

MIKE DEMPSEY

The Capital Asset Pricing Model (CAPM): The History of a Failed Revolutionary Idea in Finance?

The capital asset pricing model (CAPM) states that assets are priced commensurate with a trade-off between undiversifiable risk and expectations of return. The model underpins the status of academic finance, as well as the belief that asset pricing is an appropriate subject for economic study. Notwithstanding, our findings imply that in adhering to the CAPM we are choosing to encounter the market on our own terms of rationality, rather than the market's.

Key words: CAPM; Fama and French three-factor model; Finance models.

Modern academic finance is built on the proposition that markets are fundamentally rational. The foundational model of market rationality is the capital asset pricing model (CAPM). The implications of rejecting market rationality as encapsulated by the CAPM are very considerable. In capturing the idea that markets are inherently rational, the CAPM has made finance an appropriate subject for econometric studies. Industry has come to rely on the CAPM for determining the discount rate for valuing investments within the firm, for valuing the firm itself, and for setting sales prices in the regulation of utilities, as well as for such purposes as benchmarking fund managers and setting executive bonuses linked to adding economic value. The concept of market rationality has also been used to justify a policy of arm's-length market regulation—on the basis that the market knows best and that it is capable of self-correcting. Nevertheless, we consider that in choosing to attribute CAPM rationality to the markets, we are imposing a model of rationality that is firmly contradicted by the empirical evidence of academic research.

In *Fisher Black and the Revolutionary Idea of Finance*, Mehrling (2007) considers the CAPM as the 'revolutionary idea' that runs through finance theory. He recounts the first major step in the development of modern finance theory as the 'efficient markets hypothesis', followed by the second step, which is the CAPM. While the efficient market hypothesis states that at any time, all available information is imputed into the price of an asset, the CAPM gives content to how such information should be imputed. Simply stated, the CAPM says that investors can expect to attain

MIKE DEMPSEY (michael.dempsey@rmit.edu.au) is a Professor in the School of Economics, Finance and Marketing, RMIT University.

a risk-free rate plus a ‘market risk premium’ multiplied by their exposure to the market. Mehrling presents the model formally as:

$$E(R_j) = r_f + \beta_j \cdot [E(R_M) - r_f] \quad (1)$$

where $E(R_j)$ is the expected return on asset j over a single time-period, r_f is the riskless rate of interest over the period, $E(R_M)$ is the expected return on the market over the period, and β_j identifies the exposure of asset j to the market.

In Mehrling’s account, Black (1972) recognized that a rational market effectively requires the CAPM. As Black saw it, if the market of all assets offers investors a ‘risk premium’— $[E(R_M) - r_f]$ —in compensation for bearing risk exposure, then, all else being equal, each individual stock, j , must rationally offer a risk premium equal to $\beta_j \cdot [E(R_M) - r_f]$, since β_j measures the asset’s individual exposure to market risk. Market frictions (limited access to borrowing at the risk-free rate, for example) might imply adjustments, but, at the core, the CAPM must maintain (Black, 1972).

Nevertheless, we argue that the CAPM fails as a paradigm for asset pricing. To this end, we show, first, how a re-examination of the research of Black *et al.* (1972), which did much to lay the empirical foundation for the CAPM, reveals that the data do not actually provide a justification of the CAPM as claimed, but rather constitute confirmation of the null hypothesis, namely that investors impose a single expectation of return on assets. Researchers, however, did not wish to abandon the core paradigm of market rationality. Such paradigm, after all, justified the status of finance as a subject worthy of ‘scientific inquiry’. Second, we show that though the evidence now obliges academics to admit the ineffectiveness of beta, the impression remains that the CAPM (in some adjusted form) is core to the empirical behaviour of markets. Fama and French, for example, resolutely defend their three-factor model (which currently stands as the industry-standard alternative to the CAPM) as a multi-dimensional *risk model* of asset pricing. Nevertheless, they concede that the average return for an asset over multiple periods is insensitive to its beta. This fact alone suggests that markets might be unable to price risk differentially across assets.

There is a correspondence here with the observation of the scientific philosopher Thomas Kuhn (1962), who states that facts always serve to justify more activity without ever seriously being allowed to threaten the paradigm core. In Kuhn’s view, ‘normal science’ generally consists of a protracted period of adjustments to the surrounding framework of a central paradigm with ‘add-on’ hypotheses aimed at defending the central hypothesis against various ‘anomalies’. The continued defence of the CAPM—adding more factors to the CAPM to explain more anomalies—has led the single-factor CAPM model to become the three-factor model of Fama and French. To this model are added additional factors for idiosyncratic volatility, liquidity, momentum, and so forth, all of which typify Kuhn’s articulation of ‘normal science.’

If the CAPM must be rejected, we are obliged to return to a view of markets as predating the introduction of the CAPM. Namely, that markets respond generally positively to good news, and negatively to bad news, but wherein Keynesian crowd psychology as each investor looks to other investors inevitably influences the

reaction, which may take on a degree of optimism or pessimism that disconnects from the fundamental news. Markets may indeed be capable of self-correction ‘in the long-term’, but this may be of little compensation to members of society enduring losses and the negative impact on the economy in the meantime. Such a view of markets would imply that a research agenda aimed at understanding market fallibility and their potential for self-destruction, rather than aimed at enriching an account of ‘markets in equilibrium’, provides a more useful contribution to policy making. In effect, the paradigm of the CAPM and efficient markets may need to be replaced with a paradigm of markets as vulnerable to capricious behaviour.

1 BACKGROUND

By the late 1950s, the prestige of the natural sciences had encouraged the belief that the modelling of decision-making and resource allocation problems could be identified through the elaboration of optimization models and the general extension of techniques from applied mathematics. Into this environment, Modigliani and Miller (1958, 1963) ushered their agenda for the modern theory of corporate finance. Thus the discipline was transformed from an institutional normative literature—motivated by and concerned with topics of direct relevance to practitioners (such as technical procedures and practices for raising long-term finance, the operation of financial institutions and systems)—into a microeconomic positive science centred about the formation and analysis of corporate policy decisions with reference to perfect capital markets. A capital market where prices provide meaningful signals for capital allocation is an important component of a capitalist system. When investors choose among the securities that represent ownership of firms’ activities, they can do so under the assumption that they are paying fair prices given what is known about the firm (Fama, 1976). The foundations of modern finance theory embrace such a view of capital markets. The underlying paradigm asserts that financial capital circulates to achieve those rates of return that are most attractive to its investors. In accordance with this principle, prices of securities observed at any time ‘fully reflect all information available at that time’ so that it is impossible to make consistent economic profits by trading on such available information (e.g., Modigliani and Miller, 1958; Fama, 1976; or Weston, 1989).

