelihood of mortgage refinance was reduced these securities became more and more attractive. However, the market underplayed the risk that banks would be unable or reluctant to refinance bad mortgages, in other words, the market underplayed the likelihood of depression as elaborated below.

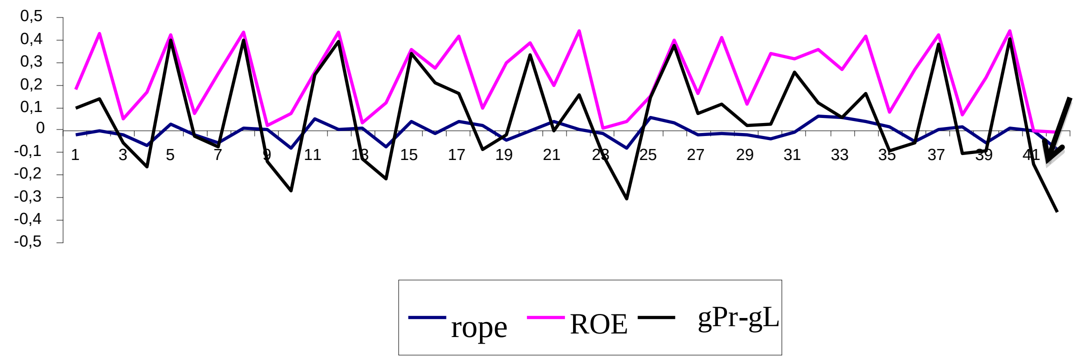
Although I will only consider securities 'backed' by corporate loans in our context, the valuation method is valid for other types of asset-backed securities. For reasons of simplicity we will assume that half of the bank loan portfolio comprises of productive corporations paying interest at a rate below the average i , while the other half pays interest at a rate above average. We will assume further that banks pool their loans in two units (tranches) one involving productive low-interest corporate loans and the other unproductive high-interest loans. They then issue one-year securities on each unit which they sell through 'special purpose vehicles'. Returns, risks, and excess returns for both units appear in the equations that follow:

$$(rtr)_{1_t} = \left(i - \left(\frac{1}{2}\right) \cdot \sigma_{(ROE)_t}\right) \Rightarrow (ertr)_{1_t} = (rtr)_{1_t} - (irf)_t = \left(\frac{1}{2}\right) \cdot \sigma_{(ROE)_t} \quad and \quad (rope)_{1_t} = r - \left(i - \left(\frac{1}{2}\right) \cdot \sigma_{(ROE)_t}\right) \quad (Eq.II.7)$$

$$(rtr)_{2_t} = \left(i + \left(\frac{1}{2}\right) \cdot \sigma_{(ROE)_t}\right) \Rightarrow (ertr)_{2_t} = (rtr)_{2_t} - (irf)_t = \left(\frac{3}{2}\right) \cdot \sigma_{(ROE)_t} \quad and \quad (rope)_{2_t} = r - \left(i + \left(\frac{1}{2}\right) \cdot \sigma_{(ROE)_t}\right) \quad (Eq.II.8)$$

Where rtr_{1_t}, rtr_{2_t} stands for return on tranches 1 and 2 and $rope_{1_t}, rope_{2_t}$ denotes the rate of profit of enterprise for the two corporate groups. Expected excess returns, denoted by $ertr$, are equal to half the annual volatility of growth for group 1 and one and a half (1.5) times volatility of growth for group 2. Although the first unit will have a positive rate of profit of enterprise if $r_1 > i$, the second unit may experience negative $rope$ even if the corporations included have an average rate of profit equal to the economy average. Therefore, in highly volatile growth security holders rely on the willingness of banks to refinance these loans, which in turn rests on the conviction that growth will resume enabling the borrower to perform. This is of course the case when banks are liquid. But when bank liquidity deteriorates like the times close to breakdown things change. The simulation chart which follows pictures the risk associated with unit 2 securities in various states of the economy.

Figure 3.17



The blue line is the rate of profit of enterprise of unit 2 calculated. The purple line is the return on equity (gross profit growth) for the whole economy as before and the black line the rate of growth of profit minus the rate of growth of debt. The latter is a measure of bank liquidity growth. Although the rate of profit of enterprise turns negative on many occasions, profits catch up quickly and banks refinance low-grade debt. At the eve of a breakdown, however (marked by the arrow on chart 5) as the rate of profit of enterprise of unit 2 turns negative banks experience a huge decline in liquidity since the corporate sector as a whole experiences losses. As result, low-grade loans do not get refinanced and asset-backed security holders experience huge losses.

The scenario presented roughly imitates the collapse of the sub-prime market in the U.S. Securities issued on low-grade mortgages, the so-called 'toxic' unit, was held on the assumption that the housing market will keep growing and the collateral value will cover the loan. This in turn implied that banks would refinance mortgages when turned problematic protecting the security holders from capital losses. When this did not happen in 2007 the market collapsed.

A good deal of contemporary heterodox literature understood the sub-prime collapse as the cause of the crisis, in a 'post hoc ergo propter hoc' (Tobin 1970) reasoning. They argued further that the level of wages was the cause of the sub-prime collapse. The wage income expropriation theory (Lapavitsas 2009) and the monopoly version of the under-consumption argument fall in this category. In the latter capitalism is stagnant by nature and growth resulted from consumer credit expansion (Magdoff & Sweezy 1987). Both versions arrive at an amazing conclusion:

world capitalism entered a depression because wages were low limiting commercial credit expansion!

Nevertheless, this type of asset remains quite popular. The Hercules plan for bank NPLs recently implemented in Greece and Italy falls in this category. It involves the sale of bad debt of all types (corporate, mortgage, consumption) by banks to special purpose vehicles. In the Greek case, the debt is categorized into (three) tranches based on its collateral. The senior tranch (the debt associated with the best collateral) is backed by Greek government bonds guaranteed by the ECB and the ESM on top of its collateral. The plan assumes that the loans will be sold at a sufficient discount that will enable the SPV manager to recover sufficient amounts to pay for the principal and the coupon of the securities. It is beyond doubt that the whole project rests on the assumption that the collaterals will be auctioned at the anticipated prices something which implies also that banks will be prepared to lend to the potential buyers. The valuation of the collaterals is based on recently recorded prices for similar assets assuming that they will prevail in the future when a vast number of alike collaterals will be auctioned. It is beyond doubt that no one can estimate the magnitude of the risk. The assumption that collateral prices will follow some normal distribution pattern can be disastrous in this context not only for the holders of these securities but also for the Greek state since the SPV managers will probably call on the state guarantee sooner or later. The US pattern of government-sponsored agencies is much better than the SPV solution applied by the Greek government. At least in this case the asset will have a willing buyer before going to auction since the agency will try to keep the company or the mortgage functioning before auctioning the collateral.

We have used a simple framework to show that an unstable growth path emerging from low profitability produces financial crisis episodes because corporate growth cannot absorb bank liquidity. In this context, the financial crisis reflected in spiky reductions of returns on various asset categories (stocks and asset-backed securities) precedes sharp reductions in output and employment. This result rests on the assumption that returns on financial assets reflect the underlying fundamentals. The latter follow patterns quite different from those anticipated by neoclassical theory and elaborated by ‘modern investment theory’. This reasoning has important implications for economic policy and financial regulation demonstrated in the following section.

3j. Policy Implications. Some notes on financial regulation

The failure of the investment bank Bear Sterns in 2007 marked the beginning of the current depression. At first, regulators thought it was an isolated case that could be contained through traditional monetary policy tools. By mid-2008, however, the subprime market failure made clear that the situation required extraordinary measures since most of the U.S. and global banking system had collapsed. The main policy followed aimed to securitize banks through capital injection, troubled asset purchases, and central bank accommodation against low-grade collateral. Governments supported this policy with state budgets and central banks through asset purchase programs that were intensified after the COVID19 pandemic. The state issued bonds to raise central bank capital and support the 'socialization' of financial-sector losses. In the U.S. alone public debt increased from about 8.7 trillion dollars in 2007 to almost 27 trillion dollars at the end of 2020. Public debt in almost every country followed a similar path.

These monies prevented meltdown mainly by enabling banks to revolve or turn corporate debt to equity, maintaining consumer credit as well. Most of the economic activity remained in place instead of collapsing and the world economy entered a period of weak investment and volatile growth. In the context presented by equation 3.56, this means that parameter (a) was reduced to sustainable levels. But this cannot restore the gross profit rate to growth sustainable levels. This is the reason banks sequestered most of the liquidity they received. Actual investment activity and credit expansion will appear again when corporate profitability and consequently the bank depository base are restored.

For contemporary mainstream literature, the persistence of the crisis is unanimously accepted nowadays. Explanations vary, ranging from high debt (mainly public debt) hampering growth (Reinhart & Rogoff 2013)116, to blaming austerity policies applied to contain debt (actually to suppress wages). Recent mainstream research talks about conditions of 'secular stagnation' (Summers 2015). The latter approach stresses the limitations of monetary policy summarized in the so-called 'zero interest limit' and promotes fiscal expansion (Krugman 2012). However, the high debt explanation disregards that low returns brought about the debt crisis in

[116] I site the last paper of the two authors because in it they admit on one hand that the crisis persists over the last six years and second that austerity measures cannot turn debt sustainable as argued so far by austerity policy proponents.

the first place, while the second ignores that in depression corporations and banks sequester monies rather than invest them. Therefore, Keynesian ‘trickle-down’ policies justifying fiscal expansion have limited effect.

The reasoning appearing here suggests alternative policies promoting direct state investments (Shaikh 2011). That is policies restoring economic activity and bank liquidity through increases in employment. As we have shown profit-motivated growth breaks down in a depression. At this stage, it is state investments following social goals that can offer employment to those who need it the most and have a ‘rise-up’ effect on businesses serving the increased demand.

Nevertheless, official policies support different trends. As public debts pile up and bank liquidity surges speculative financial investments are taking up a substantial part of bank portfolios. Stock exchanges have hit record prices, not supported by corporate fundamentals, whereas sovereign bond yields are negative for some time in major European economies like Germany. All these are raising concerns that a new financial crisis is around the corner. If central banks downsize accommodation policies and governments issue new bank regulation directives financial episodes may reappear from the burst of the current speculative bubble. This situation worries policymakers around the globe. Recently, rumors started circulating that there were discussions about mutual write-offs of sovereign debt between G20countries. Irrespective of the success of such policies, but the fact that such discussions may be held shows that expansionary monetary policy is about to reach its limits.

At the level of bank regulation, the clearest policy outline is the ‘Volcker rule’ passed on Dec 10th, 2013 by the U.S. legislative bodies. A similar but slower process took place in the E.U. around the so-called ‘banking union’ with the establishment of the SSM as the central regulatory body.

Sticking to the ‘Volcker rule’ because of concreteness we note that its main aim is to prevent banks from assuming equity and derivative risk through hedge funds and other vehicles but does not prevent them from running that risk directly in their balance sheet. The only factor discouraging the assimilation of risk is increasing capital requirements. This is a policy relying on the assumption that financial assets carry a particular amount of relatively stable risk. If the risk is stable, banks can securitize depositors by assigning the appropriate amount of additional capital to back the risky assets appropriations. But, as we have shown above, this does not hold especially when growth trends turn unstable, in such times capital requirements may prove insufficient and the taxpayer will lift the burden once again. The 'Volcker rule' is the latest chapter in a long series of regulations going back to the 'Peel act'117 in mid-19th century England. Marx in *Capital* Vol. III (Marx 1894) mocked this early policy for being useless when the system was in normal accumulation and was withdrawn in the crisis of the 1850s to avoid bank failures.

The target of bank regulation is to protect the broad public, at least in part. Given uncertainty underlying financial markets, the rules applied must focus on what kind of assets pension funds, banks, and the broad public can hold and to what proportions, to contain possible future damages. Depressions cannot be managed away through appropriate policies because they emerge from the contradictions of profit-motivated growth. These contradictions become manifest in the fact that depressions appear every thirty to forty years the first on record dated as back as 1790. In this regard, financial crises will always be a potential trigger of such events and regulation policies can only mediate losses by directly constraining risk. This means that institutions that take deposits or pension plan installments cannot hold just any kind of risky asset and the assets permitted cannot assume just any proportion of the asset side. This should be the focus of regulatory policies. Unfortunately, recent amendments applied by the FDIC in July 2020 have softened the restrictions for banks. The latter now can invest in certain categories of venture capitals and SPVs thereby extending their exposure in risky assets rather than placing rules in the structure of their balance sheet. Perhaps such a move has been made in order to sustain the New York Stock Exchange bubble until the November 2020 US presidential election. It may, however, reflect policies of a more permanent nature. Irrespective of the underlying intentions, however, these recent developments are indicative of the limitations of financial regulation in capitalism.

At present, the likelihood of a new major financial crisis depends on how stable the currently prevailing roughly stagnant growth path is and how it may be affected by

[117] The Peel Act of 1844 named after the British premier Sir Robert Peel on the one hand prevented commercial banks from issuing their own banknotes and on the other placed restrictions on the Bank of England in issuing banknotes. The idea was that with the restrictions in place inflation would remain stable and financial panics would cease to appear. Marx scorns the fact that the restrictions of the act were never needed or applied during a normal accumulation upswing and the provisions of the act were altogether abandoned when the system entered a depression.

the pandemic. Stability seems to rely on the extraordinary liquidity measures taken by the Fed, the ECB, and most of the other central banks in the world. These policies are keeping interest rates low and keeps ‘enhancing short term speculative financial investments. The capital impairment that would boost the rate of profit leading to gradual recovery seems to move at a slow and uncertain pace. When these policies will eventually stop financial panics and sharp corrections cannot be ruled out. Recent legislation in Greece and other EU countries hampered by the crisis indicates that a period of accelerated capital impairment may take place in the years to come. Such policies will bring sustainable growth at some point, but they will aggravate the consequences of the crisis for the vast majority of the population. In this regard, the policy of direct state investment mentioned above (Shaikh 2011) becomes more relevant for an inclusive recovery.

Recovery from the present depression is proceeding at a very slow pace so far. Looking back to the history of crises, we have to go back to the 1873-1896 depression, the longest capitalist crisis on record, to find something similar.

Conclusion

In this chapter, we have shown that asset pricing is important for crisis theory and financial regulation. The fact that it has been downplayed in the context of the current depression has led to important shortcomings in its explanation and policy suggestions. For the Marxist tradition, this was due to a certain extent to the fact that the relevant section (section V) in The Capital Vol. III is incomplete. As we elaborated the critical factor that held back the efforts for developing an asset pricing theory from a Marxist perspective is whether the various categories of financial capital enter the profit equalization process like commercial capital.

The profit-based approach is based upon the assumption that capital mobility equalizes the returns between the corporate and the financial sector. This is not an interpretation of Marx but more of a reconciliation of his insights with a theory of asset price determination. As we saw this theory can price loans, stocks, and bonds. But when it comes down to derivatives and asset-backed securities systematic mispricing is the rule. Nevertheless, we saw that this category of fictitious capital follows the laws of capital accumulation as well.

This last result is important for bank regulation and to a certain degree, it has been incorporated in the initial version of the Volcker rule in the US. However, the legislation never prevented banks from purchasing and holding derivatives, asset-backed securities, and risky assets in general. It prevented them only from holding these assets through SPVs and this way made the trade more expensive for banks since they needed additional reserves to back their depository base. The rationale behind this is that risk is calculable and for this reason, adequate reserves can secure depositors. We saw that this is not the case because stock, bond, and interest rate returns do not follow the normal distribution. In other words, they do not experience a constant standard deviation. This means that any amount of reserves can prove insufficient. For this reason, I proposed the limitations to be placed on the percentage of risky assets in the bank balance sheet.

The whole discussion on bank regulation acknowledges that capitalist crises cannot be managed away because they are inherent in the system. Their effect on the financial system can only be tempered through regulation. This is known to us since the time of Marx who used to scorn the Peel act for holding in times of normal accumulation and being withdrawn in times of crisis. Therefore, the main issue is the persistence of the present depression and the limitation of monetary policy and fiscal austerity policies in creating an environment of sustainable growth. In this regard, the implementation of policies of direct state investment is more important than any set of bank regulatory rules.

Appendix 3.1: Definitions of certain Marxist Categories

Value Composition of Capital c/v: The value composition of capital or the ratio of constant (c) to variable capital (v) is the most immediate measure of the composition of capital. It measures in labor value terms the ratio machines and materials to labor power.

Technical Composition of Capital - TC: The proportions in which machines and materials combine with workers in the production process. It is the 'inner measure' of the composition of capital since it stands behind the ratio c/v or the Value Composition of Capital.

Materialized Composition of Capital c/l: It is the ratio of constant capital (c) to total labor value v+s. Where (v) is variable capital and (s) is surplus value. It is the outer measure of the composition of capital or the technical composition in value terms.

These three categories are intrinsically related in the Organic Composition of Capital

Organic Composition of Capital = TC/vo: Where TC is the technical composition of capital and vo the value of labor power in the initial production period. (Shaikh 1986)

Appendix 3.2: Derivation of equation 3.26 and derivation of root y_3

Derivation of equation 3.26

$l_t = \frac{L_t}{P_t} = \frac{1-y_t}{i_t}$ from equation 3.18

Taking time differences in the last term on the right-hand side $\left(\frac{1-y_t}{i_t}\right)$

$$1.\ l_{t+1} - l_t = -(y_{t+1} - y_t)\cdot\frac{1}{i_t} + \frac{a}{i_t}\cdot(y_{t+1} - y_t)\cdot l_t = \frac{1}{i_t}\cdot(y_{t+1} - y_t)\cdot(a\cdot l_t - 1)$$

$$from\ 3.18\ and\ 3.16\ we\ get\ a\cdot l_t - 1 = \frac{a - a\cdot y_t - r_1 + a\cdot y_t}{i_t} = \frac{a - r_1}{i_t}$$

$$substituting\ above\ \boldsymbol{l_{t+1} - l_t = \frac{a - r_1}{i_t^2}\cdot(y_{t+1} - y_t)}$$

$$2.\ l_{t+1} - l_t = \frac{L_{t+1} - L_t}{P_t} - \frac{P_{t+1} - P_t}{P_t}\cdot l_t\ because\ L_{t+1} - L_t = \left(\frac{a}{r} - 1\right)\cdot s_t\cdot NP_t$$

$$\rightarrow l_{t+1} - l_t = \left(\frac{a}{r} - 1\right)\cdot s_t\cdot y_t - s_t\cdot a\cdot y_t\cdot l_t = s_t\cdot y_t\cdot\left(\frac{a}{r} - 1 - a\cdot l_t\right)$$

$$under\ the\ previous\ a\cdot l_t - 1 = \frac{a - r_1}{i_t}$$

$$\rightarrow l_{t+1} - l_t = s_t \cdot y_t \cdot \left(\frac{a}{r} - 1 - a \cdot l_t + 1 - 1\right) = s_t \cdot y_t \left(\frac{a}{r} - 2 - \frac{a - r_1}{i_t}\right)$$

$$\rightarrow \boldsymbol{l_{t+1} - l_t = \frac{1}{r_1} \cdot \left(\left(\frac{a}{r} - 2\right) \cdot i_t - (a - r_1)\right) \cdot y_t}$$

equalizing 1,2

Derivation of root y_3

$$\rightarrow (y_{t+1} - y_t) = \frac{1}{r_1 \cdot (a - r_1)} \cdot \left(\left(\frac{a}{r} - 2\right) \cdot i_t - (a - r_1)\right) \cdot i_t^2 \cdot y_t$$

$$\rightarrow (y_{t+1} - y_t) = \frac{1}{r_1 \cdot (a - r_1)} \cdot \left(\left(\frac{a}{(1+z) \cdot r_1} - 2\right) \cdot (r_1 - a \cdot y_t) - (a - r_1)\right) \cdot (r_1 - a * y_t)^2 \cdot y_t$$

$$\left(\frac{a}{(1+z) \cdot r_1} - 2\right) \cdot (r_1 - a \cdot y_t) - (a - r_1) = 0$$

$$\rightarrow \frac{a \cdot r_1}{(1+z) \cdot r_1} - r_1 - a - \left(\frac{a}{(1+z) \cdot r_1} - 2\right) \cdot a \cdot y_t = 0$$

$$\rightarrow \left(\frac{a^2 - 2 \cdot a \cdot (1+z) \cdot r_1}{(1+z) \cdot r_1}\right) \cdot y_t = \frac{a \cdot r_1 - (r_1 + a) \cdot (1+z) \cdot r_1}{(1+z) \cdot r_1}$$

$$\rightarrow y_3 = -\frac{(r_1 + (r_1 + a) \cdot z) \cdot r_1}{(a - 2 \cdot (1+z) \cdot r_1) \cdot a} = -\frac{(r + a \cdot z)}{(a - 2 \cdot r)} \cdot y_{max}$$

$$in\ the\ case\ of\ y_3\ i = r_1 + \frac{(r + a \cdot z)}{(a - 2 \cdot r)} \cdot r_1 = r_1 \cdot \left(1 + \frac{(r + a \cdot z)}{(a - 2 \cdot r)}\right)$$

$$for\ r > \frac{1}{2} \cdot a\ \ \frac{(r + a \cdot z)}{(a - 2 \cdot r)} > -1 \rightarrow (r + a \cdot z) > -(a - 2r) \rightarrow a \cdot z > (r - a) \rightarrow a > r_1$$

Stability for $\boldsymbol{y_1 = 0}$

$$\frac{r_1}{(a - r_1)} \cdot \left(\frac{z}{(1+z)} \cdot a + r_1\right) < 2$$

$$\rightarrow r_1 \cdot \left(\frac{z}{(1+z)} \cdot a + r_1\right) < 2 \cdot (a - r_1) \rightarrow r_1^2 + 2 \cdot r_1 < a \cdot \left(2 - \frac{z}{1+z} r_1\right)$$

$$\rightarrow r_1 \cdot (r_1 + 2) < a \cdot \frac{(2 \cdot (1+z) - z \cdot r_1)}{1+z} \rightarrow \boldsymbol{\frac{r \cdot (r_1 + 2)}{[(2 \cdot (1+z) - (r - r_1)]} < a}$$

Chapter 4
The empirical testing of the profits-based approach

Introduction

The fourth and final chapter of this project refers to the empirical testing of certain aspects of the profit-based approach. A full test of all aspects of the theory requires a good deal of development and application of empirical techniques that needs more than a dissertation. This will become evident from the present chapter although it is confined to the empirical estimation of the profit-based approach on stocks. The reason is that additional econometric techniques are required to assess certain parts of the theory even on stocks alone.

The exposition begins by replicating and extending to the present time the empirical tests of the theory conducted by Anwar Shaikh (1997, 2016). This is done in section 4a. Shaikh (1997, 2016) estimated stock prices and stock returns against the incremental rate of profit. Specifically, he estimated the S&P 500 rate of return from the Shiller data base and calculated the incremental rate of profit from the BEA tables. All estimations are described and explained in section 4a and in Appendix 4.1. The National Income and Product Accounts (NIPE) of the U.S. Bureau of Economic Analysis (BEA) data on profitability goes back to 1947 and for this reason this is the starting year for the calculations. As it will become evident in section 4a the results are supportive of the profit-based approach.

Nevertheless, the time series of both and S&P 500 rate of return and the incremental rate of profit are not stationary. This raises estimation issues. Specifically, it was impossible for Shaikh to estimate the model parameters and draw statistical inference on them. For this reason, he restricted himself in drawing inference coming from the simulation of the warranted against the actual S&P 500 prices presented below in Figure 4.3 (Shaikh 2016) and the calculation of the R^2 from detrended data as presented in Figure 4.2 (Shaikh 1997). Although, the results are strongly supportive. no specific inference could be drawn on the influence of the incremental rate of profit on actual prices and returns of the S&P 500.

In order to address these issues, I have modified the empirical model. This is elaborated in section 4b. Specifically, I have used the rate of growth of the Earnings Per Share (EPS) of the companies comprising the S&P 500 (the data is recorded in the Shiller data base) as a proxy for the incremental rate of profit.[118] I argue that the change in the EPS of these companies (between the previous and the current year) is a good proxy of changes in the profitability of the 'regulating capital' (see section 3a for the definitions). Assuming further that investment is a linear function of the last period corporate profit, the rate of growth of the EPS becomes

[118] The EPS is calculated from net corporate earnings divided by the number of shares (excluding from the denominator the number of shares comprising corporate buybacks). It is the key measure of corporate profitability for bankers and fund managers as indicated by George Soros (1994) and elaborated in section 3.6.

an approximation of the incremental rate of profit ($Irop_t$).[119] This permits us to regress the S&P 500 detrended logarithmic values against the logarithm of the EPS for a period going back to 1900. Following Shiller (1989b: 78-82), and Shaikh (1997: 398), I detrended the data using the 30-year moving average. The results are impressive and enable us to draw statistical inference for the model parameters.

