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Does Finance Theory Make the Case for Capitalisation-Weighted Indexing?

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Executive Summary

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Proponents of cap-weighted stock market indices often argue that such indices provide efficient risk/return portfolios. This paper reviews the evidence in the academic literature and concludes that only under very unrealistic assumptions would such indices be efficient investments. In the presence of realistic constraints and frictions, cap-weighted indices cannot, according to the academic literature, be expected to be efficient investments.

Pioneering work in financial theory (Markowitz 1952; Sharpe 1964; Lintner 1965) led to the development of an elegant theory, the capital asset pricing model (CAPM), formulated by Sharpe (1964), which held that the portfolio made up of all existing risky assets, weighted by their market capitalisation, named the market portfolio, offered an efficient risk/return tradeoff. In other words, no other combination of risky assets makes it possible to obtain a better return for the same degree of risk, or a lower risk for the same expected return. Any risky portfolio other than the market portfolio will introduce some unsystematic, and hence unrewarded risk, and thus will not be a valuable investment. According to the tenets of the CAPM, all investors will choose to build their portfolios by dividing their wealth between the market portfolio and a risk-free asset (two-fund separation theorem), with the relative split between the two assets allowing them to adjust the risk of their global portfolios. Index providers relied heavily on this theory to present cap-weighted indices as the best media for indexation management, a technique that, for financial theory, could not be outperformed by any other management technique.

Like many theories, however, the CAPM relies on assumptions that seek to simplify reality and thus that do not resemble real market conditions. In addition, indexation could not use the true market portfolio. Indeed, this portfolio is not observable, since it would have to include traded assets (stocks, bonds, and so on), as well as non-traded assets (human capital) or illiquid assets (real estate). Investment managers use cap-weighted stock market indices as a proxy for the market portfolio. The objective of this paper was thus to answer two questions. Is the market portfolio still efficient if one of the assumptions on which the model relied does not bear out? Can a market index serve as a valid proxy for the market portfolio?

A detailed review of the literature allowed us to conclude that, as soon as one of the CAPM assumptions no longer holds, financial theory does not predict that the market portfolio is efficient. Therefore, it seems important to ask whether the assumptions of the theory are at all realistic.

The theory that has it that the cap-weighted market portfolio will be efficient assumes that investors have identical preferences and that they all have the same investment horizons. It also assumes unlimited borrowing, tradability of all existing assets, and no taxes or transaction costs. From this list, it becomes clear that it is unreasonable to expect that all these assumptions hold. After all, investors are unlikely to have the same preferences and the same investment horizons. In addition, the existence of taxes and transaction costs is quite real. Nor is unlimited borrowing feasible for most investors. Likewise, not

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all assets are tradable, and investors may invest significant portions of their wealth in non-tradable assets (human capital, for example) or illiquid assets such as real estate. So it is hardly surprising that the model frequently fails in empirical tests, as a detailed review of the empirical literature shows.

The second key point of this study was to establish whether an index could serve as a good proxy for the market portfolio. According to the CAPM, only the market portfolio is efficient. Stock market indices appear to be very poor proxies for the market portfolio. Though the true market portfolio is assumed to contain a vast collection of assets, including unlisted and illiquid assets, stock market indices include only a small fraction of listed assets. Thus, the many empirical studies done to test the CAPM have attempted to come up with reasonable proxies for the market portfolio, including not only many more stocks than indices do, but also bonds, real estate, and non-tradable assets such as human capital.

To conclude, it turns out that stock market indices are far from being the market portfolio. Stock market indices in reality reflect only a fraction of wealth in the economy, ignoring the share of wealth represented by human capital, social security benefits and illiquid assets. Even if it were possible to build and hold the market portfolio that includes all these assets, the market portfolio would be efficient only if a set of highly unrealistic assumptions held. And not even under more realistic assumptions does financial theory necessarily conclude that the market portfolio is efficient. In view of these arguments, it seems that financial theory alone does not justify the current practice of using cap-weighting indices.

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Introduction

Introduction

The proponents of cap-weighted indices frequently refer to the theoretical groundings of this means of constructing indices (Vanguard 2003; Cavanaugh Capital Management 2004; Ambrosio and Philips 2008). The main argument for capitalisation weighting comes from Sharpe's (1964) capital asset pricing model (CAPM). Goetzmann (1997) writes: "Not co-incidentally, widespread use of index funds began about the time the CAPM was developed". Likewise, Mauldin (2006) notes that "[the CAPM] is the basis for a number of index models, especially capitalisation-weighted indexes like the S&P 500". This relation between the commercial development of cap-weighted indices and index funds and the theoretical background from the CAPM is well documented in a large body of literature.[1]

In the 1970s, after the CAPM became widely known, Wells Fargo was among the first to propose index funds (see Jahnke and Skelton 1990 for a description). In 1989, Wells Fargo noted "that CAPM has given us all a fertile intellectual garden to grow in" (quoted in Hebner 2007).

The two main theoretical predictions of the CAPM are, first, that the market portfolio is mean-variance efficient. In other words, no other portfolio can provide a higher return with the same risk, or lower risk with the same return. Second, it predicts that only systematic risk, *i.e.*, the beta of a stock with the market portfolio, is rewarded by higher expected returns. It can actually be shown that the second prediction follows from the first (Cochrane 2005). In this paper, then, we concentrate on analysing the efficiency of the market portfolio. If the market portfolio is inefficient, the beta pricing relationship usually does not hold.[2]

The recommendation that follows from the theory is that investors should hold the market portfolio. If this portfolio is the most mean-variance efficient, mean-variance investors would obviously prefer it. Likewise, if the only way of achieving higher returns is to increase the beta of one's investment, the investor can simply choose between a certain fraction invested in the market portfolio and another fraction invested in a risk-free asset to adjust his overall beta to his desired risk and expected return. Since any portfolio that is different from the market portfolio would introduce some unsystematic and hence unrewarded risk only the market portfolio is of interest to the investor.

From these theoretical recommendations, index providers have concluded that the best thing to do is to buy a stock market index. For this conclusion to be of practical relevance, the CAPM theory must hold and stock market indices must be identical to the market portfolio. This paper looks at both of these issues in detail. We review the existing literature in order to analyse what finance theory has to say on the following two questions:

- Should we expect the market portfolio to be efficient?
- Can stock market indices represent the market portfolio?

As it happens, the CAPM makes many tenuous assumptions. It assumes that investors are rational mean-variance investors; that investors' wealth is entirely described by their holdings in tradable

1 - In an article published in 2001 Haas underlined that "passive investing is based on a sound theoretical foundation: the efficient market hypothesis (EMH) and the capital asset pricing model (CAPM)" (25). Jaeger and Wagner (2005) noted that traditional equity indices became vehicles for passive investment after the development of the CAPM, which established that the market portfolio represents the optimal combination in terms of risk-return. Schoenfeld (2004) also mentions that the CAPM theory makes market-capitalisation-weighted indices the dedicated tool for index funds. This kind of argumentation is also to be found in textbooks (for example, Bodie, Kane, and Marcus 1999). These authors underline that the CAPM implies that indexing is the optimal way to invest in equities and that it provides the intellectual justification for the development of index funds. Similar arguments are made by Harrington and Korajczyk (1993). Hogan (1994) also refers to the development of index funds in the context of market portfolio theory. The link between the CAPM and the development of index funds is also summarised in Bernstein (1992, 2007), Mauldin (2006), and Broby (2007).

2 - In fact, it can be shown that any mean-variance-efficient portfolio will lead to a beta pricing relationship. For example, Markowitz (2005) underlines that a beta pricing relationship holds if a portfolio located on the efficient frontier is used to compute beta, but that it no longer exists if the reference portfolio is not efficient. However, Roll and Ross (1994) show that an inefficient index can generate an arbitrary linear relationship between the expected return and the beta of stocks, with a slope that may be negative, positive or zero. Therefore, by pure chance, it is possible for an inefficient index to produce a significant beta pricing relationship in a given dataset, even if the market portfolio proxy is not efficient.