The efficient market hypothesis—the notion that market prices react rapidly to new information (weak, semi-strong or strong form)—is claimed to be the most extensively tested hypothesis in all the social sciences (e.g., Smith, 1990). Consistent with the efficient market hypothesis, detailed empirical studies of stock prices indicate that it is difficult to earn above-normal profits by trading on publicly available data because they are already incorporated into security prices. Fama (1976) reviews much of this evidence, though the evidence is not completely one-sided (e.g., Jensen, 1978). Yet even allowing that empirical research has succeeded in broadly establishing that successive share price movements are systematically uncorrelated, thus establishing that we are unable to reject the efficient market hypothesis, this does not describe how markets respond to information and how information is impounded to determine share prices. That is to say, the much-vaunted efficient market hypothesis

does not in itself enable us to conclude that capital markets allocate financial resources efficiently. If we wish to claim allocative efficiency for capital markets, we must show that markets not only rapidly impound new information, but also meaningfully impound that information.

The variant of the efficient market hypothesis that encapsulates such efficient allocation is the capital asset pricing model (CAPM). The CAPM has dominated financial economics to the extent of being labelled ‘the paradigm’ (Ross, 1978; Ryan, 1982). Since its inception in the early 1960s, it has served as the bedrock of capital asset pricing theory and its application to practitioner activities. The CAPM is based on the concept that for a given exposure to uncertain outcomes, investors prefer higher rather than lower expected returns. This tenet appears highly reasonable, and following the inception of the CAPM in the late 1960s, a good deal of empirical work was performed aimed at supporting the prediction of the CAPM that an asset’s excess return over the risk-free rate should be proportional to its exposure to overall market risk, as measured by beta.

The underlying intuition of the CAPM has appealed forcibly to practitioners in the fields of finance and accounting. At universities, future practitioners are inculcated with the notion of the CAPM and its attendant ‘beta’. Management accountants are likely to instinctively determine an acceptable discount rate in terms of the CAPM and a ‘project beta’ when discounting. Corporate and fund management performances are measured in terms of ‘abnormal’ returns, where ‘abnormal’ is relative to a CAPM-determined return.

Early tests of the CAPM showed that higher stock returns were generally associated with higher betas. These findings were taken as evidence in support of the CAPM while findings that contradicted the CAPM as a completely adequate model of asset pricing did not discourage enthusiasm for the model.¹ Miller and Scholes (1972), Black *et al.* (1972) and Fama and McBeth (1973) also demonstrate a clear relationship between beta and asset return outcomes. Nevertheless, the returns on stocks with higher betas are systematically less than predicted by the CAPM, while those of stocks with lower betas are systematically higher. In response, Black proposed a two-factor model (with loadings on the market and a zero-beta portfolio). Thus the claim was made that the CAPM could be fixed by substituting the risk-free rate in the model with the rate of return on a portfolio of stocks with zero beta.

Controversially, Fama and French (1992) show that beta cannot be saved. Controlling for firm size, the positive relationship between asset prices and beta disappears. Additional characteristics such as firm size (Banz, 1981), earnings yield (Basu, 1983), leverage (Bhandari, 1988), the firm’s ratio of book value of equity to its market value (Chan *et al.*, 1991), stock liquidity (Amihud and Mendelson, 1986), and stock price momentum (Jegadeesh and Titman, 1993) now appear to be important in

¹ For example, empirical work as far back as Douglas (1969) confirms that the average realized stock return is significantly related to the variance of the returns over time, but not to their covariance with the index of returns, thereby contradicting the CAPM. Douglas also summarizes some of Lintner’s unpublished results that also appear to be inconsistent with the CAPM (reported by Jensen, 1972). This work finds that asset returns appear to be related to the idiosyncratic (non-market) volatility that is diversifiable.

describing the distribution of asset returns at any particular time. The Fama and French (1996) three-factor model identifies exposures to differential returns across high and low book-to-market stocks and across large and small firms to the CAPM as proxies for additional risk factors. As is often remarked, the model derives from a fitting of data rather than from theoretical principles. Black (1993) considered the then fledgling Fama and French three-factor model as ‘data mining’. Although Fama and French have decried the capacity of beta, they nevertheless insist that their two factors are ‘additional’—designed to capture ‘certain anomalies with the CAPM’. Formally, their model is presented as a refinement in the spirit of the CAPM. The trend of adding factors to better explain observed price behaviours has continued to dominate asset pricing theory. Subrahmanyam (2010) documents more than 50 variables used to predict stock returns. Nevertheless, the CAPM remains the foundational conceptual building block for these models. The three-factor model of Fama and French (1993, 1996), and the Carhart model (1997) which adds momentum exposure as a fourth factor, are now academically mainstream.

2 EXPECTATIONS MODELS IN FINANCE

In what is generally recognized as the first methodologically satisfactory test of the CAPM, Black, Jensen and Scholes (1972) (hereafter, BJS) find that there is a positive relation between average stock returns and beta (β) during the pre-1969 period. BJS, however, recognized that although this observation might be interpreted as encouraging support for the CAPM, it is not actually sufficient to substantiate the CAPM. Insightfully, they recognized that even if it were the case that beta is actually ignored by investors, beta would still be captured in the data of stock returns as $\beta_j \cdot [R_M - E(R_M)]$, where β_j is the beta for a stock j , and $[R_M - E(R_M)]$ represents the actual market return (R_M) over what it was expected to be ($E(R_M)$). To see where the $\beta_j \cdot [R_M - E(R_M)]$ term comes from, consider that a researcher wishes to test the null hypothesis that investors actually ignore beta and simply seek those stocks offering the highest returns, with the outcome that all stocks are priced to deliver the same expected return, say 10%, in a given year. Now, suppose that the actual market return for this year turns out to be 18%. In accordance with the null hypothesis model (all stocks are priced to deliver the same return), should the researcher now expect to find that outcome returns for this year are distributed around 18% and that beta has no explanatory role? Surprisingly, the answer is ‘no’. Consider, for example, that Stock A has a sensitivity to the market described by its beta of 1.5, and Stock B has a sensitivity to the market described by its beta of 0.5. BJS argue that the researcher should expect to find that each stock has achieved a return equal to the initial expectation (10%) plus the ‘surprise’ additional market return ($8\% = 18\% - 10\%$) multiplied by that stock’s beta (defined as an asset’s return sensitivity to the market return). In other words, the researcher expects to find that the outcome return for Stock A is $10\% + 1.5 \cdot 8\% = 22\%$, and for Stock B is $10\% + 0.5 \cdot 8\% = 14\%$, even though both stocks were priced to give the same expected outcome of 10%.