Yet, the most important contribution of this chapter has to do with the estimation of the dynamics of the correlation between the incremental rate of profit and the rate of return of the S&P 500. Shaikh (1997) correctly pointed out that the two variables are not linearly related and for this reason, the Pearson statistic takes a small value. Nevertheless, the incremental rate of profit and the stock market rate of return have roughly the same mean and standard deviation. This implies among other issues that for the profit-based approach there is no unexplained volatility of stock returns since stock market volatility reflects the variability of the underlying corporate fundamentals. In section 4c.6 this finding is elaborated further. I will apply a non-parametric statistic named 'Mutual Information' (MI). It measures the reduction of the uncertainty about stock returns from knowing the corporate fundamentals. It is a non-linear correlation statistic originally applied by Shannon (1948) that has been incorporated and developed in the context of Transfer Entropy (TE). The application will reveal important patterns on the dynamics of the relation between stock market returns and corporate fundamentals especially in the transition from normal times to market crash. As it has been argued analytically in Chapter 3, for the profit-based approach financial turmoil is the trigger rather than the cause of economic crises. The idea is that corporate fundamentals deteriorate before the stock market crashes and not the other way around. Using data going back to 1880 I will show empirically that this is the case, and that 'phase transition' in the stock exchange reflects a pattern explained in Soros' 'reflexivity theory' elaborated in the previous chapter.

Although, the profit-based approach has not been tested extensively even for stocks, in all of the few empirical tests the findings are highly supportive. This will become evident from the presentation of Shaikh's (1997, 2016) estimations, as well as my contribution that follows. Overall, empirical testing provides a strong initiative for further elaboration on the analytical and empirical findings of this project.

---

[119] The idea is kind of simple as outlined in the equations that follow. I start from the definition of the incremental rate of profit and arrive at the approximation. A full explanation is provided in section 4b.

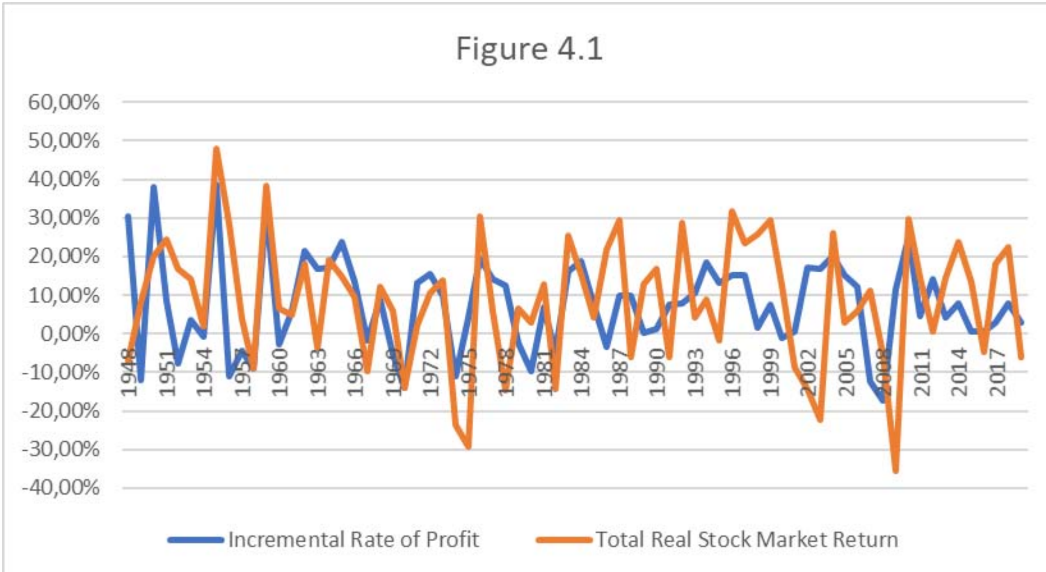
$$Irop_t = \frac{P_t - P_{t-1}}{I_{t-1}} \; if \; P_t - P_{t-1} \approx EPS_t - EPS_{t-1} \; and \; I_{t-1} = \rho \cdot P_{t-1} \; and \; \rho > 0 \; \rightarrow Irop_t = \frac{EPS_t - EPS_{t-1}}{EPS_{t-1}}$$

$$and \; P_t = corp.\ profit, I_{t-1} = Investment, EPS = Earnings\ per\ Share, Irop_t = Incr.Profit\ Rate$$

4a. The main assumptions of the profit-based approach on stocks - Summary and Empirical Handling

The main assumption of the profit-based approach when it comes to stock pricing is that stock market returns tend to become equal to the returns in the corporate sector. This is not something new, since mainstream theory also assumes equalization of risk-adjusted rates of return (Chapter 2). However, in the profit-based approach, the equalization of returns takes place around the volatile incremental and not the constant or slowly varying average rate of return (profit) of mainstream theory. The application of the incremental rate of profit is based on the Classical/Marxian theory of competition. In this context, equalization takes place between the incremental profit rates of the regulating capitals of each industry (Chapter 3 Section 3a). Given that in competitive economies corporations are expected to constantly bring to the market new products and apply new techniques, the incremental rate of profit is expected to be a highly volatile measure. Its volatility is enhanced further from the structure of expectations (Chapter 3 section 3f). We saw that in the 'reflexivity theory', expectations affect prices which, in turn, affect fundamentals that reflect upon prices, and so on. This means that stock price investments are inherently short term, since persistent variations in the incremental rate of profit bring forward new positions of risky arbitrage, or 'turbulent arbitrage', as Shaikh (1997) calls it. In other words, equalization is a dynamic and evolving process around an equilibrium path.

For this reason, when it comes to empirical testing the reasonable thing to do is to directly associate the incremental rate of profit with stock prices and returns. Although the assumption is that the incremental rate of profit of regulating capitals tends to become equalized, following Shaikh 1997, we will begin by calculating the time series of the average incremental rate of profit. the latter is the independent variable in our calculations. The dependent variable is the rate of return of the S&P 500 as presented in the publicly available database of the Nobel prize laureate Robert Shiller that can be found online (**Shiller 1**). The time series are pictured in the chart that follows:



Source: author's calculations

Figure 4.1 extends previous calculations of the time series of the (adjusted) incremental rate of profit (blue line) to the real total return (including the dividend yield) of the S&P 500 as recorded in the Shiller database. The incremental rate of profit is the ratio of the yearly change in real corporate profits (including depreciation) divided by real investment. Data sources (BEA tables), deflators, and formulas applied in the calculations are detailed in Appendix 4.1. The calculation covers the period from 1948-2019. It is an extension of previous calculations of the same series in Shaikh (1997) covering the period from 1948 – 1992 and in Shaikh (2016: 470-471) for the period 1948-2011.

In all three calculations, the time series retains the same properties. They have almost the same mean, standard deviation, and coefficient of variation. The prices of these descriptive statistics are detailed in table 4.1 that follows:

Table 4.1

	IROP	Total Return S&P500
Average	7.77%	8.46%
Standard deviation	11.90%	16.11%
Coefficient of Variation	1.53	1.90

Although both the time series and the descriptive statistics indicate that the two variables are strongly associated the R^2 between the two is only 10% (the Pearson correlation coefficient is 0.31). The reason is that the correlation between them is non-linear. Nevertheless, the data summarized in table 4.1 prove that for the profit-based approach there is no 'unexplained volatility' in stock market prices. You will recall that this whole project began (Chapter 1 section 1b) by presenting Shiller's (1989 a, b) work on the matter. The latter had shown that the variability of stock prices cannot be justified by the variations of dividends discounted by a constant, or almost constant, required rate of return that underlies the efficient market hypothesis. Here, using the incremental rate of profit as the required rate of return, it is shown that the volatility you get in the stock market is the one you should expect. It results from the rough return equalization process between the stock market and the corporate sector.

There are, however, additional elaborations in the initial empirical evaluations of the profit-based approach for stocks that are worth mentioning. The initial reaction of Shaikh to the empirical findings outlined above was a calculation of an equation like 3.45. Nevertheless, to apply the traditional correlation statistics, the data needs to be detrended to avoid spurious correlation. Following Shiller (1989b), this was done by dividing stock market prices by the 30-year moving average of the earnings per share.

Shaikh followed this practice to make his results comparable to those of Shiller. Specifically, in his (1989b: 78-82) book Shiller compares the detrended by the 30year moving EPS average S&P 500 prices to the DCF model prices calculated with a constant discount factor. From this comparison Shiller concluded that there exists excess, i.e., unexplained, volatility of actual stock prices as compared to DCF prices. By following the exact same practice and changing only Shiller's constant discount factor with the incremental rate of profit Shaikh claims that any difference in the results of two models is due to different discount factors applied. The results of Shaikh s' (1997) estimation extended to 2020 is summarized in Figure 4.2

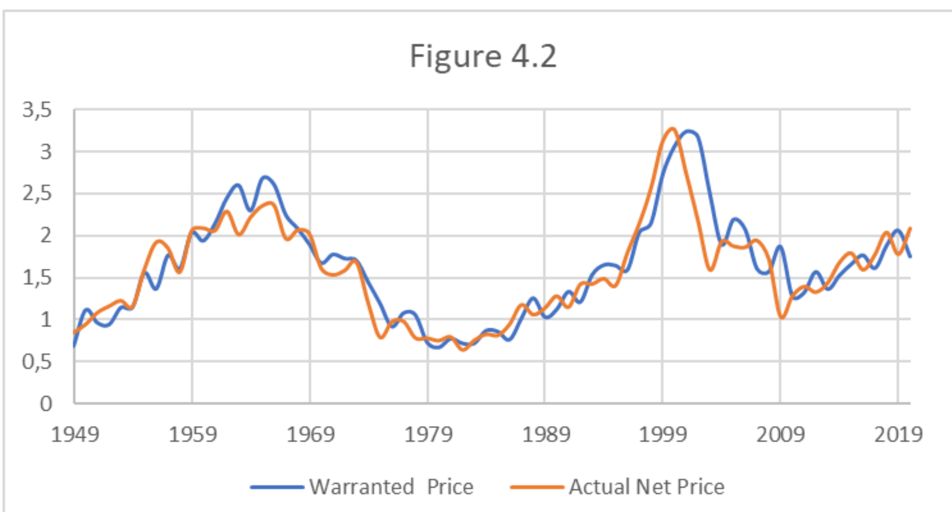


Figure 4.2 compares the warranted price (blue line) calculated from equation 3.45 $(P_{rt}{}^{w} = Pr_{t-1} \cdot [1 + (rror_t - divy_t)])$ with the detrended actual net price of the S&P 500 (brown line). The required rate of return is the incremental rate of profit calculated above from which I have deducted the dividend yield $divy_t$. The actual real price of the S&P 500 is

taken from the Shiller database divided by the 30-year moving average of the earnings per share. The R^2 between the two variables is 0.8. The strong correlation holds also for subperiods. Specifically, Shaikh (1997) performing the same calculation found an R^2 of 0.875 for the period 1948-1993. These results are extremely strong compared to calculations of DCF models where the R^2 is never greater than 0.09 (Shiller 1989: 81-82, Barsky and De Long 1993). Moreover, the difference in the R^2 can be attributed to the application of the incremental rate of profit instead of the Shiller constant discount factor.

Finally, a third elaboration is presented in Shaikh (2016). It is based on the methodology applied by Shiller in his book *Irrational Exuberance* published in 2000 (Shiller 2009) and the databases he updates and makes available online ever since (**Shiller 1**). The difference with the previous model is that, in this case, the data is not detrended. This time Shaikh (2016) wanted to show that the warranted price calculated from the profit-based approach is the 'gravity center' of the actual price. Therefore, any deviations cannot be attributed to irrationality, as claimed by the behaviorists. As you may recall, in Chapter 2 (section 2d.4) the behaviorist approach was considered in the context of the alternatives offered by orthodox theorists to the empirical failure of mainstream asset pricing models. It suggests that mainstream models fail because agents are 'irrational'. The latter leads to positive or negative extremes in financial asset prices. However, the benchmark of rationality for this theory is the 'efficient market hypothesis' (EMH). Shiller presented this notion empirically using a version of the martingale model (Samuelson 1964), presented in section 2f.2, against the real actual price of the S&P 500. Specifically, he calculated an average interest rate for the period from 1871-1999 (7.6%) and used it as the constant discount factor. Then he discounted dividends and arrived at 'Present Value of Real Dividend Prices'. The latter appears in his database (**Shiller 2**) updated until 2009.

Shaikh performed a simulation of the equation 4.1 (appearing herein below). It is similar in concept to equation 3.45 with the difference that, in the former, warranted prices are calculated based on previous warranted prices ${P_{rt-1}}^w$ and not actual prices Pr_{t-1}. However, in order to perform the iteration an initial price must be estimated based on an acceptable criterion. Shaikh reproduced the calculation constructing an initial price that equalizes the warranted and actual price averages for the period 1948-1995. On this ground, he constructed a simulation of the profit-based approach warranted prices using equation 4.1.

4.1 $${P_{rt}}^w = {P_{rt-1}}^w \cdot [1 + \text{rror}_t] - Div_t$$

$$and\ rror_t \approx Irop_t$$

The difference between the two calculations is the required rate of return. In equation 4.1 it is the highly volatile incremental rate of profit $Irop_t$ pictured in Figure 4.1 whereas the Shiller-EMH prices are calculated basis a constant rate of 7.6%. The results are summarized in Figure 4.3 below. The only thing I have added is that the profit-based approach warranted price calculation is extended to 2020.

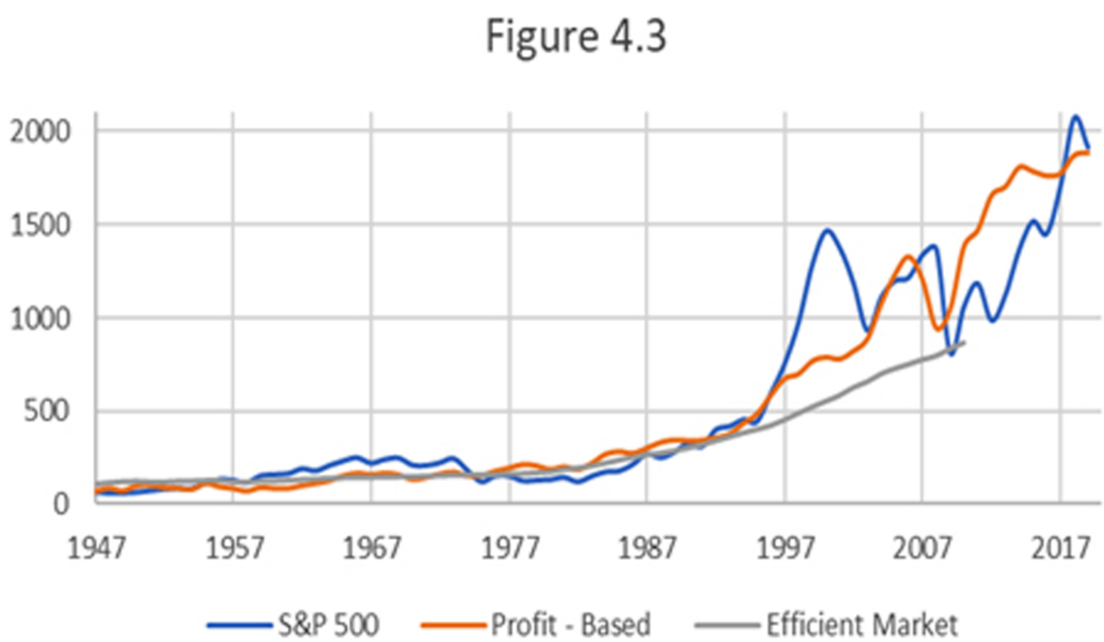


Figure 4.3 is indicative in many respects. The blue line which pictures the real price of the S&P 500 is the benchmark for the warranted price calculated from the profit-based approach (brown line) and the Efficient Market Hypothesis (grey line). For Shiller, the differences in actual prices from the grey line are indications of irrationality. The same is true of the volatility of actual prices compared to the smooth EMH prices. For the profit-based approach bubbles or underpricing can appear as indicated by Soros' reflexivity theory presented in Chapter 3 (section 3f). However, as Soros' reflexivity theory indicates, fundamentals rule in the end. This is confirmed in the simulation pictured above and it holds both in normal times as well as during financial and economic crises. The chart pictures the boom of the 1950s and the 1960s where actual prices exceed fundamental prices, the opposite happens during the times of the great stagflation (1970-1981) when actual prices underscore warranted prices. This pattern persists in the first years of the neoliberal era. However, following 1985 actual prices overshoot the underlying fundamentals reaching a climax in the dot com bubble (around 2000). The correction that follows was steep but short. Actual prices gravitated around fundamental prices and collapsed shortly after the collapse in the underlying fundamentals that preceded the 2007 crisis. A finding that supports the analytical approach of section 3d of Chapter 3 which argues that a financial crisis is only a trigger of major depressions. The irony is that Shiller's EMH estimated prices

lose any association to the actual prices in the years of neoliberalism when the idea of 'self-regulated markets' was at its peak.

Nevertheless, the most striking part of the simulation is that when extended to 2019 it does not picture a bubble as most of us would expect (at least I did). Of course, we should keep in mind that the time interval for the calculation of the initial price was picked arbitrarily. For a different initial price, we would end with a different warranted price. For this type of calculation, an 'unobserved component model' identifying the relation between stock market returns and the incremental rate of profit is required. Here I will present a different (non-parametric) statistic to identify this relation. Although we cannot derive a warranted price by applying this method, it will prove a step forward for the empirical evaluation of the profit-based approach. But before we move to this, we can draw interesting statistical inference by applying traditional econometric methods to the detrended stock returns and EPS data. This will be presented in the next section.

4b. Linear Regression - Statistical Inference for Detrended Prices – Using EPS Data

One of the missing points in the empirical analysis of the profit-based approach for stocks is the absence of any direct statistical inference for the explanatory variables. However, the correlation between detrended data and corporate fundamentals pictured in Figure 4.2 is a good starting point for an econometric model from which we can draw statistical inference.

The first step for this is to approximate the Incremental Rate of Profit with the rate of growth of the Earnings Per Share (EPS). This will provide access to data going back to 1871 and perform econometric calculations with time series from 1900 to 2019 even when we detrend the data using the 30year moving average.[120] This will permit us to take advantage of the properties of large samples. Moreover, this handling of the data does not contradict the profit-based approach. George Soros (1994), who's reflexivity theory is an integral part of the profit-based approach, uses the EPS as the key fundamental in his stock valuations and investment decisions.

The EPS growth, when associated with the companies of the S&P 500, can be considered as a closer proxy of the incremental rate of profit of regulating capitals, rather than the average incremental rate of profit we have used so far. If one simply looks at the companies that comprised the index through the years, he will realize that most corporations that reshaped and created markets for more than a century were at their peak in the S&P 500 index. For example, companies like Apple, Microsoft, Dupont, and General Mills are currently members of the index. To put it differently, the 500 corporations with the greatest market capitalization (this is the basic criterion for the construction of the S&P 500 since 1988[121]) in

[120] I keep this assumption so that the calculation will be comparable to Shiller (1989b) and Shaikh (1997).

[121] The composition criteria of the S&P 500 are not uniform throughout its history. To start with it did not always include 500 stocks. Originally it tracked only 233 stocks. In 1957 when it included 425

the NY stock exchanges and maybe in the world are probably (although not necessarily) regulating capitals.

As far as the numerator of the incremental rate of profit formula $Irop_t = \frac{P_t - P_{t-1}}{I_{t-1}}$ is concerned, substituting profit differentials with the change in earnings per share $EPS_t - EPS_{t-1}$ is a good proxy for the change in profitability. The EPS is the ratio of net corporate profits to the number of shares adjusted for any share buyback.[122] Things are more complicated for the denominator, since we cannot directly construct time series of investment for the S&P 500 companies from their balance sheets. Nevertheless, we can find an approximation for this measure by making certain restrictive, but plausible, assumptions. I elaborate on this by using equation 3.14 as follows:

$$4.2 \quad \frac{K_t - K_{t-1}}{K_{t-1}} = s_t \cdot (r_{1_t} - i_t)$$

$$K_t = capital\ advanced, s_t = r.o.\ savings, r_{1_t} = regulating\ r.o.\ profit, i_t = r.o.\ interest$$

$$let\ i_t = \delta \cdot r_{1_t}\ and\ \delta > 0, I_t = K_t - K_{t-1} and\ s_t = s$$

$$\rightarrow I_t = s \cdot (1 - \delta) \cdot r_{1_t} \cdot K_{t-1}$$

$$making\ use\ of\ r_t = \frac{P_t}{K_{t-1}}\ and\ asuming\ that\ r_1 = \frac{1}{1+z} \cdot r\ as\ in\ 3.15\ we\ get$$

$$\rightarrow \boldsymbol{I_t = \rho \cdot P_t\ and\ \rho = \frac{s \cdot (1 - \delta)}{1 + z}}$$

Equation 4.2 tells us that if the interest rate follows the regulating rate of profit r_{1_t} (the loan/ reserve ratio is constant) and that the ratio of the regulating to the average gross rate of profit is constant then investment I_t is a linear function of gross profitability. If we apply this to our modification of the incremental rate of profit it will read as follows:

$$4.3\ Irop_t \approx \frac{P_t - P_{t-1}}{I_{t-1}} = \theta \cdot \frac{EPS_t - EPS_{t-1}}{EPS_{t-1}}, \qquad \theta = \frac{1}{\rho} > 0$$

Equation 4.3 tells us that the incremental rate of profit is a linear function of the rate of growth of the earnings per share (EPS). Where earnings per share is the gross measure that includes dividends.

industrial, 50 utilities and 15 railway stocks it represented 90% of the total capitalization of the stock exchange. It is surprising that Financial companies were first included in the index in 1970. However, the objective throughout its history was to create a gauge for the market if not for the economy. The impact of the index is so great that some mainstream economists wonder if there exists an S&P 500 index effect on the prices of the stock that comprises the index (Kasch and Sarkar 2012).

[122] For example, if a company has net profits of one million euros and one million shares, its earnings per share will be 1 euro. If it buys back 200,000 shares its EPS will increase to 1.25 euros (1,000,000/800,000).

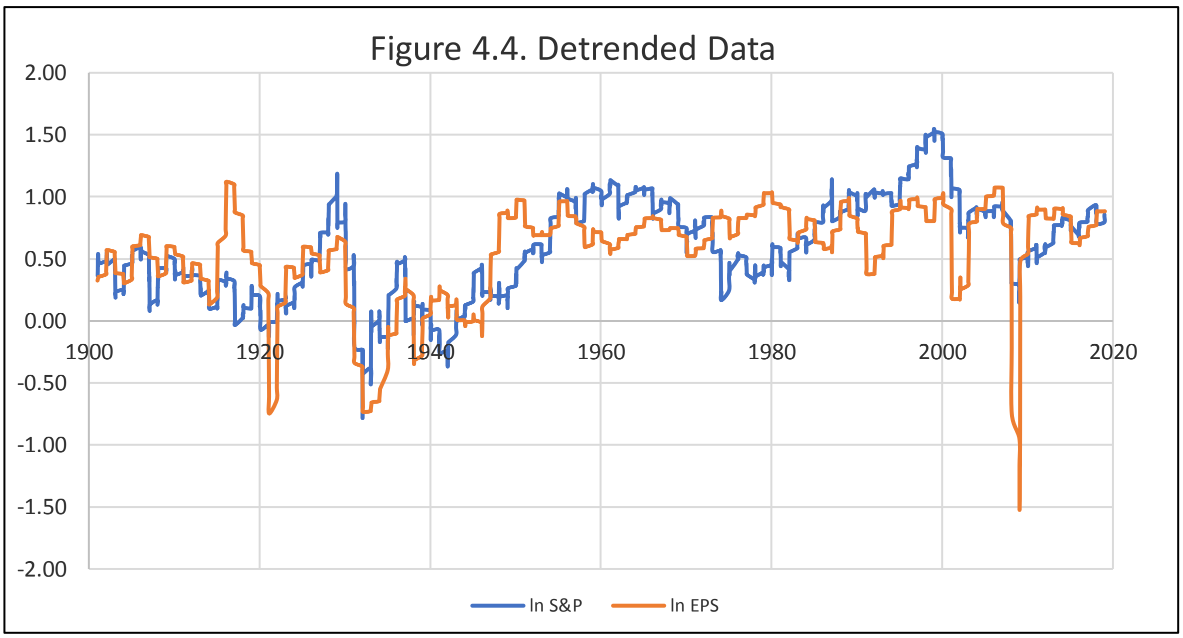
When it comes down to drawing inferences for the variables, we need to linearize these relations by using logarithms. In this regard we turn to log growth and linearize the following relation:

$$4.4\ ln\frac{Pr_t}{Pr_{t-1}} = \theta \cdot ln\frac{EPS_t}{EPS_{t-1}} \rightarrow \ln Pr_t - \ln Pr_{t-1} = \theta \cdot \ln EPS_t - \theta \cdot \ln EPS_{t-1} \rightarrow$$

$$\ln Pr_t = \ln Pr_{t-1} + \theta \cdot \log EPS_t - \theta \cdot \log EPS_{t-1}$$

$$and\ Pr_t = the\ price\ of\ the\ S\&P\ 500\ at\ time\ t$$

Equation 4.4 can be easily transformed into an econometric model where we can estimate θ using Ordinary Least Squares (OLS) provided that the two variables $\log Pr_t, \log EPS_t$ are stationary. This is achieved by dividing the time series of the S&P 500 and the EPS by their 30year moving average. The detrended variables are pictured in the following chart:



The chart pictures the natural logarithms of the detrended data. In the latter, all the important economic events of the past 120 years can be identified. The great depression of 1929, the great stagflation of the 1970s, the dot.com bubble, the Asian crisis, and the first depression of the new century (2007). Throughout a century the variations of the S&P 500 follow the variations in real earnings per share (EPS). This is confirmed from the regression of the following econometric model:

$$4.5\ \log Pr_t = Const + \log Pr_{t-1} + \theta \cdot \log EPS_t - \theta \cdot \log EPS_{t-1} + \varepsilon_t$$
$$where\ Const = constant, \varepsilon_t = the\ residual\ term$$

The results are summarized in the Table 4.2 that follows.

