OECD Economic **Studies** No. **20,** Spring **1993**

THE STOCK MARKET AND INVESTMENT

Warren Tease

CONTENTS

The author is Senior Economist (Business Finance) in the Economic Analysis Department of the Reserve Bank of Australia. This paper was prepared while he was an administrator in the Money and Finance Division of the OECD. He would like to thank Paul Atkinson, John P. Martin, Giuseppe Nicoletti, Paul Francis O'Brien, Jeffrey Shafer, Hiromichi Shirakawa and Peter Sturrn for thoughtful comments on an earlier drafl of the paper. Efficient statistical assistance was provided by Laure Meuro and secretarial assistance by Andrea Prowse. Any remaining errors rest with the author.

INTRODUCTION

The stock market has an important role in the allocation of resources, both directly as a source of funds and as a determinant of firms' value and borrowing capacity. However, a growing body of empirical evidence has raised some doubts about whether equity markets are efficient in the sense of appropriately reflecting relevant and available information.[1] The large swings in equity prices in several countries during the 1980s provided additional evidence that market valuations were more variable than the earnings prospects of firms. These episodes encouraged proposals for reforms aimed at limiting volatility,[2] because excess volatility or mispricing could have undesirable real consequences and lead to a misallocation of resources.

The aim of this paper is to examine the relationship between equity prices and business investment, addressing the question of whether investment is influenced by inefficient pricing in equity markets. It considers: whether share prices influence investment once some of the important macroeconomic determinants of investment are controlled for; whether estimates of the deviation of share prices from their estimated equilibrium values affect investment; and the behaviour of investment and share prices in periods when share prices appear to have deviated widely from fundamentals. The results suggest that, while there is a significant relationship between share prices and business investment in some countries (the United States, Japan, the United Kingdom and Canada), this largely reflects stock price correlation with, and anticipation of, other macroeconomic developments. This suggests that pricing inefficiencies, to the extent they are present, do not have a statistically or economically significant influence on business investment.

There are a number of important caveats to bear in mind when considering the analysis attempted in this paper. First, tests of stock market efficiency are joint tests of efficiency and a model generating expected returns. Hence, the empirical evidence presented in Section I and elsewhere cannot be used to reject the efficiency hypothesis ***per se.*** Still, the accumulating weight of evidence suggests that economic policy should not take efficiency for granted. Second, some of the tests presented in Section II require estimates of the deviation of actual share prices from those that would be found in an efficient market. Efficient market prices are not observable and must be controlled for or proxied in some way. Therefore, a finding that deviations from these estimated efficient prices affect investment may be due solely to an estimate of the equilibrium price that omits the effects of certain important factors. Hence, these tests will be biased towards finding that inefficient pricing in equity markets does affect investment. Even with this bias, however, the results presented later do not strongly support such a finding.

The paper is structured as follows. Section I examines the evidence on whether equity markets price efficiently. The relationship between investment and stock prices is then considered in Section II. Conclusions are provided in Section III.

I. THE BEHAVIOUR OF EQUITY PRICES

The efficient markets hypothesis states that security prices should fully reflect all available, relevant information. If this is the case then deviations of actual returns from expected returns should be random – they ought, on average, to be zero and uncorrelated with information available to the market. To test whether prices satisfy these conditions it is necessary to specify a model of the behaviour of expected returns and to compare this with their actual performance. For this reason, tests of market efficiency are joint tests of the efficiency hypothesis and the assumed model of expected returns.[3]

The most straightforward way to test efficiency is to assume that the expected rate of return is constant. If this is the case, then changes in share prices should not be serially correlated since the past history of share prices is the most readily available piece of information in the market and any information in this history should already be embedded in the current price. Price changes should only reflect new information becoming available. Over short horizons (daily and weekly returns for example) this appears to be the case (Fama, 1970). However, price changes in some markets have been found to be serially correlated over longer horizons. A common feature of this finding is that low-order price autocorrelations are positive but become negative over longer lags. Fama and French (1988) identified such behaviour in stock prices in the United States. This type of behaviour is also apparent in other countries (Poterba and Summers, 1988). Figure 3 contains the correlogram of quarterly changes in stock prices in the major seven OECD countries. This pattern, positive correlation at short horizons and negative correlation at longer horizons, seems to occur in a number of countries. In most cases, the hypothesis that the price changes are not serially correlated can be rejected {Table 1). Cutler *et al.* (1990*a*) show that this type of pattern is not confined to stock markets. It appears in a wide range of asset markets across a number of countries.