Thus for BJS, the outcome regression equation to test a hypothesis for the expectation of return, $E(R_j)$, for assets j against the actual outcome returns, R_j , for the assets, becomes:

$$R_j = E(R_j) + \beta_j \cdot [R_M - E(R_M)] + \varepsilon_j \quad (2)$$

where $E(R_j)$ formulates the model to be tested (e.g., the right-hand side of the CAPM expression in equation (1) and $[R_M - E(R_M)]$ is the ‘unexpected’ excess market return multiplied by the asset beta (β_j) and ε_j allows an error term (cf. BJS, equation (3)). Note again that the β_j term here does not depend on any assumptions regarding investor expectations.

In seeking to test the CAPM, BJS therefore formed their appropriate regression equation by substituting the CAPM equation for $E(R_j)$ as equation (1) into equation (2) to give:

$$R_j = r_f + \beta_j \cdot [E(R_M) - r_f] + \beta_j \cdot [R_M - E(R_M)] + \varepsilon_j$$

The $E(R_M)$ terms cancel out and the required regression equation of the excess asset return $R_j - r_f$ on the excess market return ($R_M - r_f$) becomes:

$$R_j - r_f = \beta_j \cdot (R_M - r_f) + \varepsilon_j \quad (3)$$

A significant advantage of the regression equation is that its inputs are observable output data and not ‘expectations’.

BJS (1972) and Black (1993) apply equation (3) to the data following a double-pass regression method so as to achieve a number of testable predictions. Thus they founded the elements of the methodology that underpins all subsequent tests of asset pricing models. The method can be explained briefly. In a first pass, equation (3) is run as a time-series regression of each stock’s monthly excess return ($R_{j,t} - r_f$) at time t on the monthly excess market return ($R_{M,t} - r_f$) for that month so as to determine each stock’s beta (β_j) as the ‘slope’ of the regression:

$$(R_{j,t} - r_f) = \alpha_j + \beta_j \cdot (R_{M,t} - r_f) + \varepsilon_{j,t} \quad (4)$$

where α_j denotes the ‘intercept’ of the regression and $\varepsilon_{j,t}$ are the regression error terms, which are expected to be symmetrically distributed about zero (cf. BJS, equation (6)). The stocks are then ranked by their beta and 10 decile portfolios are partitioned from lowest beta to highest beta stocks. In this way, an average intercept (α_P) and average slope (that is, beta, β_P) may be assigned to each portfolio. We can see that if the CAPM of equation (1) is well specified in describing expectations, the intercepts α_P for each portfolio should be close to zero. In the second pass, equation (3) can now be run as a single cross-section regression of the excess portfolio returns ($R_P - r_f$) on the portfolio betas (β_P) (as determined in the prior time-series regression as the explanatory variable):

$$(R_P - r_f) = \gamma_0 + \gamma_1 \cdot \beta_P + \varepsilon_P \quad (5)$$

(cf. BJS, equation (10)). Again, if the CAPM of equation (1) is well specified, the intercept γ_0 term should be statistically indistinguishable from zero, and the coefficient γ_1 on the β_P 's should identify the average excess market return, $(R_M - r_f)$.

In the time-series regressions, the BJS studies determine that the intercept α_{ps} are consistently negative for the high-risk portfolios ($\beta > 1$) and consistently positive for the low-risk portfolios ($\beta < 1$). In the cross-sectional regression, they find that the intercept is positive and the slope is too low to be identified with an average excess market return, $(R_M - r_f)$. Both pass regressions therefore contradict the CAPM.

As highlighted in Mehrling's biography (2007), Black realized that without some meaningful version of the CAPM, markets cannot be held to be rational. As Black (1993) explained, if the market does not appropriately reward beta, no investor should invest in high-beta stocks. Rather, the investor should form a portfolio with the lowest possible beta stocks and use leverage to achieve the same market exposure but with a superior return performance as compared with a high-beta stock portfolio.

The simplest way to make the CAPM fit the data is to replace the risk-free rate, r_f (typically the return on short-term U.S. Treasury bonds) with some larger value, R_z , since that would adjust the intercepts and explain the lower slope of the cross-sectional regressions. In fact, BJS use the data to calculate the required substitute rate, R_z , that offers the best fit. As Mehrling's biography recalls, 'the R_z term was a statistical fix in search of a theoretical explanation' (p. 114). Accordingly, Black proposed his version of the CAPM as:

$$E(R_j) = E(R_z) + \beta_j \cdot [E(R_M) - E(R_z)] \quad (6)$$

where R_z is postulated as representing the return on a portfolio that has zero covariance with the return on the market portfolio. Black argued that the model is consistent with relaxing the assumption of the existence of risk-free borrowing and lending opportunities.

The test of whether the data are being generated by the process of equation (6) is that of whether the actual outcome returns are explained by the regression equation (3) with the standard risk-free rate r_f replaced by R_z :

$$R_j = R_z + \beta_j \cdot (R_M - R_z) + \varepsilon_j$$

which (because we wish to maintain the regression format of a dependence of $R_j - r_f$ on $R_M - r_f$ as the independent variable) can be rewritten as:

$$R_j - r_f = (R_z - r_f) \cdot (1 - \beta_j) + \beta_j \cdot (R_M - r_f) + \varepsilon_j$$

That is, the first-pass time-series regressions of the excess return $(R_j - r_f)$ on the excess market return $(R_M - r_f)$ now has predicted intercepts α_P for the portfolios as:

$$\alpha_P = (R_z - r_f) \cdot (1 - \beta_P) \quad (7)$$

where R_z is the average excess mean return on the zero-beta portfolio over the period. Equation (7) (and therefore equation (6)) could therefore be declared

consistent with the *JBS* findings that the intercept α_P s are increasingly negative (positive) with increasing (decreasing) betas from the base $\beta_P = 1$. Additionally, the second-pass cross-section regressions of the portfolio returns (R_P) on the portfolio betas (β_P) as equation 5 above:

$$(R_P - r_f) = \gamma_0 + \gamma_1 \cdot \beta_P + \varepsilon_P \quad (5)$$

now predicts:

$$\gamma_0 = (R_Z - r_f) \text{ and } \gamma_1 = R_M - R_Z \quad (8)$$

which is consistent with the determinations of *JBS* of a positive intercept and a slope that understates the excess market return.