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Similar considerations can also be found in Kandel and Stambaugh (1987, 1989, 1995).

securities; that it is possible to borrow unlimited amounts at the risk-free rate or that there are no restrictions on short selling; that all investors have identical preferences and identical horizons; and that taxes, transaction costs, and other frictions are insignificant for most investors and assets.

Our review of the literature shows that if any one of these assumptions does not bear out the CAPM predictions are no longer valid. Financial theory tells us that under real world conditions the market portfolio is not necessarily an efficient portfolio and thus is not the optimal portfolio that every investor should hold. In addition, our review of the empirical literature on testing the CAPM highlights the evidence for its invalidity; in view of the model's great reliance on unrealistic assumptions, this evidence is hardly surprising.

Let us repeat that even if the CAPM theory were valid, it is the market portfolio that is the optimal choice for all investors. The CAPM actually suggests that stock market indices are not efficient portfolios unless they are identical to the market portfolio. What is this market portfolio that the CAPM theory is based on? It is the cap-weighted portfolio of all assets that reflects the aggregate wealth in the economy. Thus, the market portfolio includes all sorts of financial assets, including unlisted securities, as well as other illiquid assets such as private housing. To draw the conclusion that there is a theoretical basis for holding cap-weighted stock market indices, these indices would have to include all assets in the economy. Clearly, stock market indices, which usually include only a fraction of the stocks listed on an exchange, do not fulfil this requirement.

The remainder of the paper proceeds as follows. We first give a short recap of the CAPM model. We then investigate the consequences of relaxing some of the fundamental assumptions of the model. We also analyse whether the literature finds stock market indices to be reasonable proxies for the market portfolio and we provide an extensive list of these proxies. A final section provides our conclusions.

Introduction

1. A Refresher on the CAPM

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The capital asset pricing model (CAPM) was derived by Sharpe (1964) and Lintner (1965). According to the CAPM, the expected excess return of an asset is linearly proportional to the expected excess market return, called the market risk premium. Excess returns are returns above the risk-free interest rate. The market risk of an asset is measured by its beta, which reflects the systematic risk of the asset. Formally, it can be written in the following way:

$$E(R_i) = R_f + \beta_i (E(R_M) - R_f)$$

where $E(R_i)$ is the expected return of asset i; $(E(R_M) - R_f)$ is the market risk premium; β_i is the systematic risk.

The capital asset pricing model (CAPM) relies on several assumptions:

- Investor preferences

a. Investor behaviour: Investors are risk-averse and seek to maximise the expected utility of their wealth at the end of the period.

b. Mean-variance preferences: When choosing their portfolios, investors consider only the first two moments of return distribution: the expected return and the variance.

- No operational friction: there are no taxes or transaction costs. All assets are infinitely divisible.

- No short sales constraints or borrowing constraints: Investors have a limitless capacity to borrow and lend at the risk-free rate.

- All assets can be traded: All existing assets in the economy are tradable. That is, all claims to future cash-flows can be freely exchanged. This also means that each investor's wealth is entirely made up of tradable assets.

- Homogeneous beliefs: The investment period is the same for all investors. Information is accessible free of charge and is available simultaneously to all investors. All investors therefore have the same return, variance, and covariance expectations for all assets.

The two-fund separation theorem has established that, in the presence of a risk-free asset, the optimal portfolio choice is always made up of a linear combination of the risk-free asset and a fraction of an optimal risky portfolio. This risky portfolio is the tangency portfolio, the portfolio that provides the highest expected return per unit of risk, or the highest Sharpe ratio. The tangency portfolio is the same for all investors, regardless of their risk aversion. The investor's risk aversion will determine the fraction he invests in the tangency portfolio. The investment decision, then, can be broken down, first, into the choice of the tangency portfolio and, second, depending on the desired risk, into the choice of the split between the risk-free asset and the tangency portfolio. All these portfolios are efficient and are located on a straight line, the efficient frontier in the presence of a risk-free asset, also called the capital market line (see figure 1). All possible portfolios of risky assets form a convex frontier, but only the tangency portfolio is of interest to investors, since it has the highest Sharpe ratio and makes it possible to form portfolios on the capital

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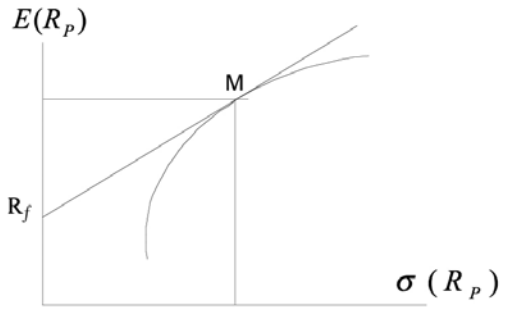
market line, which dominate all other portfolios.

Figure 1. The capital market line



This insight was first published by Tobin (1958). It leads to practical advice: investors should seek the maximum Sharpe ratio portfolio and then leverage up or down using a risk-free investment, depending on their risk aversion. The CAPM theory extended this investment perspective to an equilibrium theory. What happens if all investors behave this way and they all have the same beliefs about expected asset returns and covariance? They will all end up with the same portfolio of risky assets, although they may weight it differently. Since all investors hold the same tangency portfolio and all assets have to be held in equilibrium, the tangency portfolio will be made up of all assets available weighted by their market value. This is the market portfolio. This theory leads to two central assertions, that the market portfolio is efficient and that the beta pricing relationship exists.

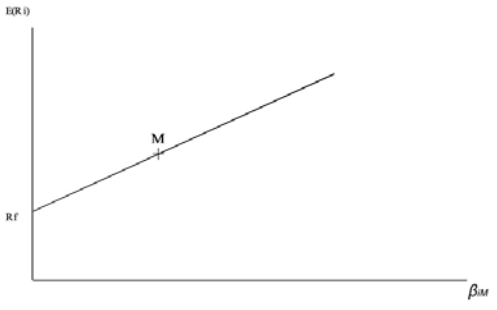
1. The Efficient Market Portfolio

The central prediction of the CAPM is that the market portfolio of invested wealth is mean-variance efficient in the sense of Markowitz (1952, 1959). It is the portfolio *M* in figure 1, which has the highest Sharpe ratio among all possible portfolios. This market portfolio is an asset portfolio that mimics the market: it is made of all assets in the economy and these assets are capital-weighted; that is, each asset is weighted by its percentage of the total value of the entire market for assets.

2. Beta Pricing Relationship

The efficiency of the market portfolio implies that each security's beta with the market portfolio can be used to price the security. Expected returns on securities are a positive linear function of their market beta—the slope in the regression of a security's return on the market return—and differences in the beta of different stocks completely capture the variation of expected returns across stocks. This formulation can be represented by the security market line (see figure 2). Figure 2 shows that the expected return on asset *i* (denoted as $E(R_i)$) depends on the risk-free rate (R_f) and the asset's beta with the market portfolio (β_{iM}).

Figure 2. The security market line



The CAPM thus leads to very elegant predictions about the pricing of assets (the beta pricing relationship) and optimal investment strategy (the efficient market portfolio). Strongly implied is that if the CAPM holds investors need simply

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hold the market portfolio. They can thus spare themselves the trouble of analysing expected returns and covariances. The best possible portfolio in a mean-variance sense is simply the market portfolio. In the next section, we will look at some of the assumptions behind this prediction and we will see whether the prediction changes if the assumptions do not bear out.

2. Does Theory Predict That the Market Portfolio Will Be Efficient?

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As mentioned above, the CAPM makes a range of assumptions that lead to the prediction of a mean-variance-efficient market portfolio at equilibrium. We review each of these assumptions and outline how the result of the efficient market portfolio changes when the assumption does not hold. We will see that the failure to hold of any one of these assumptions may mean that theory does not predict an efficient market portfolio. It is then important to ask whether the assumptions are reasonable.

1. Investor Preferences

The model makes bold assumptions about investor preferences; as a result, investors choose mean-variance optimal portfolios. We look now at what happens if these assumptions are incorrect.

