

## Chapter 2: Literature Review

### 2.1 Chapter Introduction

This chapter illustrates the theoretical framework of this dissertation in four major sections: Firstly grand fundamental theories on the cross-section of stock returns are discussed. Secondly deductive academic studies are critically reviewed. Thirdly, recent developments and findings are examined, focussing on international and sector specific aspects of the risk-return relationship. In the fourth section, gaps within the literature are outlined to support the importance of this dissertation.

### 2.2 Fundamental Theory

This work builds on different theories and important areas of study. As the existence of **efficient markets** is a basic assumption for asset-pricing models in general its analysis is conducted. Then, the importance of diversification and stock-picking is illustrated by having a close look at the **modern portfolio theory**. This is followed by a critical review of the **CAPM** which is deduced from the aforementioned theories in order to allocate the best securities within a portfolio. This will include the area of **Behavioural Finance** which tries to explain market anomalies. Furthermore, alternative **asset-pricing theories** which have been developed by the opponents of the CAPM are highlighted. Finally, international and sector specific research is presented in the section on **recent development**.

#### 2.2.1 Efficient Markets

Market efficiency is the basic assumption for asset pricing models. Cohen *et al.* (2009) proved that a joint hypothesis between the CAPM and market efficiency approximates the pricing of stocks well at price level for both growth and value securities. Therefore, this dissertation

discusses the development and recent findings about the most important theories, the **Random walk hypothesis** and **efficient-market hypothesis**.

### *2.2.1.1 Random Walk Hypothesis (RWH)*

The RWH finds its origin in the early works of Bachelier (1900). Extended and translated into English by Cootner (1964) this theory submits that stocks at the end of a certain time period largely show future prices. These seem to be generated by a random process and show independent (Gaussian or normal standard) distributions. Other chartist theories however share the common assumption that history repeats itself and therefore historical stock price behaviours can be used to predict a share's price (Fama 1965).

Bachelier (1900) and later Osborne (1959) inductively transferred botanic observations like the Brownian motion to build a mathematical model to explain price fluctuations on the stock market. Even though both tried to justify this theory empirically, they felt short as they only used cross-sectional data. Moore (1962), analysing only eight shares from the U.S. Stock market (NYSE), and Kendall (1953), examining 19 British industrial indices, deductively proved that successive stock prices cannot be predicted by adjusting historical prices. They observed an approximately normal distribution; however they acknowledged that most of the distributions were leptokurtic which weakens their findings. To provide more reliable facts, Fama (1965) analysed the whole Dow-Jones Industrial Average index (30 stocks). He was also able to explain the "fat tails" within his sample by using the findings of Mandelbrot (1963), who states that distributions show a stable Paretian (Levy 1925) shape with characteristic exponents smaller than 2.

The efficiency of information also plays a major role within this research area. If any information is distributed or accessible to/from each investor there would not be any fluctuation or variation in stock prices. Only when

new information is created the market reacts (Fama 1965). If the market (buyers and sellers) knows about a company's future, this would already be reflected in the current stock price (Samuelson 1965). As information is processed in different ways and there is existing disagreement about a company's intrinsic value stock prices fluctuate randomly. Fama (1965) calls it the market's "noise" and forms a fundament for short-term behavioural models like the one of Barberis *et al.* (1998). According to Fama (1998) this does not contradict the long-term market efficiency but underlines its power. One of the best established investment strategies, the long-term focussed *buy and hold* approach, is based on this idea. It is used to create an optimised portfolio according to the major aim of this dissertation.

Even though there is strong evidence provided by several renowned academics supporting the market efficiency of the RWH (Jensen 1978), Lo & MacKinlay (1988) rejected it with their quantitative analysis of 625 US stocks during a 1,216-week time period by applying a variance-ratio test. However, by increasing the observation interval from one to four weeks they were not able to reject the hypothesis. These findings raise the question if information is not incorporated fast enough or if there is too little information on small firms available to the market.

To summarise, a rapid incorporation of information leads to market efficiency where price changes are independent. These findings play a major role to create the different "levels" of market efficiency which are discussed in the following subsection.

### 2.2.1.2 *Efficient-Market Hypothesis (EMH)*

As Jensen (1978) states in his symposium the EMH has become an accepted fact within the financial literature. The major contribution of this hypothesis can be described as follows:

"It is not possible to make economic profits in an efficient market by trading on the basis on an information set  $\theta_t$  which is already given in the moment of trading."