Table 4.2

N	1418						
Mean of Y	.0.579661034						
Equation	Y = .0.003047 + .0.1269 X - .0.1238 X-1 + .0.9923 Y-1						
R^2	.0.989						
R^2 adjusted	.0.989						
RMSE	.0.042171321						
Parameter	Estimate	95% CI		SE	t	p-value	VIF
Constant	.0.003047	-.0.001108	to .0.007201	2.1179E-03	1.44	.0.1505	-
X	.0.1269	.0.07236	to .0.1815	.0.027810	4.56	<.0.0001	94.39
X-1	-.0.1238	-.0.1783	to -.0.06929	.0.027786	-4.46	<.0.0001	94.20
Y-1	.0.9923	.0.9853	to .0.9993	3.5684E-03	278.07	<.0.0001	1.59

Source	SS	DF	MS	F	p-value		
Difference	############	3	73.170552074	41143.57	<0.0001		
Error	2.514686267	1414	0.001778420				
Null model	############	1417	0.156687609				

H0: E(Y|X=x) = μ
The model is no better than a null model Y=μ.
H1: $E(Y|X=x) = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \ldots$
The model is better than the null model.

Term	SS	DF	MS	F	p-value		
X	0.037034957	1	0.037034957	20.82	<0.0001		
X-1	0.035299843	1	0.035299843	19.85	<0.0001		
Y-1	############	1	1.375157E+02	77324.64	<0.0001		

The impressive thing about this estimation is not the 0.989 R^2. It is that all parameters come at their expected values. Specifically, the constant *Const* is almost equal to zero and statistically insignificant. The parameter of the price in the previous period is positive, significant, and more importantly almost equal to unity (1) as expected. Similarly, the parameter θ is almost equal for $\log EPS_t, \log EPS_{t-1}$, statistically significant, and with the appropriate sign for both. All this holds for a model that has been tested for a period over a century during which three major capitalist crises, two world wars, and major financial bubble episodes took place. However, during all these times stock market fluctuations followed closely the variations of the earnings per share. In this context, it is difficult to attribute stock price volatility to externalities or persistent irrationality in investment behavior. In other words, the volatile fundamentals rule.

Nevertheless, this is achieved through significant manipulation in the data, through which the nonlinear relation between stock market returns and the incremental rate of profit is linearized. Therefore, the question of estimating and drawing inference from the original data remains. If we want to evaluate empirically the overall relationship between the incremental rate of profit and the stock market return, we need to apply the appropriate non-parametric statistics because of nonlinearity. This is attempted in the next section.

4c. Non-parametric statistics-The case of transfer entropy

The empirical evaluation of the profit-based approach for stocks is limited because both the stock market (S&P 500) returns, and the Incremental Rate of Profit time series are not stationary. For this reason, direct statistical inference can be drawn from models like equation 4.5 or by applying cointegration techniques (the latter are not implemented here). As indicated in the previous paragraph in the case of regression models the data is smoothened, and the relations are linearized using logarithms. Drawing inference by comparing the original data remains an important matter for the profit-based approach. The non-parametric techniques applied here is a step forward for the analysis.

I argue that the non-parametric statistic 'transfer entropy' is appropriate. The reasons have to do with the properties and the insights that underlie the statistic. Specifically, the application of the 'transfer entropy' theory does not require that the investigated time series must follow any specific probability distribution. Every probability distribution can apply. Moreover, certain statistics measure the (asymmetric) transfer of information between two sets of time-series data. In other words, 'transfer entropy' is appropriate for non-linear processes. It is indicative that when estimating causality, between stationary time series the applied statistic reduces to the Granger causality as we will elaborate below. However, when the time series are non-stationary Granger and TE measure different things. In short, this technique is appropriate to measure the extent the Incremental Rate of Profit affects the returns on the S&P 500 without requiring any manipulation of the data. For the calculations, we will use again the logarithmic rate of growth of the real EPS as the proxy of the incremental rate of profit. This way we will estimate the full Shiller database starting from the 19th century, and not a calculation starting from 1947.[123]

[123] Shaikh's estimations of the incremental rate of profit begin in 1947 due to data availability.

4c.1. The Transfer Entropy (TE)

Before we move to this a brief outline of the notions of 'entropy' and 'transfer entropy' is appropriate. The exposition will be mainly conceptual before considering computational issues. 'Entropy' as a term has been coined by Rudolf Clausius from the Greek word for transformation (*τροπή*).[124] In modern science, it was associated with the second law of thermodynamics which states that the entropy of an isolated system does not diminish in time.[125] On the contrary, entropy maximizes when the system reaches thermodynamic equilibrium. This is a notion of equilibrium close to the perception of classical political economy and the profit-based approach. A turbulent process where the system (in our case the stock exchange) persistently transforms to new states through the sequel of positions of risky arbitrage.

The breakthrough in the calculation of entropy came from Claude Shannon (1948) a Bell Labs scientist, who developed concepts and formulas that can measure the microscopic disorder to the problem of random losses of information in telecommunication signals. This is the reason that the measurement of entropy took the name 'information theory'. In practice, the whole exercise is an effort to connect microscopic interactions to macroscopically observable behavior.

When it comes to random time series processes, in our case the rate of return of the stock exchange, and the incremental rate of profit, the concept of 'mutual information' is applied and extended. This means that the various algorithms attempt to calculate 1) How much uncertainty about the state of the stock exchange (S&P 500) returns is resolved by knowing the state of the incremental rate of profit (and *vice versa*)? 2) How much information is shared between the incremental rate of profit and S&P 500 returns? 3)How may we quantify the degree of statistical dependence between the two variables? In short, we attempt to calculate a non-linear correlation coefficient which, under additional assumptions, also specifies a causal relationship between the variables. The difference with the traditional measures is that the information is asymmetric it involves the impact of past values of the incremental rate of profit on the current rate of return of the stock exchange but also the impact of past values of the S&P 500 on its current price. This is a statistical notion remarkably close to the ideas of the reflexivity theory of Gorge Soros presented in Chapter 3

[124] "I propose to call the magnitude *S* the *entropy* of the body, from the Greek word τροπή, *transformation*. I have intentionally formed the word *entropy* so as to be as similar as possible to the word *energy*; for the two magnitudes to be denoted by these words are so nearly allied in their physical meanings, that a certain similarity in designation appears to be desirable." (Clausius 1867: 357). This is a translation from the original German in Clausius 1865: 46, where it appears as *Entropie.*

[125] The second law of thermodynamics establishes the concept of *entropy* as a physical property of a thermodynamic system. Entropy predicts the direction of spontaneous processes and determines whether they are irreversible or impossible. The second law may be formulated by the observation that the entropy of isolated systems left to spontaneous evolution cannot decrease, as they always arrive at a state of thermodynamic equilibrium, where the entropy is highest. If all processes in the system are reversible, the entropy is constant.

section 3f. The idea is that past values of the incremental rate of profit will eventually take over stock market returns, or that actual prices will gravitate around warranted prices like in the simulation presented in Figure 4.3 above.

Having outlined certain important aspects underlying 'transfer entropy' we can move to a more formal definition of the concept. In this definition, I will use at some point the Granger causality test as the benchmark. For now, we need to keep in mind that in this perception of entropy it is not only the past prices of the incremental rate of profit that must be considered but also the 'shared information' between past and present stock prices and returns. For our investigation, this indicates that for 'transfer entropy' prices and returns can be path-dependent as assumed by 'reflexivity theory' (Chapter 3 section 3f).

In light of the above, we can define (the one-period lag) transfer entropy keeping our investigation as the example and emphasizing non-stationary time series processes.

4.6 $T_{Irop \to smr(t)} \equiv I(smr_t : Irop_{t-1} \vdots smr_{t-1})$ *and*

$$I(smr_t : Irop_{t-1} \vdots smr_{t-1}) = H(smr_t : smr_{t-1}) - H(smr_t : smr_{t-1}, Irop_{t-1})$$

Equation 4.6 is a conditional 'mutual information function' it tells us if $T_{Irop \to smr(t)} = 0$ (where T stands for 'transfer entropy' and $I =$ 'information transfer') then the incremental rate of profit $Irop$ plays no part in the knowledge on the return of the S&P500 in the next period denoted by smr_t. The reason is that the measure is always nonnegative (see footnote 4). The operators H are measures of uncertainty.[126] In the linearized model summarized in equation 4.5 above (for detrended prices) the statistical significance of the parameters of the (detrended) earnings per share $\log EPS_t, \log EPS_{t-1})$ prove that linearized prices do not depend only on their past values. Here we will examine whether the same result holds for the actual data comparing returns and fundamentals. The time subscript appearing in

[126] For example, we can measure the average conditional uncertainty of the stock market returns on their last period price using the fundamental Shannon conditional entropy formula:

$$H(smr_t : smr_{t-1}) = -\sum_{smr} p(smr : smr_{-1}) \cdot \log_2 p(smr : smr_{-1})$$

Where p is the average conditional probability of smr. The equation calculates the probability of a certain set of stock returns to appear from a particular value in the previous period. Returning to formula 4.6 this presentation indicates that if the incremental has no impact on stock returns then:

$$H(smr_t : smr_{t-1}, Irop_{t-1}) = H(smr_t : smr_{t-1})$$

Keep in mind that mutual information (MI) is non-negative only for the averaged forms of the Shannon formula, not for local forms as we will see below. In this case the minimum Shannon entropy is 0 and the maximum equal to the entropy of the target variable.

equation 4.6 indicates the non-stationary process. In the remaining of the chapter, the incremental rate of profit will be referred to also as the 'source' variable and the S&P 500 return as the 'target' variable.

Of course, the one-period lag of the 'source' variable history in equation 4.6 is by no means the only time lag considered. To see how the concept works we need to consider the appropriate variable history. It has been suggested (Lizier *et al.* 2012) that for non-stationary 'target' variables the history length should tend to infinity. This means that the information the past target prices provide about state transitions in the target goes back to the distant past. There is no such rule for the history of the source variable although everyone suggests that it is no harm to go back as possible for the source variable as well (Bossomaier *et al.* 2016: 71)

Given the points on the optimum history of both source and target variables transfer entropy definitions can be generalized in various directions. The lag between the source and target variable is based on the idea that information is stored in the past values of the target variable (in our case the past rate of return of the S&P 500, or the last period price) whereas the impact of the last period source variable (in our case the incremental rate of profit, or the past value of the earnings per share) reflects how much information the source variable provides about state transitions in the target variable. The first matter that needs to be defined in this framework is how much information is transferred from the past value of the target variable in its next period price or the Active Information Storage (AIS) as it is called TE terminology. It is a rationale that reflects a good part of empirical discussions on the Efficient Market Hypothesis, the assumptions of behavioral finance, and the profit-based approach. Let us assume that we wish to evaluate stock prices if the efficient market hypothesis holds all information is passively stored (AIS=0) in the past price and any variations are due to random shocks. If behavioral finance assumptions are valid, then all information comes from the past price (active storage different from zero) and variations in the fundamentals play no part. Finally, for the profit-based approach, both changes in the fundamentals and the past prices play a decisive part. In the latter case, average Transfer Entropy is greater than zero.

Additionally, there are categories of conditional TE relating to a common driver effect that determines both the source and the target variables. In this regard, transfer entropy is redefined. The degree of uncertainty about the current target variable resolved by the past state of the source variable, the target variable, and the common driver together is subtracted from the degree of uncertainty of the current target variable already resolved by its past state and the past state of the common driver. This way the direct impact of the source variable is identified. Similarly, in concept, TE can be extended to various multivariate processes like 'global entropy' (Barnett *et al.* 2013).

Returning to the one-period lag question we can conclude that it is not binding for the source variable. TE can be calculated for any lagged value of the source variable. A fixed period lag is binding only for the storage target variable. In other words, the calculation of the impact of the lagged value of the target variable can only have a specific period lag. It has been shown that this way the Wiener principle of causality is preserved (Wibral *et al.* 2012). The Wiener 'principle of observational causality' argues that a time series X is called causal to a second time series Y if knowledge about the past of X and Y together allows one to predict the future of Y better than knowledge about the past of Y alone. In our case, if the incremental rate of profit or the earnings per share can predict the rate of return or the price of the S&P 500 better than their past value alone this constitutes a causal relation. We will elaborate on this matter further in relation to the traditional Granger causality test later in this section (4c.3).

For now, we need to consider an additional aspect of transfer entropy. So far, we have outlined how a calculation of the average TE can provide us with inference about the effect of a (source) variable on a target variable although their relationship is not (necessarily) linear. We have implied further that we have tools (not presented yet) to calculate this relation. Moreover, if such a relation exists it can imply a causal link between the source and the target variable. Nevertheless, averages hide the dynamical structure of the relation between the source and the target variable. On the contrary, the local perspective can reveal the dynamic structure. Applied to time-series data, local measures tell us about the dynamics of information in the system, since they vary with the specific observations in time. To be specific, a measured average of 'mutual information' and/or 'transfer entropy' does not tell us about how the symmetric or directed relationship between two variables fluctuates through time, how different specific source states may be more predictive of a target than other states, or how coupling strength may relate to changing underlying experimental conditions. On the contrary local measures can be revealing of these relations helping the resolutions of problems we have encountered already in the simulation originating from Shaikh (2016) and presented in section 4.1 (Figure 4.3). Local estimations is the part of TE theory we will apply in the present work.

4c.2. Transfer Entropy (TE) Estimators and calculations

I will present the transfer entropy estimators based on the assumption that both the incremental rate of profit and the rate of return of the stock exchange are discrete-time variables. As it will become evident shortly this means that we can estimate TE directly from the probability distribution functions of the source and the target variable. This is in accordance with the basic assumption of the profit-based approach (Shaikh 1997) where stock market returns must react to the underlying fundamentals. Moreover, the estimation does not rely on specific assumptions of the probability distribution of the variables.

To understand how the process works we can consider the Shannon mutual information (MI) formula. It reads as follows:

4.7 $I(smr_t, Irop_t)$

$$= \sum_{smr_t \in smr} \sum_{Irop_t \in Irop} prob_{smr,Irop}(smr_t, Irop_t) \cdot \log_2 \frac{prob_{smr,Irop}(smr_t, Irop_t)}{prob_{smr}(smr_t) \cdot prob_{Irop}(Irop_t)}$$

Where $prob_{smr,Irop}(smr_t, Irop_t)$ is the joint mass probability function of the stock market returns smr_t and the incremental rate of profit $Irop_t$ and $prob_{smr}$, $prob_{Irop}$ are the marginal probability density functions of the source and the target variable. MI tells us how much uncertainty about stock returns is reduced from knowing the incremental rate of profit.[127] For example, if the two variables are independent then $I(smr_t, Irop_t) = 0$ proven as follows:

$$If\ the\ variables\ are\ indipendent\ \rightarrow prob_{smr,Irop}(smr_t, Irop_t) = prob_{smr}(smr_t) \cdot prob_{Irop}(Irop_t)$$

$$\rightarrow \log_2 \frac{prob_{smr,Irop}(smr_t, Irop_t)}{prob_{smr}(smr_t) \cdot prob_{Irop}(Irop_t)} = \log_2 1 = 0$$

Equation 4.7 can be calculated straight forward provided we know the probability functions. However, the calculation is not always so easy since it involves sample and other biases that can increase MI. The Kozachenko-Leonenko entropy estimator (Delattre and Fournier 2016) and its development in the KSG algorithm (Kraskov, Stögbauer and Grassberger 2004) enables the approximation of equation 4.7 without knowing the probability function. More importantly, these algorithms can estimate also TE limiting any possible biases. However, in our estimation, we will be able to estimate probabilities directly (see section 4.3.6 below).

As stated already while commenting equation 4.6 TE is a case of conditional MI presented in the following Shannon equation:

4.8 $T_{Irop \rightarrow smr(t)} \equiv I(smr_t : Irop_{t-1} \vdots smr_{t-1})$

$$T_{Irop \rightarrow smr(t)} = \sum_{smr_{t-u} \in smr_{-1}} \sum_{Irop_{t-i} \in Irop} \sum_{smr_t \in smr} prob_{smr_{-1},Irop,smr}(smr_{t-1}, Irop_{t-1}, smr) \cdot \log_2 Z$$

$$Z = \frac{prob_{smr_{-1},Irop,smr}(smr_{t-1}, Irop_{t-1}, smr) \cdot prob_{smr_{-1}}(smr_{t-1})}{prob_{smr,smr_1}(smr_t, smr_{t-1}) \cdot prob_{Irop,smr_1}(Irop_{t-1}, smr_{t-1})}$$

Like equation 4.7 equation 4.8 is difficult to estimate directly. Nevertheless, the algorithms mentioned in the previous paragraph, especially the KSG algorithm can provide reliable estimations. In fact, the algorithms are incorporated in open-source software applicable in MATLAB and R.

[127] There is no rule about using a particular unit of measurement for the log values. In discrete variables it involves logarithms of base 2 and 10. I use logarithms with base 2 that are the most common in bibliography.

Before we move to the actual calculation, we need to address the issues of causality, inference, and applications of transfer entropy in financial time series. This way we will have a more complete understanding of TE theory before applying the appropriate statistic in testing the profit-based approach.

4c.3. Transfer Entropy and Causality a Comparison with Granger Causality

Here I will not enter the discussion of whether the Granger causality test is a true statistical estimation of causal relations between two or more time series. I will take Granger causality for granted. The reason is that at the conceptual level Granger causality and Transfer Entropy appear to be almost identical. In short, Granger suggested that if the past values of a certain explanatory (source) variable explained the fluctuations of the dependent (target) variable above its past values then this means that a causal relationship exists between the explanatory variable and the dependent variable.

Up to this point, it is hard to find a difference between the Granger test and the concept of TE. However, when moving to the calculation of causality under this concept Granger applied linear models and more importantly focused on predictability and not information transfer. Specifically, he suggested that causality can be estimated from the comparison of what he called the *full* and the *reduced* model. If we wanted to test our assumption of the relation between the incremental rate of profit and the stock market returns our Granger would look as follows:

$$4.9\ smr_t = a_1 \cdot smr_{t-1} + a_2 \cdot smr_{t-2} + \cdots a_k \cdot smr_{t-k} + \beta_1 \cdot Irop_{t-1} + \beta_2 \cdot Irop_{t-2} + \cdots + \beta_l \cdot Irop_{t-l} + \epsilon_t$$

$$4.10\ smr_t = a'_1 \cdot smr_{t-1} + a'_2 \cdot smr_{t-2} + \cdots + a'_k \cdot smr_{t-k} + \epsilon'_t$$

Equation 4.9 is the full model and 4.10 the reduced model. Both are VAR models. The model parameters are the coefficient matrices a_ι, β_j, a'_i and the covariance matrices $\Sigma \equiv c(\epsilon_t),\ \Sigma' \equiv c'(\epsilon'_t)$. The elements $\epsilon_t,\ \epsilon'_t$ are the serially uncorrelated residuals of the estimation. Of course, the estimation of the relation between $smr_t\ and\ Irop_{t-i}$ with such a model is not adequate. First, the relation is assumed linear, and second, the probability distribution of both variables is assumed stationary. This implies that both variables follow a Markov process something that has proven inadequate for the calculation of risk and volatility in financial asset time series as discussed in chapters 1 and 2.

To put it differently, Granger tests were applied for linear models involving stationary variables. The calculation of causality was performed by applying two roughly equivalent approaches. The first had to do with the calculation of a statistic indicating causality on the grounds of better predictability of the full model compared to the reduced model. The second had to do with the calculation of the likelihood ratio. Let us begin with the first approach:

$$4.11\ F_{Irop \to smr} = log \frac{|\Sigma'|}{|\Sigma|}$$

Equation 4.11 is the log ratio of the determinants of the covariance matrices defined above. It is presented here by applying the approach of Geweke (1982) on Granger causality for linear models and not the traditional approach applied by Sims (for example) in his (1972) paper. The statistic is based on the *generalized* rather than the *total variance* of the residuals[128]. The meaning of 4.11 is simple if the generalized variance of the full model $|\Sigma|$ is equal to the generalized variance of the reduced model $|\Sigma'|$this means there is no causal relation between the variables. Moreover, the greater value of the statistic the stronger the causal relation. Geweke (1982: 306) gives a full account of the properties of the statistic pointing also that if the time series is Gaussian the maximum likelihood estimate of F is easy to construct.

The latter brings us to the second equivalent approach. If the time series is Gaussian, then the statistic 4.11 is the log-likelihood ratio with a null hypothesis:

$$4.12\ H_0: \beta_1 = \beta_2 = \cdots = \beta_l = 0$$

4.12 shows a null hypothesis where the parameters of β_i in equation 4.9 are simultaneously zero. The interesting part with the maximum likelihood approach, in this case, is that the F statistic described in equation 4.11 is associated with an (asymptotic) χ^2 distribution with degrees of freedom equal to the difference in the number of free parameters between the full and the reduced model. Therefore, causality can be formally estimated statistically in this context.

Granger causality has certain additional properties. It can be extended from the time to the spectral/ frequency domain. This means that causal interactions can be decomposed by frequency. Moreover, the 4.11 statistic is invariant in the time and frequency domain if stationarity is strengthened through filtering. However, filtering leads to poor modeling. These issues will prove intuitive in understanding the relation between Granger causality and Transfer Entropy.

To start Granger causality and transfer entropy are linearly related only in the case the underlying time series reflect a Gaussian joint process. The relation is the following:

$$4.13\ T_{Irop \to smr} = \frac{1}{2} \cdot F_{Irop \to smr}$$

The proof is provided in Bossomaier *et al.* (2016: 86).

128 The total variance is the sum of variances whereas generalized variance is, by definition, the determinants of the covariance matrices.

In the same fashion if the underlying processes are Markov processes with a certain degree of ergodicity the Maximum likelihood transfer entropy estimator will converge towards the TE estimator defined in equation 4.8. The proof is provided in Bossomaier *et al.* (2016: 87).

Nevertheless, the association between a non-linear Granger causality test with a parametric (Maximum Likelihood) TE statistic can hold only under these restrictive assumptions. If we move from the Markov ergodic world any association between Granger and TE theories is lost. In short for non-Gaussian processes TE and Granger statistics (even if the latter incorporate certain non-linear relations) do not calculate the same thing. Transfer entropy calculates information flow whereas Ganger tests emphasize on predictability.

4c.4. Transfer Entropy and Statistical Significance/ Inference

Due to bias issues the statistical significance and confidence intervals of TE measures are calculated using sub-sample techniques. In practice, we set a *null hypothesis* and check whether it is true or false. Of course, this requires knowledge of what the probability distribution would look like if the null hypothesis H_0 is true. One way is to use surrogate variables with the same statistical properties as the tested variables generated under the null hypothesis. For example, if we assume that the null hypothesis is that $Irop$ and smr are not associated then if the null hypothesis holds this means that the distribution of the null hypothesis will be that of smr_t conditional on smr_{t-u}.