The CAPM assumes that investors seek to maximise expected utility, as defined in Von Neumann and Morgenstern (1944). The theory of maximum expected utility posits that investors always seek to maximise their terminal wealth. It also assumes that investors can compare alternatives, will establish a preference order, and will make consistent choices. The assumption that investors would rather have more than less underpins the choices it is assumed they make. This theory has been criticised by Allais (1953), Ellsberg (1961), Kahneman and Tversky (1979, 1992), and others. These critics point out that it is not always consistent with investors' psychology and that investors often behave in keeping with what Kahneman and Tversky (1979) call prospect theory. Indeed, investors may not consider terminal wealth; instead, they look at gains and losses throughout the investment period. They also appear to be loss averse, a trait not without consequences for the CAPM theory. These consequences have been studied by Levy and Levy (2004), De Giorgi, Hens, and Levy (2004), and others. De Giorgi, Hens, and Levy (2004) established that the cumulative prospect theory, posited by Kahneman and Tversky (1992), does not allow the existence of financial market equilibrium and, consequently, of the CAPM. A modification of utility function forms can, of course, make the theory compatible with financial market equilibrium. However, this compatibility is achieved only if asset returns are normally distributed. For Hearings and Kluber (2000), investor loss aversion may mean that the utility function is not concave and that market equilibria do not exist.

Although the efficiency of the market portfolio relies on an equilibrium in which all investors use an identical and clearly defined strategy of expected utility maximisation, a large and growing body of literature that takes into account investor behaviour concludes that equilibrium may not even be defined in the presence of more complex investor preferences.

2. No Operational Friction

The CAPM theory assumes that there is no operational friction, that is, that there are no transaction costs and that investors are not subject to taxation. These are two distinct considerations, and we look now at what the theoretical literature has to say about the efficiency of the market portfolio if these assumptions are false.

a. Taxes

If taxes are ignored, investors are supposed to have no preferences for capital gains or dividends. If, on the contrary, taxes are taken into account, investors subject to different taxation will certainly not hold

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the same portfolio of risky assets. They will still hold diversified portfolios, not far from the market portfolio, but investors subject to lower taxes will hold more high-dividend stocks than will investors subject to higher taxation. Long (1977) demonstrates that the existence of taxes leads to the disappearance of the mean-variance efficiency. Basak and Gallmeyer (2003) conclude that investors facing different after-tax opportunity sets of investment will require different risk premia and thus will not share the same market equilibrium model.

However, several authors have argued that even in the presence of taxation the market portfolio may be efficient. Brennan (1970) assumes that investors have homogeneous expectations for returns and derives a modified linear form of the CAPM including dividend yields. Elton and Gruber (1978) extend the analysis and show that investors will choose to hold a portfolio made of a fraction of the market portfolio and a fraction of a dividend-weighted portfolio. These authors do not reject the efficiency of the market portfolio in the presence of taxes, as they conclude that the existence of taxes does not change the structure of the CAPM.

b. Transaction costs

Transaction costs, ignored in the CAPM, can also affect the efficiency of the market portfolio. Transaction costs keep investors from fully diversifying their portfolios, as they choose not to hold all tradable assets. In addition, investors will rebalance only if the increase in expected returns is sufficient to offset the resulting transaction costs. This observation is underlined by Markowitz (1959), Tobin (1965), and Magill and Constantinides (1976), who note an association of transaction costs and less frequent and only partial portfolio revision. As a result, each asset will be held by only a fraction of investors, a phenomenon leading to heterogeneous investor holdings; the investor's optimal portfolio is no longer the market portfolio.[3]

3. No Short Sales Constraints or Borrowing Constraints

For the market portfolio to be mean-variance efficient, at least one of the two assumptions—about the existence of the risk-free asset or the possibility of unrestricted short sales of risky assets—must hold, as was demonstrated by Black (1972).

Black (1972) showed that if there is no risk-free asset, but short selling is allowed, the CAPM theory is still valid. The risk-free asset is replaced by a zero-beta portfolio. Instead of lending or borrowing at the risk-free rate, the investor takes short positions on the risky assets. In that case, investors select mean-variance-efficient portfolios and the aggregate of these individual mean-variance-efficient portfolios is also efficient, so the market portfolio is still efficient.

If there is no risk-free asset and short sales of risky assets are not allowed, mean-variance investors still choose efficient portfolios. But in that case, we lose the convenient property that combinations of efficient portfolios are themselves efficient. So the market portfolio, a portfolio obtained by aggregating the efficient portfolios chosen by investors, is no longer efficient.

This issue is explained in Markowitz (2005). In fact, the market portfolio is the optimal mix of risky securities if and only if each investor can adjust the risk of his portfolio by buying or lending the risk-free asset (or by selling short risky assets, if there is no risk-free asset), in

3 - This result has been underlined by Milne and Smith (1980), Mayshar (1981) and others. The existence of transaction costs thus modifies equilibrium asset prices, as defined in the traditional CAPM. Indeed, Levy (1978) and Lintner (1965) have shown that, if portfolio diversification is only partial, the equilibrium price of assets is affected only by the attitude of investors who hold those assets in their portfolios. Mayshar (1981) concludes that the integration of transaction costs leads to significant changes in the CAPM model.

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keeping with his risk tolerance. If borrowing capacity is limited and if it is not possible to sell short without restrictions, it is no longer possible to derive a portfolio with a risk suitable for each investor by combining the market portfolio and the risk-free rate. As a consequence, investors will choose a risky portfolio that corresponds to their appetite for risk, and different investors will hold different portfolios. The key conclusion of the CAPM, that all investors hold the same risky portfolio and combine it with holdings in the risk-free asset, no longer holds.

In this case, there are multiple efficient set lines, one for each investor, not a unique efficient set. And the combination of these efficient set lines does not allow us to obtain an efficient portfolio, as this aggregation no longer represents the optimal consensus for all investors. Markowitz (2005) shows that, if there is no risk-free asset and if short selling is restricted, there is no longer a linear relationship between expected asset returns and beta.

Likewise, Sharpe (1991) analyses asset pricing when short sales are not possible and comes to the conclusion that the market portfolio may not be efficient and that there may be no linear relationship between expected returns and CAPM beta.

So, Markowitz, who laid the groundwork for the CAPM by introducing the concept of mean-variance portfolio choice in the 1950s, and Sharpe, who published the seminal paper on CAPM theory in the 1960s, have both concluded more recently that the market portfolio may not be efficient if risk-free lending and borrowing and short sales are restricted.

4. All Assets Can Be Traded

The CAPM assumes that all assets are tradable. Assets that cannot be traded, such as claims to labour income, are assumed not to exist. Alternatively, it is assumed that claims to future labour income are tradable. In the real world, of course, human capital is a great source of income for investors, as well as a great source of risk, and this asset is not tradable.

Mayers (1972, 1973) was the first to investigate the consequences of the existence of non-tradable assets on the standard form of the CAPM. He derives a pricing relationship that is still linear, but in which factors other than the covariance with the market portfolio are important. The return on an asset will depend on its covariance with the portfolio of tradable assets, its covariance with the portfolio of non-tradable assets, and the covariance between the two portfolios. The model implies that the portfolios of tradable assets of investors will differ widely, as they will depend on their holdings of non-tradable assets. So it appears that the market portfolio of tradable assets will no longer be the optimal portfolio for individual investors. Instead, different investors will hold different portfolios, depending on their holdings of non-tradable assets.

In the same vein, Athanasoulis and Shiller (2000) point out that the CAPM prescription of holding the market portfolio "disregards the correlation of portfolio returns with other endowments, traded risks with non-traded risks" (303). Put differently, investors will want to hedge the risk posed by the non-traded assets in their portfolio. Van den Goorbergh, de Roon, and Werker (2003) show that, in the presence of non-tradable

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assets, the optimal portfolio that an investor holds can be split into two components: speculative demand, corresponding to the traditional mean-variance optimal portfolio, and hedging demand[4] owing to the non-tradable risks the investor is exposed to.[5] Such hedging demand will cause a different allocation of the investor's tradable portfolio. For example, to remain diversified, an investor working in a publicly traded company should hold less of this company's stock than other investors. Bodie, Merton, and Samuelson (1992) show that, over the long term, an investor receiving labour income, assumed risk-free, should invest more of the tradable share of his portfolio in stocks than an investor who receives no labour income. Jagannathan and Kocherlakota (1996) offer the same advice, as long as human capital and stock returns are relatively uncorrelated.[6]

In short, investors will not choose the same optimal portfolio if non-tradable assets play a role, and the market portfolio will not be an efficient portfolio.

