MARKET EFFICIENCY AND EQUITY PRICING: INTERNATIONAL EVIDENCE AND IMPLICATIONS FOR GLOBAL INVESTING

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1. INTRODUCTION

In this chapter we examine the notion of market efficiency and present a survey of the international evidence regarding the validity of the Efficient Market Hypothesis. The focus is on the most recent evidence which is generally at odds with the Efficient Market Hypothesis. We also investigate the validity of the Capital Asset Pricing Model and the Arbitrage Pricing Theory as descriptors and predictors of common stock returns in various stock exchanges around the world. Throughout the chapter we examine the implications of our findings for global portfolio management.

2. THE EFFICIENT MARKET HYPOTHESIS

In this section we first discuss the meaning and implications of the Efficient Market Hypothesis (EMH) and then examine its empirical validity. In discussing the concept of market efficiency we must first distinguish between two kinds of efficiency[1]: informational (or outside) efficiency and operational (or inside) efficiency. Outside efficiency refers to the performance of a market as an information processor and a price setter whereas inside efficiency refers to the performance of a market as an exchange system. If we want to know whether a market is informationally efficient we must ask if that market is able to process information rapidly and set the price of securities at a level that reflects all what is known about firms. If we want to know whether a market is operationally efficient we must ask if that market offers an inexpensive and reliable trading mechanism. In other words, we wish to know what is the magnitude of transaction costs (commissions, bid-ask spread, market impact of trade, etc. . . .), how fast can orders be executed and how long does it take to settle a trade. Note that informational efficiency and operational efficiency are related. Poor operational efficiency may delay the adjustment of prices to new information and prevent prices from reaching their equilibrium value. The operational efficiency of equity markets around the world is examined elsewhere in this book. Several aspects of their informational efficiency are reviewed below.

2.1 What is an Informationally Efficient Market?

Broadly speaking, a market is said to be informationally efficient if, at every moment in time, the current price of securities fully reflects all available and relevant information.[2] If prices do reflect all what is known about firms, then, security prices should be equal to their true value defined as discounted future cash flows. This, in turn, implies that investors cannot use public information to earn abnormal returns. In practice, however, prices may differ from true value because of factors such as the speed of price adjustment to new information and transaction costs. If prices adjusted instantaneously to new information and transaction costs were zero then security prices would be equal to their true value at every moment in time.

The idea underlying the EMH is quite simple. If all information is readily available to a large number of rational profit-seeking investors, or if the trading decisions of informed investors are imitated, then arbitrage operations should drive the current price of a security to its true value. Investors who consistently do better than average in picking undervalued stocks will accumulate these stocks at the expense of those which they believe to be overvalued. This investment strategy will drive the price of securities toward their true value. Conversely, investors who consistently do worse than average in picking undervalued stocks (that is, they end up with overvalued stocks) will carry fewer of those stocks, driving their prices down. It follows that in an efficient market, securities will trade at prices which are close to their true value and investors will be unable to systematically earn above normal profits.

Efficiency, of course, can only be defined relative to a specific type of information. Types of information are usually classified in three distinct categories. The first type is the historical sequence of prices. The second is public knowledge of companies' past performance as well as public forecasts regarding future performance and possible actions. Finally, the third type is private or privileged information. It is only available to insiders and those who have access to companies' policies and plans. These three types of information are then used to define three forms or degrees of market efficiency. The weak form of the EMH corresponds to the first type of information. It asserts that current prices fully and instantaneously reflect all the information implied by the historical sequence of prices. The semistrong form of the EMH corresponds to the second and first types of information. It asserts that current prices fully and instantaneously reflect all public information about companies, including, of course, the information implied in the historical sequence of prices. Finally, the strong form of the EMH corresponds to the third, second, and first types of information. It asserts that current prices fully and instantaneously reflect all information, public as well as private. Note that when we define degrees of market efficiency from weak to strong the information set becomes wider and cumulative.

2.2 Early Evidence on the Validity of the Efficient Market Hypothesis

Although rather simple to define, the EMH is quite difficult to test. One cannot say for certain whether the EMH holds true. For example, it is practically impossible to provide evidence that all possible mathematical combinations of past prices are not good in predicting future prices. Also one may not be able, for example, to conclude that a market is efficient in the semistrong form because the information set (all publicly available information) cannot be tested exhaustively. Prices may react efficiently to a given subset of information (say earnings announcements) and inefficiently to another subset (say stock splits).

A large number of tests of the EMH in its three forms have been conducted, first with U.S. stock market data and later with data from foreign equity markets. Tests of the weak form of efficiency concluded that changes in the price of common stocks follow a random walk, that is, their behavior is consistent with the notion of an efficient market in its weak form.[3] One way to test the Random-Walk Model is to find out whether the historical sequence of returns on a given security are independent of one another or whether they are related to one another. This can be done by calculating the serial correlation coefficient between the sequence of the stock's daily returns and the same sequence lagged one, two or more days.[4] If the calculated serial correlation coefficient is not significantly different from zero in a statistical sense, we can conclude that the Random-Walk Model is valid, that is, the knowledge of the past behavior of a stock's price movements cannot be used to predict the future behavior of that stock's price movements. A large number of studies have tested this model on U.S. and foreign stock prices and have shown that, with few exceptions, the Random-Walk Model cannot be refuted.[5] Significant correlations between stock returns may exist over daily return intervals but disappear with the lengthening of the time interval over which securities' returns are measured. Serial correlation coefficients, however, even when statistically significant, are generally not <u>strong</u> enough or sufficiently <u>stable</u> to enable investors to achieve above normal profits. There may exist, however, complex patterns of common stock returns which serial correlation analysis is unable to detect. These complex patterns, if they existed, could be taken advantage of by formulating mechanical trading rules such as filter rules, point-and-figure charts, moving averages, relative strength rules and portfolio rebalancing strategies. A mechanical rule is considered successful if its systematic application to stock prices would have enabled a trader to earn a higher return than a passive buy-and-hold strategy, at the same level of risk and net of transaction costs. The evidence based on U.S. and foreign markets indicates that none of these techniques can be used to achieve systematic and permanent superior performance.[6]

Tests of the semi-strong form of efficiency are usually performed by examining the speed with which the price of securities adjust to the new information contained in dividend and earnings announcements, as well as announcements regarding new issues of common stocks, mergers and acquisitions, block trading, and changes in accounting rules and reporting methods. If prices adjust no later than the date of the announcement, the market is informationally efficient with respect to that type of information. If price adjustments are observed after the date of the announcement, the market is informationally inefficient with respect to that type of information. A large number of tests based on U.S. and foreign data concluded that markets are generally informationally efficient in the semi-strong form.[7]

In a strong-form efficient market, all information (including inside information) is fully reflected in the price of securities. This means that individuals with monopolistic access to non-public information would be unable to earn abnormal profits. This may not be the case on the New York Stock Exchange (NYSE). There is evidence indicating that corporate insiders (who must list their trading with the Security and Exchange Commission) tend to purchase in months prior to a price increase and sell in months before a price decline.[8] No similar studies have been performed in markets outside the United States because of a lack of data on insider trading. Nevertheless, the widely held view on this matter is that trading on inside information does take place on most foreign stock exchanges and that some individuals and institutions do manage to garner abnormal profits from these activities. We must await rigorous empirical work in this area before drawing any meaningful conclusion.

An alternative test of the strong form of market efficiency is to examine the performance of professionally managed institutional portfolios. Professional portfolio managers should be able to obtain and profit from valuable investment information before it is fully reflected in the market. Several studies have shown that managers of U.S. mutual funds were unable to consistently beat the market. There exists a small number of studies which have investigated the performance of European institutional investors.[9] The results are usually in line with those found on the NYSE. Professional European investors have not been able to consistently outperform the market.

2.3 Recent Evidence at Odds with the Efficient Market Hypothesis

A growing number of studies have recently uncovered several phenomena that are inconsistent with the EMH in its weak and semi-strong forms.[10]

There is evidence of recurrent seasonality in common stock returns in the U.S. and foreign markets. Stock market returns differ, on average, depending on which day of the week they are measured (day-of-the-week effect) or which month of the year they are calculated (month-of-the-year effect). This phenomenon is inconsistent with the weak form of market efficiency since investors can predict higher or lower returns for specific days of the week or months of the year. The seasonal behavior of common stock returns and its implications for global investment management are examined in sections 4 and 6.

There is also evidence that portfolios constructed on the basis of firm size (market value of shares outstanding) have different average returns. Small-firm portfolios tend to outperform their larger counterparts even after returns are adjusted for the difference in the level of risk that may exist between small and large companies. This size-effect is inconsistent with the semi-strong form of market efficiency since investors can predict a higher average return for a portfolio constructed on the basis of publicly available information (market capitalization). The small-firm effect, other stock market anomalies and their implications for global investment management are examined in sections 5 and 6.

3. MODELS OF EQUITY PRICING

Until the early eighties, the Capital Asset Pricing Model (CAPM) was the standard tool used to describe common stock returns in an efficient market.[11] A large number of empirical studies published in the seventies concluded that the CAPM was a good descriptor and predictor of the behavior of common stock returns in the United States, Europe and Japan. In the late seventies, however, the validity of the CAPM was seriously questioned, first conceptually and later empirically.[12] As this was happening, an alternative equity pricing model, known as the Arbitrage Pricing Theory (APT), was developed in the mid-seventies to overcome some of the deficiencies of the CAPM. This model was tested in the early eighties using U.S., European and Japanese data.[13] At the time of this writing, the most recent tests of equity pricing models seem to cast some doubt on the validity of the CAPM as a descriptor and predictor of common stock returns. They also indicate that the APT may provide a superior alternative to the CAPM. In what follows we provide a description of both models and a review of their empirical tests.

3.1 The Capital Asset Pricing Model

One of the fundamental principle of modern finance is that the higher the risk of an asset, the higher its expected return. If you buy a high-risk, high-expected-return portfolio and hold it over a sufficiently long period of time (say a few years), that portfolio should earn a higher actual return than the low-risk, low-expected-return portfolio.