In the case of known distributions of the underlying variables, the task is easier. For discrete Gaussian processes, for example, we know that $T_{Irop\rightarrow smr}$ has an asymptotic distribution (discussed in the previous section $x^2/2 \cdot N \cdot \log 2$. The degrees of freedom are $(M_{smr} - 1) \cdot (M_{Irop} - 1) \cdot M_{smr}$ where M stands for cardinalities and that the two variables $(smr, Irop)$ have the same history. In general, even for skewed distributions as $N \rightarrow \infty$ the x^2 distribution described above holds asymptotically. These issues can prove complicating and this is one of the reasons we have applied the MI instead of the TE statistic.

4c.5 Applications of Transfer Entropy in Financial Time Series Data

I will conclude this brief outline with some applications of TE for financial time series. As we have seen already both analytically and to a certain extend empirically the profit-based approach combines both the 'market sentiment and market fundamentals' (Bossomaier *et al.* 2016: 127). This is precisely the understanding of the calculation of Transfer Entropy for stock market returns in Bossomaier *et al.* as quoted. Nevertheless, the authors of the cited book on transfer entropy are not familiar with any part of the profit-based approach argument. This is a strong indication of how adequate is TE theory for evaluating statistically the argument of the profit-based approach on stock returns.

Despite this hint, most of the applications of TE in the financial market were interested in the direction of the causal arrow between different financial variables rather than the direct estimation of the information flows between fundamentals and stock prices and returns. Specifically, some investigations were focused on identifying whether information flows from stocks to indexes or the opposite. The idea was that if indexes were the crucial factor then the momentum overrides the fundamentals and if the causality is the other way around (form equities to indexes) fundamentals rule. This, besides other issues, indicates why it is important to estimate stock prices and returns directly from the fundamentals instead of trying to infer their influence through assumptions that are not directly tested. The latter will become evident when considering specific stock-index empirical models.

The most known study is that of Kwon and Oh (2012) who worked with indexes and stocks from the Us, Europe, UK, and the Asia Pacific finding in all nine indexes considered a univocal flow of information from indexes to stocks rather than the other way around. In fact, in all cases, there was almost no indication of information transfer from stocks to indexes. This finding was considered as a verification of an investment behavior where traders try to anticipate what the other buyers and sellers believe. In this regard, they referred to Keynes' quote from the *General Theory* (Keynes 1936, Ch. 12: 156) on the newspaper beauty competition to emphasize the effort of traders to understand the market beliefs. In other words, the model implies an 'inefficient market' where the next movement can be predicted through 'technical analysis' although everybody knows this has not proven to be the case. Moreover, our findings on the association of the S&P 500 prices and returns with the Incremental Rate of Profit (Sections 4.1, 4.2) do not just justify the conclusion. The theoretical reasoning is so arbitrary that someone could even argue that the stock index is a proxy of the market portfolio and the findings are supportive of the capital asset pricing model where the market portfolio is the only source of undiversifiable risk. For our purposes, it must be clear that nonparametric models can lead to the inference, regarding the underlying theory only when the actual assumption is the one tested. Otherwise, the findings can be associated with practically any theory.

A more interesting application of TE in financial markets can be found in the effort of looking into financial market fluctuations and crashes as a 'phase transition' like the ones studied in physical phenomena. In a (2006) paper Kiyono, Struzik, Yamamoto studied the Black Monday of the New York Stock Exchange. They found that the financial system behaves a lot like a physical system through a varying underlying parameter that proves the non-stationarity of financial data. To put it differently, an underlying factor parameter varies as the system approaches the critical point and this alters the probability distribution of prices. Subsequently, Wicks, Chapman, and Dendy (2007) have shown that 'mutual information' (MI) can be a tool for detecting order/ disorder transitions in various systems. Harré and Bossomaier (2009) applied this methodology for financial markets. However, again the argument was not one relating fundamentals with prices but different stocks of the S&P 100 from 1995-2008 and the MI between them.

This discussion closes the rather lengthy, but I hope useful, introduction to Transfer Entropy. From what follows it will become evident that our application to transfer entropy is an original contribution since it attempts to infer on a theory and not simply to the properties of the time series. In other words, we pick the estimation technique basis the anticipated properties of the time series and not the opposite as it frequently happens in the empirical analysis.

4c.6. Mutual Information Local Estimations for the S&P 500 and EPS Growth 1880-2020

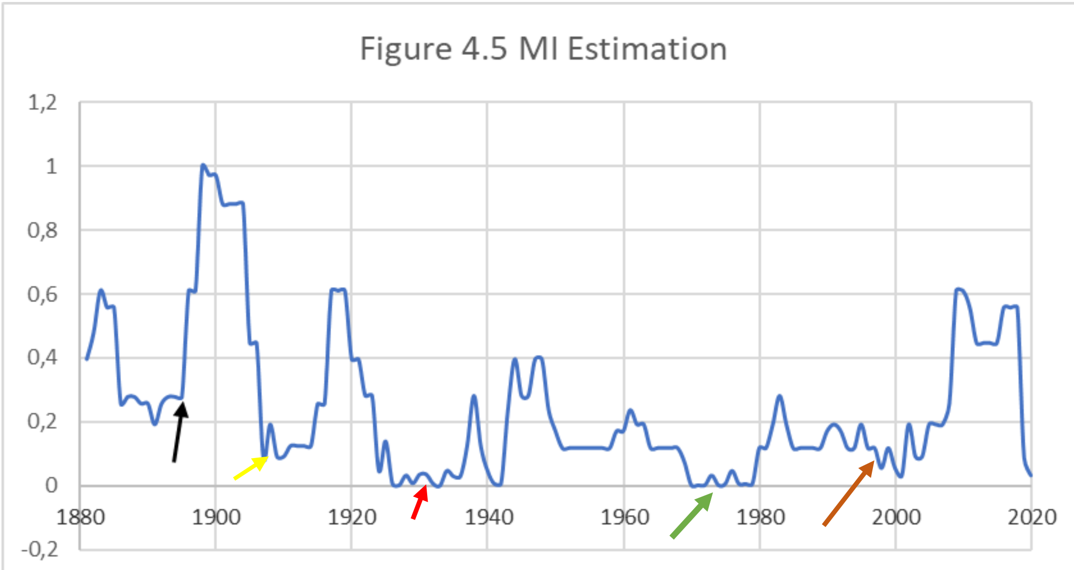
I work on the Wicks, Chapman, and Dendy (2007) methodology. The difference is that I calculated the local MI measures comparing the log growth of the S&P 500 directly to the log growth of the Earnings per Share (EPS). To calculate probabilities, I defined four possible states. One where the EPS increases and so does the S&P 500, one where both decline, and two cases where they move in the opposite direction. The case where the S&P 500 increases whereas the EPS declines will lead to a bubble if it is persistent. The opposite 'state' (the index drops although EPS increases) if persistent it will lead to underpricing. The MI statistic was calculated by applying equation 4.7 for the log-returns going back ten years. The table that follows is an example of the first calculation covering the period 1872-1881.

Table 4.3

Probability Table 1872-1881				
		S&P		
		Incr.	Dec.	10
EPS	Incr.	0.50	0.00	0.50
	Dec.	0.20	0.30	0.50
		0.70	0.30	
H S&P	**H EPS**	**I(S&P, EPS)**	**H(S&P, EPS)**	**MI (S&P, EPS)2**
-0.3602	-0.5	0.257287	-0.5	
-0.52109	-0.5	0	0	
0.881291	1	-0.16147	-0.46439	
		0.3	-0.52109	
MI		**0.395816**	1.485475	**0.395815602**

Table 4.3 shows that during the decade the S&P 500 increased together with the EPS five years, they simultaneously decreased for 3 years and in the remaining 2 years of the decade, the index increased although EPS fell. The mutual information (MI) is almost 40% and explains about 45% of the entropy of the S&P 500 which is 0.88. I repeated this same

calculation until the present dropping the first year of the calculation and including the next (1873-1882 and so on). The findings are summarized in Figure 4.5 that follows.



It is evident that the Local MI statistic experiences severe fluctuations over the past 140 years.

However, these fluctuations are indicative of an interesting pattern. The value of the statistic experiences a strong decline in almost all phase transitions that took place during the past century and a half. The black arrow points to the year 1893 it is the year that marked the end of the 'long crisis' (1872-1893). Thereafter, the price of the statistic MI surges and tends to explain the total of the S&P 500 returns entropy for a short time. The time between 1882 (when MI begins to fall) and 1885 (when the statistic begins to recover) was a period of depression in the United States as recorded by the National Bureau of Economic Research (NBER). The period from 1879 to 1881 was a period of prosperity (railroad growth). The latter explains MI prices of around .0.6 as it will become clear shortly. A similar reason (a recession involving a decline in industrial activity of 16%) stands behind the decline of the (MI) statistic for the period (1906-1913) indicated by the yellow arrow. The statistic, as well as the market, recovered from 1913 to 1926 having a cumulative increase of 36% over the period. However, following 1926 it became clear that the S&P 500 was a bubble. The MI index becomes almost zero (red arrow) indicating an increasing market with deteriorating fundamentals. Following the crash of 1929-1932 the opposite happened, the market did not reflect the recovery of the corporate fundamentals. It was only after the end of the so-called 'Roosevelt depression' in 1938 that the (MI) recovered to drop in the first war years (1940-1041) and recover for good after 1943. However, the dependence of the stock market on the earnings per share calculated by the (MI) statistic did not reach the pre-war levels during the Golden fifties and sixties. It was stable for values between 10 and 20%. Nevertheless, when corporate fundamentals began to deteriorate in the late 1960's early 1970s' the pattern persisted as indicated by the green arrow. Again the (MI) value dropped to zero and remained weak throughout the great 'stagflation'. It was only after 1980 when the crisis ended that corporate fundamentals were reflected in the market. The neoliberal era did not change this strong and long-lasting pattern. Although corporate fundamentals did not deteriorate the (MI) statistic reacted to the burst dot–com bubble of 2000 as pointed by the brown arrow. However, because the bubble was not hiding a depression the market recovered quickly and remained in line with the fundamentals throughout the first decade of the new century. The latter is confirmed also by the simulation of Figure 4.3. We can see there that in 2008 the stock market collapsed shortly after the collapse of the corporate fundamentals. Actually, after the millennium (MI) took high prices that were not witnessed since the second decade of the previous century. The reason is that the bubble did not burst together with the depression but 10 years earlier in the dot-com crisis.

There is both an economic theory but also intuition coming from physics behind this pattern. In physical phenomena 'a few particles' are sufficient for 'system transformation' (Wicks, Chapman, and Dendy 2007, Kiyono, Struzik, and Yamamoto 2006). In our context, this means that a few years of one-sided motion between the market and the fundamentals is sufficient to destabilize the market provided that the fundamentals keep deteriorating. As we saw in chapter 3 this is not simply a property of the (MI) statistic it is also indicative of a pattern in investment behavior. This is no other than the 'reflexivity theory' of George Soros. Financial capital controls stock market returns making positive expectations a self-fulfilling prophesy for some time. However, at some point, everybody realizes that the market is a bubble, and this leads to a sharp correction. If the market remains in line with the fundamentals like in 2008 the correction is dramatic, but the market recovers soon.

Conclusion

The models of the profit-based approach are complementary to each other. Simulation models like Shaikh (2016) presented in Figure 4.3 indicates a strong and long-lasting correlation between warranted and actual prices. The regression presented in section 4.2 gives clear inference that stock market returns depend on corporate fundamentals. Finally, the 'Mutual Information' model presented in paragraph 4.3.6 proves that this is not the result of manipulations in the data (detrending) but reflects long-lasting patterns. This means that the stock market volatility is perfectly rational since it reflects turbulent fundamentals but also path-dependent investment expectations. Overall, this research can open investigations both on the profit-based approach for stocks, but also other assets priced by the theory. In case these models are applied for professional use they must be evaluated together. If treated separately they can prove misleading.

Appendix 4.1

Calculation of the modified incremental rate of profit in Shaikh (1997, 2016).

The table that follows is an extract of the calculation of the incremental rate of profit. The nominal data come directly from the BEA tables as indicated in the description. This data is deflated by the Implicit Price Deflator to give real gross Investment (IRG corp.). This concludes step1. Step 2 calculates Gross corporate Profits (including depreciation) from BEA tables and deflates the nominal amount arriving at Real Gross Profit (using the Implicit Price Deflator). The amended incremental rate of profit for 1948 is the Difference in Real Gross Profit divided by Real Gross Corporate investment in the previous period.

Step1 Implicit Price Deflator Gross Investment				
	1947	**1948**	**1949**	**1950**
FA T.6.7 line 2	17.30	19.50	17.80	19.50
FA T.6.8 line 2	4.96	5.14	4.58	4.91
(IGRcorp. index bea (t)/100)*IGCcorpbea(2005): Bills-2005$	64.28	66.62	59.25	63.54
Implicit Price Deflator, Gross Investment, pIG corp bea	26.92	29.27	30.04	30.69
Step2				
BEA Table 6.4 line 2 Current - Cost Corporate Depreciation	9.80	11.50	12.40	13.30
BEA Table 1.14 line 11	23.20	30.10	27.90	34.80
Gross Corporate NIPA Profit (sum of excel lines 8+9)	33.00	41.60	40.30	48.10
Real Gross Corporate Profit = line 10x100/ line 6	122.61	142.12	134.15	156.73
Modified Incremental Rate of Profit		**0.30**	-0.12	0.38
	formula	**(C11-B11)/B5**		

Conclusion

This project presents a theory of financial asset pricing from the Classical/ Marxian tradition. This is not a one-sided matter. It is important for understanding the theoretical and empirical shortcomings of mainstream theory, the causes and the trigger mechanism of economic crises, the essence, and the limits of financial regulation.

Mainstream Asset Pricing Assumptions, Empirical Performance, and the Present State of Research

The first two chapters were devoted to the identification of the assumptions underlying mainstream theory and their connection to its poor empirical performance. I began by presenting the constant required rate of return underlying the present value principle. Although, it is this a matter of mathematical tractability (to derive the present value formula) constant or slowly varying required returns obey the assumptions of Mainstream Theory. The first chapter argues that constant or slowly variable rates of return stem directly from the neoclassical equilibrium theory where the required (risk-free) rate of return is the rate of interest, a measure that, under perfect competition and frictionless markets, is not expected to exhibit any particular variability or trend.

This result has important repercussions for investment selection and financial asset pricing. Elton and Gruber (1976) have shown that investors (shareholders), in a world of perfect competition and perfect capital markets, face a smooth investment opportunities frontier. So, knowing the availability of future investment opportunities in every rate of return, they can decide on a constant lifetime rate of return on new investment which is associated with a constant known risk factor. In the neoclassical world of the model, this is quite realistic. No one is expected to attack prices and market shares since all corporations are assumed to be price takers. Therefore, investors can decide on the desired, relatively constant, 'cut off rate of return', for new investment. The latter will be associated with a certain risk premium reflecting greater or lesser volatility around the mean of the stationary probability distribution of future returns. This is the minimum or required rate of return. Elton and Gruber show that on these grounds, shareholders make investment decisions that maximize the company value. Therefore, the rate of profit on new investment (the incremental rate of profit) is assumed roughly constant and (almost) equal to the average rate of profit. The latter justifies the constant discount factor of the Discounted Cash Flow (DCF) models.

Unfortunately, when DCF models are placed under the scrutiny of empirical testing the results are far from satisfactory. Robert Shiller (1989) has shown that under the efficient market hypothesis, warranted prices – like those calculated by discounting future dividends using the present value formula – should exhibit greater variability than actual prices. This assumption is fully rejected by the stock market data. Shiller (1989b) extended his investigation to encompass covariance of the differences between warranted (present value) and actual prices for two different shares. He found that it is positive, although under the efficient market hypothesis it should be negative. In other words, the more shares you add to a portfolio, the greater the difference between expected and actual returns. Therefore, the anticipated equality between expected and actual returns, under the efficient market hypothesis, does not hold when equity prices are calculated from DCF models. In other words, the variability of dividends cannot explain variations in stock prices. This can mean three things, 1) investors' reference prices come from a different price model, 2) the efficient market hypothesis does not hold, and 3) both the efficient market hypothesis and DCF models do not reflect the actual operation of capital markets. Given that under the efficient market hypothesis rates of return are assumed roughly constant the argument presented here is that proposition (3) should hold.

These are not, however, the only empirical problems facing mainstream theory. In the latter, variability is strongly associated with the level of returns. Highly volatile stocks are expected to have higher returns than stocks that exhibit lower volatility because they are considered riskier. The difference between the return on stocks and treasury bonds is referred to as the 'risk premium'. In an Arrow–Debreu frictionless and liquidity unconstrained model, the risk premium is associated with the volatility of the 'risk-free asset' return because risk aversion is assumed constant. Moreover, in this Arrow – Debreu context, shocks in per capita consumption are the source of volatility for both stock and bond returns. Therefore, the difference in returns is calculated by multiplying the volatility of bond (risk-free) interest rates with the level of risk aversion. Finally, the time path of per capita consumption is assumed to follow an 'ergodic Markov chain' (Mehra and Prescott 1985). In other words, it is stationary, exhibiting random variations of constrained amplitude.

After an extensive survey of the relevant literature, Mehra and Prescott (1985) suggested that the maximum admissible level of risk aversion is below ten (10). Calculating the volatility of the real risk-free rate (a weighted average of short-term US bonds with an average rate of 0.8% approximating the T– Bill) in the US from 1889-1978 they found that the maximum admissible risk premium coming from a model of this form is 0.35%. Unfortunately, the actual average risk premium of the S&P 500 during the same period is 6.18%, almost 18 times greater. This result has gone down in the literature as the 'equity risk premium puzzle'.

The 'profit-based approach' shares the notion that the required rate of return for the stock market is the rate of return on new investment as in Elton and Gruber (2000). However, contrary to mainstream theory, it is expected to be a highly volatile measure. This is because it relies on the classical theory of competition, where competition is 'war' fought by the cheapening of commodities. Any equalization of returns between industries, as well as between the corporate and the financial sector is constantly disrupted by developments of all sorts, new products, new techniques, etc. The result is a turbulent process where the corporate and financial sector rates of return constantly fluctuate around each other never becoming exactly equal. The latter implies that persistent mobility of capital between the corporate and the financial sector is required to maintain equalization of returns at least as a tendency. Mobilization of funds and equity positions of such magnitude can be implemented only by financial capital. Therefore, contrary to mainstream theory, where shareholders decide the 'cut off' rate of return as in Elton and Gruber, the stock market rate of return lies in the corporate sector. This means also that financial capital regulates the rate of return. This is a conclusion in contrast to the efficient market hypothesis where, in the absence of privileged information, everyone receives the market rate of return at the end of the day.

Based on these findings in Chapter 2 we investigated how these rates of return are determined and structured in the context of asset pricing models and considers the empirical relevance of the results by reviewing the literature. Following a short history of mainstream asset pricing, the exposition moved to the Capital Asset Pricing Model (CAPM). There is no doubt that, although its empirical performance is 'poor enough to invalidate the way it is used in applications' (Fama and French 2004: 25) the CAPM is still the "centerpiece of MBA investment courses" (*ibid*.) and dominates the field. Since Arbitrage Pricing Theory (APT) was offered as a solution to the 'specification problem' underlying the CAPM (Roll 1970, Ross 1976) it followed in the presentation. Early attempts by mainstream theory to resolve the poor empirical performance of these models like 'behavioral finance' (Shiller 2009) and the 'Three-Factor Model' (Fama 1996) are considered as well. The chapter moves to the discussion of the assumptions and conclusions underlying the 'efficient market hypothesis'. In this regard it explains, the relation between information efficiency and constant or relatively stable discount factors underlying mainstream asset pricing models.

In the context of mainstream theory, it comes as no surprise that the first assumption of the CAPM is that asset returns follow the normal distribution. In other words, investors decide based on the mean and standard deviation of stock returns. This implies among other issues that stock returns are (roughly) uncorrelated with each other. Otherwise, their probability distribution will diverge from the normal distribution even as we add shares in well-diversified portfolios since the 'law of large numbers' will not apply. In a world where 'normality' does not hold, investment decisions cannot rely on the mean and standard deviation. So, in the CAPM world, investors believe that the performance of one corporation cannot affect the performance and returns of other corporations in a persistent manner. Any difference in performance among corporations, in the same industry, for instance, appears randomly and is smoothened out almost immediately. This implies that deviations in corporate returns do not emerge intensely and persistently, since perfect competition restrains corporate investment selection. The market share of corporations is not attacked by competitors reducing prices. Therefore, investors facing a smooth investment opportunity frontier can simply decide not to undertake projects below a certain rate of return.

In short, the first assumption of the CAPM can be explained only with reference to a neoclassical equilibrium in the corporate sector which underlies investment selection. This argument, however, is not supported by financial data. In a book written in 2000 and titled the '(Mis)behavior of Markets' the mathematician, Benoit Mandelbrot underlines the striking difference between the actual probability distribution of stocks, commodities, exchange rates, and other asset prices and returns and the normal distribution assumed by the CAPM.

Nevertheless, by incorporating two additional assumptions, namely: 1) that investors (who share the same investment horizon) agree on the joint distribution of stock returns during the reference period and 2) that there exists unconstrained liquidity at the 'risk-free rate', the CAPM arrives at an amazing conclusion. The conclusion is that there exists a portfolio of risky assets superior to all other portfolios because it has the highest return/ risk ratio. Therefore, all investors will be willing to hold this particular portfolio irrespective of their risk preferences, since it is optimal to any other portfolio on the basis of the risk/ return tradeoff. In other words, in the presence of a 'risk-free asset', risk preferences are separated from the stocks to be held. This is the so-called 'separation theorem' (Tobin 1958). Investors adjust their financial holdings to their individual risk preferences by altering the proportions in which they hold the 'risk-free asset' and the optimal portfolio. Since the latter is unanimously held it can be no other than the 'market portfolio'.

It is truly amazing: all investors from Warren Buffet to a worker who began his investment 'career' by purchasing 10 shares of the corporation he works for, will end up holding the same portfolio, the market portfolio. This means also that all investors will receive the market return on their risky assets. As James Tobin has suggested the 'separation theorem' reduces the CAPM to a 'representative agent model' under the second assumption (investors agree on the joint distribution of stock returns). Therefore, huge banks and financial corporations, equity and hedge funds managing multibillion-dollar portfolios, either do not exist in the CAPM world or, if they do, they behave like the guy next door who has invested some few thousand euros in stocks and other financial assets. At the same time, the first assumption (asset returns follow the normal distribution) reduces the CAPM to a 'representative firm' model, the 'market' playing the part of the representative firm. This is why Mehra and Prescott 1985 conducted their test of the risk premium by applying a single corporation and a single household model.

Although most of the mainstream critique of the CAPM has focused on the unrealistic assumptions relating to the common view of investors on the joint distribution of returns and unconstrained liquidity, the key assumption in my view is the first assumption. It is the no (or very limited) correlation between stock returns assumption which results to assign total risk, associated with each share, to a single common factor (the market return). The latter implies also that aggregate market returns will also be stationary, by virtue of the law of large numbers. Therefore, market returns will also exhibit limited variability due to the properties of the normal distribution.

In this world, corporate fundamentals, especially corporate profitability, have no direct impact on, stock and financial asset returns. Financial investment selection is based only on the contribution of the (assumed) individual financial asset volatility to market volatility. In other words, the covariance between stock returns can be fully attributed to their covariance with the market portfolio. It could be no different in a world where corporate competition is limited to perfect competition. If instead of perfect competition we assume that the classical theory of competition holds, then inter-industry competition will constantly disrupt equilibrium with new products and techniques. This will affect the returns of other companies since the most efficient competitor(s) will try to attack the market share of the less efficient reducing their profitability and the latter will fight back. This may create also a divergence of returns between different sectors accelerating capital flows into the higher 'incremental profit rate' sector, eventually reducing its returns and the economy average. Finally, returns are correlated through the impact of various types of business cycles like the five and ten -year cycle, or major crises that affect profitability. However, the impact is different between the efficient and the less efficient corporations, as well as different branches of the economy. In short, it is impossible to eliminate 'particular risk' through diversification, because in real competition the returns of one corporation have a persistent, greater or lesser, impact on the returns on other corporations and this reflects on the aggregate stock market returns as well as individual stock returns. This means that as one adds shares in a portfolio, he may be accumulating rather than reducing risk. The positive covariance of the error term generated by comparing DCF and actual stock prices (Shiller 1989b) is an example of this case. In other words, in the 'profit-based approach' like in real life, uncertainty rather than calculable risk accompanies investment decisions. This rationale can be extended to interest rates and fixed income assets, as well as derivatives and asset-backed securities. Financial markets are maybe the most profound example that the 'ergodic axiom' (Davidson 1991) underlying neoclassical static equilibrium does not hold.