5. Homogeneous Beliefs

For the CAPM, investors have homogeneous expectations about the probability distribution of asset returns. Many studies have examined the accuracy of CAPM predictions in the presence of investor heterogeneity.

Lintner (1969) was the first to look into heterogeneous beliefs. He assumed that investors had negative exponential utility functions, and he showed that current asset prices depend on a weighted average of individual investors' expectations and on the covariance matrix of these expectations. He concludes that heterogeneity in expectations would not affect the basic conclusions of the CAPM. Following Lintner's work, other authors have investigated the consequences of investors' heterogeneous beliefs on the equilibrium model. Most conclude that the CAPM still holds (Sun and Yang 2003; He and Shi 2009; Chiarella, Dieci, and He 2006a, 2006b; Levy, Levy, and Benita 2006).

Investors may have heterogeneous views not only of asset returns and risk but also of desirable investment periods. Gressis, Philippatos, and Hayya (1976) investigate this case, assuming that all other CAPM hypotheses are valid. Investors are assumed to invest over different horizons. The model shows that an efficient market portfolio is associated with each horizon and the optimal portfolio of each investor will be a combination of the market portfolio that corresponds to the length of his investment horizon and of the risk-free asset. In this context, the overall equilibrium market portfolio is a linear combination of the market portfolios of the various periods, with each of these portfolios efficient relative to its market segment. However, a linear combination of portfolios efficient for different time horizons is not necessarily an efficient portfolio overall.

Hence, if investors have differing time horizons, the market portfolio cannot be expected to be efficient, even if all other CAPM assumptions hold.

6. The CAPM Assumptions in Practice

According to the literature referred to above, the violation of even one of the CAPM hypotheses means that the

4 - On hedging demand, see Anderson and Danthine (1981).
5 - The approach of van den Goorbergh, de Roon, and Werker (2003) is more general than that of Mayers (1972), as it is not restricted to the traditional mean-variance framework. Their model takes into account the diversity of investor risk aversion. The resulting hedging demand portfolio is weighted depending on risk aversion, whereas the portfolio obtained with Mayers's restrictive hypotheses is independent of investor risk aversion.
6 - Lioui and Poncet (2001) introduce an intertemporal (multi-period) capital asset pricing model (ICAPM) in which the mean-variance efficiency of the market portfolio is neither a necessary nor a sufficient condition. They consider a partial equilibrium continuous time framework à la Breeden (1984), which is itself a generalisation of Merton (1973). The context is more general than that of the usual ICAPM, as the model is derived in a market in which investors can invest not only in primitive risky assets and in the risk-free asset, but also in futures contracts that can serve as hedging components. These futures contracts deal not with financial assets and commodities but with non-tradable assets (weather, natural catastrophes, the consumer price index, and the gross national product), which are non-redundant long-lived futures. The model is derived in a frictionless market. In this context, investors' optimal portfolios will be made of the risk-free assets together with a perturbed mean-variance portfolio of primitive risky assets and a perturbed mean-variance-efficient portfolio of futures contracts. The possible inefficiency of the market portfolio is the result of non-redundant futures contracts in investors' portfolios.

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theoretical market portfolio may not be mean-variance efficient. Under the CAPM, the market portfolio must be efficient. But this efficiency is based on many unrealistic assumptions. Finance theory tells us that the market portfolio may not be efficient if investors face restrictions on borrowing or short selling, if they hold non-tradable assets such as human capital, or if they have different time horizons.

So can we reasonably assume homogeneous preferences, the absence of taxes, transaction costs, and non-tradable assets, unrestricted borrowing or short selling, and identical time horizons? The immediate response would seem to be that we cannot. As Merton (1987) puts it: "Financial models based on frictionless markets and complete information are often inadequate to capture the complexity of rationality in action".

In fact, investors often fail to seek utility maximisation (Barberis and Thaler 2003). This phenomenon has been described by Kahneman and Tversky (1979), who observed that people's choices do not always tally with those that expected utility theory would suggest. Individual investors may also seek risk after incurring losses, just as they may shed risk after posting gains (Jahnke 2006): investors will keep a losing position too long, hoping trends will reverse; they will also liquidate winning positions too early to secure their gains. Boyer, Mitton, and Vorkink (2009) argue that investor preferences can be described as a gamble in which investors seek exposure to lottery-like payoffs rather than as mean-variance preferences in which investors seek mean-variance efficiency.

The existence of taxes and transaction costs is undeniable. For many investors, taxes matter. Although they may be low for the most liquid and the most heavily traded assets, transaction costs are likewise a fact of life.

Unlimited borrowing is hardly feasible for most investors. Although short selling is an alternative that would be sufficient to save the CAPM, it is somewhat restricted in most countries. For example, some regulators require that all short sales be executed on an uptick. During the 2008 financial crisis, regulatory authorities around the world adopted a complete ban of short sales for certain stocks for a limited period. In addition, apart from any regulatory considerations, the costs and friction in the market for borrowing stocks also limit short sales.

Lilti, Rainelli-Le Montagner and Gouzerth (2006) indicate that such non-tradable assets as human capital account for a significant percentage of investor wealth, as measured by the gross domestic product (GDP). For the United States, Japan and European Union countries, the share of salaries in GDP ranges from 63% to about 70%. In comparison, the share of dividends in per capita income nowhere exceeds 5%. So, it is clearly unreasonable to assume that all assets are traded. In addition to assets that cannot be traded per se, there are assets, such as housing and claims to social security benefits, that can, in principle, be traded but for which markets are highly concentrated and illiquid or simply do not exist (Athanasoulis and Shiller 2000). Such assets often account for a large share of an individual's wealth.

2. Does Theory Predict That the Market Portfolio Will Be Efficient?

Investors also have clearly different investing horizons. A young investor saving for retirement, for example, will have a longer horizon than if he is saving to buy a house or for his children's education. Nor do all institutional investors have equally distant horizons. Some sovereign wealth funds, for example, are set up to save for future generations, whereas others serve to smooth out short-term fluctuations in the economy (Rozanov 2007). So it is unrealistic to assume that all investors have the same investing period. In addition, many papers point out that there are different groups of investors with long horizons and others with short time horizons (Mankiw, Summers, and Weiss 1984; De Long *et al.* 1990).

7. Empirical Tests of the CAPM Theory

The previous discussion shows that from a purely theoretical standpoint the CAPM predictions do not hold if one makes reasonable assumptions about investors' borrowing and shorting capacity, the role of non-tradable assets or the heterogeneity of investors' time horizons. Regardless of the assumptions made by the CAPM, one may also test whether the theoretical predictions of the CAPM can be rejected empirically. Fama and French (2003) provide a comprehensive review of CAPM tests. We summarise those tests and their results in an appendix. In most cases, empirical studies reject the validity of the CAPM, hardly surprising in view of the assumptions it makes. However, Fama and French (2003) note: "Unfortunately, the empirical record of the [CAPM] model is poor—poor enough to invalidate the way it is used in application" (1). They also note that "whether the model's problems reflect weakness in the theory or in its empirical implementation, the failure of the CAPM in empirical tests implies that most applications of the model are invalid" (2).

2. Does Theory Predict That the Market Portfolio Will Be Efficient?

3. Can Stock Market Indices Represent the Market Portfolio?

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The CAPM makes the central prediction that the true market portfolio is efficient. In the real world, of course, the construction of a good proxy for the market portfolio is difficult and it is not necessarily efficient, as the proxy may not represent all sources of investment. That the true market portfolio of the CAPM is not observable was famously noted by Roll (1977). In addition, when using financial data to test whether the market portfolio is efficient, empirical studies have paid considerable attention to their proxy for the market portfolio. Thus, reviewing which proxy has been used in these studies may shed light on whether a relatively narrow stock market index can serve as a proxy for the market portfolio. We now turn to these two issues.