This joint hypothesis also implies that price changes should not be predictable using other readily available information. Recent evidence shows that this may not be the case. Simple measures of the deviation of the existing price from an estimate of the equilibrium price seem to predict future price movements. Cutler *et al.* (1990*a*) show that the gap between a constant multiple of real dividends {their proxy for fundamental influence on stock prices) and the current stock price helps predict future changes in stock prices. The coefficient on this term tends to be positive, indicating that when current prices are below the estimates of fundamentals, prices are more likely to rise than to fall subsequently. This behaviour is also apparent, though to a lesser extent, in other asset markets.

It has been suggested that these patterns indicate that the speculative behaviour of market participants may drive prices away from equilibrium in the short run (hence the positive serial correlation) but that over time prices slowly revert to equilibrium

Table 1. **Value of Q statistics**

United States	25.24*
Japan	26.76**
Germany	34.69**
Ffance	8.92
Italy	32.89**
United Kingdom	20.94
Canada	20.67

*(**) Significant at the ten (one) per cent level.

$$Q = \sum_{i=1}^{12} a_i^2 * N$$

N = number of observations

a_i = sample autocorrelations of lag i = 1 12

Q is distributed as a chi-squared variable with 12 degrees of freedom.

Note: The Q statistic tests whether the expected value of successive price changes are independent of all previous changes (for an application see Dooley and Shafer, 1983). The critical value for Q indicates the probability of rejecting this hypothesis. A rejection implies that there is autocorrelation.

Sample period: 1960:1-1991:4: United States, Germany, Italy, Canada.
1961:4-1991:4: Japan.
1963:4-1991:4: France.
1962:1-1991:4: United Kingdom.

Sources: See Figure 1.

(hence the negative serial correlation at long horizons). Such patterns can be derived from models in which some traders (sometimes called noise or feedback traders) base their demand for assets on past price movements rather than the expected future income streams (see Cutler *et al.,* 1990*a* and De Long et *al.,* 1990). A recent survey of traders in the foreign exchange market would seem to confirm that trading decisions are based on the past behaviour of prices. At least 90 per cent of those surveyed placed some weight on analysis of past trends in prices when making trading decisions, particularly in the short run (Taylor and Allen, 1992).

While these patterns do not fit the predictions of the simple efficiency hypothesis, they do not necessarily imply that the behaviour of traders is irrational particularly when market participants have short horizons (Froot et *al.,* 1992). In a market with both rational speculators[4] and feedback traders it may be optimal for the former to anticipate the behaviour of the latter – buying when they expect some future buying by feedback traders (De Long et *al.,* 1990). Thus, even informed investors could act to drive prices away from fundamentals. One of the more important findings in this theoretical literature is that rational speculation need not ensure that prices reflect fundamentals in the short run. Even though the expected return to arbitraging away mispricing (buying underpriced stocks, for example) may be positive, it is not riskless. If the risk is sufficiently large, then the mispricing will not be quickly eliminated.

The results in Table 2 add additional support to the view that speculative dynamics may drive share prices away from their equilibrium in the short run but that prices gradually revert to equilibrium over time. Table 2 reports the results of estimating an unrestricted error correction model of the form.[5]