It is worth pointing out that this is not merely an academic debate; the CAPM is a model broadly used for the determination of the 'cost of capital' in corporate actions and transactions justifying billions of dollars and Euros changing hands through the capital markets. Amazingly, its poor empirical performance has been disregarded by the profession.

The empirical tests of the CAPM are numerous. They are usually grouped by their publication date into three periods (early, middle, and recent). The reason for this categorization is not merely chronological. Each period focuses on the empirical testing of different aspects of the model. For example, the shape and slope of the 'securities market line,' the investigation of the properties of the market portfolio, etc., have characterized different periods Because of their volume, we cannot present them in the concluding section. However, I consider the Fama and French empirical study of (1992) the benchmark of all the empirical work associated with the CAPM. The study showed a negative relation between stock returns and beta. In this regard, it was the fatal blow to any empirical relevance associated with the model.

One way out of the problem was the introduction of the theory and the models of 'behavioral finance'. The idea is that investors are 'irrational' and this leads them to exaggerations in the one or the other direction. The latter explains the turbulence in asset prices and returns. The key variable is the book to market value ratio. High book to market value is an indication that a company has fallen in 'bad times' while the low book to market ratios implies growth firms. Sorting firms based on their book to market value, argue the 'behaviorists', reveals the overreaction of investors to good and bad times. Investors over-extrapolate past performance, resulting in stock prices that are too high for growth (low B/M) firms and too low for distressed (high B/M, so-called value) firms. When the overreaction is eventually corrected, the result is high returns for value stocks and low returns for growth stocks. Proponents of this view include DeBondt and Thaler (1987), Lakonishok, Shleifer and Vishny (1994), and Haugen (1995). Of course, the most prominent members of the group are the Nobel Prize laureate Robert Shiller (2009) and Nouriel Rubini (Rubini and Mihm 2011) who have attempted to interpret the current depression through the creation and burst of asset bubbles.

The problem of behavioral theories is that they assume irrationality for investors in financial markets, while assuming that consumers and corporations behave 'rationally' in accordance with the neoclassical equilibrium model. People cannot function under a certain pattern as consumers and corporate capitalists and under a different pattern as financial investors. The advantage of the 'profit-based approach' is that the profit motive dominates all functions of economic life, including financial investments. In this regard, the financial asset valuation model presented herein is part of a broader paradigm originating from the classical/ Marxian political economy.

A second alternative to the CAPM is the so-called 'multifactor models'. The 'three-factor model' introduced by Fama and French in 1993 and 1996 is one of the most popular examples. Fama and French inserted the size and value (book to market value) effects, besides market return, to capture variations in stock returns. They argue that these variables reflect hidden 'state' variables which are sources of un-diversifiable risk common to all stocks. In short, they consider the 'three-factor model' as a version of the Intertemporal CAPM. This is, however, quite problematic: there is no proof that the performance of diversified portfolios reflects 'state variables'. It can be argued that it represents other types of investment behavior as argued by the behaviorists or simply un-diversifiable particular risk (structural uncertainty) as argued here. In short, the 'three-factor model' is maybe the best of many efforts to introduce variables with considerable correlation with asset returns to improve the empirical performance of mainstream models. However, the interpretation of the corporate size effect, for example, as a hidden common source of un-diversifiable risk is perfectly arbitrary.

The introduction of 'state variables' instead of the market portfolio as sources of un-diversifiable risk is also the central idea of the Arbitrage Pricing Theory (APT). This multifactor model was introduced, at least in part, as a solution to the empirical problems of the CAPM. One important empirical aspect of the CAPM was the specification of the market portfolio. Although all investors are assumed to hold the same portfolio of risky assets theorists are not sure which assets comprise the portfolio. On this ground Roll and Ross (Roll 1977, Ross 1976) argued that the CAPM is practically an empirically untestable theory, because its only explanatory variable, the return of the market portfolio, cannot be specified. Noting in passing that it is kind of odd to suggest on one hand that the 'market portfolio' is held by each and every investor in risky assets and, on the other, that it cannot be specified, we will turn to the theoretical specification of the APT.

In his famous 1976 paper Stephen Ross suggested that, besides specification, the CAPM had also certain theoretical problems. The original Sharp-Lintner version of the model-based the normality assumption for the returns of the market portfolio on the law of large numbers. In other words, it is assumed a priori that individual stock returns are uncorrelated. Therefore, as we add stocks to a portfolio its returns will tend to become normally distributed. This had no economic justification. Furthermore, the second condition for choosing financial assets on the grounds of mean and standard deviation, the quadratic utility function condition, argues Ross (1976), is also difficult to justify. It suggests that utility is maximized at a certain level of wealth and declines afterward. This means that as wealth increases the propensity to take risk declines. The latter is unrealistic since it is beyond doubt that rich people are willing to take more risks than poor people.

To address these shortcomings, Roll and Ross introduced the APT arguing that its assumptions are backed by theory and can be tested empirically. The intuition behind the model draws from Arrow-Debreu security pricing (Huberman and Wang 2005). In this context, an asset's payoff is the weighted average of the payoffs of certain (common) fundamental securities. If we take this rationale to determine returns and expected returns, rather than payoffs and prices, then the unexpected part of an asset's return is the weighted average of the unexpected returns on the fundamental securities. Under a similar rationale, Fama and French introduced the 'Three-Factor Model' mentioned above, where diversified portfolios constructed under various ad hoc criteria were arbitrarily considered as 'fundamental securities'. With the Arbitrage Pricing Theory, the reader has to be more imaginative to consider the four common factors i.e. (unexpected) changes in: 1) inflation, 2) industrial production, 3) risk premiums and 4) the term structure of interest rates, suggested by Roll and Ross (1980), as unexpected variations of 'fundamental securities'. If on top of this we assume a constant risk aversion concave utility function, ensuring that risk preferences do not change as the number of assets increases, unlimited short selling, and consequently the no-arbitrage condition, we arrive at a linear relationship between asset returns and factor betas (loads).

The theoretical intuition of Roll and Ross is very illuminating on the underlying assumptions of mainstream asset pricing models. It was the basis of our criticism of the CAPM since we treated it as a 'single factor model', the market portfolio being the 'single factor'. The same is true also for the APT. When it is presented in mathematical form it appears as a linear regression where the constant term is the expected return and the coefficients (betas) calculate the impact of unanticipated variations of the common factors which appear as the independent variables. Finally, the linear regression includes the error term which reflects idiosyncratic risk which is expected to be eliminated through diversification. The first aspect of the model is the constant expected return reflecting a neoclassical static equilibrium. In the same fashion, the unanticipated changes in the factors are assumed random and stationary, also in line with a neoclassical equilibrium. The probability distributions of the common factors represent a set of 'states' of the economy known from the past which are expected to reappear with a certain probability in the future. It is the well- known ergodic axiom which underlies Modern Investment Theory and reduces true uncertainty to calculable risk.

However, the key assumption on which both previous results rely is that the residual term is uncorrelated between stocks, or, in other words, that the returns of one share do not affect the returns of other shares. This ensures the no-arbitrage condition. Arbitrage in this context is a situation of profit without risk and capital. It appears when asset returns are not in a linear relation with the factor loads. In this case, an investor can sell short the overpriced share and use the proceeds to purchase underpriced shares. Eventually, the value of overpriced assets and portfolios declines, the value of underpriced assets and portfolios increases, and the linear relation between risk and return is restored. But, if the idiosyncratic risk is not eliminated with diversification, as elaborated above, then selling short a portfolio of risky assets, which appears overpriced, may end up in a loss. For example, a certain stock that is part of the portfolio may report high profits and this may boost expected returns on the whole portfolio, its value may rise rather than fall and consequently, the short seller will suffer losses. In the real world of highly volatile asset returns positions of arbitrage constantly prevail. However, they are positions of risky arbitrage or 'turbulent arbitrage' (Shaikh 1997) where current and expected profits generate new opportunities and new positions of profit or loss.

Although the APT is a solution to the specification problem of the CAPM, it has important specification problems of its own. The main problem is that the assumption of zero covariance between factors, required for linear regression, is so obviously wrong that it pushes empirical testing towards techniques that do not require explicit reference to the underlying factors. Otherwise, one must argue that unanticipated variations in inflation have no impact on industrial production, or on the term structure of interest rates, something both theoretically and empirically wrong.

Taking the above into account, in one of the initial tests, Roll and Ross (1980), attempted to dissociate the empirical evaluation of the model from factor specification. They suggested that a theory 'should be tested by its conclusions, not by its assumptions' (Roll and Ross 1980)[129]. In this context, they suggested that '(o)ne should not reject the APT hypothesis …by merely observing that returns do not exactly fit a k-factor linear process'[130]. This methodology gave rise to a long line of tests which, using 'factor analysis', investigates the weak hypothesis that all factor prices are not simultaneously equal to zero. On these grounds, the theory is not accepted but it is not rejected as well. As admitted by many theorists these tests are highly problematic since they are conducted on subsets of stocks and financial assets and their results cannot be generalized (Haugen 1999, Lehmann and Modest 1985). When factors are expressly specified the model underperforms *ad hoc* models as pointed out by Haugen in one of the most popular textbooks in Modern Investment Theory (Haugen 1999)

The previous discussion and the elaboration in Chapter 2 show that the key assumption of all mainstream models is that the return of one financial asset does not affect the returns on other assets. This permits the determination of asset returns from (a) common factor(s), or common 'fundamental asset(s)' in the Arrow – Debreu terminology. This idea stems directly from the notion of perfect competition where corporations are assumed to be price takers. In this regard, their performance does not affect the performance of other corporations, since they will not attack the market share of their competitors by applying more productive techniques and reducing prices. This has important implications both on individual and

[129] A notion of 'methodological positivism' that was initially elaborated by Friedman (1953). This idea underlies many important aspects of Modern Investment Theory.

[130] Actually, Roll and Ross found different factor prices along subgroups as I elaborate in chapter 2.

aggregate corporate returns which in the context of neoclassical equilibrium do not exhibit any particular variability or trend. The latter underlies the assumption of stationary returns assumed by mainstream asset pricing models. The idea is that market returns follow a 'random walk' which represents different 'states' of the economy, known in advance, with a specific probability of occurrence. This is the ergodic axiom that reduces uncertainty to calculable risk and the latter determines the structure of returns. The efficient market hypothesis is the best proof for these points since it focuses on the properties of the market rather than a particular asset pricing model. To put it differently, the theory of efficient markets is the application of neoclassical equilibrium to the financial asset markets (LeRoy 1989).

For this reason, two basic assumptions underlie the efficient market hypothesis. First, that financial markets have perfect informational efficiency and second, that prices are optimal equilibrium prices like those solving an Arrow-Debreu general equilibrium model (Crotty 2011). In reality, the assumption that markets are efficient is a presumption for the construction of mainstream asset pricing models of market equilibrium (Fama 2007). To understand how these notions fit together an answer to the following questions is required: 1) What is the relevant information set available to investors? 2) What does it mean that information is fully reflected on security prices?

The answer to the first question suggests that investors know that risk-adjusted rates of returns are roughly constant. Therefore, fluctuations in future cash flows can happen only from unexpected variations of common factors that appear randomly. In short, the future is a repetition of known 'states' of the economy that have a given probability of occurrence, and investors with 'rational expectations' are aware of this. Some heterodox theorists (Crotty 2011) have suggested that informational efficiency implies 'perfect foresight'. This is not correct; it implies only that investors operate according to the neoclassical equilibrium model.

Regarding the second question, the answer is that investors will have adequate means to convert their expectations about future cash flows into security prices. This means adequate liquidity, unlimited short selling, and more generally the elimination of all possible arbitrage positions that can distort asset prices. The conclusion is that if these prerequisites hold, expected prices will tend to become equal to actual prices and all investors will receive the market return. The unprecedented deregulation of financial markets following 1980 was justified by this premise. If investors are capable to estimate risk correctly then financial markets do not need regulation, they are self-regulated.

This view was held during the aftermath of the crisis of the 1970s, otherwise referred to as the 'great stagflation'. Financial markets were fully deregulated, although, the efficient market hypothesis was rejected when tested against the traditional asset pricing models (Shiller 1989 a, b). Policymakers paid no attention to these findings despite the fact they were published in the top economic journals. Certain mainstream theorists made matters worse arguing that it is impossible to distinguish whether 'anomalous evidence on the behavior of returns' is due to the pricing model or the efficiency of the market (Fama 1991). An obviously wrong statement, since both mainstream asset pricing models and the efficient market hypothesis rely on the same view on corporate and asset returns. That is, the neoclassical view that both are stationary and exhibit limited volatility.

From 1989 onwards most mainstream economists rejected the efficient market hypothesis. Besides behavioral finance and 'factor models', 'rational bubbles', 'moral hazard' and various externalities are considered by the theory. This research is outlined in section 2.g of chapter 2. What I can say in brief is that these models mainly explain why actual asset prices do not follow those coming from mainstream models rather than providing an asset pricing theory. This is the reason that this research focuses more and more on 'market design' (Roth and Wilson 2019). That is in building the appropriate institutions that will make investors function like neoclassical price takers. Of course, this is difficult if fundamentals exhibit strong inherent variability as argued by the profit-based approach.

The Profit-Based Approach: Theory and Implications

The 'profit-based approach' shares the premise that capital mobility will tend to equalize returns between the corporate and financial sectors. However, contrary to the postulations of modern investment theory the required rate of return around which this equalization takes place is a highly volatile measure that constantly creates positions of risky arbitrage. Therefore, equalization is a turbulent process where the corporate, stock market, and financial asset returns, in general, fluctuate around each other. For stocks, this implies a tendency of equalization with profit rates while for loans and bonds this means that they will remain below profit rates most times. Finally, for derivatives and asset-backed securities, this means systematic mispricing due to the erroneous assumptions on the distribution of returns of the underlying asset which affects mainstream model pricing. The insight behind this view stems from the social relations of capitalist production and their manifestation through 'real competition' in Marx.

In Marxist economics, the rate of profit is the key factor of economic activity. It measures the force motivating the unsaturated appetite for profit which fuels investment and growth in capitalism. When a Marxist economist refers to the rate of profit, she or he means the basic (average) rate of profit. In other words, the ratio of aggregate gross normal capacity utilization profits divided by the total capital advanced. The level and dynamics of the 'basic rate of profit' are governed by the tendency of capitalists to increase the mechanization of production in order to intensify the exploitation of labor, the extraction of 'relative surplus value’ in Marxist terminology. In monetary terms, the rate of profit can be written as the product of the output/ capital ratio and the profit share[131]. The output/ capital ratio is expected to fall. This is because increased mechanization implies investments with higher ‘fixed costs’, lower ‘variable costs’, but higher total costs. In Marx’s own words ‘increase in productive power (of labor) must be paid for by capital itself, is not free of charge’ (Marx 1973: 776, see also Shaikh 1978, Mejorado and Roman 2016: 118). The profit share, on the other hand, cannot increase without limit since the necessary conditions for the reproduction of the working class must be maintained. On these grounds, it has been shown (Rosdolsky 1977) that a declining output/ capital ratio is a sufficient condition for the declining tendency of the (basic) rate of profit. The above describes a long-term process that dominates accumulation under capitalism. The actual average rate of profit can be derived by multiplying the basic rate with the current level of capacity utilization. In this regard, it is a more volatile measure since it incorporates the effect of short-term cyclical fluctuations like the five and ten -year cycle. However, it cannot apply as a determinant of stock and financial market required returns as it will become evident here-below.

The inherent process of mechanization of production manifests itself through capitalist competition. However, the notion of competition in classical political economy and Marx has little or nothing to do with the neoclassical notion of perfect competition as mentioned above in various instances. In Marx, capitalist competition is a ‘battle’ ‘fought by the cheapening of commodities’ (Marx 1867: 777). It is a process where companies in the same industry constantly try to introduce new products and implement more productive techniques in order to penetrate the market share of their competitors. These are the higher ‘organic composition’ techniques mentioned in the previous paragraph. When the prices of the most efficient producers become industry prices then lower profit rates prevail for the whole branch. Through capital mobility between sectors, these lower returns are fused in the whole economy eventually reducing the average profit rate. The whole process is one of conflict where rates of return trend to become differentiated through competition in the same industry and equalized through competition between industries.

But which profit rates tend to become equalized between industries and why? This is important for the theory since we have allowed for the coexistence of different techniques in the same industry. Consequently, the theory must identify which ‘price of production’ will regulate the market price. As mentioned in the previous paragraph, in the Marxist context, this is the price of production of the most cost-efficient capitalist (producer). The latter is referred to in the literature as the ‘regulating capital’ (e.g., Botwinick 1993, Tsoulfidis and Tsaliki 2005). The rationale is simple, if the primary goal of capitalist competition is to

[131] If P is profit and K is capital and Q is output then $r = \frac{P}{K} = \frac{P}{Q} \cdot \frac{Q}{K}$ (P/Q) is the profit share and (Q/K) the output capital ratio.

conquer the market share of the competitor, mainly through price cutting, the cost-efficient producers should be capable of imposing prices. This means that the price of production of the 'regulating capital' will be the 'normal' price and the profit rate the 'normal profit rate'. Therefore, the mobility of capital between industries will accelerate towards the sectors with a higher rate of return of the regulating capital. Evidently, equalization of returns refers to regulating capital rates of return. The latter is different from the 'average rate'. Furthermore, investment grows in every sector to meet increasing demand. Hence, when we talk about the acceleration of capital investment towards a particular industry, we are referring to investment beyond the average rate of growth of the economy. Such projects are motivated by higher profit rates on new investments. In short, due to the incentive underlying the mobility of capital, it is the 'incremental rate of profit' which tends to become equalized between industries. Moreover, the incremental rate of profit is different from the average rate of profit of the economy.

In this context, the incremental rate of profit of each branch of the economy and the economy as a whole is a highly volatile measure reflecting the underlying conditions of capitalist competition, but also a whole set of transitory factors affecting short term profitability. For instance, relative prices play a part of their own on aggregate profit, which may differ from fundamental profit, due to transfers of value within the circuit of capital or between the circuit of capital and the circuit of revenue[132]. It also reflects disequilibrium dynamics prevailing when part of the product remains unsold and aggregate profit falls or even becomes negative.

So far, the presentation refers to the corporate commodity sector. Therefore, the obvious question is whether this rationale can apply to a potential equalization of returns between the corporate and the financial sector. If we give up the neoclassical and modern investment theory 'representative agent' understanding of the financial sector, presented in the CAPM, then it is reasonable to extend this logic to the equalization of returns between regulating corporate and financial capitals. Banks and financial firms, in general, are corporations seeking to maximize their profits and this analysis of the conditions of capitalist competition should hold for them as well.

This rationale resolves a long discussion in classical and Marxist economics as extensively discussed in sections 3.2. and 3.3. The reason is that if banking and financial capital, in general, enters the equalization process, we can determine a monetary rate of interest. If we assume (abstracting from direct banking costs and fixed capital investments) that the

[132] M-C-M' is the circuit of capital where money is advanced to make more money and C-M-C is the circuit or income where commodities are sold for money and then used to purchase commodities of equal value. This is a way of understanding the impact of what Marx calls 'profit upon alienation' and its association with profit on production.

banking rate of return (profit) is equal to interest income divided by bank reserves, then the equilibrium rate of interest will be equal to the product of the ratio of reserves to loans times the rate of profit (Shaikh 2015). This form ensures a positive 'rate of profit of enterprise'[133] since the ratio of reserves to loans is less than unity. One can arrive at similar results by assuming that interest rates are determined through the competition between borrowers and lenders as noted by Marx in Capital VIII. I have shown elsewhere that the rate of interest is equal to the gross general rate of profit minus the share of corporate profits of the commodity sector out of total profits[134] (Stravelakis 2012). This definition draws from the reference of Marx to Ramsay in Volume III of *Capital* (Marx 1894 Ch22:245-6), where he notes that interest rates depend on gross profits and the competition between borrowers and lenders which (partly) depends on the expected 'rate of gross profit' (Ramsay 1836: 206-207).

The two forms (Stravelakis 2012, Shaikh 2015) are equivalent. Given the rate of profit, any increase in the share of net corporate (commodity sector) profit over gross profit implies an equal decline in the ratio of bank leverage (Loans minus Reserves) over total corporate loans. This is the case in normal accumulation, higher commodity sector corporate profits create higher liquidity for corporations and banks, which leads to lower interest rates. As corporate leverage increases, due to accelerated investments arising from the increase in the rate of profit of enterprise, corporate and bank liquidity declines, interest rates rise, and production is downsized to release funds to reduce debt[135]. If, however, the rate of gross profit remains below a certain limit the downsizing of production leads to corporate losses and a decline of liquidity for both the corporate and the financial sector. In that event, as elaborated in section 3.4, interest rates explode, the rate of profit of enterprise turns zero or negative and a major crisis is triggered. Herein I worked with my own arrangement of the rate of interest because it fits better in describing both conditions of secular growth and the trigger mechanism separating times of normal accumulation and crisis. Overall, we must stress that in the Marxist context the difference between the rate of profit and the rate of interest is not a 'risk premium' as in modern investment theory but a structural factor that depends on corporate profitability.

On these grounds, two important points can be derived from the theory. First, the profit rate around which equalization takes place depends on the structure of interest rates in the banks' loan portfolio. For instance, if all interest rates are variable interest rates the average and incremental rate of return of banks would be equal. In the opposite case, where all

[133] The rate of profit of enterprise is the difference between the rate of profit and the rate of interest.

[134] $i_t = r - \alpha \cdot y_t$ where *i* is the rate of interest, *r* the rate of gross profit, α positive constant and *y* the ratio of net corporate profits to gross profits *NP/P*.

[135] This is the process underlying the five and ten-year cycle which appears in capitalist economies.

interest rates on loans or bonds are fixed, then incremental profit rates will diverge from the average rate. Following the discussion on competition, I considered the 'general (regulating) rate of profit' relevant for the determination of the rate of interest. This will be proxied by the 'incremental rate of profit', i.e., the rate of profit on new investment.

The second point relates to a debate over Marx's position on the determination of interest rates. Marx seems to appreciate both the idea of the association of the rate of profit with the rate of interest as mentioned above, as well as the association of the rate of interest with the price level as argued by Tooke (Tooke and Newmarch 1838) and Gibson (1923). This has been considered by some as a contradiction in his work. However, knowing that 'price' waves are associated with the dynamics of the rate of profit (Kondratieff 1984, Mandel 1992), the tendency of equalization of returns between the corporate and the financial sector explains why interest rates are associated with both profit rates and the price level. This can serve also as an explanation of the Gibson Paradox[136] (Keynes 1930: 177-86) on which many important economic debates have taken place (Shiller and Seigel 1977). Actually, the association between nominal interest rates and the wholesale price index is very strong from 1857-1933 when the pattern of 'Kondratieff waves' appeared both for currency and gold prices. Thereafter the association is looser and is almost completely lost in the years of the great stagflation and the neoliberal era when the policy-induced suppression of interest rates took place. The whole discussion makes clear that the definition of the rate of interest elaborated herein does not imply a 'natural rate of interest'. In other words, the rate of interest is a monetary phenomenon associated with profitability through the forces of competition. As Marx puts it: "The average rate of interest prevailing in a certain country [...] cannot be determined by any law" (Marx 1894a: 246). In other words, a highly volatile rate of interest brings the rough equalization between corporate and banking capital. This theoretical definition explains why interest rates were suppressed so effectively and for so long during the neoliberal era and why interest rates collapsed under the quantitative easing programs in the US and the EU. Nevertheless, growth policies based on the suppression of interest rates, in the context of low-profit rates, triggered the current depression in 2007 (Stravelakis 2012, 2014).

The determination of interest rates through competition can be extended to explain also their term structure. In normal times, long term interest rates are generally greater than the short-term rates because they have higher (banking) costs (depository and operational). This reflects on the upward slope of the yield curve. A treatment in the spirit of Hicks (1965). In this context, the shape and slope of the yield curve depend on the competition within the banking sector mainly for deposits. The level of interest rates, on the other hand,

[136] Keynes refers to the phenomenon as a paradox since it contradicts the mainstream monetary hypothesis that interest rated should follow the rate of change in prices.

reflects the competition between borrowers and lenders and capital mobility between sectors outlined above. Under this rationale, arbitrage will tend to equalize yields between bonds and equivalent corporate loans. Therefore, bond rates are also expected to systematically remain below profit rates through arbitrage. This does not hold in times of major crises when 'a rise in interest separates prosperity and its reverse' (Marx 1894: 244).