1. Roll's Critique

Roll's (1977) core criticism of the CAPM has to do with the impossibility of observing the true market portfolio. The CAPM relationship implies that the market portfolio is mean-variance efficient. So, to test the validity of the model, it is necessary to show that the market portfolio is efficient. Roll, of course, remarked that the true market portfolio cannot be observed, because it must include all risky assets, not just traded financial assets, but also consumer durables, real estate, and human capital. Empirical studies use variables that are supposed to approximate the true market portfolio. Such imperfect proxies may well be highly correlated with the unobservable market portfolio, but Roll (1977) argues that even if they are they would not be as efficient as the market portfolio.

Although Roll's critique was aimed mainly at empirical tests of the CAPM, our interest is whether, from a theoretical perspective, passive indexing strategies can provide mean-variance-efficient portfolios. Let us sum up what Roll's critique means in this context. If the CAPM holds in the real world, the true market portfolio is a mean-variance-efficient portfolio. But Roll (1977) tells us that this portfolio is not observable. In fact, any constructed index will never be more than an imperfect proxy for the market portfolio. This proxy may be very different from the true market portfolio. So, even if the true market portfolio is efficient, we cannot expect that a given index will be as well. In addition, even if this index and the true (and efficient) market portfolio are highly correlated, there is no reason to expect that the index itself would be efficient.

2. Proxies Used in Empirical Work

Empirical studies that test the CAPM theory must construct an observable proxy for the true market portfolio to test the mean-variance efficiency of this proxy. Many proxies, sometimes of very different natures, have been used in empirical research. They provide insight into what financial researchers consider reasonable approximations of the true market portfolio. We can then compare these proxies and real world indices.

Early studies used simple indices including only stocks, such as the S&P 500. As Sinclair (1998) notes, the S&P 500 accounts for only about 70% of total market capitalisation and does not include other investments such as bonds or the stocks of smaller companies. So it is not a good proxy for the market

3. Can Stock Market Indices Represent the Market Portfolio?

portfolio. He also argues that none of the market indices used in the studies to proxy for the market portfolio was efficient.

Roll's critique has led researchers to use more complex proxies of the market portfolio in their empirical studies. These proxies include assets such as bonds and property. In addition to financial assets, many researchers have added non-tradable assets in their approximations of the market portfolio. For example, Ibbotson and Fall (1979) point out that an index made of the main asset categories may not be considered an optimal market portfolio, as some assets, such as human capital and consumer durables, are left out. The derivation of a proxy for the world market portfolio is even more complex than that for a domestic portfolio. Ibbotson and Siegel (1983) point out that it is almost impossible to represent all investment markets.

The following table shows the indices and combinations of indices that have been tested in empirical studies; conclusions about their efficiency are also shown.

Table 1: Market portfolio proxies tested in empirical studies

Author(s)	Journal(s)	Description of the proxy	Assets included in the proxy			Conclusion
			Stocks	Bonds	Other assets	
Black, Jensen, and Scholes (1972); Fama and MacBeth (1973); Gibbons (1982)	*JPE; JFE*	Equal-weighted portfolio of all NYSE-listed stocks	*			Efficient
Frankfurter (1976)	*JF*	Dow Jones Ind. Average, S&P 500, Geometric mean market value index (522 stocks)	*			Not conclusive
Zhou (1981)	*JFE*	CRSP value-weighted index of NYSE stocks	*			Not efficient
Gibbons (1982)	*JFE*	Equally weighted index of NYSE stocks	*			Efficient
Stambaugh (1982)	*JFE*	NYSE common stocks, US corporate and government bonds and bills, residential real estate, house furnishings, and automobiles.	*	*	*	Efficient
Shanken (1985, 1987)	*JFE*	Equal-weighted CSRP index and/or long-term US government bond portfolio	*	*		Not efficient
Brown and Brown (1987)	*JPM*	Different market proxies including common stocks, fixed-income corporate issues, real estate, government bonds, municipal bonds	*	*	*	Not conclusive
Gibbons, Ross, and Shanken (1989)	*Emtrca*	Value-weighted CRSP index of all NYSE stocks	*			Not efficient
Harvey and Zhou (1990)	*JFE*	Value-weighted portfolio of all NYSE stocks	*			Not efficient
Harvey (1991)	*JF*	MSCI indices for a collection of countries.	*			Not efficient
Haugen and Baker (1991)	*JPM*	Wilshire 5000	*			Not efficient
Grinold (1992)	*JPM*	Commercial indices like S&P 500, FTA, All Ordinaries, TOPIX, DAX	*			Not efficient
Jagannathan and Wang (1993, 1996)	*FRBM, JF*	Market portfolio proxy including human capital (labour income)	*		*	Not conclusive
Fama and French (1998)	*JF*	MSCI global index	*			Not efficient
Dalang, Marty, and Osinski (2001/2002)	*JPM*	FT Global Equities Index	*			Not efficient
Kandel, McCulloch, and Stambaugh (1995)	*RFS*	Stocks listed on the NYSE and AMEX	*			Not efficient
Fama and French (2004)	*WP*	Value weighted portfolio of all NYSE, AMEX and NASDAQ stocks	*			Not conclusive

Journal abbreviations: JPE, Journal of Political Economy; JFE, Journal of Financial Economics; JF, Journal of Finance; JPM, Journal of Portfolio Management, Emtrca, Econometrica; RFS, Review of Financial Studies; FRBM, Federal Reserve Bank of Minneapolis; WP: working paper

3. Can Stock Market Indices Represent the Market Portfolio?

This table shows that researchers try to use proxies that extend the universe to include assets that are not easily tradable. Jagannathan and Wang (1993, 1996), for example, include proxies for human capital, and Stambaugh (1982) includes durable consumer goods and residential real estate. Stambaugh (1982) specifies that, on average, the weight of common stocks is 25%, whereas consumer durables and real estate together account for about half of the portfolio. The market portfolio proxy he proposes is thus much broader than a stock market index, or even a proxy made of both stocks and bonds.

Even if stocks alone are used, the equity portfolio used as a proxy does not resemble the commonly used stock market indices. Proxies used by researchers are in fact much broader, in the sense that they include many more stocks than a standard index such as the S&P 500 or the Russell 1000. Researchers usually use the portfolio of all stocks traded on at least the NYSE or even all the stocks traded on the NYSE, the NASDAQ, or the AMEX, a practice that leads to portfolios of many thousands of stocks.

In addition, many researchers prefer an equal-weighted index of NYSE stocks to its cap-weighted version (Black, Jensen, and Scholes 1972; Fama and MacBeth 1973; Gibbons 1982; Shanken 1985, 1987). It may be that these researchers consider the equal-weighted portfolio a better approximation of the market portfolio than the cap-weighted portfolio.

The majority of the proxies for the market portfolio that were tested were also found to be inefficient (see table 1).

In short, researchers view cap-weighted stock market indices as components of the market portfolio, not as the market portfolio. They consider it reasonable to give relatively low weights to stocks in their proxies for the market portfolio. More often than not, equal-weighted stock indices are preferred to cap-weighted indices in empirical proxies for the market portfolio. This literature suggests that commercial stock market indices are poor proxies for the market portfolio.

3. Inefficiency of Subsets of the Market Portfolio

In addition to empirical tests of the efficiency of different proxies of the market portfolio, a simple consideration also shows that such proxies cannot be expected to be efficient. Starting with a cap-weighted index, one would have to include additional assets to get to the true market portfolio. For the cap-weighted index to be efficient, adding assets would have to be done without changing the optimal weighting of assets already in the portfolio. In practice, of course, expanding the asset universe is likely to change optimal weightings of the existing assets. So it is contradictory for both a subset of the true market portfolio (such as a cap-weighted stock market index) and the true market portfolio to be efficient.