What do we mean by risk and how is it measured? What is the relationship between a portfolio's expected return and its risk? The Capital Asset Pricing Model (CAPM) provides answers to these questions.

One of the building blocks of the CAPM is the principle of risk decomposition. The total risk of a security can be broken down into two independent components: market-related component and a firm-specific component. The former is a measure of the extent to which the price of a security fluctuates in response to the general market movement. The latter is a measure of the extent to which the price of a security fluctuates in response to information unique to the firm which issued the security. We can write:

$$\text{TOTAL RISK} = [\text{MARKET RISK}] + [\text{FIRM-SPECIFIC RISK}] \;,$$

where the variance of a security's returns is the measure of its total risk.[14]

It can be shown that the market risk of a security is proportional to the variance of the market as a whole:

$$[\text{MARKET RISK OF SECURITY}_i] = (\beta_i^2)[\text{VARIANCE OF THE MARKET}] \;,$$

where the proportionality factor β_i is called the beta coefficient of security return to the returns of the market. A security with a beta coefficient equal to one has as much market risk as the market as a whole. But a security with a beta coefficient greater than one has more market risk than the market as a whole. And a security with a beta coefficient smaller than one has less market risk than the market as a whole. In other words, high-beta stocks have higher market risk than low-beta stocks. Suppose that security i has a beta of 0.80 and that the variance of its returns is 0.25 percent. Suppose, further, that the market as a whole has a variance of 0.10 percent. According to the above equation, the market risk of security i is $(0.80)^2$ (0.10 percent) = 0.064 percent. And since its total risk is 0.25 percent it follows that security i has a firm-specific or residual risk of 0.186 percent (.25 percent minus .064 percent). Note that 25.60 percent (0.064 percent divided by 0.25 percent) of the total risk of security i is generated by the market movement (market risk) and the remaining 74.40 percent of its total risk is generated by information unique to firm i (firm-specific risk).

The CAPM builds on the above principle of risk decomposition as well as on two other basic facts. First, individuals dislike risk, that is, they are risk averse. Second, security prices do not move in perfect unison, that is, their returns are less than perfectly correlated. Hence, increasing the number of securities in a portfolio can reduce its total risk without changing its expected return. As a result, investors will tend to hold well-diversified portfolios. What then is the relevant measure of the risk of a security when that security is part of a well-diversified portfolio? Only the market risk of a security is relevant in a portfolio context because the firm-specific risk is diversified away. Indeed, an investor holding a well-diversified portfolio of securities only bears the market risk of the securities making up the portfolio. The firm-specific component of the risk of the securities will offset one another and approach zero as the size of the portfolio increases.

Since the firm-specific risk of a security can be eliminated by investors by simply holding the security as part of a portfolio, the CAPM claims that the firm-specific risk of a security is irrelevant in the pricing of that security. In other words, because investors can diversify away the firm-specific risk of securities, they do not have to bear that risk and hence should not be compensated for it. They should only be remunerated for bearing market risk because market risk cannot be diversified away. Thus, the expected return of a security (the remuneration for holding that security) must be related only to the market risk of that security. Securities with high-beta coefficients (a measure of their market risk) must have higher expected returns than securities with low-beta coefficients.

The CAPM gives the theoretical equilibrium relationship that must exist between an asset's expected return [$E(R_i)$] and it beta coefficient (β_i):

$$E(R_i) = R_F + \left[E(R_m) - R_F\right] \cdot \beta_i \ .$$

According to the CAPM, the expected return on a risky asset is equal to the return on a risk-free asset (R_F) plus a risk premium which is proportional to the beta coefficient of that asset. The proportionality factor (also called the market risk premium) is the difference between the expected return on the market as a whole (indicated by the subscript m) and the risk-free rate of return. If the risk-free rate is 6 percent and the expected return on the market is 11 percent, then, according to the CAPM, the expected return of security i is given by:

$$E(R_i) = 0.06 + 0.05\beta_i \ .$$

If security i has a beta coefficient of 0.80, its expected return is 10 percent according to the CAPM, the sum of a risk-free rate of 6 percent and a risk premium of (0.05)(0.80) = 4.00 percent.

3.2 Early Evidence on the Validity of the CAPM

How can we test the validity of the CAPM? Note that the model is based on expected returns which are not observable. But if the relation between security returns remains relatively stable through time, then historical average returns can be used as a proxy for the unobservable expected returns. Thus, to verify the empirical validity of the model we can examine the historical relation between portfolio average returns and their corresponding estimated beta coefficients. If that relation is linear with an intercept equal to the risk-free rate and a slope equal to the excess return on a broad market index then the CAPM is a valid model of stock price behavior. We will have an additional test of the validity of the CAPM if we can show that firm-specific risk is unrelated to average returns. Recall that, according to the CAPM, firm-specific risk can be diversified away and, hence, should not be priced in the market. In other words, an asset's firm-specific risk should not be related to that asset's average return.

One of the first rigorous test of the CAPM was performed on portfolios of stocks traded on the NYSE from 1935 to June 1968.[15] The estimated relationship between average monthly returns ($\bar{R}_i$) and beta (β_i), squared (β_i^2), and firm-specific risk over the 34-year period was found to be:

$$\bar{R}_i = \boxed{0.0020} + \boxed{0.0114}\,\beta_i - 0.0026\beta_i^2 + 0.0516[\text{firm-specific risk}] \ ,$$

where the framed coefficients are the only one that are significantly different from zero in a statistical sense. The above empirical relationship has an estimated monthly intercept of 0.20 percent (2.4 percent on an annual basis) and an estimated monthly beta-slope of 1.14 percent (13.48 percent on an annual basis). The intercept is not significantly different from the average risk-free rate prevailing over the period 1935-1968 and the slope is not significantly different from the prevailing market premium (average market return minus average risk-free rate) over that same period. The conclusion is obvious. The CAPM, when tested over a long period of time on the NYSE, cannot be rejected. Market risk is the only factor which has a significant relationship with average returns. Firm-specific risk is irrelevant for security pricing and so is beta squared, implying that average return is a positive and linear function of systematic risk.

Similar, but somewhat weaker, conclusions were reached when the CAPM was first tested on European and Japanese data. In general, the price behavior of common stocks was found to be consistent with the CAPM in Canada, the United Kingdom, Germany, France, Spain, Belgium, Japan and Thailand.[16]

But despite the empirical evidence supporting the CAPM, it has not been universally accepted. Criticisms range from its simplicity to the problem of how one should define the 'market'. Recently, the empirical validity of the CAPM was re-examined in light of the size anomaly and the seasonal behavior of stock market returns (see Section 2.3). The most recent evidence cast some doubt on the validity of this model as a descriptor and descriptor of common stock returns. This evidence and its implications are examined in Section 7 following a review of stock market anomalies in sections 4, 5 and 6.

3.3 The Arbitrage Pricing Theory Model

The APT is a multifactor equilibrium pricing model which is more general than the CAPM. It assumes that the returns of securities are linearly related to a small number of common or systematic factors rather than a single factor long as their number is much larger than the number of common factors. The model does not require that investors hold all outstanding securities and hence the "market", which is central to the CAPM, plays no particular role in the APT.

Suppose that there are three common factors that influence the stock market. According to the APT, the expected return of asset i [$E(R_i)$] is:

$$E(R_i) = R_F + \lambda_i \cdot b_{1i} + \lambda_2 \cdot b_{2i} + \lambda_3 \cdot b_{3i} ,$$

where λ_1, λ_2 and λ_3 are the three risk premia corresponding to the three sensitivity coefficients of asset i, b_{1i}, b_{2i} and b_{3i}. These sensitivity coefficients are similar to the beta coefficient in the CAPM. The beta of a stock is a measure of the sensitivity of that stock returns to the returns of the market as a whole. Likewise, b_{1i} is a measure of the sensitivity of the returns of stock i to the returns of the first common factor, etc. . . . .

Clearly, there is a <u>structural</u> similarity between the APT model and the CAPM. Assuming there is only one common or systematic factor affecting <u>all</u> securities outstanding and that this factor is the return on the market as a whole then the APT pricing relationship collapses to the CAPM pricing relationship. In this case, the sensitivity coefficient to the unique market-factor is the beta coefficient and the risk premium λ_1 is equal to $[E(R_M) - R_F]$, the CAPM risk premium.

The APT's generality, however, is to some extent a weakness. The model indicates that an asset's expected return is a linear function of a set of sensitivity coefficients to systematic or common factors. But the number of common factors and their nature are not known. As a consequence, tests of the APT model are particularly difficult to design. Most tests of this model employ the methodology suggested by Roll and Ross (1980). This methodology, outlined below, has been recently applied to French, German and U.K. data.[17]

Before discussing the available European and Japanese evidence, we present a brief review of the Roll and Ross approach to testing the APT model. They used daily returns data from July 1962 through December 1972 for a sample of about 1260 NYSE and AMEX companies. Their sample of stocks was divided into 42 groups of 30 securities each and each group's variance-covariance matrix was estimated from the returns data. Because of limitations imposed by computer software, each group was analyzed separately. By applying maximum likelihood factor analysis, they determined simultaneously the number of common factors (F_j) and their corresponding sensitivity coefficients (b_{ij}) called factor loading. Finally, they performed a cross-sectional test of the APT model by running a linear regression in which average stock returns is the dependent variable and the set of factor loadings (b_{ij}) are the independent variables. This method allows them to estimate the risk premia associated with each factor and to determine the number of factors that are "priced" according to the APT. They found that for 75 percent of the groups they analyzed, there is a 50 percent chance that five factors are significant and that 3 to 4 factors explain the cross-sectional variation in average stock returns. They concluded that the APT model performs well under empirical scrutiny.

The results of tests of the APT model applied to European data indicate that equity pricing is generally consistent with this model. The number of significant common factors varies across studies. In the case of France 7 common factors are significant in explaining the variance of common stock returns. For German data the number of factors retained depends on the criterion employed to select those which are significant. The smallest number of factors is 1 and the largest 43. British studies suggest 15 to 20 relevant factors for U.K. data.