Suppose, however, that we insist on testing the possibility that investors contravene Black's CAPM and can be modelled as adhering to our (heretical) null hypothesis that all assets j have the same expected rate of return, $E(R_j)$, which is then necessarily that of the market, $E(R_M)$:

$$E(R_j) = E(R_M) \quad (9)$$

How do the regressions separate the hypotheses as preferable explanations of the data? To test the equation (9) hypothesis, we would form the regression equation (with equation (2)) as:

$$R_j = E(R_M) + \beta_j \cdot [R_M - E(R_M)] + \varepsilon_j \quad (10)$$

Note again how β_j above identifies the 'drag' of the excess market return on the return on asset j . Equation (10) (again for the purpose of expressing a preferred regression dependence of $R_j - r_f$ on $R_M - r_f$ as the independent variable) can be rewritten as:

$$R_j - r_f = (1 - \beta_j) \cdot [E(R_M) - r_f] + \beta_j \cdot (R_M - r_f) + \varepsilon_j$$

The first-pass time-series regressions should now have the intercept α_P :

$$\alpha_j = (1 - \beta_j) \cdot [E(R_M) - r_f] \quad (11)$$

and the second-pass cross-section regressions (equation (5)):

$$(R_P - r_f) = \gamma_0 + \gamma_1 \cdot \beta_P + \varepsilon_P \quad (5)$$

should reveal the parameters γ_0 and γ_1 as:

$$\gamma_0 = [E(R_M) - r_f] \text{ and } \gamma_1 = R_M - E(R_M) \quad (12)$$

Thus we find that the difference in predictions between the traditional CAPM (equation (1)), Black's CAPM (equation (6)) and the null hypothesis model of equation (9) are as follows. For the traditional CAPM hypothesis the predictions (as above) are:

$$\alpha_P = 0$$

$$\gamma_0 = 0 \text{ and } \gamma_1 = R_M - r_f$$

for Black's CAPM hypothesis:

$$\alpha_P = (1 - \beta_P) \cdot (R_z - r_f) \quad (7)$$

$$\gamma_0 = (R_z - r_f) \text{ and } \gamma_1 = R_M - R_z \quad (8)$$

and for the null hypothesis:

$$\alpha_P = (1 - \beta_P) \cdot [E(R_M) - r_f] \quad (11)$$

$$\gamma_0 = [E(R_M) - r_f] \text{ and } \gamma_1 = R_M - E(R_M) \quad (12)$$

Thus, the original CAPM hypothesis predicts $R_z = r_f$, Black's CAPM hypothesis predicts R_z = a value greater than r_f but less than $E(R_M)$. The null hypothesis predicts $R_z = E(R_M)$. So what do the data say? BJS actually observe:

This (the beta factor, R_z) seems to have been significantly different from the risk-free rate and indeed is *roughly the same size as the average market return* (R_M) of 1.3 and 1.2% per month over the two sample intervals (1948–57 and 1957–65) in this period. (p. 82, emphasis added)

In other words, the BJS results validate the null hypothesis of equation (9) in favour of either the CAPM of equation (1) or Black's CAPM of equation (6)! This is an extraordinary observation; the evidence from the beginning has always been squarely against the notion that investors set stock prices rationally in relation to stock betas. Such a revelation, however, would have fundamentally undermined the determination of finance to be accepted as a domain of economics with its study of 'efficient markets' in terms of econometric techniques.

3 THE FAMA AND FRENCH MODEL

Fama and French (hereafter, FF) have been aggressive in pronouncing the ineffectiveness of the relation between beta (β) and average return (see also, Reinganum, 1981, and Lakonishok and Shapiro, 1986). They commence their 1992 paper with the pronouncement that 'when the tests allow for variation in β that is unrelated to size, the relation between β and average return is flat, even when β is the only explanatory variable'. They find, however, that two other measured variables, the market equity value or 'size' of the underlying firm (ME) and the ratio of the book value of its common equity to its market equity value (BE/ME), 'provide a simple and powerful characterization of the cross-section of average stock returns for the 1963–90 period' (FF (1992), p. 429) and conclude that 'if stocks are priced rationally, the results suggest that stock risks are multidimensional' (p. 428).

As BJS (1972) before them, Fama and French realize the necessity of retaining a risk-based model of asset pricing. In the absence of such a model, the rational

integrity of markets is undermined. In their 1996 paper, Fama and French place their model squarely in the tradition of the CAPM, stating that ‘this paper argues that many of the CAPM average-return anomalies are related, and that they are captured by the three-factor model in Fama and French (1993)’. The model says that the expected return on a portfolio in excess of the risk-free rate $[E(R_j) - r_f]$ is explained by the sensitivity of its return to three factors: (a) the excess return on a broad market portfolio $(R_M - r_f)$; (b) the difference between the return on a portfolio of small firm stocks and the return on a portfolio of large firm stocks $(E(R_{SMB}), \text{small minus big})$; and (c) the difference between the return on a portfolio of high-book-to-market stocks and the return on a portfolio of low-book-to-market stocks $(E(R_{HML}), \text{high minus low})$. Specifically, the expected return on portfolio j is,

$$E(R_j) - r_f = b_j \cdot [E(R_M) - r_f] + s_j \cdot E(R_{SMB}) + h_j \cdot E(R_{HML}) \quad (FF1)$$

where $E(R_M) - r_f$, $E(R_{SMB})$, and $E(R_{HML})$ are expected premiums, and the factor sensitivities or loadings, b_j , s_j and h_j , are the slopes in the time-series regression,

$$R_j - r_f = \alpha_P + b_j \cdot (R_M - r_f) + s_j \cdot R_{SMB} + h_j \cdot R_{HML} + \varepsilon_j \quad (FF2)$$

where α_E and ε_E represent, respectively, the intercept and error terms of the regression.