Conclusion

Conclusion

The CAPM theory is often evoked to show that cap-weighted stock market indices are efficient portfolios and attractive investments. Thus have Sharpe's (1964) theoretical findings, which extend the work of Markowitz (1952, 1959), given providers of cap-weighted indices, as Well Fargo puts it, "a fertile intellectual garden to grow in" (Hebner 2007).

In this paper we have shown that a cap-weighted stock market index is not the market portfolio of financial theory. That it is not is clear from the choices made in empirical studies that attempt to come up with reasonable proxies for the market portfolio. These studies attach great importance to including many more stocks than indices do, and their proxies of the market portfolio include bonds, real estate, and non-tradable assets such as human capital.

Moreover, even if it is possible to construct and hold the market portfolio, the theory does not predict that the market portfolio is efficient unless we make highly unrealistic assumptions. In fact, Sharpe (1991) and Markowitz (2005) themselves have emphasised that the market portfolio may not be efficient in a more realistic setting.

In view of these arguments, it seems that financial theory alone does not justify the current practice of cap-weighting. In fact, from a theoretical perspective, cap-weighted stock market indices seem to offer no particular advantage.

Appendix: Review of Empirical Tests of the CAPM

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In addition to the theoretical developments summarised in the main part of this paper, the CAPM has been subjected to a wide range of empirical tests. One may in fact argue that it is unreasonable to judge a theory on its assumptions. Instead, one should look at the validity of its predictions. This is one of the principles of critical rationalism (Popper 1963), but it also seems pragmatic. If the predictions are accurate, the necessary simplification of the real world through the model is useful.

The first premise of the CAPM is that the market portfolio is efficient. The second premise, the linear beta pricing relationship, is a consequence of efficiency of the market portfolio. The beta pricing relationship implies that expected returns of securities depend in linear fashion on the returns of the mean-variance-efficient portfolio. Hence, assessing the beta pricing relationship allows us indirectly to test for mean-variance efficiency.

Testing the CAPM involves empirically evaluating the relationship between expected return and market beta, as defined by the model. First, all assets must have expected returns linearly related to their beta, and no other factor must account for the returns. Second, we must find a positive risk premium, corresponding to an excess return of the market portfolio, compared to assets uncorrelated with the market. Finally, the return of the assets that are not correlated to the market must be equal to the risk-free interest rate for the Sharpe-Lintner version of the CAPM.

The capital asset pricing model has been put through extensive empirical testing, which has usually led to rejection of the single beta relationship. Empirical tests are not easy to do, and their conclusions are sometimes controversial, as they involve estimating unobservable parameters. For example, historical data must be used to estimate the asset beta. Results may also be sensitive to the sample period used to run the tests. In addition, the true market portfolio is not observable and proxies for this portfolio are used in the tests. In the section 3, we describe in detail several market portfolio proxies used in empirical research. We describe here the conclusions of the main empirical studies of the CAPM.

In our review, we group the studies by their conclusions. The first group has examined different structures for the CAPM. The initial form of the CAPM (Sharpe-Lintner) has been tested and the absence of clear support for this model has encouraged tests of the extended form described by Black (1972) (zero-beta form). The second group of studies has tested the CAPM from a different angle, by identifying pricing anomalies and suggesting that factors other than market beta are required to account fully for stock price variations.

1. Tests of the Structure of the Model

The first studies of the Sharpe-Lintner version of the CAPM conclude with a rejection of the CAPM. They found a positive relationship between beta and average return, but this relationship was too flat, as the value obtained for the market risk premium was smaller than expected. Using cross-section regressions, several studies, including those by Douglas

7 - These results were confirmed in studies using time-series analysis over a more recent period, with even flatter relationships (Friend and Blume 1970; Black, Jensen, and Scholes 1972; Stambaugh 1982; Lakonishok and Shapiro 1986). Gibbons (1982) finds similar results using the maximum likelihood ratio test. Other studies rejecting the CAPM because the relationship between average return and beta for common stocks is too flat include Reinganum (1981), Shanken (1985), Lakonishok and Shapiro (1986), Fama and French (1993, 1996), Davis (1994). Fama and French (2004) confirm the results over a more recent period. The results of empirical studies may differ from one country to another. For example, Green (1990) has tested the CAPM on UK data and has found that the model does not hold, whereas Sauer and Murphy (1992) have run similar tests on German stock market data and found that the CAPM is the best model for describing stock returns.

8 - Recall from the first section that Black's version of the CAPM was developed in a context in which there is no risk-free asset. Black showed that the CAPM was still valid if the risk-free asset is replaced by a zero-beta portfolio, that is, a portfolio whose variations are totally independent of those of the market portfolio. In this model, the possibility of lending or borrowing at the risk-free rate is replaced by the possibility of taking short positions in risky assets. In this configuration, the return on any risky assets can be written as a linear combination of the zero-beta portfolio return and the market portfolio return.

9 - Similar results were found by Fama and MacBeth (1973), Gibbons (1982), and Stambaugh (1982).

Appendix: Review of Empirical Tests of the CAPM

(1968), Black, Jensen, and Scholes (1972), Miller and Scholes (1972), Friend and Blume (1973), Fama and MacBeth (1973), and Fama and French (1992), conclude that the intercept is greater than the risk-free rate and that the coefficient on beta, which represents the market risk premium in the CAPM model, is less than the average excess market return.[7]

Using time series regression analysis on NYSE stocks grouped in portfolios, and for the period from 1931 to 1965, Black, Jensen, and Scholes (1972) found that the slope and the intercept of their regression line are significantly different from their theoretical values. The intercept term is different from zero and is time varying. It is negative when beta is greater than one and positive when beta is lower than one. This study rejects the prediction that the premium per unit of beta is the expected market return minus the risk-free rate. Although the Sharpe-Lintner version of the CAPM is mostly rejected, some studies seem to accept Black's version of the CAPM, according to which beta accounts for expected returns, and which predicts only that the beta premium is positive. In fact, Black, Jensen, and Scholes (1972) conclude that their results are consistent with the Black version of the CAPM,[8] described as a two-factor model, and that this model describes returns on securities better than the one-factor model.[9]

2. Identification of Price Anomalies

The classic studies of asset pricing anomalies are those by Fama and French.[10] Considering a large collection of stocks, including NYSE, AMEX, and NASDAQ stocks, for the period from 1963 to 1990, Fama and French (1992) found that beta has no ability to explain the cross-sectional variation in average returns, whereas size does. Including the book-to-market ratio in their model, they found that this additional factor not only accounts for a substantial portion of the cross-sectional variation in average returns but is also more powerful than the size factor. Higher book-to-market ratios are associated with higher returns. Fama and French (1992) conclude that their empirical test provides no evidence of a positive relationship between average stock returns and systematic risk, measured by beta. Instead, differences in firm size and book-to-market ratios account for expected returns. This finding contradicts the tenets of the CAPM, which hold that market beta alone can account for the expected returns on stocks, and thus that no additional factors are required. Fama and French (1993, 1996) confirmed their initial findings in new work using time series analysis. Fama and French (1998) show that anomalies identified in stock returns with US data are also present in the stock returns of twelve non-US major markets, as well as in emerging markets.[11] Although these findings have sparked controversy, it is now widely accepted that multifactor models provide better descriptions of risk premia in the stock market than does the single-factor CAPM.[12]

10 - Other studies have identified only one additional factor for asset returns. Size anomalies, for example, were identified by Banz 1981, anomalies related to B/M (book-to-market) by Basu (1977), Bhandari (1988), Stattman (1980), Rosenberg, Reid, and Lanstein (1985), Chan, Hamao, and Lakonishok (1991), Capaul, Rowley, and Sharpe (1993), Lakonishok, Shleifer, and Vishny (1994), Fama and French (2004).
11 - For other countries, other authors, including Chan, Hamao, and Lakonishok (1991) in Japan, and Capaul, Rowley, and Sharpe (1993) in four European countries and in Japan, find similar results.
12 - According to Kothari, Shanken, and Sloan (1995) Fama and French's (1992) findings depend on the interpretation of their statistical tests. In addition, they argue that the ratio of book-to-market equity data used by Fama and French (1992) are not free of survivorship and back-filling biases. Using a set of data free of backfilling bias, Breen and Korajczyk (1993) found a much weaker effect of the book-to-market equity ratio than that reported by Fama and French (1992). Amihud, Christensen, and Mendelson (1992) and Black (1993) share the view that the data used by Fama and French (1992) are too noisy to allow them to conclude that the CAPM is not valid. Amihud, Christensen, and Mendelson (1992) argue that it is possible to find a positive and significant relationship between average return and beta if a more efficient statistical method is used. Other studies identifying statistical problems in the procedure for testing the CAPM model include Chan and Lakonishok (1993), Jagannathan and McGrattan (1995), Grundy and Malkiel (1996).