The disparity in the number of significant common factors reported in these studies is essentially due to differences in the size of the groups analyzed, the statistical technique employed to extract the factors from the data and the type of criterion adopted to select those factors which are relevant. Turning to the cross-sectional evidence, 3 to 5 factors seem to explain the cross-sectional variation of average return of French stocks. The number is about 8 for German stocks and 1 to 7 for U.K. stocks. What general conclusion can be drawn from these results? There is strong evidence that more than one common factor explains the variation of European stock returns and that the first factor explains 25 to 40 percent of that variation. This factor, which is highly correlated with a market index, may be the return on the market as a whole.

A major weakness of the tests of the APT model described above is their inability to identify the nature of the common factors. We know that a few common factors are involved in the pricing of equity but what are they? An alternative approach to testing the APT model is to prespecify a set of macro-economic variables which are believed, a priori, to act as common factors and examine whether the sensitivity coefficients of stock returns to these common factors explain the cross-sectional variation of average stock returns. This approach has been applied to both U.S. stocks and Japanese stocks.[18] The latter study is briefly described below.

A set of eight economic variables were selected as likely common factors that would affect the monthly returns of Japanese stocks traded on the First Section of the Tokyo Stock Exchange (TSE) from January 1975 to December 1984. These are: (1) the monthly growth rate in an index of industrial production; (2) changes in expected inflation; (3) unexpected inflation (expected inflation minus actual inflation); (4) unexpected changes in the risk premium with the risk premium defined as the spread between government and corporate bonds; (5) unexpected changes in the slope of the term structure of interest rates with the slope defined as the spread between the rate on long-term government bonds and the short-term risk-free rate; (6) unexpected changes in the forward Yen/Dollar exchange rate; (7) the growth rate in oil prices (translated in Yen); and (8) the return of a market index of TSE stocks. It was found that only <u>three</u> of these factors have a significant effect on Japanese common stock returns. These are: (1) changes in expected inflation, (2) unexpected changes in the risk premium, and (3) unexpected changes in the slope of the term structure of interest rates. Monthly growth rate in industrial production, unexpected changes in the foreign exchange and oil price changes are not priced on the Tokyo Stock Exchange. More important, however, is the finding that once the three significant common factors are taken into account, the market index does not have any influence on stock returns. This result should not be interpreted to mean that market index is irrelevant in pricing equity. Actually, the market index, when taken alone, does influence stock returns. But it has not <u>additional</u> effect on stock returns beyond the joint effect of the three significant common factors.

4. SEASONALITIES IN STOCK MARKET RETURNS

In Section 2 we suggested that the presence of seasonalities in stock market returns is inconsistent with the weak-form of the Efficient Market Hypothesis (EMH) unless we can show that the higher average returns earned during specific days of the week or during particular months of the year would disappear once returns are adjusted for transaction costs and incremental risk monthly returns of the stock market indices of a sample of countries that includes Australia, Canada, Europe, Japan, Singapore and the United States. Of the two phenomena, we will see that the most relevant to global investment strategies is the monthly seasonal. For this reason, the causes of monthly seasonality and the implications of this phenomenon for global portfolio management are examined in separate sections.

4.1 Seasonality in Stock Market Daily Returns

Table 1 provides the average daily return of nine market indexes for the first five days of the week. The sample covers nine countries over a 16-year period (January 1969 to December 1984) except for the case of Australia, Finland and Spain for which the daily mean returns are calculated over shorter periods. Framed returns are significantly different from zero in a statistical sense. These returns are computed using the closing value of the market index. For example, Monday returns are computed from Friday close to Monday close and hence include the week-end (Friday close to Monday open) as well as Monday (Monday open to Monday close). In all the countries in the sample except Japan, the exchange is closed during the week-end (Saturday and Sunday). In Japan, however, the exchange is open every second Saturday for morning trade.

Several observations can be made:

(1) There is a significant "day-of-the-week" effect in all countries. That is, average stock market returns on different days of the week are not the same (although not provided in Table 1, a statistical test confirms that statement for the nine countries in the sample);

(2) Average daily returns during the last three days of the week (Wednesday, Thursday and Friday) are <u>positive</u> whereas average daily returns during

TABLE 1

INTERNATIONAL EVIDENCE OF DAILY SEASONALITY IN STOCK MARKET RETURNS[1]

	DAILY MEAN RETURNS: 1969-1984 (unless otherwise indicated)[2]				
COUNTRY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
AUSTRALIA (4/1975 - 1984)	0.044%	-0.116%	0.045%	0.198%	0.157%
CANADA	-0.157%	-0.003%	0.073%	0.075%	0.094%
FINLAND[3] (1977 - 1982)	0.086%	0.066%	0.030%	0.070%	0.074%
FRANCE	-0.050%	-0.157%	0.100%	0.152%	0.082%
JAPAN	0.090%	-0.095%	0.139%	0.025%	0.039%
SINGAPORE	-0.036%	-0.107%	0.079%	0.121%	0.100%
SPAIN (1979-1983)	MARKET CLOSED	-0.072%	0.003%	0.037%	0.071%
U.K.	-0.095%	0.106%	0.090%	0.011%	0.044%
U.S.	-0.134%	0.013%	0.057%	0.021%	0.058%

1. Sources: Australia: Ball and Bowers (1985); Finland: Berglund (1985); Spain: Santesmases (1986); all other countries from Condoyanni et al. (1987).

2. Framed returns are significantly different from zero at the 0.05 level. Nonframed returns are not significantly different from zero.

3. The Finnish returns are calculated from September to May only. The Helsinki Stock Exchange is closed on Mondays during the summer months (June to August).

(3) Average returns are significantly negative on Monday in North America (Canada and the United States) and the United Kingdom, a phenomenon known as the "Monday effect";

(4) There is no Monday effect in the Far East (Japan and Singapore), Australia, Finland and France. Except for the case of Finland, the Monday effect is replaced by a Tuesday effect. That is, significantly negative average returns are observed on Tuesday in these countries.

Several questions immediately come to mind. Can these patterns of daily returns be explained? Why do they differ across countries (Monday effect in Canada, the United States and the United Kingdom and Tuesday effect in the Far East, Australia and France)? Do they violate the weak-form of the Efficient Market Hypothesis? Do they have any practical implications for global investing?

A partial explanation of the Monday effect in the United States and the United Kingdom is based on the settlement-delays hypothesis; the fact that there exists a delay of several days between the day a stock is traded and the day the funds are actually transferred.[19] On the NYSE there is a five-business-day settlement period to which we must add a business day for check clearing. This means that for stocks purchased on a business day other than Friday, the buyer will have eight calendar days before losing funds. For stocks purchased on Friday, he will have ten calendar days and thus two more days of interest earnings. In an efficient securities market the buyer should be willing to pay more for stocks purchased on Friday by an amount not exceeding two days of interest. Consequently, observed returns on Friday should be higher than those on other days of the week and those of Monday should be lower. A similar argument may explain the Monday effect reported on the London Stock Exchange.[20] On that exchange trading takes place over consecutive account periods of two weeks' length beginning every other Monday. Settlement, however, is made on the second Monday after the end of the account. This means that for stocks purchased on the first Monday of the account, the buyer will have 21 calendar days before losing funds; whereas for stocks purchased the preceding Friday, he will have only 10 calendar days. For stocks purchased on the second Monday of the account, the buyer will have 14 calendar days but 17 calendar days for stocks purchased the preceding Friday. According to the settlement-delay hypothesis, the first Monday returns of the account should be higher than the returns on the other days of the week and the second Monday returns should be smaller. However, the fact that stocks generally go ex-dividend on the first Monday of the account will partly offset the rise in price and return predicted for that day by the settlement-delay hypothesis. Indeed, returns on non-ex-dividend Mondays are generally negative, whereas returns on ex-dividend Mondays are generally positive. This result is qualitatively consistent with the settlement-delay hypothesis but the magnitude of the Monday effect on the NYSE and the LSE cannot be fully explained by the settlement-delay hypothesis. At the time of this writing it remains a partial puzzle.

The Tuesday effect in Australia, France, Japan and Singapore may be the result of time zone differences relative to New York. With the exception of France, these countries are all one day ahead of New York. Hence, the Tuesday effect in these countries may reflect the earlier Monday effect in New York suggesting that there exist significant correlations among daily stock returns across the world's stock exchanges. These correlations are lagged by a day rather than being contemporaneous. The Tuesday effect in the French index may be explained by the fact that, contrary to the U.K. index, the French index is compiled before the U.S. market opens.

Can these phenomena be interpreted as violations of the Efficient Market Hypothesis? It is doubtful that a trader could earn abnormal returns by exploiting the Monday/Tuesday effects. It would require short selling which may not be available. And transaction costs are likely to eliminate most of the abnormal profit. What are the implications for global investing? The evidence clearly indicates that the major stock exchanges around the world are part of a global market in which the price movements of individual exchanges are closely interrelated. The linkages among the major exchanges around the world is practically instantaneous. Lags in the correlation structure of stock returns around the world seem to reflect differences in time zones. The Monday effect reported in North America and the United Kingdom is replaced by a Tuesday effect in countries outside the New York time zone. There may be some advantages to be gained from that knowledge; investors planning to buy stocks should do so preferably on Monday for Canadian, U.S. and U.K. stocks and on Tuesday for French and Far Eastern stocks. And a stock sale should be preferably carried out on a Wednesday, Thursday or Friday.

4.2 Seasonality in Stock Market Monthly Returns

Table 2 provides the average monthly returns of eleven market indexes for every month of the year. The sample covers nine countries over a 21-year period (January 1959 to December 1979) except for the case of the Finnish stock market and the U.K. Financial Times All Share Index for which the period of analysis differ.