In seeking to establish their model as a strictly risk-based model, Fama and French argue that the size of the underlying firm and the ratio of the book value of equity to market value are ‘risk-based’ explanatory variables, with the former a proxy for the required return for bearing exposure to small stocks, and the latter a proxy for investors’ required return for bearing ‘financial distress’, neither of which are captured in the market return (FF, 1995). They also claim that their model provides both a resolution of the CAPM (FF, 1996) and a resolution of prior attempts to generalize a risk-based model of stock prices:

At a minimum, the available evidence suggests that the three-factor model in (FF 1) and (FF 2) (see above), with intercepts in (FF 2) equal to 0.0, is a parsimonious description of returns and average returns. The model captures much of the variation in the cross-section of average returns, and it absorbs most of the anomalies that have plagued the CAPM. More aggressively, we argue in FF (1993, 1994, 1995) that the empirical successes of (FF 1) suggest that it is an equilibrium pricing model, a three-factor version of Merton’s (1973) inter-temporal CAPM (ICAPM) or Ross’s (1976) arbitrage pricing theory (APT). In this view, R_{SMB} and R_{HML} mimic combinations of two underlying risk factors or state variables of special hedging concern to investors. (FF, 1996, p. 56)²

We nevertheless observe an inherent contradiction between, on the one hand, Fama and French’s repeated denouncement of β , and on the other hand their inclusion of β as an explanatory variable in their model. In testing their model, FF

² Nevertheless, the model does not work entirely satisfactorily. As Fama and French (1996) concede, there are large negative unexplained returns on the stocks in their smallest size and lowest BE/ME quintile portfolios, and large positive unexplained returns for the stocks in the largest size and lowest BE/ME quintile portfolios.

(1996) form 25 (5×5) portfolios on ‘book-to-market value’ and ‘firm size’. Crucially, they do not form portfolios on β , with the outcome that the b_j coefficients of the 25 portfolios are all very close to 1.0 (none diverge by more than 10% as shown in Table 1 of FF, 1996). In effect, the Fama and French three-factor model has made redundant β as an explanatory variable, which makes sense given their studies confirming that beta has little or no explanatory power. But thereby we have a disconnect between the FF three-factor model and the CAPM: whereas the CAPM states that all assets have a return equal to the risk-free rate ‘as a base’ plus a market risk-premium multiplied by the asset’s exposure to the market, the FF three-factor model states that all stocks have the market return ‘as a base’ plus or minus an element that depends on the stock’s sensitivity to the differential performances of high and low book-value-to-market-equity stocks and big and small firm size stocks. The FF model might equally (and more parsimoniously) be expressed as a ‘two’ rather than a ‘three’ factor model:

$$E(R_j) = E(R_M) + s_j \cdot E(R_{SMB}) + h_j \cdot E(R_{HML})$$

But to express it thusly would be to concede that investor rationality, as captured by the CAPM, is now abandoned, whereas by allowing the loading b_j coefficients on the excess market return $[E(R_M) - r_f]$ to remain in the model, a formal continuity with the CAPM and the illusion that the three-factor model can be viewed as a refinement of the CAPM is maintained.

The Fama and French model states that U.S. institutional and retail investors (a) care about market risk but (b) do not appear to care about how such risk might be magnified or diminished in particular assets as captured by their beta (thereby contradicting the CAPM), while (c) simultaneously appearing to care about the book-to-market equity ratio and the firm size of their stocks. But if sensitivity to market risk as captured by beta does not motivate investors, it is, on the face of it, difficult to envisage how the book-to-market equity and firm size variables can be expected to motivate them. Lakonishok *et al.* (1994) argue that the Fama and French risk premiums are not risk premiums at all, but rather the outcome of mispricing. They argue that investors consistently underestimate future growth rates for ‘value’ stocks (captured as high market-to-book equity value), and therefore underprice them. This results in value stocks outperforming growth stocks. Dichev (1998) and Campbell *et al.* (2008) also provide evidence against the Fama and French premiums as proxies for risk premiums by showing that the risk of bankruptcy is negatively rather than positively related to expected returns. If the Fama and French book-to-market premium proxies for distress risk, it should be the case that distressed firms have high book-to-market values, which they find not to be the case.³ From another perspective, Daniel and Titman (1997) provide evidence against the premiums as risk premiums by finding that the return performances of the Fama and French portfolios do not relate to covariances with the risk premiums as the Fama and

³ The findings are qualified by Griffin and Lemmon (2002) who report that distressed firms often have low book-to-market ratios.

French model dictates, but, rather, relate directly to the book-to-market and size of the firm as attributable ‘characteristics’ of the stock.

4 BEYOND THE FAMA AND FRENCH THREE-FACTOR MODEL

The risk-return rationality of the CAPM and Fama and French three-factor models has stimulated a very substantial volume of asset pricing literature aimed at testing the models and recording an ‘anomaly’ when a new variable adds to the description of the cross-section of *ex post* stock returns. The new variable may then be incorporated in an extended FF three-factor model. For example, the ‘value’ and ‘size’ effects in the FF three-factor model have been augmented by a stock return momentum effect which is now viewed as a standard variable in asset pricing models (the Carhart, 1997, model). The model captures the observation that stocks that have recently performed well are likely to continue such performance for a period. Since Jegadeesh and Titman (1993) demonstrated a momentum effect based on three to 12 months of past returns, the effect and its relation to other variables has spurred considerable research effort. Grinblatt and Moskowitz (2004) explore the effect in terms of a dependence on whether the returns are achieved discretely or more or less continuously, while Hong *et al.* (2000) relate the momentum effect negatively to firm size and analyst coverage. Chordia and Shivakumar (2002) argue that momentum profits in the U.S. can be explained by business cycles; which finding is elaborated by Griffin *et al.* (2003) and Rouwenhorst (1998), who report evidence of momentum internationally; while Heston and Sadka (2008) report how winner stocks continue to outperform the same loser stocks in subsequent months.