The definition of the information set is the reason for different versions of the EMH: weak, semi-strong and strong. They were first mentioned by Roberts (1967) and have been tested and reviewed widely by various academics since (Jensen 1978, Dimson & Mussavian 1998, Fama 1998, Sewell 2011). The typology is defined as follows (Fama 1970, LeRoy 1989, Spremann 2008):

The information set in the **weak form** includes all historical stock prices at the time of the appraisal, public or private information is excluded. As this is given for all markets this form is not under consideration within the literature.

In the **semi-strong** set contains besides the historical prices all publicly available information (e.g. annual reports). Private information is excluded from this set.

A **strong form** of efficiency exists if the set comprises historical prices, public information and private knowledge (e.g. inside information).

The model of a strong form of market efficiency has generally been rejected and only used "...as a benchmark against which the importance of deviations from market efficiency can be judged" (Fama 1970, p.414). It has been pointed out by the early example of market making specialists at the New York Stock Exchange. Niederhoffer & Osborne (1966) proved that "insiders" with private knowledge (positions within the order book) are able to gain excessive returns in more than 80% of the undertaken transactions. This contradicts the core idea of a strong-form-efficient market where all information is given and accessible to all investors. However Rozeff & Zaman (1988) provide the scarce counter evidence. They proved in their quantitative study of 679 outsiders and 722 corporate insiders that corporate insiders could not gain excessive returns any different to outsiders.

Regarding the semi-strong form, Fama (1970) states that there is no relevant counter-evidence to reject this hypothesis. This implies that

stock prices fully reflect all available information after having them rapidly incorporated and consequently lead to an efficient adjustment. The quantitative “event” study of Fama et al. (1969), using data from the NYSE of 940 stock splits (collected by the CRSP), proves that after the announcement of stock splits (public information) abnormal returns cannot be gained. After a prompt price adjustment at the moment of the announcement (new information) there will not be any further trends and the prices will fluctuate randomly. This confirms the semi-strong hypothesis.

In conclusion, the semi-strong form is the generally accepted pattern of thought, if the meaning of “publicly available” is accurately defined (Jensen 1978). In non-collegiate surroundings this form represents the basic understanding of an efficient market. As possible contradictions to market efficiency have been proven false and explained by scientists, research became as popular as Behavioural Finance and will which will be discussed later.

### 2.2.2 *Modern Portfolio Theory (MPT)*

With his pioneering work Markowitz (1952, 1956, 1959) laid the foundation for MPT, for which he was lauded with the Nobel Prize in 1990. His theory is the conceptual framework for portfolio management methods used by practitioners. It is also the groundwork for evolutionary theories of renowned academics including the Single-Index-Model (Sharpe 1963), the Capital Asset Pricing Model (Sharpe 1964, Lintner 1965, Mossin, 1966), and the Arbitrage Pricing Theory (Ross 1976).

Markowitz (1952) explains that the biggest challenge for an investor is to find the perfect combination of stocks (“risky assets”) in regards to expected return and variance of return; in other words an efficient portfolio in terms of yield and risk.

### 2.2.2.1 *Efficient Frontier*

A basic assumption for the perfect combination of stocks is that the portfolio with the highest return is not automatically the portfolio with the lowest risk (variance). This idea assumes that either the expected return of a portfolio increases when the investor is willing to take additional risk or a risk-averse investor is able to reduce the variance in exchange to a lower expected return. Markowitz (1952) defines this connection as the E-V rule (Expected return – Variance of returns). This enables an investor to calculate an infinite number of portfolios allocated out of the world's stock portfolio. As a consequence, this approach also provides a dazzling array in terms of risk and return. Figure 2 highlights that the most efficient portfolios lay on the grey semicircle ("Efficient Frontier") which are "...those with minimum V for given E or more and maximum E for given V or less..." (Markowitz 1952, p.82).