Several observations can be made:

(1) There is a significant "month-of-the year" effect in all countries. That is, average stock market returns on different months of the year are not the same (although not provided in Table 2, a statistical test confirms

TABLE 2

INTERNATIONAL EVIDENCE OF MONTHLY SEASONALITY IN STOCK MARKET RETURNS[1]

	MONTH-TO-MONTH PERCENTAGE MEAN RETURNS (Jan. 1959 to Dec. 1979)[2]												
UNTRY	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	All Months
stralia	2.65	-0.58	0.51	0.84	0.97	0.43	0.66	-0.37	-2.39	2.13	-0.85	3.99	0.67
lgium	3.20	1.09	0.40	1.48	-1.36	-0.84	1.44	-1.17	-1.87	-0.69	0.42	-0.09	0.17
nada	2.90	0.07	0.79	0.41	-0.96	-0.30	0.69	0.60	-0.06	-0.82	1.44	2.61	0.61
nland	3.62	2.09	2.63	0.95	-0.02	1.55	2.53	0.97	-0.76	0.77	0.61	2.51	N.A.[3]
ance	3.72	-0.18	1.98	0.94	-0.66	-1.90	1.53	1.03	-1.21	-0.72	0.43	0.15	0.43
pan	3.53	1.13	1.88	0.30	0.96	2.06	-0.32	-0.83	-0.13	-0.98	1.65	1.80	0.92
ain	2.24	1.29	0.32	1.59	-1.87	0.06	0.79	1.29	-1.64	0.19	-0.44	-0.01	0.32
K.	3.40	0.69	1.25	3.13	-1.21	-1.69	-1.11	1.88	-0.24	0.80	-0.61	2.06	0.70
K. FT-A	3.06	0.79	1.15	3.57	-1.00	-0.85	-0.22	2.62	0.03	1.26	0.16	2.34	1.08
S.	1.04	-0.41	1.27	0.96	-1.38	-0.56	0.14	0.34	-0.79	0.78	1.03	1.42	0.32
S. E.W.[4]	5.08	0.55	1.55	0.44	-1.42	-1.00	0.73	0.72	-0.42	-0.79	1.79	1.37	N.A.[3]

Sources: Finland: Berglund (1985); U.K. FT-A (Financial Times All Share Index): Levis (1985); all other data are from Gultekin and Gultekin (1983) and are based on stock markets indexes from Capital International Perspective (value-weighted indexes).

Except for Finland where the period covered is from January 1970 to December 1983 and the U.K. FT-A where the period covered is from January 1958 to December 1982.

Not available

Equally-weighted index of New York Stock Exchange shares.

.2.2

(2) Average returns during January are always positive and generally significantly higher than during the rest-of-the-year;

(3) The "January effect" depends on the composition of the stock market index. Broader and equally-weighted indexes exhibit a stronger January effect than narrower indexes. The equally-weighted index of all NYSE shares has a January returns of 5.08 percent compared to 1.04 percent for a value-weighted index. This phenomenon is a manifestation of the small firm effect. The equally-weighted index gives more weight to small firms than does the value-weighted index. And small firms are generally responsible for the January effect. This important aspect of the January effect is discussed in a following section.

The January effect raises the same set of questions as those raised by the Monday effect. How can it be explained? Does it violate the Efficiency Market Hypothesis? What are its implications for portfolio management and global investing. These questions are addressed in the following four sections.

5. A SIZE EFFECT IN STOCK MARKETS AROUND THE WORLD

Which of two portfolios has the higher probability of achieving a higher average return in the near future? We have already pointed out in Section 3 that the CAPM claims that it is the portfolio with the higher systematic risk. But we have also mentioned earlier that a substantial body of empirical evidence, gathered over the last 10 years, suggests that the portfolio containing the securities of firms with the smallest market capitalization outperforms, on average, the portfolio with the larger market capitalization even after adjusting returns for the difference in the level of risk that may exist between small and large firms. This is what we called "the size effect" in equity markets.

In Section 2 we argued that the size effect is inconsistent with the semi-strong form of the Efficient Market Hypothesis. In this section we report evidence of a size effect in most equity markets around the world. But we show that this phenomenon is not stable over time. It does not manifest itself over all holding periods or during every month of the year. We will see that this aspect of the size effect has obvious implications for the design and implementation of investment strategies that seek to exploit this anomaly to improve portfolio performance. We also examine some possible explanations of the size effect and conclude with a brief survey of stock market anomalies other than the size anomaly.

5.1 International Evidence of a Size Effect

The evidence is summarized in Table 3 for the Australian, Canadian, European, Japanese and American stock markets. First note the difference in size (market capitalization) between the largest and the smallest portfolio in the samples drawn from the nine countries. In the case of Spain the largest portfolio is 228 times larger than the smallest portfolio. But in the case of Japan the largest portfolio is only 25 times larger than the smallest portfolio. The size premium earned by the smallest portfolio is measured by the difference between the average monthly return on the smallest portfolio of firms and the average monthly return on the largest portfolio of firms. The size premium is positive in all countries. But its magnitude varies across markets. It is most pronounced in Australia (5.73 percent per month) and Japan (0.89 percent per month) and least pronounced in the United Kingdom (0.40 percent per month) and Canada (0.44 percent per month). Note that the annualized size premium (monthly size premium multiplied by 12) varies from 68.76 percent in Australia (over the 24-year test period) to only 4.75 percent in the United Kingdom (over the 25-year test period). A size effect exists in

TABLE 3

INTERNATIONAL EVIDENCE OF A SIZE PREMIUM[1]

	AUSTRALIA	BELGIUM	CANADA	FINLAND	FRANCE	JAPAN	SPAIN	U.K.	U.S.
iod	1958-1981	1969-1983	1973-1980	1970-1981	1968-1980	1966-1983	1963-1982	1958-1982	1926-1979
f securities[2]	281 to 937	170	391	50	201	First Section TSE	98 to 140	All LSE	All NYSE
f size portfolios	10	5	5	10	5	5	10	10	5
alue of largest portfolio s divided by market value lest portfolio of firms[3]	N.A.	188	67	113	83	25	228	182	124
monthly return on the t portfolio of firms[4]	6.75%	1.17%	1.67%	1.65%	1.62%	2.03%	0.58%[5]	1.33%	1.77%
monthly return on the portfolio of firms[4]	1.02%	0.65%	1.23%	0.89%	0.97%	1.14%	0.02%[5]	0.93%	0.93%
mium (small minus large)	5.73%	0.52%	0.44%	0.76%	0.65%	0.89%	0.56%	0.40%	0.84%
risk of smallest portfolio									
rd beta coefficient[6]	1.04	1.01	N.A.	0.36	0.42	1.12	N.A.	0.31	1.45
ed beta coefficient[7]	N.A.	N.A.	N.A.	0.50	0.55	1.22	N.A.	0.64	1.60
risk of largest portfolio									
rd beta coefficient[6]	0.95	0.98	N.A.	1.00	1.05	0.81	N.A.	1.01	0.96
ed beta coefficient[7]	N.A.	N.A.	N.A.	0.95	1.05	0.77	N.A.	1.02	0.93

rces: Australia: Brown et al. (1983); Belgium: Hawawini et al. (1988); Canada: Berges et al. (1984); Finland: Wahlroos and Berglund (1986); nce: Hamon (1986); Japan: Nakamura and Terada (1984); Spain: Rubio (1986); U.K.: Levis (1985); U.S.: Banz (1982).

= Tokyo Stock Exchange; NYSE = New York Stock Exchange

ratio is based on average market value over the sample period, except for the U.S. where the ratio is calculated in 1975 and Finland where it calculated in 1970.

returns are significantly different from zero at the .05 level.

Spain the average return on the small and the large portfolios are returns in excess of those predicted by the Capital Asset Pricing Model, t is, they are risk-adjusted return.

ndard beta coefficients are estimated using Ordinary Least Square regression; N.A. = not available.

usted betas are estimated using the Scholes and Williams (1977) method in the case of France and the Dimson (1979) method in all other es. These two methods adjust the estimated beta coefficient for the thin trading that characterizes smaller firms; N.A. = not available.

the nine countries but it is not significant in the United Kingdom and Canada. Also, because the sample periods are different across countries, we do not know whether the magnitude of the size effect is significantly different across the nine countries.

What about risk? Can differences in risk between the smallest and largest portfolios explain the size premium? The evidence is found in Table 3. In three European countries for which data is available, the market risk of the smallest firms is lower than the market risk of the largest firms (Finland, France and the United Kingdom). In Australia and Belgium it is the same. It is not clear why small firms in Finland, France and the United Kingdom have, on average, lower betas than large firms but the implication is clear. If we adjust for differences in risk, the size premium would be higher than the one reported in Table 3 in the case of these three countries (since small firms have lower betas) and about the same in Australia and Belgium (since small and large firms have, on average, roughly the same betas in these two countries). In Japan and the United States we have the opposite phenomenon: small firms have, on average, higher market risk than large firms. This is intuitively more appealing. Small firms are, on average, more risky than large firms in Japan and the United States. But the higher market risk of small firms in these two countries does not account for the size premium. The risk-adjusted size premium is smaller than the unadjusted risk premium reported in Table 3 for Japan and the United States but it is still significantly different from zero.

5.2 Stationarity of the Size Premium and Implications for Investment Management

Is the size premium a stable and recurrent phenomenon or does it manifest itself randomly over time? The answer to this question is important because the knowledge of the time behavior of the size premium is crucial to the design and implementation of investment strategies that seek to exploit the size effect in order to improve portfolio performance.

The evidence suggests that the size effect is a recurrent phenomenon but there are periods of time over which large firms, on average, outperform small firms. Also, the magnitude of the size premium is not constant. For example, in the case of the United States (the country for which we have the most extensive evidence) the size premium varied between a low of -10.20 percent over the subperiod 1926-1930 and a high of 43.80 percent over the subperiod 1931-1935.

In the next section we will show that the magnitude and the sign of the size premium are not the same, on average, during all months of the year. In most countries the size premium is usually large and positive during specific months of the year, particularly during the month of January.