Although it is possible to conjecture how momentum may come about as an outcome of a stock’s attractiveness continuing to build on its recent performance, it is difficult to justify stock return momentum (which, in effect, offers a level of predictability for a stock’s price movement) as an inherent risk factor. The challenge has recently been recognized by Fama and French (2008), who indicate that mispricing may need to be incorporated in asset pricing explanations (with the momentum effect allowed to differentiate across firm size).⁴

A good deal of research has also been aimed at replacing the Fama and French ‘high book-to-equity-value’ and ‘small firm size’ explanatory variables with economic variables that appear to relate more naturally to investors’ concerns. As examples of the work in this area, Petkova (2006) shows that a factor model that incorporates the term and credit spreads of bonds makes redundant the Fama and French (1993) risk proxies for the Fama and French 25 portfolios sorted by size and book-to-market. Also working with the Fama and French 25 portfolios, Brennan *et al.* (2004) report that the real interest rate along with the Sharpe ratio (of market excess return to market standard deviation) describe the expected returns of assets

⁴ Allied with momentum over six to 12 month horizons, researchers such as DeBondt and Thaler (1985, 1987) have also reported evidence of long-term *reversal* in stock under- and over-performance over three- to five-year periods. This finding, although challenged by Conrad and Kaul (1993), finds essential support from Loughran and Ritter (1996) and Chopra *et al.* (1992).

in equilibrium. Again with reference to the Fama and French portfolios, Da (2009) reports that the expected return of an asset is the outcome of the asset's covariance with aggregate consumption and the time pattern of market cash flows; and Campbell and Vuolteenaho (2004) also argue for focusing on an asset's covariance with market cash flows as the important risk factor. And Jagannathan and Wang (1996) argue that a conditional CAPM where betas are allowed to vary with the business cycle works well when returns to labour income are included in the total return on the market portfolio (which is supported by Santos and Veronesi, 2006, who show that the labour income to consumption ratio is a useful descriptor of expected returns). It comes, of course, as no surprise that aspects of the economy relate to stock price formation. Nor is it a surprise that the relations are evident as covariances in the data of stock price returns. This is in fact what we expect (as clarified in Section 3). Such observations need 'not cause a ripple' (Cochrane, 2005, p. 453).

Stock returns have also been related to 'micro-finance'—the institutional mechanics of trading equities. Thus, Amihud and Mendelson (1986) relate asset returns to stock liquidity, measured for example by the quoted bid–ask spread. Liquidity is promoted as an explanatory variable in understanding asset returns by Chordia *et al.* (2002, 2008) and Chordia *et al.* (2005). More recently, studies have begun to identify cross-sectional predictability with frictions due to the cognitive limitations of investors (e.g., Cohen and Frazzini, 2008; Chordia *et al.*, 2009).⁵ But again, it is difficult to see how such variables might be interpreted as proxies for 'risk' factors. Fama and French (2008) have reported accruals, stock issues and momentum as robustly associated with the cross-section of returns, while Cooper *et al.* (2008) argue that growth in assets predicts returns. Haugen and Baker (1996) consider past returns, trading volume, and accounting ratios such as return on equity and price/earnings as the strongest determinants of expected returns, and go so far as to report that they find no evidence that risk measures (such as systematic or total volatility) are influential in the cross-section of equity returns.

As we stress, the integrity and rationality of markets in a CAPM sense is founded not on covariances of market returns with economic or psychological considerations, or with market institutional (liquidity attributes) considerations, but on their ability to monitor and price risk. Indeed, it is now the convention for models not to make the claim to be 'asset pricing' models in the risk-return sense, but rather to be 'factor' models. The identification of the correlation of a variable with asset returns is then presented as either an 'anomaly' or as the demonstration that the variable is 'priced' by the markets.⁶ This is what Black meant by saying that the exercise amounts to data mining.

⁵ Shiller (1981) was one of the very early academic researchers to conclude from the history of stock market fluctuations that stock prices show far too much variability to be explained by an efficient market theory of pricing, and that one must look to behavioural considerations and to crowd psychology to explain the actual process of price determination.

⁶ A choice example is perhaps Savov (2011), which shows how in a cross-section of portfolios, garbage growth is 'priced'.

Even if we have failed to identify and quantify the essential risk-return relationship of the markets, we can at least claim that we have acquired a fairly detailed *description* of correlations in asset pricing over a sustained period of stock market history. Yet, interesting though the findings undoubtedly are, the findings can be questioned as satisfactorily generalizing the functioning of markets. With regard to value stocks—which constitute the dominant factor in the Fama and French model—Malkiel (2004) observes:

While there appear to be long periods when one style seems to outperform the other, the actual investment results over a more than 65-year period are little different for value and growth mutual funds. Interestingly, the late 1960s through the early 1990s, the period Fama and French use to document their empirical findings may have been one of the unique long periods when value stocks outperformed growth stocks. (p. 132)

With reference to actual funds of small firm capitalization, Malkiel (2004) also observes that periods of small firm outperformance are followed by periods of underperformance. On the whole, he finds no consistency of performance that points to a dependable strategy of earning excess returns above the market, quite independent of any risk consideration. Reflecting Malkiel's observation, Cochrane (2005) also recognizes caution in making definite conclusions due to the difficulty of measuring average returns with statistical meaningfulness.

5 CONCLUSION

The capital asset pricing model (CAPM) captures the idea that markets are essentially rational and are an appropriate subject for scientific inquiry. Unfortunately, the facts do not support the CAPM. The additional variables brought in to describe the distribution of asset returns generally resist interpretation as contributing to a risk–return relation. For this reason, we cannot interpret more recent models as refinements of a fundamentally robust risk–return relation. Rather, they represent a radical departure from the essential risk–return premise of the CAPM. Nevertheless, the impression is often given that the CAPM model of rational markets has simply paved the way for more sophisticated models. This is unfortunate. A good deal of finance is now an econometric exercise in mining data either for confirmation of a particular factor model or for the confirmation of deviations from a model's predictions as anomalies. The accumulation of explanatory variables advanced to explain the cross-section of asset returns has been accelerating, albeit with little overall understanding of the correlation structure between them. We might consider that the published papers exist 'on the periphery of asset pricing'. They show very little attempt to formulate a robust risk-return relationship that differentiates across assets.

We might query why academic finance should be given to such a colossal commitment to data mining. In a review of the U.S. CRSP (Center for Research in Security Prices) data base, *The Economist* magazine (20–26 November 2010) observes that a reason for the high level of 'data mining' is the opportunity that the CRSP database offers financial economists (it estimates that more than one-third of published papers in finance represent econometric studies of the data base). Robert

Shiller in the same article in *The Economist* is quoted as saying that with the creation of the CRSP data base, economists have been led to believe that finance has become scientific, and that conventional ideas about investing and financial markets—and about their vulnerabilities—are out of date. He adds that to have seen the financial crisis coming, it would have been better to ‘go back to old-fashioned readings of history, studying institutions and laws. We should have talked to grandpa.’