This equalization process does not apply to stocks. Stocks are priced by the market given the corporate dividend policy and have no fixed commitment to pay any sum or match any yield. Therefore, contrary to interest rates on loans and bonds, arbitrage will tend to equalize stock market returns with the returns of the corporate sector. The first implication of this result is that stocks are expected to have higher returns than loans and bonds. This is a consequence of the equalization process, implemented through capital mobility, and does not have anything to do with the volatility of consumption which results in the 'equity risk premium puzzle' (Mehra and Prescott 1985). The 'equity risk premium' has mystified standard economic theory to date. It is indicative that three top mainstream economists Caballero, Farhi, and Gourinchas (2017) attempt to explain the wedge between stock and bonds rates of return from the difference of the average rate of profit and bond rates. Although the direct equalization of stock returns with the average rate of profit is certainly a step towards realism, the attempt is problematic. The reason is that it relies on the average rather than the incremental rate of profit and that it insists on the introduction of the mainstream notion of 'risk' in order to explain the 'wedge'.[137] In reality, in both neoclassical and neo-Ricardian economics the average and the incremental rate of profit are always equal (see Chapter 3 section 3.f). Moreover, the average rate of profit is a measure that does not exhibit high volatility. Consequently, the model cannot grasp variations in stock market returns, and the analysis is reduced to equity return averages over long periods. More importantly, the introduction of the concept of risk to explain the difference between stock and bond returns falls apart between 2007 and 2009, the years of financial turmoil. During this period, the calculated 'risk premium' declines, although one would expect it to surge, given the condition of the financial markets. For this reason, the times of the peak of the financial crisis are excluded from the data analysis presented in the paper.

This discussion strengthens further the profit-based approach argument that the measure relevant to the mobility of capital is the incremental rate of profit which under real competition is expected to be different from the average rate of profit both in measure and volatility. This is the rate around which corporate commodity 'normal rates of profit' become equalized. Consequently, this is also the rate at which corporate and stock market returns should tend to become equalized. This highly volatile measure persistently creates

[137] As elaborated in chapters one and two and outlined above in the mainstream context the absence of risk would make the loan, bond and equity returns exactly equal to the rate of profit, which would be constant (McCulloch 1982)

positions of risky arbitrage. This happens when its value is altered resulting in overvaluation or undervaluation of stocks which triggers capital flows in and out of the stock market to make prices adjust to the new rate of return. These adjustments also give rise to speculative expectations about future returns. For example, excessive inflows of capital may enter the stock market as a result of bullish expectations on future returns. Excessive stock purchases will increase prices moving stock market returns further away from corporate fundamentals. This process will also alter fundamentals since they influence the 'regulating rate of profit'. However, this process has a limit as elaborated in section 3.6 where the 'reflexivity theory' of the speculator George Soros (2009) is presented. It describes a process in which actual prices oscillate around their fundamental values which serve as the center of gravity.

Nevertheless, reflexivity theory supports two especially important results. Because expectations influence fundamentals the center of gravity is path-dependent (Arthur 1994, David 2001). Therefore, the future is not a stochastic reflection of the past. In other words, the system is non-ergodic (Davidson 1991) since expectations can generate disequilibrium cycles. The latter invalidates the efficient market hypothesis because actual prices may diverge from equilibrium prices persistently and for a long period of time. On the other hand, the dependence of fundamentals on actual prices invalidates rational expectations, because it is impossible to incorporate all future information on fundamentals into current expectations since expectations may affect fundamentals (Soros 2009: 216-222).

In more concrete terms the above means that financial capital regulates stock market returns. It can affect actual prices and fundamentals and adjust big stock market positions to their evolution. Expectations matter but they cannot create a reality that validates them, because equity returns depend on the incremental rate of profit which mainly reflects competition in the commodity sector. This is the reason that booms give way to busts and fundamentals, in the end, rule, since the equalization of rates of returns between different applications of capital is the dominant process. However, the volatility of the incremental rate of profit gives room for investors with different expectations on asset returns. The result is a turbulent equalization process, motivated by differences in the return between different applications of capital, which dominates the mobility of capital between corporations and financial markets.

The volatility of the incremental rate of profit which gives rise to turbulent arbitrage processes in the stock market and the financial sector in general underlies a world of true uncertainty as opposed to calculable risk assumed by mainstream theory. For this reason, the profit-based approach applies directly to corporate profitability to keep track of changes in stock market returns, instead of making assumptions on their structure and distribution like mainstream models. Following Elton and Gruber (1991) the incremental rate of profit is defined as the ratio of changes in corporate profits normalized by investment. This means, contrary to mainstream theory postulations which focus on the lifetime rate of return, that for the 'profit-based approach' stock market investments are inherently short-term since changes in corporate profitability reflect a whole set of transitory factors as outlined above. This is the basis of the empirical evaluation of the theory with data from the S&P 500 index in chapter 4.

In Marxist economics the difference between the rate of profit and the rate of interest otherwise referred to as the 'rate of profit of enterprise', is the main determinant of capital accumulation. The rate of interest serves as the opportunity cost for engaging or abstaining from active investment. This notion together with the analysis of interest and stock prices briefly outlined above can provide a scheme for understanding major depressions and explaining their trigger mechanism.

Capitalist crises/ depressions prevail approximately every forty years throughout the history of capitalism. Their underlying cause is the tendency of the average rate of profit to fall. It has been shown that if the rate of profit declines it will eventually reduce the mass of profit bringing a breakdown to capital accumulation (Grossman 1929). However, the average rate of profit is a 'slow' variable, since it depends on the dynamics of the basic rate of profit which is dominated by the implementation of higher organic composition techniques. In this regard, it comes as a surprise that some Marxist economists consider that a sharp decline in the average rate of profit is a necessary condition that must hold if we are to explain the crisis from profit rate dynamics. The trigger mechanism of depressions is more complex and involves the stagnation of the rate of profit of enterprise (Shaikh 1992) which is initiated by a sharp increase in the rate of interest rather than a decline in the rate of profit. This process is presented in section 3.4 using a non-linear dynamic model elaborated also in Stravelakis (2012). It shows that if the rate of profit is below a certain limit then interest rates explode, the rate of profit of enterprise turns zero or negative and normal accumulation turns to a crisis.

However, additional matters must be addressed in order to understand the underlying causes of the current depression. The reason is that it was preceded by a long period of relatively stable average profit rates. These resulted from the severe labor market deregulation and wage suppression that began during the crisis of the 1970s, otherwise referred to as the 'great stagflation'. Consequently, profit rates, which were persistently declining in the post-war era, were stabilized. Nevertheless, no vast destruction of capital took place and so profit rates never increased to growth sustainable levels. In order to restore growth interest rates declined to historical lows, supported by low central bank intervention rates and severe deregulation of the financial sector. The aim was to boost the rate of profit of enterprise and enhance corporate investment. Growth returned, but increased leverage ratios triggered an unprecedented growth of the financial sector. Banks extended their balance sheets to exceptional levels based on moderate corporate deposits while undertaking new forms of debt and supporting new assets, markets, and non-bank financial intermediaries. Finance fused in all aspects of life and economists named the phenomenon: the financialization of capital, associating its appearance with 'profit upon alienation' emerging from transfers of value from the circuit of income to the circuit of capital and inside the circuit of capital[138].

Many heterodox economists[139] argue that the increasing reliance of capitalist economies on transfers of value between corporations and banks and mainly between banks and households stand behind the crisis. I argue differently. The key factor was low-profit rates which initiated a policy of low-interest rates to boost growth. The reason is that profitability places a limit on financial expansion even when interest rates are suppressed at exceptionally low levels. Therefore, the expansion of finance and the consequent discussion on financialization should focus on the underlying conditions of profitability and growth rather than the variety of assets and debt recipients (Stravelakis 2014). In section 3.9 I discuss this rationale arguing, in line with Marx, that even fictitious capital like derivatives and categories of asset-backed securities follows the dynamics of capital accumulation.

In other words, the reasoning presented in Chapter 3 does not prevent the occasion of the crisis to be triggered by a collapse in the financial sector. Asset-backed securities, like the subprime mortgages, were priced at a premium, relative to equivalent bonds, due to the likelihood of refinancing. The latter was calculated on the grounds of the mean life of the mortgage (before refinance) and the standard deviation around the mean. This implied an 'ergodic' repetition of past events in the future. In other words, asset-backed securities issuers priced their assets based on a chain of possible 'states' of the economy which excluded the case banks to be unwilling or unable to refinance the underlying mortgages. However, if banks are illiquid like the times close to the economic breakdown then they are reluctant to refinance the underlying asset. As a result, asset-backed securities breakdown preceded economic collapse although the latter was caused by the extension of finance to levels that could not be accommodated at the current level of profitability (Stravelakis 2014). This is the reason that the collapse of a market with a total value less than 2% of the world GDP was followed by a depression where more than 20% of the world GDP was lost (Crotty 2011, Mohun 2016, Shaikh 2015)

---

[138] One example is the real estate boom which initiated transfers of value from households (circuit of income) to banks (circuit of capital). Another is the securitization of subprime mortgages by issuing asset backed securities sold to corporations (circuit of capital) and private investors (circuit of income).

[139] For example, Lapavitsas calls these transfers the "The lethal mix of financial expropriation and investment-banking" (Lapavitsas 2009: 135).

This rationale can be extended to various financial crisis episodes triggering a depression, for instance, a stock market breakdown caused by a decline in the incremental rate of profit. If such a correction in stock prices is associated with corporate downsizing, which instead of deleveraging leads to losses for corporations and illiquidity for banks, it will be followed by a depression although it has not caused it. Finally, assuming that stock and financial asset returns follow the normal distribution leads to systematic mispricing of various types of derivatives, such as options and forwards. As elaborated in chapter 3 (section 3.9) the distribution of asset returns generated from nonlinear dynamic models are bent to the right fitting the four-parameter Dagum distribution (Dagum 1975) and not the normal distribution. Therefore, the standard deviation of asset prices calculated and applied as if the underlying asset returns follow the normal distribution leads to systematic mispricing. This can explain the pile-up of derivative contracts to notional amounts almost 25 times the world GDP (Shaikh 2015). This is a phenomenon that can trigger a major financial crisis episode in the immediate future.

The whole analysis underlying the profit-based approach has important implications for financial regulation. As analyzed above and elaborated in chapter 2 the efficient market hypothesis justified financial markets deregulation following the 'great stagflation'. The certainty that markets are efficient supported the notion that agents calculate risk correctly and, in this regard, markets are self-regulated. Following the crisis market deregulation policies and practices received severe criticism. Policymakers all over the world issued rules aiming to control 'moral hazard' and 'asymmetric information'. These policies are based on the idea that it is market distortions, leading to mispricing of financial assets, which must be contained through regulation. The bottom line is that depressions are not inherent and can be managed away if the appropriate rules are implemented. The argument presented herein postulates the exact opposite, capitalism grows in 'long waves' where periods of prosperity give way to periods of crisis. In this regard, financial turmoil will always be a potential trigger of crises. Therefore, regulation policies can only mediate losses by containing financial institutions' exposure. This means that institutions that take deposits or pension plan installments cannot hold just any kind of assets and at any amount. Certain assets should be excluded, and others should occupy a small percentage of the asset side of the balance sheet of Banks, Pension Funds, and Financial Institutions in general. Especially assets that are systematically mispriced like derivatives must be directly regulated.

Finally, the discussion in section 3j indicates that the resolution of the present depression is moving at a very slow pace because the destruction of capital involves bank losses and an additional burden for state budgets. In this regard, a policy of direct state investment will prove more effective than monetary accommodation and bank regulation policies.

Empirical Testing of the Profit Based Approach for Stocks

In chapter 4 various empirical tests of the profit-based approach for stocks with data from the S&P 500 composite index were implemented. The empirical investigation included prices and index returns, as well as parametric and non-parametric estimation. Here only a few points will be mentioned.

The potential equalization of the index rate of return with the incremental rate of profit has been investigated in Shaikh 1997 and Shaikh 2016. The results were very encouraging, especially for prices. Specifically, following Shiller, warranted prices were calculated from the product of the sum of unity plus the net required rate of return, which in our case is the incremental rate of profit minus the dividend yield, multiplied by the index price in the previous period.[140] The simulation pictured in Figure 4.3 shows that warranted prices remain in line with actual prices although bubbles and periods of persistent stock underpricing appear. Moreover, when both warranted and actual prices were divided by the thirty-year moving average of real earnings per share to detrend the data (Shiller 1989) the Pearson correlation coefficient between the two sets of (detrended) prices (warranted and actual) was 0.8 compared to .,296 found by Shiller (1989) under the standard dividend discount model. Similarly, Barsky and De Long (1993) with varying dividend growth rates arrive at a disappointing 9% R^2.

I conducted similar tests for the aggregate S&P 500 index using the growth of the real Earnings Per Share (EPS) as a proxy of the incremental rate of profit. The first reason was that data for this variable goes back as far as 1871 in the Shiller database, whereas National Income and Product Accounts data on corporate investment and profitability go back as far as 1947. Moreover, earnings per share is a measure closely monitored by investors, so it is reasonable to assume that financial capital will adjust its positions to its anticipated and actual variations. Finally, the Shaikh tests were conducted by dividing warranted and actual prices with the thirty-year moving average of EPS, a variable that is closely correlated with both. In my calculations, I detrended the data by dividing prices and earnings per share with their thirty-year average respectively and linearized using logarithms afterward. The linear regression covering a period from the beginning of the 20th century to date has significant coefficients for both the log of (EPS) and last year price (Pt-1) with the appropriate parameter signs and prices, whereas the R^2 is over 98%. With these results, it is very difficult to argue that deviation of the actual stock prices from those calculated from mainstream models can be attributed to 'irrational behavior' externalities or 'asymmetric information'. The inherent volatility of the underlying fundamentals is a far more sensible reason.

[140] The equation has the following algebraic form $P_t{}^{w} = P^{w}_{t-1} \cdot [1 + (rror_t - y_t)]$. Where Pw is the warranted price in the current period, P^{w}_{t-1} is the warranted price in the previous period, rror is the gross required rate of return and yt is the dividend yield.

However, using regression analysis in evaluating the model empirically is not in line with a good part of what has been discussed in the thesis. The ideas presented herein suggest that prices and returns have non-stationary probability distributions. Therefore, testing the model assumptions by normalizing the time series of index prices and fundamentals is not sufficient.

To address these issues, I applied the non-parametric statistic known as 'Mutual Information'. It is a non-linear correlation coefficient that measures the reduction of stock market entropy from knowing the Incremental rate of profit. The latter is approximated from the log growth of Earnings Per Share. I calculated the local (decade) measure of Mutual Information from 1881-2020 and the results were presented in Figure 4.5. The data exhibit a remarkably interesting pattern. Before and during depressions the MI measures collapse to zero indicating a bubble preceding each depression. In all other periods, MI has positive, significant, and stable values. This is true of the long crisis (1871-1893), the 'great depression' and the 'great stagflation'. It appeared also in the burst of the dot-com bubble (2000-2002) although it was not associated with a depression. The only case that the pattern did not appear was in the 2008 depression. This is because following the burst of the dot-com bubble stock prices remained in line with the fundamentals. The S&P 500 collapsed in 2008 shortly after the collapse of the earnings per share.

Overall, the empirical evaluations of the profit-based approach for stocks are very encouraging. Contrary to the mainstream theory where stock volatility is 'unexplained' for the profit-based approach the volatility of fundamentals explains the volatility of stocks. Moreover, they reveal interesting patterns relating to 'phase transition' between normal periods and financial turmoil.

Final Remarks

The theory of asset pricing and interest rate determination presented herein and referred to as the 'profit-based approach' is built on four propositions.

First, the rate of profit of enterprise is the determinant of capital accumulation. This implies that the rate of interest remains below the rate of profit in times of normal accumulation and a sharp increase in the rate of interest "separates prosperity and its reverse" (Marx 1894a: 244).

Second, this result is ensured from the equalization of the bank rate of return with the general (regulating) rate of profit. This results from the competition between borrowers and lenders as indicated by Marx's quotation of George Ramsay: "This proportion again depends upon the competition between the lenders of capital and all the borrowers having good security to offer; which competition is influenced, though by no means entirely regulated, by the rate of gross profit expect ed to be realized." (Ramsay 1836: 207; Marx 1894a: 246)). In other words, the rate of interest relates to the rate of profit only through the forces of competition and there is no 'natural rate of interest'. This explains also why interest suppression during the neoliberal era was so effectively implemented and for so long.

Third, bond yields are equalized with equivalent loan rates of interest. This means that bond yields will also remain below the 'general (regulating) rate of profit'.

Fourth, the equity rate of return is equalized with the 'general (regulating) rate of profit' which is approximated by the rate of profit on new investment, referred to as the 'incremental rate of profit'. The latter is expected to be different from the average rate of profit. This means that the equity rate of return will be greater than the rate of interest and the dividend yield need not be equal to any interest rate.

These propositions have been incorporated in a nonlinear dynamic model where the rate of interest surges when the rate of profit is below a certain limit and the rate of profit of enterprise turns zero or negative. For higher rates of profit, the model exhibits circular growth (section 3d, Stravelakis 2012). This rationale can be extended in a situation where suppressed interest rates lead to debt accumulation that cannot be accommodated by low profit rates and the system collapses (section 3i, Stravelakis 2014). The model imitates the 2007 collapse which triggered the current depression. In this context, it will be shown that financial crisis episodes like stock market crashes, the asset-backed securities meltdown, and a possible crisis in the derivatives market, may trigger depressions when debt accumulation cannot be backed by the rate of profit. In the case of asset-backed securities illiquid banks become reluctant to refinance the mortgages triggering the present depression. For stock prices, a correction coming from a decline in the incremental rate of profit due to corporate downsizing may trigger depression if associated with corporate losses, indicating a rate of profit that cannot sustain growth. Finally, derivatives, such as options and forwards, are systematically mispriced by standard models. Therefore, pressure on derivative credit lines from contracts falling out of the money in an illiquid banking system may trigger a major crisis in the immediate future.

These analytical findings have important implications on the nature and effectiveness of financial regulation. It shows that in capitalist production relations crises cannot be managed away irrespective of the rules implemented. This means that financial turmoil will always be a potential trigger for crises. Therefore, regulation policies can only mediate losses by containing financial institutions' exposure. This means that institutions that take deposits or pension plan installments cannot hold just any kind of assets and at any amount. Certain assets should be excluded, and others should occupy a small percentage of the asset side of the balance sheet of Banks, Pension Funds, and Financial Institutions in general.

Data Sources and Tables

BEA For the calculations of the average incremental rate of profit I have used the tables of the Bureau of Economic Analysis (U.S. Department of Commerce) [BEA, at https://www.bea.gov/] for Figures 4.1, 4.2., and 4.3):

Tables F.A. T.6.7 and FA T.6.8 to calculate gross investment (Appendix 4.1)

Tables 6.4 and 1.14 were used to calculate gross profits (Appendix 4.1)

Shiller 1 For the Calculation of S&P 500 prices and returns, as well as the Earnings per Share Approximation (appearing in Figures 4.1, 4.2, 4.3, 4.4, 4.5 and used for the estimation of the Econometric Equation 4.5) I used the publicly offered data base of Robert Shiller, *Online Data Robert Shiller*. The data base can be downloaded from the following electronic address http://www.econ.yale.edu/~shiller/data.htm

Shiller 2 The calculation of the Efficient Market Hypothesis S&P 500 prices appearing in Figure 4.3 a different data base of Robert Shiller was used. The latter can be freely downloaded from http://www.econ.yale.edu/~shiller/data/chapt26.xlsx [**Shiller, R., U.S. Stock Price Data, Annual, with consumption, both short and long rates, and present value calculations].**

Realecon For the extension of the simulation of the profit-based approach warranted prices appearing in Figure 4.3 I used data and elements from the data appendixes of Shaikh's (2016) book. This data can be found and downloaded from Anwar Shaikh's website *realecon.org* [http://realecon.org/] at http://realecon.org/ data/, table 10.2.

References

Altman, Edward I., and Mary Jane McKinney (1987). *Handbook of Financial Markets and Institutions*, New York, NY: Wiley. 6th edition.

Andreades, Andreas M. (1933). *A History of Greek Public Finance*, transl. Carroll N Brown, Cambridge, MA: Harvard University Press, Revised and enlarged edition. 1st Greek edition: *Ιστορία της ελληνικής Δημόσιας Οικονομίας*, 1928.

Arjaliès, Diane-Laure, Philip Grant, Iain Hardie, Ekaterina Svetlova and Donald A MacKenzie (2017). *Chains of Finance: How Investment Management is Shaped.* Oxford: Oxford University Press.

Akerlof, George A. (1970). "The Market for 'Lemons': Quality Uncertainty and the Market Mechanism", *Quarterly Journal of Economics*, 84(3): 488-500.

Arrow, Kenneth J., (1971). "Insurance, Risk and Resource Allocation", in *Essays in the Theory of Risk-Bearing*, Amsterdam: North-Holland: 134-143. Reprinted in Georges Dionne and Scott E. Harrington (eds), *Foundations of Insurance Economics: Readings in Economics and Finance*. Dordrecht: Springer, 1992: 220-229. [Huebner International Series on Risk, Insurance and Economic Security, 14].

Arrow, Kenneth J., and Gerard Debreu (1954). "Existence of an Equilibrium for a Competitive Economy", *Econometrica*, 22(3): 265–290.

Arthur, W. Brian (1994). *Increasing Returns and Path Dependence in the Economy*, Ann Arbor, MI: University of Michigan Press.

Avellaneda, Marco, and Rama Cont (2011). "Transparency in OTC Equity Derivatives Markets: A Quantitative Study", *Finance Concepts*, August, ISDA.

Ayres, Leonard P. (1939). *Turning Points in Business Cycles*. New York, NY: Macmillan.

Azariadis, Costas (2018). “Riddles and Models: A Review Essay on Michel De Vroey's *A History of Macroeconomics from Keynes to Lucas and Beyond*”, *Journal of Economic Literature*, 56(4): 1538–1576.

Bachelier, Louis (1900). « Théorie de la spéculation », *Annales Scientifiques de l'École Normale Supérieure*, 3(17) : 21–86. In book form: *Théorie de la spéculation*, Paris : Gauthier-Villars, 1900. English translation as *Louis Bachelier's Theory of Speculation: The Origins of Modern Finance.* Translated and with commentary by Mark Davis and Alison Etheridge, Foreword by Paul A. Samuelson, Princeton, NJ: Princeton University Press, 2006.

Bagehot, Walter (1873). *Lombard Street: A Description of the Money Market,* London: Henry S. King and Co.

Ball, Ray (1978). “Anomalies in Relationships Between Securities’ Yields and Yield-Surrogates”, *Journal of Financial Economics,* 6(2): 103–126.

Banz, Rolf W. (1981). “The Relationship Between Return and Market Value of Common Stocks”, *Journal of Financial Economics*, 9(1): 3-18.

Barnett, Lionel, Joseph T. Lizier, Michael Harré, Anil K. Seth and Terry Bossomaier (2013). “Information Flow in a Kinetic Ising Model Peaks in the Disordered Phase”, *Physical Review Letters*, 111:177203.

Barsky, Robert, and J. Bradford De Long (1993). “Why Does the Stock Market Fluctuate?”, *Quarterly Journal of Economics*, 108(2): 291–311.

Basu, Sanjoy (1977). “Investment Performance of Common Stocks in Relation to their Price-Earnings Ratios: A Test of the Efficient Market Hypothesis”, *Journal of Finance*, 32(3): 663-682.

Bernoulli, Daniel (1738). “Specimen theoriae novae mensura sortis”, *Commentarii Academiae Scientiarum Imperialis Petropolitanae*, 5: 175-192. English translation as “Exposition of a New Theory on the Measurement of Risk”, *Econometrica*, 22(1): 23-36 (1954).

Bellofiore, Riccardo (2001). “Monetary Analyses in Sraffa’s Writings: A Comment on Panico”, in Terenzio Cozzi and Roberto Marchionatti (eds), *Piero Sraffa’s Political Economy: A Centenary Estimate*, London: Routledge: 362–376.

Bernanke, Ben S. (2010). *“Causes of the Recent Financial and Economic Crisis”, Testimony* Before the Financial Crisis Inquiry Commission, Washington, D.C., 2 September. Available at https://www.federalreserve.gov/newsevents/ testimony /bernanke20100902a.htm.

Bhandari, Laxmi Chand (1988). “Debt/Equity Ratio and Expected Common Stock Returns: Empirical Evidence”, *Journal of Finance,* 43(2): 507–528.