The implication for investors who seek to exploit the size effect by holding portfolios of small firms is that such portfolios must be held over a period of time of sufficient length (at least 10 years) to insure a high probability of achieving superior performance.[21] Note that the fact that the size premium manifests itself during specific months of the year can also be exploited to achieve superior performance. This is shown in the next section as well as in Section 8.

5.3 Possible Explanations of the Size Effect

There are basically two possible interpretations of the small firm effect. The first is that the phenomenon does not exist; its appearance is simply the result of poor measurement procedures. If stock returns and market risk were measured properly, the size effect would disappear. The second specification of the pricing model (the CAPM) we are using to calculate the risk-adjusted size premium. If we had a "correct" model of the risk-return relationship, which would incorporate all aspects of risk relevant for investors, then the risk-adjusted size-premium would disappear.

Suppose that the market risk of small firms is systematically underestimated and that the market risk of large firms is systematically overestimated. In other words, the 'true' market risk of small firms is higher than their estimated market risk and the 'true' market risk of large firms is lower than their estimated market risk. If that were the case, then the 'true' risk-adjusted return on small firms would be lower than the observed return (and that of large firms will be higher) with the end result that the risk-adjusted size premium may disappear.[22] This outcome would be reinforced if the 'true' return on small firms were lower than those estimated from the data. This may be the case if we account, for example, for the higher costs of trading small firms. In this case the size-premium measured <u>net</u> of transaction costs would be smaller if small firms have higher transaction costs than their larger counterparts.[23]

But why should the estimated market risk of small firms be below its 'true' value? The estimated beta coefficient of infrequently traded stocks is lower than their 'true' beta coefficient, and since small firms tend to trade relatively infrequently, their beta coefficients are underestimated. It is possible to adjust betas to correct for the thin trading of smaller firms. A look at Table 3 indicates that the adjusted betas of small firms are indeed higher than their standard betas. But even with adjusted betas, the size premium remains. Hence, adjusted betas reduce but do not eliminate the size premium.

The second possible explanation of the size effect is that the CAPM does not adequately adjust for risk and hence is not a reliable model to calculate risk-adjusted returns. This explanation is, of course, to some extent a truism. The CAPM is an incomplete model as shown in Section 3. There are several kinds of risk which might be responsible for the size anomaly. Suppose that smaller firms are perceived to be riskier because investors have relatively less information about them than about larger firms. If that were the case, then the excess return earned on small firms is simply a compensation for holding riskier securities. This extra risk may not be fully captured by the beta coefficient and size may simply act as a proxy for a missing risk factor introduced by differential information across firms.

5.4 Other Stock Market Anomalies

Size is not the only characteristic of firms that could be used to earn abnormal returns. Evidence of stock market anomalies other than the size effect is limited to the U.S. market. It is briefly surveyed below. Although similar studies have not yet been performed in other stock markets, our suspicion is that anomalies similar to those found in the U.S. market will soon be uncovered in stock markets around the world.

There is evidence that portfolios of firms with low price-earnings ratio outperform portfolios of firms with high P/E ratios. The earliest study of this phenomenon examined the average annual returns, from April 1957 through March 1971, of over 750 NYSE stocks assigned to one of five portfolios on the basis of the magnitude of their year-end P/E ratio.[24] The lowest P/E portfolio earned, on average, 8 percentage points more than the highest P/E portfolio after adjusting returns for the difference in risk that may exist between the lowest and the highest P/E portfolio. Is the P/E effect another anomaly or is it an indirect manifestation of the are mostly small firms and the P/E effect could be just a proxy for the size effect. Several studies concluded that once returns are controlled for differences in risk and size the P/E effect disappears. Other studies claim the opposite.[25] We do not yet know which effect is a proxy for the other or if both effects are proxies for one or more unknown risk factors (beyond systematic market risk) that generate asset returns.

Other stock market anomalies include a price-to-book value ratio effect, a 'neglected'-firms effect, a period-of-listing effect and a dividend-yield effect.[26] Firms with relatively low price-to-book value ratios seem to outperform, on average, firms with relatively high price-to-book value ratios. Firms which are not followed regularly by financial analysts and which are not widely held by institutional investors tend to outperform firms which are scrutinized by analysts and adopted by institutional investors. Firms listed on the NYSE for the least number of months earn, on average, abnormal returns. So do firms with either zero or high dividend yields. Some of these phenomena are related to the size effect (the price-to-book value effect and the 'neglected'-firms effect). Others seem to persist even after returns are adjusted for size (the period-of-listing effect and the dividend-yield effect). Some exhibit seasonality. For example, the dividend-yield effect manifests itself mostly in the month of January. It is most likely that these and similar anomalies will soon be uncovered in stock markets around the world.

6. MONTHLY SEASONALITY IN THE SIZE PREMIUM AND IMPLICATIONS FOR INVESTMENT MANAGEMENT

We have seen that a size premium exists in stock markets around the world. We have also mentioned the fact that the size premium is not stationary. It varies depending on the month of the year over which portfolio returns are measured.

In this section we present some international evidence of monthly seasonality in the size premium and show how the tax environment may provide a possible explanation of this phenomenon. We conclude with a look at the monthly risk-return performance of size portfolios on the Tokyo Stock Exchange, the world's largest exchange and the Brussels Bourse, one of the world's smallest.

6.1 International Evidence of Monthly Seasonality in the Size Premium

The evidence is summarized in Table 4 for a subsample of the countries presented in Table 3. No evidence is available for the missing countries in Table 4. The size premium is measured as in Table 3 but instead of taking all months of the year into consideration, the size premium is first measured during the month of January and then during the rest of the year (from February through December). In all countries except France and the United Kingdom the size premium is significantly larger during January than during the rest of the year. Note that the size premium is positive in all countries during the rest of the year but its magnitude is significantly smaller than during the month of January (except again for the case of France and the United Kingdom).

How can this phenomenon be explained and what are its practical investment implications? Possible explanations are discussed below. Investment implications are discussed in the following subsection.

A clue to the monthly behavior of the size premium may be found in the tax laws. January is the first month of the fiscal year in all countries listed in Table 4 except for the United Kingdom where April is the first month of the fiscal year. The seasonal behavior of the size premium may be partly

TABLE 4

INTERNATIONAL EVIDENCE OF SEASONALITY IN THE SIZE PREMIUM[1]

UNTRY	BELGIUM	FINLAND	FRANCE	JAPAN	U.K.
st period	1969-1983	1970-1983	1968-1980	1966-1983	1958-1982
mber of securities[2]	170	40	201	First section TSE	All LSE
mber of size portfolios	5	5	5	5	10
rket value largest portfolio / rket value smallest portfolio	188	113	83	25	182
nuary return on[3]:					
Smallest portfolio	5.4%	5.9%	3.7%	8.3%	2.3%
Largest portfolio	3.0%	2.5%	4.4%	2.2%	3.6%
nuary size-premium[4]	2.4%	3.4%	-0.7%	6.1%	-1.3%
st-of-the-year return on[5]:					
Smallest portfolio	0.8%	1.8%	1.4%	1.5%	1.2%
Largest portfolio	0.4%	1.0%	0.7%	0.8%	0.7%
st-of-the-year size-premium	0.4%	0.8%	0.7%	0.7%	0.5%

Sources: Belgium: Hawawini et al. (1988); Finland: Berglund (1985); France: Hamon (1986); Japan: Nakamura and Terada (1984); and U.K.: Levis (1985). Note that except for the case of Finland, the sources used in Table 4 are the same as those used in Table 3.

TSE = Tokyo Stock Exchange; NYSE = New York Stock Exchange.

All monthly mean returns are significantly different from zero.

The January size-premium is significantly different from zero only in Belgium, Finland and Japan.

Monthly mean returns are not significantly different from zero for the largest portfolios.

tax-induced. According to this hypothesis, investors can reduce their taxes by selling the stocks on which they lost money during the year. In doing so they realize capital losses that are deductible from their taxable income. The sale of securities at the end of the fiscal year depresses their prices which recover at the beginning of the next fiscal year as stocks move back to their equilibrium value. Because small-firm stocks are more volatile than large-firm stocks they are more likely to be candidates for year-end tax-selling and hence the observed January size-premium in Belgium, Finland and Japan and the April size-premium in the United Kingdom. The evidence is, however, far from conclusive. Indeed, no January size premium is reported in France, a country that taxes capital gains. But a January size premium is reported in Japan, a country that does not tax capital gains. Of course, the January size premium in Japan may be induced by foreign investors who pay capital gain taxes in their country. A piece of evidence in favor of the tax-induced hypothesis is that no seasonality was detected in the United Kingdom prior to the introduction of capital gains taxes in this country in April 1965.[27] After that date seasonality appeared both in January and April. The April seasonal is consistent with the tax-induced hypothesis. What about the January seasonal? Well, it may be due to the trading activities of foreign investors. But, then, why did it appear after 1965? We don't know.

It is worth noting that in the United Kingdom, the size premium has been shown to be the largest during the month of May where it is equal to 2.45 percent (1.29 percent for the smallest portfolio minus -1.16 percent for the largest portfolio). This represents an annualized return of almost 30 percent. Interestingly, there is an old British maxim that says "sell in May and go away." Obviously the maxim applies to large rather than small firms.[28]

6.2 Implications for Investment Management

First note that the fact that we may be able to explain the size premium (tax-induced hypothesis, for example) does not justify it persistence in the data. If investors know that there is a January size premium in Belgium or Japan why don't they take advantage of it by simply buying small firms in December and reselling them in January? Obviously, if they did, the January size premium would eventually disappear. Possible reasons for its continued presence are that transactions costs may be prohibitive and the fact that the January size premium is observed on average. There are years when the premium is actually negative. Hence any strategy which seeks to exploit the January effect is not riskless and, as pointed out in the previous section, should be a long-term strategy. That is, investors must buy small firms in December, sell them in January (when exactly?) and do so for several years with the hope that their investment would not be wiped out as a result of a significant unexpected negative January risk premium during a particular year.