Without the CAPM, we are left with a market where stock prices generally respond positively to good news and negatively to bad news, with market sentiment and crowd psychology playing a role that is never easy to determine, but which at times appears to produce tipping points, sending the market to booms and busts. Which is how markets were understood prior to the CAPM. In a non-CAPM world, the practitioner needs to understand how markets function in disequilibrium, as well as in equilibrium, with the caveat that history never repeats itself exactly. As market trends consolidate, we are naturally seduced into considering that they represent ‘the way the market works’. But a market trend can prove a fickle friend. We venture that it is in this sense that markets are ultimately risky.

The implications of not having a ‘scientific’ model of share prices are considerable. Derivation of the appropriate discount factor for valuation of cash flows requires such a model. Without a rationalized discount factor, attempts to value a firm, its projects, or impose fair prices for regulated industries, or to set realistic benchmarks for fund managers and for managers seeking bonuses, will have even more the appearance of ‘guesstimating’. For academics, an inexact science becomes even more inexact. For professionals, the image of professional expertise in controlling risk may be compromised. Ultimately, however, we must seek to understand markets on their own terms and not on our own.

REFERENCES

- Amihud, Y., and H. Mendelson, ‘Asset Pricing and the Bid–Ask Spread’, *Journal of Financial Economics*, Vol. 17, No. 2, 1986.
- Banz, R., ‘The Relationship Between Return and Market Value of Common Stocks’, *Journal of Financial Economics*, Vol. 9, No. 1, 1981.
- Basu, S., ‘The Relationship Between Earnings Yield, Market Value, and Return for NYSE Common Stocks: Further Evidence’, *Journal of Financial Economics*, Vol. 12, No. 1, 1983.
- Bhandari, L., ‘Debt/Equity Ratio and Expected Common Stock Returns: Empirical Evidence’, *Journal of Finance*, Vol. 43, No. 2, 1988.
- Black, F., ‘Capital Market Equilibrium With Restricted Borrowing’, *Journal of Business*, Vol. 45, No. 3, 1972.
- , ‘Beta and Return’, *The Journal of Portfolio Management*, Vol. 20, No. 1, 1993.
- Black, F., M. Jensen and M. Scholes, ‘The Capital Asset Pricing Model: Some Empirical Tests’, in M. Jensen (ed.), *Studies in the Theory of Capital Markets*, Praeger Publishers, 1972.
- Brennan, M., A. Wang and Y. Xia, ‘Estimation and Test of a Simple Model of Intertemporal Capital Asset Pricing’, *Journal of Finance*, Vol. 59, No. 4, 2004.
- Campbell, J., J. Hilscher and J. Szilagyi, ‘In Search of Distress Risk’, *Journal of Finance*, Vol. 63, No. 6, 2008.
- Campbell, J., and T. Vuolteenaho, ‘Bad Beta, Good Beta’, *American Economic Review*, Vol. 94, No. 5, 2004.
- Carhart, M. M., ‘On Persistence in Mutual Fund Performance’, *Journal of Finance*, Vol. 52, No. 1, 1997.

- Chan, L., Y. Hamao and J. Lakonishok, 'Fundamentals and Stock Returns in Japan', *Journal of Finance*, Vol. 46, No. 5, 1991.
- Chopra, N., J. Lakonishok and J. Ritter, 'Measuring Abnormal Returns: Do Stocks Overreact?', *Journal of Financial Economics*, Vol. 31, No. 2, 1992.
- Chordia, T., S. Huh and A. Subrahmanyam, 'Theory-Based Illiquidity and Asset Pricing', *Review of Financial Studies*, Vol. 22, No. 9, 2009.
- Chordia, T., R. Roll and A. Subrahmanyam, 'Order Imbalance, Liquidity and Market Returns', *Journal of Financial Economics*, Vol. 65, No. 1, 2002.
- , 'Liquidity and Market Efficiency', *Journal of Financial Economics*, Vol. 87, No. 2, 2008.
- Chordia, T., A. Sarkar and A. Subrahmanyam, 'An Empirical Analysis of Stock and Bond Market Liquidity', *Review of Financial Studies*, Vol. 18, No. 1, 2005.
- Chordia, T., and L. Shivakumar, 'Momentum, Business Cycle, and Time-Varying Expected Returns', *Journal of Finance*, Vol. 57, No. 2, 2002.
- Cochrane, J., *Asset Pricing*, rev. ed., Princeton University Press, 2005.
- Cohen, L., and A. Frazzini, 'Economic Links and Predictable Returns', *Journal of Finance*, Vol. 63, No. 4, 2008.
- Conrad, J., and G. Kaul, 'Long-Term Market Overreaction or Biases in Computed Returns?', *Journal of Finance*, Vol. 48, No. 1, 1993.
- Cooper, M., H. Gulen and M. Schil, 'Asset Growth and the Cross-Section of Stock Returns', *Journal of Finance*, Vol. 63, No. 4, 2008.
- Da, Z., 'Cash Flow, Consumption Risk, and the Cross-Section of Stock Returns', *Journal of Finance*, Vol. 64, No. 2, 2009.
- Daniel, K., and S. Titman, 'Evidence on the Characteristics of Cross Sectional Variation in Stock Returns', *Journal of Finance*, Vol. 52, No. 1, 1997.
- DeBondt, W., and R. Thaler, 'Does the Stock Market Overreact?', *Journal of Finance*, Vol. 40, No. 3, 1985.
- , 'Further Evidence on Investor Overreaction and Stock Market Seasonality', *Journal of Finance*, Vol. 42, No. 3, 1987.
- Dichev, I., 'Is the Risk of Bankruptcy a Systematic Risk?', *Journal of Finance*, Vol. 53, No. 3, 1998.
- Douglas, G., 'Risk in the Equity Markets: An Empirical Appraisal of Market Efficiency', *Yale Economic Essays*, Vol. 9, 1969.
- Fama, F., *Foundations of Finance*, Basic Books, 1976.
- Fama, E., and J. McBeth, 'Risk, Return and Equilibrium: Empirical Tests', *Journal of Political Economy*, Vol. 81, No. 3, 1973.
- Fama, E., and K. French, 'The Cross-Section of Expected Stock Returns', *Journal of Finance*, Vol. 47, No. 2, 1992.
- , 'Common Risk Factors in the Returns on Stocks and Bonds', *Journal of Financial Economics*, Vol. 33, No. 1, 1993.
- , *Industry Costs of Equity*, Working Paper, Graduate School of Business, University of Chicago, 1994.
- , 'Size and Book-to-Market Factors in Earnings and Returns', *Journal of Finance*, Vol. 50, No. 1, 1995.
- , 'Multifactor Explanations of Asset Pricing Anomalies', *Journal of Finance*, Vol. 51, No. 1, 1996.
- , 'Dissecting Anomalies', *Journal of Finance*, Vol. 63, No. 4, 2008.
- Griffin, J., S. Ji and S. Martin, 'Momentum Investing and Business Cycle Risk: Evidence From Pole to Pole', *Journal of Finance*, Vol. 58, No. 6, 2003.
- Griffin, J., and M. Lemmon, 'Book-to-Market Equity, Distress Risk, and Stock Returns', *Journal of Finance*, Vol. 57, No. 5, 2002.
- Grinblatt, M., and T. Moskowitz, 'Predicting Stock Price Movements From Past Returns: The Role of Consistency and Tax-Loss Selling', *Journal of Financial Economics*, Vol. 71, No. 3, 2004.
- Haugen, R., and N. Baker, 'Commonality in the Determinants of Expected Stock Returns', *Journal of Financial Economics*, Vol. 41, No. 3, 1996.