Appendix: Review of Empirical Tests of the CAPM

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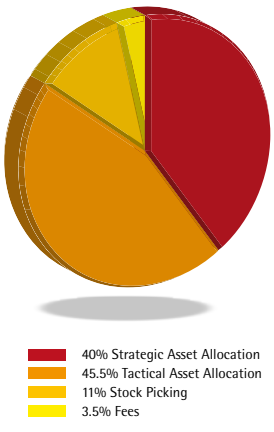
About EDHEC-Risk Institute

Founded in 1906, EDHEC is one of the foremost French business schools. Accredited by the three main international academic organisations, EQUIS, AACSB and Association of MBAs, EDHEC has for a number of years been pursuing a strategy for international excellence that led it to set up EDHEC-Risk in 2001. With 46 professors, research engineers and research associates, this centre has the largest European asset management research team.

The Choice of Asset Allocation and Risk Management

EDHEC-Risk structures all of its research work around asset allocation and risk management. This issue corresponds to a genuine expectation from the market. On the one hand, the prevailing stock market situation in recent years has shown the limitations of diversification alone as a risk management technique and the usefulness of approaches based on dynamic portfolio allocation. On the other, the appearance of new asset classes (hedge funds, private equity, real assets), with risk profiles that are very different from those of the traditional investment universe, constitutes a new opportunity and challenge for the implementation of allocation in an asset management or asset-liability management context. This strategic choice is applied to all of the centre's research programmes, whether they involve proposing new methods of strategic allocation, which integrate the alternative class; taking extreme risks into account in portfolio construction; studying the usefulness of derivatives in implementing asset-liability management approaches; or orienting the concept of dynamic "core-satellite" investment management in the framework of absolute return or target-date funds.



Source EDHEC (2002) and Ibbotson, Kaplan (2000)

An Applied Research Approach

In an attempt to ensure that the research it carries out is truly applicable, EDHEC has implemented a dual validation system for the work of EDHEC-Risk. All research work must be part of a research programme, the relevance and goals of which have been validated from both an academic and a business viewpoint by the centre's advisory board. This board is made up of internationally recognised researchers, the centre's business partners and representatives of major international institutional investors. The management of the research programmes respects a rigorous validation process, which guarantees the scientific quality and the operational usefulness of the programmes.

Six research programmes have been conducted by the centre to date:

- Asset allocation and alternative diversification
- Style and performance analysis
- Indices and benchmarking
- Operational risks and performance
- Asset allocation and derivative instruments
- ALM and asset management

These programmes receive the support of several financial companies, both from within France and abroad, representing some thirty different sponsors (including *AXA Investment Managers*, *Barclays Global Investors*, *BNP Paribas Investment Partners*, *Citigroup*, *CACEIS*, *Deutsche Bank*, *FBF*, *Fortis*, *Eurex*, *LODH*, *NYSE Euronext*, *HSBC*, *Pictet*, *Robeco*, *Morgan Stanley*, *NewEdge*, *SG CIB*, *State Street*, *UBS*, *UFG*, and many others).

About EDHEC-Risk Institute

In addition, EDHEC has developed a close partnership with a small number of sponsors within the framework of research chairs. These research chairs correspond to a commitment over three years from the partner on research themes that are agreed in common. The following research chairs have been endowed to date:

- Regulation and Institutional Investment, *in partnership with AXA Investment Managers (AXA IM)*
- Asset-Liability Management and Institutional Investment Management *in partnership with BNP Paribas Investment Partners*
- Risk and Regulation in the European Fund Management Industry, *in partnership with CACEIS*
- Structured Products and Derivative Instruments, *sponsored by the French Banking Federation (FBF)*
- Private Asset-Liability Management *in partnership with ORTEC Finance*
- Dynamic Allocation Models and New Forms of Target-Date Funds *in partnership with UFG*
- Advanced Modelling for Alternative Investments *in partnership with Newedge Prime Brokerage*
- Asset-Liability Management Techniques for Sovereign Wealth Fund Management *in partnership with Deutsche Bank*
- Core-Satellite and ETF Investment *in partnership with CASAM.*

The philosophy of the centre is to validate its work by publication in international journals, but also to make it available to the sector through its Position Papers, published studies and conferences. Each year, EDHEC-Risk organises two conferences for professionals with a view to presenting the results of its research: EDHEC-Risk Alternative Investment Days (London) and EDHEC-Risk Institutional Days (Paris), attracting more than 2,000 professional delegates.

EDHEC also provides professionals with access to its website, **www.edhec-risk.com**, which is entirely devoted to international asset management research. The website, which has more than 30,000 regular visitors, is aimed at professionals who wish to benefit from EDHEC's analysis and expertise in the area of applied portfolio management research. Its monthly newsletter is distributed to more than 400,000 readers.

EDHEC's distinguished international faculty includes renowned researchers and professors in finance and economics whose work has appeared in the major academic journals worldwide, including Professor **Noël Amenc**, Professor **René Garcia**, Professor **Pierre Mella-Barral**, Professor **Lionel Martellini**, Professor **Florencio López de Silanes** and Professor **Joëlle Miffre**.

Research for Business

The centre's activities have also given rise to an executive education offshoot.

EDHEC-Risk's executive education programmes help investment professionals to upgrade their skills with advanced risk and asset managementtraining across traditional and alternative classes.

About EDHEC-Risk Institute

The EDHEC-Risk Institute PhD in Finance

The EDHEC-Risk Institute PhD in Finance at EDHEC Business School is designed for professionals who aspire to higher intellectual levels and aim to redefine the investment banking and asset management industries.

It is offered in two tracks: a residential track for high-potential graduate students, who hold part-time positions at EDHEC Business School, and an executive track for practitioners who keep their full-time jobs.

Drawing its faculty from the world's best universities and enjoying the support of the research centre with the greatest impact on the European financial industry, the EDHEC-Risk Institute PhD in Finance creates an extraordinary platform for professional development and industry innovation.

The EDHEC-Risk Institute MSc in Risk and Investment Management

The EDHEC-Risk Institute Executive MSc in Risk and Investment Management is designed for professionals in the investment management industry who wish to progress, or maintain leadership in their field, and for other finance practitioners who are contemplating lateral moves. It appeals to senior executives, investment and risk managers or advisors, and analysts.

This postgraduate programme is designed to be completed in seventeen months of part-time study and is formatted to be compatible with professional schedules.

The programme has two tracks: an executive track for practitioners with significant investment management experience and an apprenticeship track for selected high-potential graduate students who have recently joined the industry.

The programme is offered in Asia—from Singapore—and in Europe—from London and Nice.

EDHEC Position Papers and Publications from the Last Four Years

EDHEC-Risk Institute
2009 Position Papers

- Till, H. Has there been excessive speculation in the US oil futures markets? (November).
- Amenc, N., and S. Sender. A welcome European Commission consultation on the UCITS depositary function, a hastily considered proposal (September).
- Sender, S. IAS 19: Penalising changes ahead (September).
- Amenc, N. Quelques réflexions sur la régulation de la gestion d'actifs (June).
- Giraud, J.-R. MiFID: One year on (May).
- Lioui, A. The undesirable effects of banning short sales (April).
- Gregoriou, G., and F.-S. Lhabitant. Madoff: A riot of red flags (January).