Consider the following investment strategy. At the end of every year rank a sample of securities in decreasing order of their market value. Hold either the largest or the smallest quintile portfolio only during the month of January. What would have been your realized average monthly return if you repeated this strategy for 31 years on the Tokyo Stock Exchange (from January 1955 to December 1985) and for 15 years on the Brussels Bourse (from January 1969 to December 1983)?

The average January return would have been 7.21 percent on the Japanese small portfolio compared to 3.35 percent on the large portfolio. And the average January return would have been 5.35 percent on the Belgian small portfolio compared to 3.04 percent on the large portfolio. Clearly, holding the small-portfolio only during the month of January yields a higher average return. This conclusion is not altered if we adjust portfolio returns to account for the higher market risk of the Japanese small-portfolio. In Belgium no adjustment is necessary since the two size portfolios have the same average market risk (see Table 3). The superior performance of the small portfolio, however, will be reduced by the transaction costs generated by the repeated buying and selling of small-firm securities.

We will now show that there is a higher risk, higher reward strategy. Rank the securities in the largest and smallest quintile portfolios by the magnitude of their market risk and construct four subportfolios of approximately the same size but with different levels of market risk. The results are shown in Table 5. The strategy that consists of holding the portfolio containing firms that are both small and risky would outperform all other risk- and size-related strategies and particularly so during January. The Japanese small-size, high-risk portfolio (value = 5,406 million Yens; beta = 1.97) would have achieved an average January return of 12.40 percent (almost 150 percent on an annual basis). The average January return on the corresponding Belgian portfolio (value = 33.5 million Francs; beta = 2.42) would have been equal to 10.31 percent (almost 125 percent on an annual basis). It should be emphasized that not all of these average returns are 'abnormal'. They reflect in large part the reward that compensates high-risk investment strategies.

TABLE 5

RISK AND RETURN CHARACTERISTICS OF THE LARGEST AND SMALLEST SIZE PORTFOLIOS WHICH HAVE BEEN PARTIONED INTO FOUR SUBPORTFOLIOS RANKED BY DECREASING MAGNITUDE OF THEIR RISK (BETA COEFFICIENT) IN JAPAN AND BELGIUM.[1]

JAPAN: Jan. 1955 - Dec. 1985

AVERAGE PORTFOLIO SIZE (IN MILLIONS)	SUBPORTFOLIOS RANKED BY RISK		AVERAGE MONTHLY RETURN[3]	
	RISK(BETA)[2]	SIZE	ALL YEAR	JANUARY
¥164,716[4] LARGEST QUINTILE	1.44	¥158,275	1.29%	6.20%
	0.89	¥179,708	0.77%	3.33%
	0.57	¥160,110	0.61%	2.74%
	0.21	¥160,772	0.69%	1.14%
¥4942 SMALLEST QUINTILE	1.97	¥5,406	2.02%	12.40%
	1.37	¥4,776	1.34%	8.16%
	0.97	¥4,710	1.35%	5.75%
	0.43	¥4,876	1.42%	2.51%

BELGIUM: Jan. 1969 - Dec. 1983

AVERAGE PORTFOLIO SIZE (IN MILLIONS)	SUBPORTFOLIOS RANKED BY RISK		AVERAGE MONTHLY RETURN[6]	
	RISK(BETA)[2]	SIZE	ALL YEAR	JANUARY
BF 6587[5] LARGEST QUINTILE	1.75	BF 5,985	0.82%	6.11%
	1.11	BF 6,049	0.77%	3.36%
	0.79	BF 8,278	0.38%	2.12%
	0.28	BF 6,036	0.61%	0.58%
BF 34.5 SMALLEST QUINTILE	2.42	BF 33.5	2.15%	10.31%
	1.19	BF 37.4	0.96%	5.77%
	0.64	BF 34.2	0.75%	3.58%
	-0.20	BF 32.8	0.81%	1.74%

1. <u>Sources</u>: For <u>Japan</u>: Hawawini (1988); for <u>Belgium</u>: Hawawini et al. (1988).
2. All beta coefficients are significantly different from zero at the .05 level.
3. All mean returns are significantly different from zero at the .05 level.
4. In millions of Japanese Yens.
5. In millions of Belgian Francs.
6. All mean values are significantly different from zero at the 0.05 level except for the all-year monthly return for the largest portfolio with a risk of 0.79.

7. A LOOK AT EQUITY PRICING IN LIGHT OF STOCK MARKET ANOMALIES

We have seen in Section 3 that the early tests of the CAPM indicated that the behavior of common stock returns was consistent with equity pricing according to this model. But if there exists a seasonal size premium in equity markets, early tests of the CAPM would not capture it. The relationship between average returns and market risk must be re-examined in light of the seasonal behavior of the size premium.

In this section we look at the evidence regarding the validity of the CAPM as a pricing model given the existence of a size effect and the presence of seasonality in the monthly returns of common stocks. We conclude that the evidence casts some doubt on the validity of this model.

The first test of the CAPM with an explicit recognition of size as an explanatory variable was performed using U.S. stock market data.[29] Average returns were found to be positively related to market risk and and negatively related to firm size. Later tests have shown that the relationship between average returns, market risk and firm size is unstable and seasonal.[30]

We now have evidence indicating that a similar pricing structure occurs in stock markets around the world. Some of this evidence is summarized in Table 6 for the equity markets of Canada, Europe and Japan. The tests are designed in the following manner: stocks are allocated to portfolios according to the magnitude of their market risk (Beta) <u>and</u> their year-end relative size (December 31st). Actual portfolios' returns are then calculated for every month of the year following the portfolio construction year. If the CAPM is a valid pricing model then portfolio returns must be, on average, positively and linearly related to portfolio market risk and <u>unrelated</u> to portfolio size. And this relationship should hold, on average, irrespective of the month of the year. The evidence in Table 6 is not consistent with this

TABLE 6

ESTIMATION OF AVERAGE RISK PREMIUM AND THE AVERAGE SIZE PREMIUM BASED ON THE RELATIONSHIP[1]:

$$[RETURN_P]_t = \gamma_0 + \gamma_1[BETA_P]_{t-k} + \gamma_2[SIZE_P]_{t-k}$$

Country and period over which the average premium is estimated	Average Risk Premium ($\bar{\gamma}_1$)	Average Size Premium[2] ($\bar{\gamma}_2$)
• BELGIUM (1/71 to 12/83)		
Average over all months of the year	-0.0020[3]	-0.0008
Average over Januaries only	0.0172	-0.0022
• CANADA (2/64 to 12/82)		
Average over all months of the year	0.0074	-0.0012
Average over Januaries only	0.0284	-0.0065
• FRANCE (1/71 to 12/83)		
Average over all months of the year	-0.0093	-0.0000
Average over Januaries only	0.0218	-0.0050
• JAPAN (1/57 to 12/85)		
Average over all months of the year	-0.0048	-0.0023
Average over Januaries only	0.0160	-0.0139
• SPAIN (1/78 to 12/82)		
Average over all months of the year	0.0061	-0.0165
Average over Januaries only	0.0630	-
• UNITED KINGDOM (1/57 to 12/83)		
Average over all months of the year	-0.0032	-0.0008
Average over Aprils only	0.0157	-0.0004
Average over Mays only	-0.0150	-0.0025
• UNITED STATES (1/59 to 12/82)		
Average over all months of the year	0.0073	-
Average over Januaries only	0.0529	-

1. Sources: Belgium: Hawawini et al. (1988); Canada: Calvet and Lefoll (1987); France: Hawawini and Viallet (1987); Japan: Hawawini (1988); Spain: Rubio (1986); United Kingdom: Corhay et al. (1987) and United States: Tinic and West (1984).

2. In the case of Spain the size variable is measured by the market value of firms. In the cases of the United Kingdom and Canada, the size variable is measured by the logarithm of the market value of firms. In all other cases, the size variable is measured by the ratio $(V_i - V_m)/V_m$, where V_i is the firm's market value and V_m is the average market value of all firms in the sample.

statement. In all countries except France and Japan there is no relationship, on average, between return and market risk when all months of the year are considered. Note that only framed numbers are significantly different from zero in a statistical sense. There is, however, a negative relationship between returns and portfolio size in all countries except Canada and France. Now if we turn to the average relationship between returns, market risk and size only during the month of January we find that in all countries except the United Kingdom, returns are, on average, positively related to market risk and negatively related to portfolio size. In the United Kingdom returns are, on average, positively related to market risk and negatively related to portfolio size only during the month of April. Recall that April is the first month of the fiscal year in the United Kingdom and January is the first month of the fiscal year in the other countries in the sample. Again, tax-induced trading may be responsible for this phenomenon. Note that these results are consistent with the findings summarized in Table 5 and discussed in the previous section. The estimated relationships reported in Table 6 provide, however, an explicit test of the CAPM as a linear one-factor asset pricing model.

What conclusion can be drawn from the evidence in Table 6? Clearly, the CAPM is not an adequate pricing model. As mentioned earlier, this may be due to poor estimation of market risk. But it is doubtful that "clean" betas, even if they could be obtained, would salvage the CAPM. Most likely, there are other yet unknown risk factors (beyond "clean" betas) that affect the returns of securities. One alternative to the CAPM would be a multifactor asset pricing model such as the APT with an explicit recognition of a number of common macro-economic factors that affect (explain) the return of securities. We have seen in Section 3 how such a model has been applied to Japanese common stocks with some success. Unfortunately, multifactor pricing models, like the CAPM, seem to exhibit both seasonality and a size effect.[31] At the time of this writing, there were no equilibrium pricing models that could satisfactorily explain these two phenomena.

8. SOME GLOBAL INVESTMENT STRATEGY THAT EXPLOIT STOCK MARKET ANOMALIES

Can U.S. investors exploit the anomalous price behavior observed in foreign stock markets in order to enhance the return on their portfolio without significantly increasing their portfolio's risk? In this section we present some preliminary results which indicate that the anomalous behavior of U.S. and foreign stock prices may provide an opportunity for U.S. investors to improve their portfolio performance. We provide tentative answers to two specific questions. First, can U.S. investors exploit the January size premium observed in foreign stock markets? Second, can U.S. investors exploit the size effect in order to increase their potential gains from international diversification?