THE CAPITAL ASSET PRICING MODEL

- Heston, S., and R. Sadka, 'Seasonality in the Cross-Section of Stock Returns', *Journal of Financial Economics*, Vol. 87, No. 2, 2008.
- Hong, H., T. Lim and J. Stein, 'Bad News Travels Slowly: Size, Analyst Coverage, and the Profitability of Momentum Strategies', *Journal of Finance*, Vol. 55, No. 1, 2000.
- Jagannathan, R., and Z. Wang, 'The Conditional CAPM and the Cross-Section of Expected Returns', *Journal of Finance*, Vol. 51, No. 1, 1996.
- Jegadeesh, N., and S. Titman, 'Returns to Buying Winners and Selling Losers: Implications for Stockmarket Efficiency', *Journal of Finance*, Vol. 48, No. 1, 1993.
- Jensen, M., 'The Foundations and Current State of Capital Market Theory', in M. Jensen (ed.), *Studies in the Theory of Capital Markets*, Praeger Publishers, 1972.
- , 'Some Anomalous Evidence Regarding Market Efficiency', *Journal of Financial Economics*, Vol. 6, Nos 2–3, 1978.
- Kuhn, T., *The Structure of Scientific Revolutions*, University of Chicago Press, 1962.
- Lakonishok, J., and A. C. Shapiro, 'Systematic Risk, Total Risk and Size as Determinants of Stock Market Returns', *Journal of Banking and Finance*, Vol. 10, No. 1, 1986.
- Lakonishok, J., A. Shleifer and R. W. Vishny, 'Contrarian Investment, Extrapolation and Risk', *Journal of Finance*, Vol. 49, No. 5, 1994.
- Loughran, T., and J. Ritter, 'Long-Term Market Overreaction: The Effect of Low-Priced Stocks', *Journal of Finance*, Vol. 51, No. 5, 1996.
- Malkiel, B., 'Can Predictable Patterns in Market Returns be Exploited Using Real Money? Not Likely', *Journal of Portfolio Management*, Vol. 30, No. 5, 2004.
- Mehrling, P., *Fisher Black and the Revolutionary Idea of Finance*, John Wiley and Sons, 2007.
- Merton R. C., 'An Intertemporal Capital Asset Pricing Model', *Econometrica*, Vol. 41, No. 5, 1973.
- Miller, M., and M. Scholes, 'Rates of Return in Relation to Risk: A Re-Examination of Some Recent Findings', in M. Jensen (ed.), *Studies in the Theory of Capital Markets*, Publishers Praeger, 1972.
- Modigliani, F., and M. Miller, 'The Cost of Capital, Corporation Finance and the Theory of Investment', *American Economic Review*, Vol. 48, No. 3, 1958.
- , 'Corporate Income Taxes and the Cost of Capital: A Correction', *American Economic Review*, Vol. 53, No. 3, 1963.
- Petkova, R., 'Do the Fama–French Factors Proxy for Innovations in Predictive Variables?', *Journal of Finance*, Vol. 61, No. 2, 2006.
- Reinganum, M. R., 'A New Empirical Perspective on the CAPM', *Journal of Financial and Quantitative Analysis*, Vol. 16, No. 4, 1981.
- Ross, S. A., 'The Arbitrage Theory of Capital Asset Pricing', *Journal of Economic Theory*, Vol. 13, No. 3, 1976.
- , 'The Current Status of the Capital Asset Pricing Model', *Journal of Finance*, Vol. 33, No. 3, 1978.
- Rouwenhorst, K., 'International Momentum Strategies', *Journal of Finance*, Vol. 53, No. 1, 1998.
- Ryan, R. J., 'Capital Market Theory—a Case Study in Methodological Conflict', *Journal of Business Finance and Accounting*, Vol. 9, No. 4, 1982.
- Santos, T., and R. Veronesi, 'Labor Income and Predictable Stock Returns', *Review of Financial Studies*, Vol. 19, 2006.
- Savov, A., 'Asset Pricing with Garbage', *Journal of Finance*, Vol. 66, No. 1, 2011.
- Shiller, R. J., 'Do Stock Prices Move too Much to be Justified by Subsequent Changes in Dividends?', *American Economic Review*, Vol. 71, No. 3, 1981.
- Smith, C. W., *The Modern Theory of Corporate Finance*, 2nd ed., McGraw-Hill, 1990.
- Subrahmanyam, A., 'The Cross-Section of Expected Stock Returns: What Have We Learnt From the Past Twenty-Five Years of Research?', *European Financial Management*, Vol. 16, No. 1, 2010.
- The Economist*, 'Economics Focus: Data Birth', 20–26 November 2010.
- Weston, J. F., 'What MM Have Wrought', *Financial Management*, Summer 1989.

Copyright of Abacus is the property of Wiley-Blackwell and its content may not be copied or emailed to multiple sites or posted to a listserv without the copyright holder's express written permission. However, users may print, download, or email articles for individual use.