BIS (Bank for International Settlements) (2011). *OTC derivatives market activity in the first half of 2011*, 16 November 2011, https://www.bis.org/publ/otc_ hy1111.htm

BIS (Bank for International Settlements) (2016). *OTC derivatives statistics at end-June 2016*, 10 November 2016, https://www.bis.org/publ/otc_hy1611.htm

BIS (Bank for International Settlements) (2020). *OTC derivatives statistics at end-June 2020*, 9 November 2020, https://www.bis.org/publ/otc_hy2011.htm and https://stats.bis.org/statx/srs/table/d5.1

Black, Fischer (1972). "Capital Market Equilibrium with Restricted Borrowing", *Journal of Business*. 45(3): 444–454.

Black, Fischer, Michael C. Jensen and Myron Scholes (1972). "The Capital Asset Pricing Model: Some Empirical Tests", in Michael C. Jensen (ed.), *Studies in the Theory of Capital Markets*, New York, NY: Praeger: 79–121.

Black, Fischer, and Myron Scholes (1973). "The Pricing of Options and Corporate Liabilities", *Journal of Political Economy*, 81(3): 637–654.

Blume, Marshall E. (1970). "Portfolio Theory: A Step Towards its Practical Application", *Journal of Business*, 43(2): 152–174.

Blume, Marshall E., and Irwin Friend (1973). "A New Look at the Capital Asset Pricing Model", *Journal of Finance*, 28(1): 19-33.

Böhm-Bawerk, Eugen von (1890). Capital and Interest: A Critical History of Economical Theory. Translated by William Smart, London: Macmillan. 1st German Edition: Kapital und Kapitalzins. Erste Abtheilung: Geschichte und Kritik der Kapitalzins-Theorien, Innsbruck: Wagner, 1884.

Bossomaier, Terry, Lionel Barnett, Michael Harré and Joseph T. Lizier (2016). *An Introduction to Transfer Entropy Information Flow in Complex Systems*, Cham, Switzerland: Springer International Publishing.

Botwinick, Howard (1993). *Persistent Inequalities: Wage Disparities under Capitalist Competition*, Princeton, NJ: Princeton University Press.

Briggs, Keith Martin (1997). *Feigenbaum Scaling in Discrete Dynamical Systems*, Ph.D. Dissertation, Department of Mathematics, University of Melbourne.

Bryan, Dick, Randy Martin and Mike Rafferty (2009). "Financialization and Marx: Giving Labor and Capital a Financial Makeover", *Review of Radical Political Economics*, 41(4): 458-472.

Buffet, Warren (2002). *Berkshire Hathaway Inc. 2002 Annual Report,* Available at https://www.berkshirehathaway.com/2002ar/2002ar.pdf

Caballero, Ricardo J., Emmanuel Farhi and Pierre-Olivier Gourinchas (2017). "Rents, Technical Change, and Risk Premia Accounting for Secular Trends in Interest Rates, Returns on Capital, Earning Yields, and Factor Shares", *American Economic Review: Papers and Proceedings,* 107(5): 614–620*.*

Campbell, John Y. (1991). "A Variance Decomposition for Stock Returns", *Economic Journal*, 101(405): 157-179.

Carhart, Mark M. (1997). "On Persistence in Mutual Fund Performance", *Journal of Finance.* 52(1): 57–82.

Christodoulopoulos, George (1995). *International Competition and Industrial Rates of Return*, Ph.D. dissertation, New School for Social Research, New York, NY.

Clausius, Rudolf (1865). „Ueber verschiedene für die Anwendung bequeme Formen der Hauptgleichungen der mechanischen Wärmetheorie", *Annalen der Physik und Chemie*, 125(7): 353–400.

Clausius, Rudolf (1867). *The Mechanical Theory of Heat: with its Applications to the Steam-Engine and to the Physical Properties of Bodies*, London: John Van Voorst.

Cohen, Jerome B., Edward D. Zinbarg and Arthur Zeikel (1987). *Investment Analysis and Portfolio Management*, Homewood, IL: R. D. Irwin. 5th edition.

Cowles, Alfred, 3rd (1933). "Can Stock Market Forecasters Forecast?", *Econometrica*, 1(3): 309-324.

Crotty, James (2011). "The Realism of Assumptions Does Matter: Why Keynes-Minsky Theory Must Replace Efficient Market Theory as the Guide to Financial Regulation Policy", *Economics Department Working Paper,* No. 113 (2011–05), University of Massachusetts at Amherst, (March).

Dagum, Camilo (1975). "A Model of Income and the Conditions of Existence of Moments of Finite Order", *Bulletin of the International Statistical Institute*, 46(3): 199–205.

David, Paul A. (2001). "Path Dependence, its Critics, and the Quest for 'Historical Economics'", in Pierre Garrouste and Stavros Ioannides (eds.), *Evolution and Path Dependence in Economic Ideas: Past and Present*, Cheltenham, UK: Edward Elgar: 15–40.

Davidson, Paul (1991). "Is Probability Theory Relevant for Uncertainty? A Post Keynesian Perspective", *Journal of Economic Perspectives*, 5(1): 129–143.

DeBondt, Werner F. M., and Richard H. Thaler (1987). "Further Evidence on Investor Overreaction and Stock Market Seasonality", *Journal of Finance*, 42(3): 557–581.

Delattre, Sylvain, and Nicolas Fournier (2016). "On the Kozachenko-Leonenko Entropy Estimator", *Journal of Statistical Planning and Inference*, 185 (June): 69-93.

Dempster, Arthur P., N.M. Laird and Donald B. Rubin (1977). "Maximum Likelihood from Incomplete Data via the EM Algorithm", *Journal of the Royal Statistical Society, Series B (Methodological)*, 39(1): 1-38.

Diamond, Douglas W., and Philip H. Dybvig (1983). "Bank Runs, Deposit Insurance, and Liquidity", *Journal of Political Economy*, 91(3): 401–419.

Douglas, George W. (1967). *Risk in the Equity Markets: An Empirical Appraisal of Market Efficiency*, Ph.D. dissertation, Yale University. Ann Arbor, MI: University Microfilms, Inc.

Elton, Edwin J., and Martin J. Gruber (1976). "Valuation and Asset Selection Under Alternative Investment Opportunities", *Journal of Finance*, 31(2): 525-539, Papers and Proceedings of the Thirty-Fourth Annual Meeting of the American Finance Association Dallas, Texas December 28-30, 1975.

Elton, Edwin J., and Martin J. Gruber (1991). *Modern Portfolio Theory and Investment Analysis*, New York, NY: Wiley, 4th edition.

Fama, Eugene F. (1965)*. The Behavior of Stock Market Prices,* Ph.D. Dissertation, University of Chicago, Graduate School of Business.

Fama, Eugene F. (1970). "Efficient Capital Markets: A Review of Theory and Empirical Work", *Journal of Finance*, 25(2): 383–417.

Fama, Eugene F. (1976a). "Multiperiod Consumption-Investment Decisions: A Correction", *American Economic Review*, 66(4): 723-724.

Fama, Eugene F. (1976b). "Inflation Uncertainty and Expected Returns on Treasury Bills", *Journal of Political Economy*, 84(3): 427-448.

Fama, Eugene F. (1991). "Efficient Capital Markets: II", *Journal of Finance*, 46(5): 1575–1617.

Fama, Eugene F. (1996). "Multifactor Portfolio Efficiency and Multifactor Asset Pricing", *Journal of Financial and Quantitative Analysis*, 31(4): 441–465.

Fama, Eugene F. (2007). "Interview with Eugene Fama" (by Douglas Clement), *The Region* (Federal Reserve Bank of Minneapolis), vol. 21, December: 15-23.

Fama, Eugene F., and Kenneth R. French (1992). "The Cross-Section of Expected Stock Returns", *Journal of Finance*, 47(2): 427–465.

Fama, Eugene F., and Kenneth R. French. (1993). "Common Risk Factors in the Returns on Stocks and Bonds", *Journal of Financial Economics*, 33(1): 3–56.

Fama, Eugene F., and Kenneth R. French. (1995). "Size and Book-to-Market Factors in Earnings and Returns", *Journal of Finance*. 50(1): 131–155.

Fama, Eugene F., and Kenneth R. French. (1998). "Value Versus Growth: The International Evidence", *Journal of Finance*, 53(6): 1975-1999.

Fama, Eugene F., and Kenneth R. French (2004). "The Capital Asset Pricing Model: Theory and Evidence", *Journal of Economic Perspectives*, 18(3): 25–46.

Fama, Eugene F., and James D. MacBeth (1973). "Risk, Return, and Equilibrium: Empirical Tests", *Journal of Political Economy*, 81(3): 607-636.

Farhi, Emmanuel, and Jean Tirole (2012). "Collective Moral Hazard, Maturity Mismatch and Systemic Bailouts", *American Economic Review*, 102(1): 60–93.

Feigenbaum, Mitchell J. (1980). "The Metric Universal Properties of Period Doubling Bifurcations and the Spectrum for a Route to Turbulence", *Annals of the New York Academy of Sciences*, *Nonlinear Dynamics*, 357(1): 330-336.

Fine, Ben (1985/1986). "Banking Capital and the Theory of Interest", *Science & Society*, 49(4): 387-413.

Fine, Ben (2011). «Πέραν της Χρηματιστικοποίησης» [Beyond Financialization], in Επιστημονική Εταιρεία Πολιτικής Οικονομίας (Scientific Society for Political Economy), *Οικονομική Κρίση και Ελλάδα* [Economic Crisis and Greece], Athens: Gutenberg, [Edited by Andriana Vlachou, Nicholas J. Theocarakis and Dimitris Milonakis]: 13-30.

Fine, Ben, and Laurence Harris (1976). "Controversial issues in Marxist economic theory", *Socialist Register*, 13: 141-178. [Volume edited by Ralph Miliband and John Saville].

Flavin, Marjorie A. (1983). "Excess Volatility in the Financial Markets: A Reassessment of the Empirical Evidence", *Journal of Political Economy*, 91(6): 929-956.

Fontana, Giuseppe (2003). "Post Keynesian Approaches to Endogenous Money: A Time Framework Explanation", *Review of Political Economy*, 15(3): 291–314.

Frankel, Richard, and Charles M.C. Lee. (1998). "Accounting Valuation, Market Expectation, and Cross-Sectional Stock Returns", *Journal of Accounting and Economics*. 25(3): 283–319.

Friedman, Milton (1953). *Essays in Positive Economics*, Chicago, IL: University of Chicago Press.

Friend, Irwin, and Marshall Blume (1970). "Measurement of Portfolio Performance under Uncertainty", *American Economic Review*, 60(4): 607–636.
Geroski, Paul A. (1990). "Modeling Persistent Profitability", in Dennis C. Mueller (ed.), *The Dynamics of Company Profits: An International Comparison* , Cambridge, UK: Cambridge University Press: 15–34.
Gertler, Mark, Nobuhiro Kiyotaki and Andrea Prestipino (2016). "Wholesale Banking and Bank Runs in Macroeconomic Modeling of Financial Crises", in John B. Taylor and Harald Uhlig (eds.), *Handbook of Macroeconomics*, Amsterdam: North-Holland, Volume 2B: 1345–1425.
Gertler, Mark, Nobuhiro Kiyotaki and Andrea Prestipino (2020). "Credit Booms, Financial Crises, and Macroprudential Policy", *Review of Economic Dynamics*, 37: S8-S33.
Geweke, John (1982). "Measurement of Linear Dependence and Feedback between Multiple Time Series", *Journal of the American Statistical Association*, 77(378): 304-313.
Gibbons, Michael R. (1982). "Multivariate Tests of Financial Models: A New Approach", *Journal of Financial Economics,* 10(1): 3–27.
Gibbons, Michael R., Stephen A. Ross and Jay Shanken (1989). "A Test of the Efficiency of a Given Portfolio", *Econometrica*, 57(5): 1121-1152.
Gibson, A.H. (1923). "The Future Course of High-Class Investment Values", *Bankers'* [*Insurance Managers' and Agents'*] *Magazine*, 115 (January):15–34.
Gilles, Christian, and Stephen F. LeRoy (1991). "Econometric Aspects of the Variance-Bounds Tests: A Survey", *Review of Financial Studies*, 4(4): 753-791.
Gordon, Myron J. (1962). *The Investment, Financing, and Valuation of the Corporation*, Homewood, IL: R. D. Irwin.
Graham, Benjamin, and David L. Dodd (1934). *Security Analysis*, New York, NY: Whittlesey House, McGraw-Hill Book Co.
Granger, Clive W. J., and Oskar Morgenstern (1963). "Spectral Analysis of New York Stock Market Prices", *Kyklos*, 16(1): 1-27
Greenspan, Alan (1996). "The Challenge of Central Banking in a Democratic Society", Remarks by Chairman Alan Greenspan, At the Annual Dinner and Francis Boyer Lecture of The American Enterprise Institute for Public Policy Research, Washington, D.C., December 5, 1996. The Federal Reserve Board https://www.federalreserve.gov/boarddocs/speeches/1996/19961205.htm
Grossman, Henryk (1992/1929). *The Law of Accumulation and the Breakdown of the Capitalist System, being also a Theory of Crises*, [Translated and abridged by Jairus Banaji], London: Pluto Press. Available at Marxist Internet Archive https://www.marxists.org/archive/grossman/1929/ breakdown/. Original German Edition: *Das Akkumulations- und Zusammenbruchsgesetz des kapitalistischen Systems (Zugleich eine Krisentheorie)*, Leipzig: C.L. Hirschfeld, 1929.
Grossman, Sanford J., and Oliver D. Hart (1983). "An Analysis of the Principal Agent Problem", *Econometrica,* 51(1): 7-46.
Grossman, Sanford J., and Joseph E. Stiglitz (1980). "On the Impossibility of Informationally Efficient Markets", *American Economic Review*, 70(3): 393-408.

Harré, Michael, and Terry Bossomaier (2009). "Phase-Transition-Like Behaviour of Information Measures in Financial Markets", *EPL (Europhysics Letters),* 87(1):18009.

Harrison, Paul (2003). "The Economic Effects of Innovation, Regulation, and Reputation on Derivatives Trading: Some Historical Analysis of Early 18th Century Stock Markets", *Working Paper Federal Reserve Board*, https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.580.6697&rep=rep1&type=pdf

Hilferding, Rudolf (1981). *Finance Capital: A Study of the Latest Phase of Capitalist Development,* London: Routledge & Kegan Paul. [Introduction by Tom Bottomore, translated by Morris Watnick and Sam Gordon]. 1st German edition: *Das Finanzkapital. Eine Studie über die jüngste Entwicklung des Kapitalismus,* Vienna: Wiener Volksbuchhandlung Ignaz Brand & Co., 1910. [*Marx-Studien*, 3].

Haugen, Robert A. (1995). *The New Finance: The Case against Efficient Markets*, Englewood Cliffs, NJ: Prentice Hall.

Haugen, Robert A. (2001). *Modern Investment Theory*, London: Prentice-Hall International, 5th edition.

Huberman, Gur, and Zhenyu Wang (2008). "Arbitrage Pricing Theory", *The New Palgrave Dictionary of Economics*, DOI: 10.1057/978-1-349-95121-5_374-2. Original entry by Gur Huberman in the 1987 *Palgrave*.

Hudson, Michael (2010). "From Marx to Goldman Sachs: The Fictions of Fictitious Capital, and the Financialization of Industry", *Critique*, 38(3): 419-444.

Jegadeesh, Narasimhan and Sheridan Titman (1993). "Returns to Buying Winners and Selling Losers: Implications for Stock Market Efficiency", *Journal of Finance,* 48(1): 65–91.,

Jensen, Michael C. (1968). "The Performance of Mutual Funds in the Period 1945–1964", *Journal of Finance*, 23(2): pp. 389–416.

Jevons, W. Stanley (1879). *The Theory of Political Economy*, London: Macmillan and Co. 2nd edition.

Jorescog, Karl C. (1967), "Some Contributions to Maximum Likelihood Factor Analysis", *Psychometrika*, 32(4): 443-482.

Irving, R. J. (1978). "The Profitability and Performance of British Railways, 1870-1914", *Economic History Review,* 31(1): 46-66.

Itoh, Makoto, and Costas Lapavitsas (1999). *Political Economy of Money and Finance,* Basingstoke: Palgrave Macmillan.

Kasch, Maria, and Asani Sarkar (2012). "Is There an S&P 500 Index Effect?", *Staff Report No. 484,* Federal Reserve Bank of New York, February. Revised November 2013. Available at https://www.newyorkfed.org/research/staff_reports/sr484.html

Kendall, M. G. (1953). "The Analysis of Economic Time-Series-Part I: Prices", *Journal of the Royal Statistical Society*. *Series A (General)*, 116(1): 11–25.

Keynes, John Maynard (1930). *A Treatise on Money, Vol. II: The Applied Theory of Money*, London: Macmillan, *CWJMK* 6.

Keynes, John Maynard (1933). *Essays in Persuasion*, London: Macmillan, *CWJMK* 9.

Keynes, John Maynard (1936). *The General Theory of Employment, Interest and Money.* London: Macmillan, *CWJMK* 7.

Keynes, John Maynard (1971-). [*CWJMK*]. *The Collected Writings of John Maynard Keynes*, Edited by Donald E. Moggridge, Elizabeth S, Johnson and Sir Austin Robinson, London: Macmillan for the Royal Economic Society. [Now electronically available from Cambridge University Press].

Kleidon, Allan W. (1986). "Bias in Small Sample Tests of Stock Price Rationality", *Journal of Business*, 59(2): 237-261.

Kiyono, Ken, Zbigniew R. Struzik and Yoshiharu Yamamoto (2006). "Criticality and Phase Transition in Stock-Price Fluctuations", *Physical Review Letters*, 96(6): 068701.

Kondratieff, Nikolai (1984). *The Long Wave Cycle*, Translated by Guy Daniels, New York, NY: Richardson and Snyder. Original Russian edition in 1928 (with D. I. Oparin), *Long conjuncture cycles: Reports and their discussion at the Institute of Economics*, Moscow: Institute of Economics [Кондратьев Н. Д., Опарин Д. И., *Большие циклы конъюнктуры: Доклады и их обсуждение в Институте экономики*].

Kraskov, Alexander, Harald Stögbauer and Peter Grassberger (2004). "Estimating Mutual Information", *Physical Review E*, 69: 066138. [Erratum, *Physical Review E*, 83: 019903 (2011)].

Krugman, Paul (2012). *End this Depression Now!,* New York, NY: W.W. Norton & Co.

Kwon, Okyu, and Gabjin Oh (2012). "Asymmetric Information Flow between Market Index and Individual Stocks in Several Stock Markets", *EPL (Europhysics Letters)*, 97(2):28007.

Lakonishok, Josef, and Alan C. Shapiro. (1986). "Systematic Risk, Total Risk, and Size as Determinants of Stock Market Returns", *Journal of Banking and Finance*, 10(1): 115–132.

Lakonishok, Josef, Andrei Shleifer and Robert W. Vishny (1994). "Contrarian Investment, Extrapolation, and Risk", *Journal of Finance*, 49(5): 1541–578

Lapavitsas, Costas (1997). "Two Approaches to the Concept of Interest-Bearing Capital", *International Journal of Political Economy*, 27(1): 85-106.

Lapavitsas, Costas (2009). "Financialized Capitalism: Crisis and Financial Expropriation", *Historical Materialism*, 17(2): 114–148].

Lefèvre, Henri (1873). « Physiologie et mécanique sociales : La Bourse : Fonctions de circulation », *Journal des Actuaires Français*, 2(1) : 211-250, 351-388.

Lehmann, Bruce N., and David M. Modest (1985). "The Empirical Foundations of the Arbitrage Pricing Theory I: The Empirical Tests", *NBER Working Paper Series*, No. 1725 (October).

LeRoy, Stephen F. (1973). "Risk Aversion and the Martingale Property of Stock Prices", *International Economic Review,* 14(2): 436-446.

LeRoy, Stephen F. (1976). "Efficient Capital Markets: Comment", *Journal of Finance*, 31(1): 139–141.

LeRoy, Stephen F. (1989). "Efficient Capital Markets and Martingales", *Journal of Economic Literature*, 27(4): 1583-1621.

LeRoy, Stephen F., and Richard D. Porter (1981). "The Present-Value Relation: Tests Based on Implied Variance Bounds", *Econometrica*, 49(3): 555–574.

Lewis, Michael (2010). *The Big Short: Inside the Doomsday Machine*, New York, NY: W.W. Norton. Film *The Big Short* by Adam McKay, 2015.

Lintner, John (1965). "The Valuation of Risk Assets and the Selection of Risky Investments in Stock Portfolios and Capital Budgets", *Review of Economics and Statistics*, 47(1): 13–37.

Lizier, Joseph T., Mikhail Prokopenko and Albert Y. Zomaya (2012). "Coherent information structure in complex computation", *Theory in Biosciences*, 131(3):193–203.

Lowenstein, Roger (2000). *When Genius Failed: The Rise and Fall of Long-Term Capital Management*, New York, NY: Random House.

Lucas, Robert E., Jr. (1978): "Asset Prices in an Exchange Economy", *Econometrica*, 46(6):1429-1445.

Magdoff, Fred, and John Bellamy Foster (2014). "Stagnation and Financialization: The Nature of the Contradiction", *Monthly Review*, 66(1). Available at https://monthlyreview.org/2014/05/01/stagnation-and-financialization/

Magdoff, Harry, and Paul M Sweezy (1987). *Stagnation and the Financial Explosion.* New York, NY: Monthly Review Press.

Mandel, Ernest (1980). *Long Waves of Capitalist Development: The Marxist Interpretation*; *based on the Marshall Lectures given at the University of Cambridge 1978*, Cambridge, UK: Cambridge University Press.

Mandelbrot, Benoît B. (1966). "Forecasts of Future Prices, Unbiased Markets, and 'Martingale' Models", *Journal of Business*, 39(1)), Part 2: Supplement on Security Prices: 242-255.

Mandelbrot, Benoît B., and Richard L. Hudson (2004). *The (Mis)Behavior of Markets: A Fractal View of Risk, Ruin and Reward*, New York, NY: Basic Books.

Mankiw, N. Gregory, David Romer and Matthew D. Shapiro (1985). "An Unbiased Reexamination of Stock Market Volatility", *Journal of Finance*, 40(3): 677-687.

Markowitz, Harry M. (1952). "Portfolio Selection", *Journal of Finance*, 7(1): 77–91.

Markowitz, Harry M. (1959). *Portfolio Selection: Efficient Diversification of Investments* (Cowles Foundation Monograph, No. 16), New York, NY: John Wiley & Sons.

Markowitz, Harry M. (2015). *A Special Interview with Dr. Harry Markowitz, Nobel Laureate in Economics, Part 2: The Revolution of Behavioral Finance*, Skyview Investment Advisors LLC, https://www.skyviewadv.com/wp-content/ uploads/dlm_uploads/2017/05/Harry-Markowitz-Interview-Part-2.pdf

Marx, Karl (1850). *The Class Struggles in France, 1848 and 1850*, *Selected Works*, Vol. 1, Moscow: International Publishers, 1969. Originally published in the *Neue Rheinische Zeitung, Politisch-ökonomische Revue* in 1850 in 6 parts. Published together with an Introduction by Friedrich Engels as *Die Klassenkämpfe in Frankreich 1848 bis 1850*, Berlin: *Vorwärts,* 1895. *MECW* 10: 45-145, *MEW* 7: 9-107*.*

Marx, Karl (1858). Correspondence: *Marx to Engels in Manchester (2 April)*, *MECW* 40: 296-304, *MEW* 29: 311-318.

Marx, Karl (1862). Correspondence: *Marx to Ludwig Kugelmann in Han[n]over, (28 December)*, MECW 41: 435, *MEW* 30:639-642. First published in *Die Neue Zeit,* 1902.

Marx, Karl (1865). *Value, Price and Profit*, delivered to the First International Working Men's Association on June 20 and 27, 1865. First published in book form in 1898 by Eleanor Marx Aveling. As in *Value, Price and Profit; Addressed to Workingmen by Karl Marx; Edited by his daughter Eleanor Marx Aveling with introduction and annotations by Lucien Sanial and Preface by Daniel De Leon*, New York, NY: New York Labor News Company (1913), Online edition 2006 available at http://www.slp.org/pdf/marx/vpp_km.pdf

Marx, Karl (1867). *Capital: A Critique of Political Economy, Volume One.* [Introduced by Ernest Mandel, translated by Ben Fowkes], Harmondsworth, Middlesex, England: Penguin Books in association with *New Left Review*, 1973. Original 1st German Edition: *Das Kapital. Kritik der politischen Ökonomie. Von Karl Marx. Erster Band. Buch I: Der Produktionsprocess des Kapitals*, Hamburg: Otto Meissner. 4th German Edition, Vierte, durchgesehene Auflage; Herausgegeben von Friedrich Engels, 1890. *MECW* 35, *MEW* 23.