8.1 A Strategy That Captures the January Size Premium on the Tokyo Stock Exchange (TSE)

The evidence surveyed in the preceding sections showed the presence of a size effect on the TSE. We have also seen that the size premium on the TSE is significantly larger in January than during the rest of the year. What can a U.S. investor do to exploit this phenomenon? The investor can purchase and hold a portfolio of small Japanese firms instead of a broad portfolio of Japanese firms. What would have been the risk and return characteristics of the investor's portfolio over the 10-year period from January 1975 to December 1984 after translating all returns into U.S. dollars? A look at Table 7 indicates that the annual return on a value-weighted portfolio of the smallest

TABLE 7

A STRATEGY FOR U.S. INVESTORS TO EXPLOIT THE JANUARY SIZE PREMIUM ON THE TOKYO STOCK EXCHANGE (TSE)

INVESTMENT STRATEGIES[1]	10-YEAR AVERAGE ANNUAL RETURNS (1975-1984) Arithmetic Mean	Geometric Mean	RISK Standard Deviation[5]
$TSE(all year)[2]	18%	17%	18%
$TSE/S(all year)[3]	28%	22%	38%
$TSE/S(January)$TSE(Rest-of-the-year)[4]	22%	21%	14%

1. The returns and risk characteristics of the alternative investment strategies were computed using returns compiled by Hamao (1986a).

2. U.S. dollar-adjusted return on a value-weighted index of all shares traded on the First Section of the Tokyo Stock Exchange ($TSE) if held all year.

3. U.S. dollar-adjusted return on a value-weighted index of the smallest quintile of all shares traded on the First Section of the Tokyo Stock Exchange ($TSE/S) if held all year.

4. $TSE/S held in January and $TSE held from February to December.

5. The standard deviation of returns is calculated as follows:

$$\sqrt{\sum_{t=1}^{10} (\text{Return}_t - \text{Arithmetic Mean Return})^2/10}$$

quintile of all shares traded on the First Section of the TSE would have been, on average, significantly larger than the annual return on a value-weighted portfolio of all shares traded on the First Section of the TSE: 28 percent instead of 18 percent when average returns are measured with an arithmetic mean. But the total risk of the small portfolio (measured by the standard deviation of annual returns)[32] would have been significantly higher: 38 percent instead of 18 percent. Recall that the risk and return of the portfolios listed in Table 7 include the effect of changes in the U.S. dollar-Yen exchange rate over the 10-year period. That is, they also reflect currency risk and return. Holding the small-firm portfolio increases average return but it also increases total risk.

There is an alternative strategy that may increase average return without increasing total risk. Consider the following: Since the size premium is significantly larger during January, why not hold the small-firm portfolio during January and then switch to the broad portfolio during the rest of the year? This strategy should allow investors to take full advantage of the January size premium. What would have been this strategy's risk-reward trade-off for a U.S. investor over the 10-year period from January 1975 to December 1984? A look at Table 7 indicates that the average (arithmetic) annual return would have been 22 percent and the risk 14 percent. Compared to holding the broad portfolio during the twelve months of the year, the switching strategy enhanced average returns by 4 percentage points and simultaneously <u>reduces</u> risk by 4 percentage points. Clearly, the switching strategy dominates the broad investment strategy irrespective of investors' tolerance for risk. Transaction costs, however, will reduce the average premium earned by the switching strategy. Furthermore, we did not test the alternative strategies over a sufficiently long period of time and for other stock exchanges to allow us to draw definitive conclusions. But these preliminary results are of sufficient interest to justify further investigation of the potential for portfolio improvement offered by anomalies in the returns of foreign stocks.

8.2 The Size Effect and International Diversification

The lower the correlation coefficient between the returns of two assets, the smaller the total risk (standard deviation of returns) of a portfolio containing the two assets. Since a change in the magnitude of the correlation coefficient does not affect the portfolio's average return, it follows that a lower correlation means less portfolio risk without a reduction in portfolio average return. Everything else the same, the lower the correlation coefficient between the returns of two assets, the higher the gains from diversifying one's wealth between these two assets.

Suppose that one of the two assets is a portfolio of U.S. stocks and the other is either a portfolio of U.K. stocks or a portfolio of Japanese stocks. In Table 8 we report the structure of cross correlation coefficients between the U.S. and U.K. markets and the U.S. and Japanese markets for combinations of large and small portfolios. The upper part of Table 8 gives the correlation coefficients between U.S. and U.K. annual portfolio returns and the lower part gives the correlation coefficients between U.S. and Japanese annual portfolio returns for a 10-year period from January 1977 to December 1986. Recall that all returns have been translated into U.S. dollars.

The U.S. large portfolio is the Standard & Poors 500, the U.K. large portfolio is the Financial Times All-Share-Index and the Japanese large portfolio is the larger-half of the First Section of the TSE. The U.S. small portfolio is the smallest quintile of all shares traded on the NYSE and the

TABLE 8

OPPORTUNITIES FOR INTERNATIONAL DIVERSIFICATION ACROSS LARGE- AND SMALL-CAPITALIZATION PORTFOLIOS

(Structure of Cross Correlation Coefficients between the U.S. and the U.K. markets and the U.S. and Japanese markets based on 10 years of annual returns from 1977 to 1986)[1]

UNITED STATES VS. UNITED KINGDOM

	UNITED STATES		UNITED KINGDOM	
	Large Port.[2]	Small Port.[3]	Large Port.[4]	Small Port.[5]
U.S. Large Portfolio[2]	1.00			
U.S. Small Portfolio[3]	0.44	1.00		
U.K. Large Portfolio[4]	0.31	0.24	1.00	
U.K. Small Portfolio[5]	-0.32	0.08	0.83	1.00

UNITED STATES VS. JAPAN

	UNITED STATES		JAPAN	
	Large Port.[2]	Small Port.[3]	Large Port.[6]	Small Port.[7]
U.S. Large Portfolio[2]	1.00			
U.S. Small Portfolio[3]	0.44	1.00		
Japan Large Portfolio[6]	0.28	-0.38	1.00	
Japan Small Portfolio[7]	0.15	-0.12	0.81	1.00

1. Correlation coefficients are computed using returns compiled by Dimensional Fund Advisors, Inc. (1987)
2. U.S. Large Portfolio = Standard & Poors 500
3. U.S. Small Portfolio = NYSE and AMEX (American Stock Exchange) smallest quintile (bottom fifth)
4. U.K. Large Portfolio = Financial Times All Share Index (translated into U.S. dollars)
5. U.K. Small Portfolio = Smaller half of London Stock Exchange (translated into U.S. dollars)
6. Japan Large Portfolio = Larger half of First Section of the Tokyo Stock Exchange (translated into U.S. dollars)
7. Japan Small Portfolio = Smaller half of First Section of the Tokyo Stock Exchange (translated into U.S. dollars)

of all shares traded on the LSE and the Japanese small portfolio is the smaller-half of all shares traded on the First Section of the TSE.

A look at Table 8 allows us to make the following three observations.

(1) The highest correlations are between the returns of the large and small portfolios from the same country. The returns of large and small portfolios are highly correlated in the United Kingdom and Japan (.83 and .81, respectively) but less so in the United States (.44). This result may be due to the fact that the small portfolio in the United Kingdom and Japan is defined as the smallest half of all stocks whereas in the United States it is the smallest fifth of all stock.

(2) The correlation coefficient between the returns of the small portfolios of any two countries is lower than the correlation coefficient between the large portfolios of the same two countries. The correlation coefficient between the returns of the U.S. and the U.K. large portfolios is 0.31 but it is only 0.08 between the returns of the small portfolios. The correlation coefficient between the returns of the U.S. and the Japanese large portfolios is 0.28 but it is only -0.12 between the returns of the small portfolios. The fact that the correlation coefficient between the returns of the U.S. and the U.K. small portfolios and the U.S. and Japanese small-portfolios are lower than those between the large portfolios is not surprising. We would expect, on average, a higher interdependence between the level of activity of the largest firms in the United States, the United Kingdom and Japan than between the level of activity of the smallest firms in these countries. And the higher interdependence between the level of activity of the largest firms should be translated into higher correlation coefficients between their market rates of return.

The implication of the above is that the gains from international diversification across small portfolios should be higher than the gains from international diversification across large portfolios. This is illustrated in Table 9. Consider the case of the United States and Japan. A U.S. investor that invested one half of his wealth in each of the two countries' largest portfolios over the 10-year period from 1977 to 1986 would have realized a 21 percent average annual return with a risk (standard deviation of portfolio returns) of 18 percent. But an investment of one half of the U.S. investor's wealth in each one of the two countries' smallest portfolios over the same 10-year period would have yielded an average annual return of 27 percent with a risk of 19 percent. International diversification across the smallest portfolios provides, on average, 6 percentage points of additional return with an increase in risk of one percentage point.

Note that a similar diversification strategy with the United Kingdom would have not worked as well over the 10-year period from 1977 to 1984. The diversified small-portfolio realized 27 percent, a premium of 7 percentage points above the diversified large portfolio, but the risk of the diversified small-portfolio is significantly higher than the risk of the diversified large-portfolio (19 percent versus 15 percent).

(3) Finally, note that <u>some of the lowest correlation coefficients are between large and small portfolios of different countries</u>. The correlation coefficient between the U.S. large-portfolio returns and the U.K. small-portfolio returns is -0.32 and that between the Japanese large-portfolio returns and the U.S. small-portfolio returns is -0.38. These negative correlations indicate that there are also potential gains from international diversification between small and large portfolios of different countries.