2009 Publications

- Sender, S. Reactions to an EDHEC study on the impact of regulatory constraints on the ALM of pension funds (October).
- Amenc, N., L. Martellini, V. Milhau, and V. Ziemann. Asset-liability management in private wealth management (September).
- Amenc, N., F. Goltz, A. Grigoriu, and D. Schroeder. The EDHEC European ETF survey (May).
- Sender, S. The European pension fund industry again beset by deficits (May).
- Martellini, L., and V. Milhau. Measuring the benefits of dynamic asset allocation strategies in the presence of liability constraints (March).
- Le Sourd, V. Hedge fund performance in 2008 (February).
- La gestion indicielle dans l'immobilier et l'indice EDHEC IEIF Immobilier d'Entreprise France (February).
- Real estate indexing and the EDHEC IEIF Commercial Property (France) Index (February).
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- Goltz, F. A long road ahead for portfolio construction: Practitioners' views of an EDHEC survey. (January).

2008 Position Papers

- Amenc, N., and S. Sender. Assessing the European banking sector bailout plans (December).
- Amenc, N., and S. Sender. Les mesures de recapitalisation et de soutien à la liquidité du secteur bancaire européen (December).

EDHEC Position Papers and Publications from the Last Four Years

• Amenc, N., F. Ducoulombier, and P. Foulquier. Reactions to an EDHEC study on the fair value controversy (December). With the EDHEC Financial Analysis and Accounting Research Centre.

• Amenc, N., F. Ducoulombier, and P. Foulquier. Réactions après l'étude. Juste valeur ou non : un débat mal posé (December). With the EDHEC Financial Analysis and Accounting Research Centre.

• Amenc, N., and V. Le Sourd. Les performances de l'investissement socialement responsable en France (December).

• Amenc, N., and V. Le Sourd. Socially responsible investment performance in France (December).

• Amenc, N., B. Maffei, and H. Till. Les causes structurelles du troisième choc pétrolier (November).

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• Till, H. The oil markets: Let the data speak for itself (October).

• Amenc, N., F. Goltz, and V. Le Sourd. A comparison of fundamentally weighted indices: Overview and performance analysis (March).

• Sender, S. QIS4: Significant improvements, but the main risk for life insurance is not taken into account in the standard formula (February). With the EDHEC Financial Analysis and Accounting Research Centre.

2008 Publications

• Amenc, N., L. Martellini, and V. Ziemann. Alternative investments for institutional investors: Risk budgeting techniques in asset management and asset-liability management (December).

• Goltz, F., and D. Schröder. Hedge fund reporting survey (November).

• D'Hondt, C., and J.-R. Giraud. Transaction cost analysis A-Z: A step towards best execution in the post-MiFID landscape (November).

• Amenc, N., and D. Schröder. The pros and cons of passive hedge fund replication (October).

• Amenc, N., F. Goltz, and D. Schröder. Reactions to an EDHEC study on asset-liability management decisions in wealth management (September).

• Amenc, N., F. Goltz, A. Grigoriu, V. Le Sourd, and L. Martellini. The EDHEC European ETF survey 2008 (June).

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• Amenc, N., F. Goltz, and V. Le Sourd. Fundamental differences? Comparing alternative index weighting mechanisms (April).

• Le Sourd, V. Hedge fund performance in 2007 (February).

• Amenc, N., F. Goltz, V. Le Sourd, and L. Martellini. The EDHEC European investment practices survey 2008 (January).

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• Amenc, N. Trois premières leçons de la crise des crédits « subprime » (August).

• Amenc, N. Three early lessons from the subprime lending crisis (August).

• Amenc, N., W. Géhin, L. Martellini, and J.-C. Meyfredi. The myths and limits of passive hedge fund replication (June).

• Sender, S., and P. Foulquier. QIS3: Meaningful progress towards the implementation of Solvency II, but ground remains to be covered (June). With the EDHEC Financial Analysis and Accounting Research Centre.

• D'Hondt, C., and J.-R. Giraud. MiFID: The (in)famous European directive (February).

• Hedge fund indices for the purpose of UCITS: Answers to the CESR issues paper (January).

• Foulquier, P., and S. Sender. CP 20: Significant improvements in the Solvency II framework but grave incoherencies remain. EDHEC response to consultation paper n° 20 (January).

• Géhin, W. The Challenge of hedge fund measurement: A toolbox rather than a Pandora's box (January).

• Christory, C., S. Daul, and J.-R. Giraud. Quantification of hedge fund default risk (January).

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• Ducoulombier, F. Etude EDHEC sur l'investissement et la gestion du risque immobiliers en Europe (November/December).

• Ducoulombier, F. EDHEC European real estate investment and risk management survey (November).

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• Amenc, N., L. Martellini, and V. Ziemann. Asset-liability management decisions in private banking (February).

• Le Sourd, V. Performance measurement for traditional investment (literature survey) (January).

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- Amenc, N., and F. Goltz. A reply to the CESR recommendations on the eligibility of hedge fund indices for investment of UCITS (December).

- Foulquier, P., and S. Sender. QIS 2: Modelling that is at odds with the prudential objectives of Solvency II (November). With the EDHEC Financial Analysis and Accounting Research Centre.

- Till, H. EDHEC Comments on the Amaranth case: Early lesson from the debacle (September).

- Amenc, N., and F. Goltz. Disorderly exits from crowded trades? On the systemic risks of hedge funds (June).

- Amenc, N., and P. Foulquier, La problématique du taux d'actualisation des concessionaires d'autoroutes : les cas des ASF (February). With the EDHEC Financial Analysis and Accounting Research Centre.

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- Amenc, N., P. Foulquier, L. Martellini, and S. Sender. The impact of IFRS and Solvency II on asset-liability management and asset management in insurance companies (November). With the EDHEC Financial Analysis and Accounting Research Centre.

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- Foulquier, P. Solvency II: An internal opportunity to manage the performance of insurance companies (July).

- Foulquier, P. Solvabilité II : une opportunité de pilotage de la performance des sociétés d'assurance (May).

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- Escaffre, L., P. Foulquier, and P. Touron. The fair value controversy: Ignoring the real issue (November).

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• Chéron, A. Faut-il subventionner la formation professionnelle des séniors ? (October).

• Courtioux, P. La TVA acquittée par les ménages : une évaluation de sa charge tout au long de la vie (October).

• Courtioux, P. Les effets redistributifs de la « TVA sociale » : un exercice de microsimulation (July).

• Maarek, G. La réforme du financement de la protection sociale. Essais comparatifs entre la « TVA sociale » et la « TVA emploi » (July).

• Chéron, A. Analyse économique des grandes propositions en matière d'emploi des candidats à l'élection présidentielle (March).

• Chéron, A. Would a new form of employment contract provide greater security for French workers? (March).

• Chéron, A. Le contrat unique : un outil de sécurisation des parcours professionnels ? (January).

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• Amenc, N., P. Courtioux, A.-F. Malvache, and G. Maarek. La « TVA emploi » (April).

• Amenc, N., P. Courtioux, A.-F. Malvache, and G. Maarek. Pro-employment VAT (April).

• Chéron, A. Reconsidérer les effets de la protection de l'emploi en France. L'apport d'une approche en termes de cycle de vie (January).

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• Chéron, A. Le plan national d'action pour l'emploi des seniors : bien, mais peut mieux faire (October).

• Bacache-Beauvallet, M. Les limites de l'usage des primes à la performance dans la fonction publique (October).

• Courtioux, P., and O. Thévenon. Politiques familiales et objectifs européens : il faut améliorer le benchmarking (November).

EDHEC Leadership and Corporate Governance Research Centre
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• Petit, V., and V. Boulocher. Equipes dirigeantes : comment développer la légitimité managériale ? (May).

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- Petit, V. Leadership : ce que pensent les top managers (May)
- Petit, V., and I. Mari. La légitimité des équipes dirigeantes : une dimension négligée de la gouvernance d'entreprise (January).
- Petit, V., and I. Mari. Taking care of executive legitimacy: A neglected issue of corporate governance (January).

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- Bonnin, Gaël. Piloter l'interaction avec le consommateur : un impératif

Notes

Notes

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