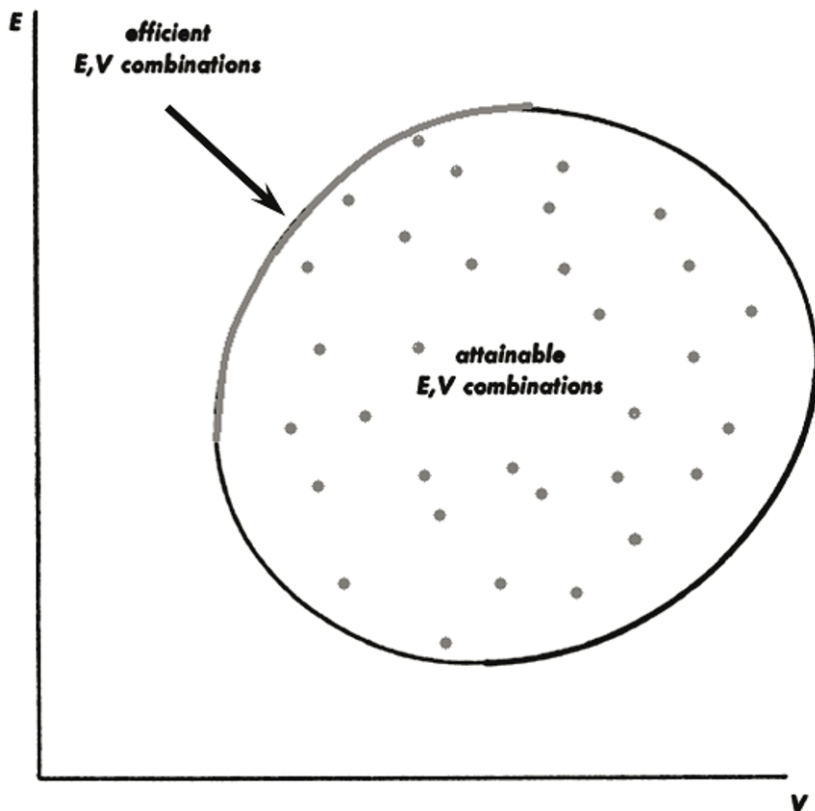


Figure 1: Attainable vs. Efficient Combinations of Risky Assets (adapted from: Roy 1952, 435; Markowitz 1952, p.82; Markowitz 1956, p.111)

Markowitz (1999) states that Roy's article (1952) shows fewer drawbacks than his own as Roy used the standard deviation instead of the variance as his measure of risk. Furthermore, he identifies the potential set of combinations as an envelope curve instead of a circle and anticipated the capital market line (CML) and the "super-efficient portfolio", long before Tobin (1958) and Sharpe (1963) developed their theories.

### 2.2.2.2 Tobin Separation Theorem

Markowitz' assumptions (1952, 1956), in particular the use of the criteria expected returns and variance were justified by Tobin (1958), again a of the Nobel Prize laureate. The innovative thinking and core of Tobin's article (Markowitz 1999) is the idea of a portfolio selection model with  $n$  risky assets and one risk free asset (cash). Moreover Tobin argues that the market portfolio might be quite inefficient even if all investors hold mean-variance-efficient portfolios. Markowitz (1999) concluded, that the idea of Tobin (1958) was pathbreaking but cautious while Sharpe (1963) revolutionised financial economics. How a riskless asset allows and affects the creation of a "super-efficient" portfolio is illustrated in Figure 3.