TABLE 9

RISK AND RETURN CHARACTERISTICS OF ALTERNATIVE INTERNATIONAL DIVERSIFICATION STRATEGIES ACROSS LARGE AND SMALL PORTFOLIOS OVER THE PERIOD 1977 TO 1986 (ALL RETURNS TRANSLATED INTO U.S. DOLLARS)[1]

Alternative Investment Strategies[2]	Average Annual Return	Risk[3] (Standard Deviation)
(1) U.S. Large Portfolio	15%	14%
(2) Japan Large Portfolio	27%	30%
(3) ½(1) + ½(2)[4]	21%	18%
(4) U.S. Small Portfolio	23%	16%
(5) Japan Small Portfolio	31%	37%
(6) ½(4) + ½(5)	27%	19%
(1) U.S. Large Portfolio	15%	14%
(7) U.K. Large Portfolio	25%	23%
(8) ½(1) + ½(7)	20%	15%
(4) U.S. Small Portfolio	23%	16%
(9) U.K. Small Portfolio	31%	33%
(10) ½(4) + ½(9)	27%	19%

1. Average returns and risk are computed using raw returns compiled by Dimensional Fund Advisors, Inc. (1897).

2. See footnotes to Table 8 for the definition of large and small portfolio in the U.S., Japan and the U.K.

3. See footnote 5 to Table 7 for the definition of the standard deviation of returns.

4. The risk or standard deviation (SD) of the combination is calculated as follows:

$$SD(3) = \sqrt{(\tfrac{1}{2})^2(SD(1))^2 + (\tfrac{1}{2})^2(SD(2))^2 + 2(\tfrac{1}{2})^2 COR((1),(2)) \cdot SD(1) \cdot SD(2)}$$

where COR is the correlation coefficient reported in Table 8.

9. CONCLUDING REMARKS

In this chapter we examined the validity of the Efficient Market Hypothesis (EMH), the Capital Asset Pricing Model (CAPM) and the Arbitrage Pricing Theory. We surveyed a large number of studies that reported anomalous empirical regularities in common stock returns. These anomalies were shown to be at odds with the EMH and generally inconsistent with equity pricing according to the CAPM. Several investment strategies that attempt to exploit stock market anomalies were presented and tested with data from foreign markets.

What general conclusion can we draw from the material covered in this chapter? We believe that there is sufficient evidence to suggest that investment strategies which attempt to exploit stock market anomalies around the world can improve <u>global</u> portfolio performance. There are several reasons why anomaly-based investment strategies can enhance <u>global</u> portfolio returns with little or no incremental risk:

(1) We have seen that the correlation coefficients between the returns of small-firm portfolios from different countries are generally significantly lower than the correlation coefficients between the returns of large-firm portfolios. The implication is that the gains from international diversification across small-firm portfolios is higher than the gains from international diversification across large portfolios. Although we do not have the evidence to back it up, we suspect that the above phenomenon can be generalized to portfolios constructed on the basis of anomalies other than the small-firm effect. Our suspicion is based on the conjecture that the level of activity of firms whose securities display anomalous price behavior is more likely to be related to the domestic sector of the economy than to the international sector.

And the returns of firms in the domestic sectors are less likely to be correlated across countries than the returns of firms in the international sector.

(2) If the above is true it follows that there are opportunities to enhance global portfolio performance by uncovering foreign securities with anomalous price behavior. This could be done by searching for the presence of anomalies in foreign markets similar to those already uncovered in the united States (see Section 5.4). It is likely that stock market anomalies similar to those found in the United States do exist in foreign markets. We have seen that this is the case for the size anomaly as well as the seasonal behavior of stock market returns. There is no reason to believe that it will not be the case for other stock market anomalies uncovered in the United States.

Note that global investment strategies that attempt to exploit the presence of recurrent anomalous price behavior such as the size effect are more likely to succeed than global investment strategies that seek to exploit the presence, if any, of inefficient price adjustments to new information about foreign firms. In the latter case, foreign investors will be at a disadvantage vis-à-vis local investors who are expected to have access to greater, better and quicker information on firms traded in the local market. This will obviously give local investors an edge over foreign investors. Anomaly-based investment strategies, however, do not put foreign investors at a disadvantage vis-à-vis local investors because, in this case, continual and rapid access to new information about local firms is no longer necessary. What is required is to construct and hold a portfolio of firms that exhibit an anomalous price behavior. With anomaly-based investment strategies, foreign investors may even outperform local investors if they uncover a stock anomaly in a local market before the local investors realize it exists and attempt to exploit it.

Anomaly-based global investment strategies, however, present as many challenges as they do opportunities. Among these we can cite:

(1) High implementation and transaction costs. Uncovering firms whose securities exhibit anomalous price behavior, gathering and interpreting information about these firms and finally trading in them will generally result in higher than average implementation and transaction costs. Hence, anomaly-based investment strategies must be long-term, buy-and-hold strategies, that minimize portfolio turnover and transaction costs.

(2) Clients' resistance to adopt unconventional investment strategies. It may be difficult to convince a potential client to commit funds to an investment strategy that calls for global diversification of portfolios constructed on the basis of stock market anomalies. Particularly if such strategies have not been tested extensively. But then, if extensive tests were available, the opportunity would no longer be there. To cite a well-known portfolio manager,[33] "I can remember discussing market imperfections (as we called them then) with clients in the mid-70's, when investing in anything other than the Nifty Fifty was considered imprudent. Academic evidence would have helped more then . . . [but] inefficiencies cease to exist just where and when they are well documented to have been present."

(3) Last but not least, we should not forget that the notion of an anomaly is not absolute but relative. When we identify an anomalous price behavior it is always vis-à-vis what we defined as a "correct" price behavior. That is, a price behavior that is consistent with a pricing model such as

the CAPM or the APT. We call the size effect an anomaly because we are not capable of fully explaining this phenomenon with our current pricing models and their related concept of risk. Hence, the abnormal returns associated with small firms and other anomalies may disappear once their risk is properly defined and correctly measured. In other words, the fundamental question remains unanswered: is the extra return earned on anomaly-based investment strategies a "free lunch" or is it simply a fair compensation on a riskier investment?

FOOTNOTES

1. This distinction is suggested by West (1975).

2. The concept of informational efficiency is developed in Fama (1970) and Fama (1976).

3. On October 19, 1987, the Dow Jones Industrial Average (New York Stock Exchange) dropped by a historic 22.61 percent, its sharpest single-day fall on record. It would be tempting to interpret this break in stock prices as an irrefutable proof of the invalidity of the EMH in general and the Random Walk Model (RWM) in particular. The October 19, 1987 crash, however, does not necessarily contradict the RWM. According to this model there is a very small probability that extremely large price changes will occur. It happened on October 19, 1987. Prices dropped dramatically and then resumed their random variations around a much lower stock price level than that prevailing before the crash. This sequence of events is not inconsistent with the RWM.

4. The serial correlation coefficient between two sequences of returns measures the strength of the relationship between the two sequences. If the serial correlation is equal to zero, the two sequences of returns are unrelated, hence, one cannot predict tomorrow's price using the information contained in the sequence of past prices. If the serial correlation coefficient is either significantly positive or negative, in a statistical sense, then there is evidence that past behavior of stock price movements can be used successfully to predict tomorrow's stock return.

5. See Hawawini (1984) for a survey of the U.S. and European evidence. For some of the Asian evidence see Ang and Pohlman (1978), D'Ambrosio (1980) and Barnes (1985).

6. See Hawawini (1984) for a survey of the U.S. and European evidence.

7. See Hawawini (1984) for a survey of the U.S. and European evidence. Few tests of the semi-strong form of the EMH were performed with data from Asian markets. For the case of Hong Kong see Dawson (1984). For the case of the Kuala Lumpur Stock Exchange, see Dawson (1981).

8. See Jaffe (1974).

9. See Hawawini (1984).

10. See Keim (1986) and Hawawini and Banz (1987).

11. The CAPM was developed by Sharpe (1964).

12. Conceptual limitations were pointed out by Roll (1977) and empirical deficiencies were documented by Banz (1981).

13. The APT was developed by Ross (1976) and tested on U.S. data by Roll and

Japanese evidence see Hamao (1986b). The outcome of these studies are briefly described and discussed in Section 3.3 of this chapter.

14. Suppose that a security will return, over a given holding period, either 5 percent or 15 percent with an equal likelihood of occurrence. The security's expected return is 10 percent (one half of 5 percent plus one half of 15 percent). Its total risk is measured by the variance of its returns as follows:

$$\text{TOTAL RISK} = \tfrac{1}{2}\,(.05 - .10)^2 + \tfrac{1}{2}(.15 - .10)^2 = .0025 = .25 \text{ percent}.$$

It is the weighted sum of the squared deviation of each outcome from their expected value where the weights are the likelihood of occurrence.

15. This test was performed by Fama and MacBeth (1973).

16. For the Canadian evidence see Calvet and Lefoll (1986). For the U.K. and German evidence, see Guy (1976) and Guy (1977), respectively. For the French and the Belgian evidence see Hawawini et al. (1983) and Hawawini et al. (1982), respectively. For the Spanish evidence see Palacios (1973). For the Japanese evidence see Lau et al. (1975) and for the Thai evidence see Sareewiwatthana and Malone (1985).

17. For France see Dumontier (1986); for Germany see Winkelmann (1984) and for the United Kingdom see Beenstock and Chan (1983) and (1984).

18. For the U.S. evidence see Chen et al. (1986) and for the Japanese evidence see Hamao (1986b).

19. See Lakonishok and Levi (1982).

20. See Theobald and Price (1984).

21. See Keim (1983) and Bauer and Wirick (1986).

22. See Hawawini (1983).

23. See Amihud and Mendelson (1986).

24. See Basu (1977).

25. See Banz and Breen (1986).

26. See, respectively, Stattman (1980), Arbel and Strebel (1982), Barry and Brown (1984) and Keim (1985).

27. See Reinganum and Shapiro (1987).

28. See Levis (1985).

29. See Banz (1987).

30. See Tinic and West (1984) and (1986).

31. See Gultekin and Gultekin (1987).

32. The standard deviation of returns is the square root of the variance of returns. See footnote 14 and the notes at the bottom of Table 7.

33. See LeBaron (1983).

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