Marx, Karl (1881). Correspondence: *Marx to Nikolai [Franzewitsch] Danielson in St. Petersburg, (19 February)*, *MECW* 46: 60-64, *MEW* 35: 154-158.

Marx, Karl (1894). *Capital: A Critique of Political Economy, Volume Three.* [Introduced by Ernest Mandel, translated by David Fernbach], Harmondsworth, Middlesex, England: Penguin Books in association with *New Left Review*, 1981. Original German Edition: *Das Kapital. Dritter Band, Buch III: Der Gesammtprocess der kapitalistischen Produktion*, Hamburg: Otto Meissner (in 2 parts). *MECW* 37, *MEW* 25.

Marx, Karl (1894a). *Capital: A Critique of Political Economy, Volume Three: The Process of Capitalist Production as a Whole.* [Edited by Friedrich Engels], Institute of Marxism-Leninism, USSR, 1959, New York, NY: International Publishers. As in the electronic edition of the *Marxist Internet Archive* at https://www.marxists.org/archive/marx/works/download/pdf/Capital-Volume-III.pdf.

Marx, Karl (1969). *Theories of Surplus Value; Volume IV of Capital; Part II*, Moscow: Progress Publishers. [Translated by Renate Simpson]. Original German Edition by Karl Kautsky: *Theorien über den Mehrwert: aus dem nachgelassenen Manuskript "Zur Kritik der politischen Ökonomie", von Karl Marx, herausgegeben von Karl Kautsky, Zweiter Band, David Ricardo*, Stuttgart: Verlag von J.H.W. Dietz Nachf., 1905. Written c. 1863

Marx, Karl (1973). *Grundrisse: Foundations of the Critique of Political Economy (Rough Draft).* [Translated with a Foreword by Martin Nicolaus], Harmondsworth, Middlesex, England: Penguin Books in association with New Left Review. Written: 1857–61; Published in German as *Grundrisse der Kritik der politischen Ökonomie*, Moscow: Verlag für Fremdsprachige Literatur, 1939-1941 (in 2 vols). *MECW* 28, 29, *MEW* 42.

Marx, Karl, and Friedrich Engels (1961-) [*MEW*]. *Marx Engels Werke*, Institut für Marxismus-Leninismus beim Zentralkomitee der Sozialistische Einheitspartei Deutschlands, Berlin (DDR): Dietz Verlag. 44 volumes.

Marx, Karl, and Friedrich Engels (2010) [*MECW*]. *Marx & Engels Collected Works*, Lawrence & Wishart Electric Book. Original print edition, London 1975-, 50 volumes.

Massie, Joseph (1750). *An Essay on the governing Causes on the natural Rate of Interest wherein the Sentiments of Sir William Petty and Mr. Locke, on that Head, are considered*, London: W. Owen. Reprinted as *Joseph Massie on the Natural Rate of Interest, 1750,* Baltimore, MD: The Lord Baltimore Press, 1912. [A Reprint of Economic Tracts, Johns Hopkins University Press].

Matthews, R.C.O (1984). "Animal spirits" [Keynes Lecture in Economics], *Proceedings of the British Academy*, 70: 209-229.

McCulloch, J. Huston (1982). *Money and Inflation: A Monetarist Approach*, New York, NY: Academic Press.

Mehra, Rajnish, and Edward C. Prescott (1985). "The Equity Premium: A Puzzle", *Journal of Monetary Economics*, 15(2): 145–161.

Mejorado, Ascensión, and Manuel Román (2016). *Profitability and the Great Recession: The Role of Accumulation Trends in the Financial Crisis,* London and New York, NY: Routledge.

Merton, Robert C. (1973). "An Intertemporal Capital Asset Pricing Model", *Econometrica*, 41(5): 867-887.

Mill, John Stuart (1874). *Essays on Some Unsettled Questions of Political Economy*. London: Longmans, Green, Reader, and Dyer, 2nd edition (1st edition 1844). Reprinted, Clifton, NJ: Augustus M. Kelley, 1968.

Miller, Merton H. (1988). "The Modigliani-Miller Propositions After Thirty Years", *Journal of Economic Perspectives*, 2(4): 99–120.

Miller, Merton H., and Myron Scholes (1972). "Rates of Return in Relation to Risk: A Reexamination of Some Recent Findings", in Michael C. Jensen (ed.), *Studies in the Theory of Capital Markets*, New York, NY: Praeger: 47-78.

Minsky, Hyman P. (1992). "The Financial Instability Hypothesis", The Jerome Levy Economics Institute of Bard College, *Working Paper,* No. 74, (May).

Mitchell, Mark L. and Erik Stafford. (2000). "Managerial Decisions and Long-Term Stock Price Performance", *Journal of Business,* 73(3): 287–329.

Modigliani, Franco, and Merton H. Miller (1958). "The Cost of Capital, Corporation Finance and the Theory of Investment", *American Economic Review*, 48(3): 261–297.

Modigliani, Franco, and Merton H. Miller (1963). "Corporate Income Taxes and the Cost of Capital: A Correction", *American Economic Review*, 53(3): 433–444.

Mohun, Simon (2016). "Inequality, Money Markets and Crisis", in Turan Subasat (ed.), *The Great Financial Meltdown: Systemic, Conjunctural or Policy Created?* Cheltenham, UK: Edward Elgar: 217–235.

Moore, Basil J. (1988). *Horizontalists and Verticalists: The Macroeconomics of Credit Money*, Cambridge, UK: Cambridge University Press.

Moser, James (1875). *Die Lehre von den Zeitgeschäften und deren Combinationen*, Berlin: Julius Springer.

Mossin, Jan (1966). "Equilibrium in a Capital Asset Market", *Econometrica*. 34(4): 768–783.

Mueller, Dennis C. (1986). *Profits in the Long Run*, Cambridge, UK: Cambridge University Press.
Mullainathan, Sendhil, and Richard H. Thaler (2000). “Behavioral Economics”, *NBER Working Paper Series*, No. 7948 (October). Manuscript written as an entry in the *International Encyclopedia of the Social and Behavioral Sciences*, [2001:1094–1100].
Nicholas, Joseph G. (2009). “Introduction to Global Macro Hedge Funds”, in Steven Drobny (ed.), *Inside the House of Money: Top Hedge Fund Traders on Profiting in a Global Market, Hoboken*, NJ: Wiley. 2nd edition
Obstfeld, Maurice, and Alan M. Taylor (2017). "International Monetary Relations: Taking Finance Seriously", *Journal of Economic Perspectives*, 31(3): 3-28.
Ohlson, James A. (1977). “Risk-Aversion and the Martingale Property of Stock Prices: Comments”, *International Economic Review*, 18(1): 229-234.
Okishio, Nobuo (1961). “Technical Change and the Rate of Profit”, *Kobe University Economic Review,* 7: 85-99.
Panico, Carlo (1988). *Interest and Profit in the Theories of Value and Distribution,* London: Palgrave Macmillan.
Phelps, Edmund (1961). “The Golden Rule of Accumulation: A Fable for Growthmen”, *American Economic Review,* 51(4): 638-643.
Philippon, Thomas (2015). “Has the US Finance Industry Become Less Efficient? On the Theory and Measurement of Financial Intermediation”, *American Economic Review*, 105(4): 1408-38.
Philippon, Thomas, and Ariell Reshef (2012). “Wages and Human Capital in the U.S. Finance Industry: 1909–2006”, *Quarterly Journal of Economics*, 127(4): 1551–1609.
Pasinetti, Luigi L. (1962). “Rate of Profit and Income Distribution in Relation to the Rate of Economic Growth”, *Review of Economic Studies*, 29(4): 267–279.
Piketty, Thomas (2014). *Capital in the Twenty-First Century,* Cambridge, MA: The Belknap Press of Harvard University Press. [Translated by Arthur Goldhammer]. 1st French edition: *Le capital au XXIe siècle*, Paris : Éditions du Seuil, 2013].
Piotroski, Joseph D. (2000). “Value Investing: The Use of Historical Financial Statement Information to Separate Winners from Losers”, *Journal of Accounting Research*, 38, *Supplement: Studies on Accounting Information and the Economics of the Firm*: 1-41.
Proudhon, Pierre-Joseph (1857). *Manuel du spéculateur à la Bourse*, Paris : Librairie de Garnier Frères, 5ème édition. [1st edition 1854].
Pyle, David (1993). "The Economic Functions of Derivatives: An Academician's Point of View", *Research Program in Finance Working Papers,* No. RPF-229 University of California at Berkeley.
Ramsay, George (1836). *An Essay on the Distribution of Wealth*, Edinburgh: Adam and Charles Black and London: Longman, Rees, Orme, Brown, Green and Longman.
Regnault, Jules (1863). *Calcul des chances et philosophie de la Bourse*, Paris : Mallet-Bachelier et Castel.
Reinhart, Carmen M., and Kenneth S. Rogoff (2011). “From Financial Crash to Debt Crisis”, *American Economic Review*, 101 (5): 1676–1706.

Reinhart, Carmen M., and Kenneth S. Rogoff (2013). "Financial and Sovereign Debt Crises: Some Lessons Learned and Those Forgotten", *IMF Working Paper,* No. 13/266, (December).

Ricardo, David. (1951). *On the Principles of Political Economy and Taxation,* The Works and Correspondence of David Ricardo, edited by Piero Sraffa with the collaboration of M.H. Dobb, Vol. 1, Cambridge, UK: Cambridge University Press for the Royal Economic Society. 1st edition London: John Murray, 1817 (2nd 1819, 3rd 1821).

Roberts, Harry V. (1959). "Stock-Market 'Patterns' and Financial Analysis: Methodological Suggestions", *Journal of Finance*, 14(1): 1-10.

Robinson, Joan. (1966). *An Essay on Marxian Economics*, London: Macmillan. 2nd edition [1st edition 1942].

Rogers, Colin (1989). *Money, Interest, and Capital: A Study in the Foundations of Monetary Theory*, Cambridge, UK: Cambridge University Press.

Rogoff, Kenneth S. (2017). "Dealing with Monetary Paralysis at the Zero Bound", *Journal of Economic Perspectives,* 31(3): 47-66.

Roll, Richard (1977). "A Critique of the Asset Pricing Theory's Tests Part I: On Past and Potential Testability of the Theory", *Journal of Financial Economics*, 4(2): 129–176.

Roll, Richard, and Stephen A. Ross (1980). "An Empirical Investigation of the Arbitrage Pricing Theory", *Journal of Finance*, 35(5): 1073–1103.

Roll, Richard, and Stephen A. Ross (1984). "The Arbitrage Pricing Theory Approach to Strategic Portfolio Planning", *Financial Analysts Journal*, 40(3): 14-19, 22-26.

Roll, Richard, and Stephen A. Ross (1995). "The Arbitrage Pricing Theory Approach to Strategic Portfolio Planning", *Financial Analysts Journal*, 51(1): 122-131, [50 Years in Review].

Romer, David (2012). *Advanced Macroeconomics*, New York, NY: McGraw Hill – Irwin. 4th edition.

Rosdolsky, Roman (1977). *The Making of Marx's 'Capital' Volume 1*, London: Pluto Press. Original German Edition: *Zur Entstehungsgeschichte des Marxschen ‚Kapital'*, Frankfurt am Main: Europäische Verlagsanstalt (EVA), 1968.

Rosenberg, Barr, Kenneth Reid and Ronald Lanstein (1985). "Persuasive Evidence of Market Inefficiency", *Journal of Portfolio Management*, 11(3): 9-16.

Ross, Stephen A. (1976). "The Arbitrage Theory of Capital Asset Pricing", *Journal of Economic Theory*, 13(3): 341–360.

Ross, Stephen A. (1977). "The Capital Asset Pricing Model (CAPM), Short-Sale Restrictions and Related Issues", *Journal of Finance*, 32(1): 177-183.

Ross, Stephen A. (2005). *Neoclassical Finance*, Princeton, NJ: Princeton University Press.

Roth, Alvin E., and Robert B. Wilson (2019). "How Market Design Emerged from Game Theory: A Mutual Interview", *Journal of Economic Perspectives*, 33 (3): 118-43

Rothschild, Michael, and Joseph E. Stiglitz (1970). "Increasing risk: I. A definition", *Journal of Economic Theory*, 2(3): 225-243

Roubini, Nouriel, and Stephen Mihm (2011). *Crisis Economics: A Crash Course in the Future of Finance*, London: Penguin Books.
Rubin, Donald B., and Dorothy T. Thayer (1982). “EM Algorithms for ML Factor Analysis”, *Psychometrika*, 47(1): 69-76.
Rubinstein, Mark (2002). “Markowitz's ‘Portfolio Selection’: A Fifty-Year Retrospective”, *Journal of Finance*, 57(3): 1041-1045.
Rutterford, Janette (2004). “From Dividend Yield to Discounted Cash Flow: A History of UK and US Equity Valuation Techniques”, *Accounting, Business and Financial History*, 14(2): 115-149.
Samuelson, Paul A. (1965). “Proof that Properly Anticipated Prices Fluctuate Randomly”, *Industrial Management Review*, 6: 41-49.
Samuelson, Paul A. (1973). “Proof That Properly Discounted Present Values of Assets Vibrate Randomly”, *Bell Journal of Economics*, 4(2): 369-374.
Schmidt, Hartmut (2009). “Retrospective Book Review on James Moser: ‘Die Lehre von den Zeitgeschäften und deren Combinationen’ (1875)”, in Wolfgang Hafner and Heinz Zimmermann (eds), *Vinzenz Bronzin’s Option Pricing Models*, Berlin: Springer.
Shaikh, Anwar (1978). “Political Economy and Capitalism: Notes on Dobb's Theory of Crisis”, *Cambridge Journal of Economics*, 2(2): 233-251.
Shaikh, Anwar (1987). “Organic Composition of Capital”, in John Eatwell, Murray Milgate, and Peter Newman (eds.), *The New Palgrave: A Dictionary of Economics*, London: Macmillan.
Shaikh, Anwar (1992). “The Falling Rate of Profit as the Cause of Long Waves: Theory and Evidence”, in Alfred Kleinknecht, Ernest Mandel and Immanuel Wallerstein (eds), *New Findings in Long Wave Research*, London: Macmillan: 174–202.
Shaikh, Anwar (1997). “The Stock Market and the Corporate Sector: A Profit-Based Approach”, in Malcolm Sawyer, Philip Arestis and Gabriel Palma (eds.), *Markets, Unemployment and Economic Policy: Essays in Honour of Geoff Harcourt, Volume Two*, London: Routledge: 389–404.
Shaikh, Anwar (2010). “Reflexivity, Path-Dependence and Disequilibrium Dynamics”, *Journal of Post Keynesian Economics*, 33(1): 3-16.
Shaikh A. (2011). “The First Great Depression of the 21st Century”, *Socialist Register,* 47: 44-63. [Volume 47 edited by Leo Panitch, Gregory Albo and Vivek Chibber].
Shaikh, Anwar (2016). *Capitalism: Competition, Conflict and Crises*, New York, NY: Oxford University Press.
Shannon, Claude E. (1948). “A Mathematical Theory of Communication”, *The Bell System Technical Journal*, 27(July): 379–423, 27(October): 623–656.
Sharpe, William F. (1964). “Capital Asset Prices: A Theory of Market Equilibrium under Conditions of Risk”, *Journal of Finance*, 19 (3): 425–442.
Shiller, Robert J. (1981). “Do Stock Prices Move Too Much to be Justified by Subsequent Changes in Dividends?”, *American Economic Review*, 71(3): 421–436.
Shiller, Robert J. (1989a). “Comovements in Stock Prices and Comovements in Dividends”, *Journal of Finance*, 44(3): 719–729.
Shiller, Robert J. (1989b). *Market Volatility*, Cambridge, MA: MIT Press.

Shiller Robert (2003). "From Efficient Markets Theory to Behavioral Finance", *Journal of Economic Perspectives*, 17(1): 83-104.

Shiller, Robert J. (2008). *The Subprime Solution: How Today's Global Financial Crisis Happened and What to Do About It*, Princeton, NJ: Princeton University Press.

Shiller, Robert J. (2009). *Irrational Exuberance*, New York, NY: Broadway Books, 2nd edition, revised and updated (1st edition 2000).

Sims, Christopher A. (1972). "Money, Income, and Causality", *American Economic Review*, 62(4): 540-552.

Singleton, Kenneth J. (1990). "Specification and Estimation of Intertemporal Asset Pricing Models", in Benjamin M. Friedman and Frank H. Hahn (eds), *Handbook of Monetary Economics*, Edition 1, Volume 1, Amsterdam: North-Holland: 583-626.

Smith, Adam (1976). *An Inquiry into the Nature and Causes of the Wealth of Nations*. [General editors: R.H. Campbell and A.S. Skinner, Textual editor: W.B. Todd], 2 volumes. Oxford: Oxford University Press (Clarendon). Volumes 2a & 2b, *The Glasgow Edition of the Works and Correspondence of Adam Smith*. 1st edition: London: Printed for W. Strahan and T. Cadell, in the Strand, 1776.

Solomon, Ezra (1963). *The Theory of Financial Management*, New York, NY: Columbia University Press.

Soros, George (1994). "Theory of Reflexivity", Delivered April 26, 1994 to the MIT Department of Economics. World Economy Laboratory Conference Washington, D.C. Available at https://ritholtz.com/2004/04/the-theory-of-reflexivity-by-george-soros/

Soros, George (2009). *The Crash of 2008 and What It Means*, New York, NY: Public Affairs.

Soros, George (2013). "Fallibility, Reflexivity, and the Human Uncertainty Principle", *Journal of Economic Methodology,* 20(4): 309–329.

Spence, Michael (1973). "Job Market Signaling", *Quarterly Journal of Economics,* 87(3): 355-374.

Stambaugh, Robert F. (1982). "On the Exclusion of Assets from Tests of the Two-Parameter Model: A Sensitivity Analysis", *Journal of Financial Economics*, 10(3): 237-268.

Stattman, Dennis (1980). "Book Values and Stock Returns", *The Chicago MBA: A Journal of Selected Papers*, 4: 25-45.

Stein, Jeremy. (1996). "Rational Capital Budgeting in an Irrational World", *Journal of Business,* 69(4): 429–55.

Stiglitz, Joseph E. (1975). "The Theory of "Screening", Education, and the Distribution of Income", *American Economic Review,* 65(3): 283-300.

Stiglitz, Joseph E., and Andrew Weiss (1981). "Credit Rationing in Markets with Imperfect Information", *American Economic Review*, 71(3): 393-410.

Sweezy, Paul M. (1942). *The Theory of Capitalist Development*, New York, NY: Oxford University Press.

Stravelakis, Nikos (2012). "Marx's Theory of Crisis in the Context of Financialization: Analytical Insights on the Current Crisis", *Journal of Advanced Studies in Finance*, 3(2): 171–191.

Stravelakis, Nikos (2014). "Financial Crisis and Economic Depression: '*Post Hoc ergo Propter Hoc*'? Implications for Financial Asset Valuation and Financial Regulation", in Renata Karkowska (ed.), *Challenges to Financial Stability: Perspective, Models and Policies, Volume I: A Framework for Modeling Systemic Risk Drivers of Different Markets*, Warsaw: ASERS Publishing: 187–210.

Stravelakis, Nikos (2018). [Book Review:] "*The Chains of Finance: How Investment Management is Shaped* by Diane-Laure Arjaliès, Philip Grant, Iain Hardie, Donald McKenzie, Ekaterina Svetlova, Oxford University Press", *Economic Issues*, 23(1): 95-96.

Stravelakis, Nikos (2020). "Inequality in Marx and Piketty: Theory and Policy Implications", forthcoming in *Research in Economics and Economic Methodology,* 4(2).

Stravelakis, Nikos, and Marianna Tziantzi (eds) (2018). *Του Ανταποκριτή μας στο Λονδίνο Καρλ Μαρξ* [From our London Correspondent Karl Marx], Athens: Kastaniotis.

Summers, Laurence H. (2015). "Demand Side Secular Stagnation", *American Economic Review: Papers & Proceedings,* 105(5): 60–65.

Taleb, Nassim Nicholas (2007). *The Black Swan: The Impact of the Highly Improbable*, New York, NY: Random House.

Tirole, Jean (1985). "Asset Bubbles and Overlapping Generations", *Econometrica*, 53(6): 1499-1528.

Tirole, Jean (2017). *Economics for the Common Good*, Princeton, NJ: Princeton University Press.

Tobin, James (1958). "Liquidity Preference as Behavior towards Risk", *Review of Economic Studies*, 25(2): 65-86.

Tobin, James (1970). "Money and Income: *Post Hoc Ergo Propter Hoc*?", *The Quarterly Journal of Econom*ics, 84(2): 301-317.

Tobin, James (1983). "Liquidity Preference, Separation and Asset Pricing" *Zeitschrift für Betriebswirtschaft* (now *Journal for Business Economics*), 53(3): 236-238.

Tomé, Juan Pablo Mateo (2011). "Financialization as a Theory of Crisis in a Historical Perspective: Nothing New under the Sun", *Working Paper Series*, No. 262, Political Economy Research Institute (PERI), University of Massachusetts at Amherst, (July).

Tooke, Thomas, and William Newmarch (1838-1857). *A History of Prices and of the State of the Circulation from 1792 to 1856,* London: Longman, Brown, Green, Longmans & Roberts. 6 vols. Also *Reproduced from the original, with an introduction by T.E. Gregory*, New York, NY: Adelphi Co, 1928.

Tooke, Thomas (1844). *An Inquiry into the Currency Principle; The Connection of the Currency with Prices and the Expediency of a Separation of Issue from Banking*, London: Longman, Brown, Green and Longmans.

Tsoulfidis, Lefteris, Constantinos Alexiou and Thanasis Parthenidis (2015). "Revisiting Profit Persistence and the Stock Market in Japan", *Structural Change and Economic Dynamics*, 33(C): 10-24.

Tsoulfidis, Lefteris, and Persefoni Tsaliki (2005). "Marxian Theory of Competition and the Concept of Regulating Capital: Evidence from Greek Manufacturing", *Review of Radical Political Economics*, 37(1): 5–22.

Weeks, John (1981). *Capital and Exploitation*, Princeton, NJ: Princeton University Press

Williams, John Burr (1938). *The Theory of Investment Value,* Cambridge, MA: Harvard University Press.

Varoufakis, Yanis (2009). "Pristine equations, Tainted Economics and the Postwar Order: Or how the Cold War fashioned a formalist economics whose dominance remains inversely proportional to its explanatory power and functional to an irrational global order", presented on 10th April 2009 at Columbia University and included in the *Proceedings of the Cold War Politics and Social Science Workshop*, Heyman Centre for the Humanities, Columbia University. Available at https://citeseerx.ist.psu.edu/viewdoc/download;jsessionid=6316FFEF53CD4EF107398ECC0764C692?doi=10.1.1.454.2849&rep=rep1&type=pdf

Weber, Ernst Juerg (2008). *A Short History of Derivative Security Markets*. Available at SSRN: https://ssrn.com/abstract=1141689

Weston, J. Fred, and Eugene F. Brigham (1982). *Essentials of Managerial Finance*, Chicago, IL: Dryden Press. 6th edition.

Wibral, Michael, Patricia Wollstadt, Ulrich Meyer, Nicolae Pampu, Viola Priesemann and Raul Vicente (2012). "Revisiting Wiener's Principle of Causality – Interaction-Delay Reconstruction Using Transfer Entropy and Multivariate Analysis on Delay-Weighted Graphs", *Annual International Conference of the IEEE, Engineering in Medicine and Biology Society (EMBC):* 3676–3679.

Wicks, Robert T., Sandra Chapman and R.O. Dendy. (2007). "Mutual Information as a Tool for Identifying Phase Transitions in Dynamical Complex Systems with Limited Data", *Physical Review E*, 75(5 Pt 1): 051125.

Wicksell, Knut (1936). *Interest and Prices* (Geldzins und Güterpreise): *A Study of the Causes Regulating the Value of Money*. [Translated from the German by R. F. Kahn with an Introduction by Professor Bertil Ohlin], London: Macmillan on behalf of the Royal Economic Society. Original German Edition: *Geldzins und Güterpreise: Eine Studie über die den Tauschwert des Geldes bestimmenden Ursachen*, Jena: Gustav Fischer, 1898.

Wishart, John (1928). "The Generalised Product Moment Distribution in Samples from a Normal Multivariate Population", *Biometrika*, 20A(1/2): 32–52.

Working, Holbrook (1934). "A Random-Difference Series for Use in the Analysis of Time Series", *Journal of the American Statistical Association*, 29(185): 11–24.