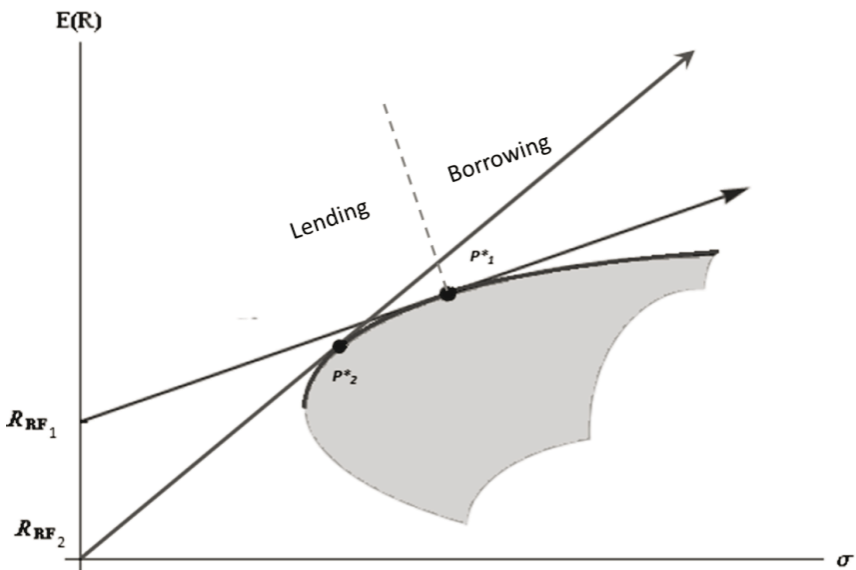


Figure 2: CML, super-efficient portfolio and riskless assets (adapted from: Roy 1952, p.435; Tobin 1958, p.78; Sharpe 1963, p.286; Brealey & Myers 2003, p.193; Fama & French 2004; p.27)

The figure comprises the four fundamental characteristics. While the grey area represents all feasible E-V combinations, the bold curve illustrates the efficient border. The capital market line (CML) starts from the

point on the vertical axis at the rates of return on the risk-free assets and tangent to the efficient frontier.  $RF_1$  represents the idea of the Sharpe ratio (1963) that Treasury Bills can be regarded as risk-free (standard deviation: 0) and the related line is the capital asset line (CAL).  $RF_2$  follows Tobin's (1958) assumption that the return of a risk-free asset is zero. At the point where the lines are tangent to the efficient frontier one will find the super-efficient portfolio as it is the perfect combination of risky and risk-free assets (Fama & French 2004).

Building on this fundamental knowledge Sharpe (1964) developed the security market line (SML). In contrast to the CML and CAL it does not measure risk and return of portfolios (asset combinations) but those of single assets (stocks); hence a combination within a portfolio (Fama & French 2004). Before, this model is described in detail, the next subsection looks at global diversification and the ideal quantity of allocated securities.

### 2.2.2.3 *Diversification*

Markowitz's (1952) E-V rule implies an adequate diversification which depends on the number of securities and on a diversification across sectors and industries in order to reduce variance. In general, companies within the same industry usually show high covariances among themselves as they react "similar" to economic events which leads to a higher risk exposure. Consequently, an investor holds a mean-variance efficient portfolio when a given (individual) level of variance (risk) receives the highest possible expected return (Campbell et al. 1997). Or, like another Nobel Prize winner famously states "Don't put all your eggs in one basket..." (Samuelson 1967, p.1). In order to reduce or even eliminate the unsystematic risk the equity allocation must show a perfect distribution of uncorrelated stocks. The only remaining risk is systematic.

Evans & Archer (1968) conduct one of the first empirical investigations on the question how many stocks should be allocated in a portfolio. They

applied a data set of 470 stocks listed in the S&P 500 index in 1958 and used quantitative univariate analysis for the period 01/1958-07/1968. They estimated the level of systematic variation at 0.1166 for the whole portfolio. Further, they conclude a diversification over 10 stocks is enough as the relationship between the level of dispersion and the number of stocks shows a rapidly decreasing function which approximates asymptotically the level of systematic variation. They found proof that most of the unsystematic risk is eliminated after having added the eighth stock to a portfolio. Only big increases lead to a further reduction of risk which was indicated by both t- and F-tests. Even though, this result has been cited throughout following academic literature it also evoked discussions and gained criticism.

Elton & Gruber (1977) criticise that Evans & Archer (1968) employed a simulation approach while advanced statistical models allow a better and analytical expression of the determination of the risk-return relationship for new conditions. They argued that the definition of risk was improper and according to their opinion "...the variation of the expected return on the population of stocks under consideration..." (Elton & Gruber 1977, p.420) would do better. They examined a data set from the NYSE and the American Stock Exchange and used weekly returns of two samples over the time period 6/1971 – 6/1974. Most of their investigations based on the small sample (150 stocks). They validated their findings as they show that the calculated the total variance of return and the expected portfolio variance by using a bigger sample (3,290 securities) had the same characteristics. Their results show a minimum total risk of 7.07 (equally weighted population portfolio) and a maximum risk of 46.811 (single stock portfolios). They conclude that Evans & Archer (1968) were right about the major decrease in risk if 10 uncorrelated stocks are allocated to a portfolio (variance: 11.033) but that it is 156% higher than the minimum. Especially for institutional investors it is quite important to diversify to that point where marginal benefits just exceed marginal costs

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the CAPM

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