Table 2. **Tests of a return to fundamentals in share prices**

	United States	Japan	Germany	France	Italy	United Kingdom	Canada
S (−1)	-0.111	-0.062	–0.046	–0.099	-0.080’	-0.206	-0.102
	(0.003)**	(0.017)**	(0.030)	(0.047)’	(0.020)**	(0.056)”	(0.035)”
i (−1)	-0.010	-0.021	-0.005	-0.010	-0.005	-0.031	-0.004
	(0.004)**	(0.006)**	(0.005)	(0.009)	(0.004)	(0.007)**	(0.005)
PY (−1)	0.101	0.054	0.038	0.087	0.042	0.223	0.070
	(0.030)**	(0.021)”	(0.019)*	(0.047)*	(0.016)”	(0.056)**	(0.024)**
AS (−1)	0.218	0.382	0.204	-0.101	0.350	0.270	0.195
	(0.098)’	(0.101)**	(0.103)‘	(0.137)	(0.105)”	(0.084)**	(0.079)*
AS (−2)	–0.033	–0.199	-0.138	-0.064	0.073	-0.128	0.111
	(0.092)	(0.108)’	(0.088)	(0.099)	(0.086)	(0.099)	(0.087)
AS (−3)	-0.026	0.109	-0.111	-0.019	0.027	0.160	-0.109
	(0.093)	(0.125)	(0.092)	(0.132)	(0.093)	(0.088)’	(0.090)
ΔS (−4)	0.112	0.013	0.087	0.047	0.143	-0.070	0.127
	(0.075)	(0.096)	(0.076)	(0.085)	(0.075)’	(0.084)	(0.092)
Ai	-0.023	-0.054	-0.029	-0.026	-0.030	-0.051	-0.016
	(0.009)”	(0.010)**	(0.019)	(0.025)	(0.018)	(0.009)**	(0.016)
Ai (−1)	-0.017	-0.004	-0.007	-0.048	0.017	0.010	-0.022
	(0.012)	(0.012)	(0.023)	(0.026)*	(0.011)	(0.010)	(0.013)’
Ai (−2)	-0.008	0.003	-0.023	-0.008	0.011	0.003	-0.008
	(0.014)	(0.010)	(0.016)	(0.020)	(0.011)	(0.008)	(0.012)
Ai (−3)	0.017	0.007	0.003	-0.004	-0.015	0.012	0.011
	(0.010)*	(0.011)	(0.015)	(0.020)	(0.013)	(0.009)	(0.011)
Ai (-4)	0.000	-0.004	–0.028	–0.044	–0.019	-0.003	-0.008
	(0.010)	(0.009)	(0.016)*	(0.024)’	(0.010)*	(0.010)	(0.011)
APY	0.688	0.476	1.463	-0.287	-0.042	-0.068	0.722
	(0.529)	(0.553)	(0.421)**	(0.386)	(0.527)	(0.377)	(0.540)
APY (−1)	-0.418	-0.685	0.349	0.003	-0.424	-0.308	-0.595
	(0.528)	(0.476)	(0.418)	(0.457)	(0.540)	(0.610)	(0.638)
APY (−2)	-0.629	0.067	–1.317	0.386	-0.873	0.384	-0.394
	(0.554)	(0.441)	(0.418)”	(0.619)	(0.466)	(0.586)	(0.583)
APY (−3)	-0.916	0.089	-0.312	-0.549	-0.175	0.838	0.230
	(0.514)’	(0.502)	(0.567)	(0.743)	(0.525)	(0.533)	(0.615)
APY (-4)	–1.045	0.230	-0.980	-0.654	-0.084	-0.248	-0.805
	(0.515)’	(0.443)	(0.429)’	(0.548)	(0.625)	(0.529)	(0.568)
α	–2.756	–1.634	–1.030	–2.370	–1.309	–5.583	–1.805
	(0.829)”	(0.678)*	(0.524)’	(I.280)*	(0.477)**	(1.41)**	(0.616)**
S.E.E.	0.056	0.058	0.065	0.111	0.090	0.072	0.065
DW	2.0	1.98	1.95	2.05	1.924	2.02	2.03
$\bar{R}^2$	0.231	0.158	0.22	0.09	0.24	0.37	0.16

*(**) Significantly different from zero at the ten (one) per cent level
Refer to equation [1] in the text.
Sources: Share prices: see Figure 1. Nominal GNP: OECD National Accounts. Long-term interest rates – OECD (except for Japan): United States: 10-year government **bonds;** Japan: government **bonds,** benchmark 119th; Germany: **7-15** year public sector bonds; France: public and semi-public sector bonds; Italy: treasury bonds; United Kingdom: 10-year government bonds; Canada: over 10 years Federal government bonds.

$$\Delta S_t = \alpha + \sum_{i=1}^{4} \Phi_i \Delta S_{t-i} + \sum_{j=0}^{4} \psi_j \Delta PY_{t-j} + \sum_{j=0}^{4} \rho_j \Delta i_{t-j} \quad [1]$$

$$+ AS_{t-1} + BPY_{t-1} + Ci_{t-1} + \xi_t$$

where: S_t = log of share prices
PY = log of nominal GDP
i = nominal 10-year bond rate

The specification assumes that, in the long run, share prices will reflect the present value of expected nominal income flows – nominal GDP and the nominal 10-year bond rate are used as estimates of the income stream and discount factor respectively.[6] The short-run dynamics of share prices are assumed to be related to changes in nominal GDP, changes in the bond rate and changes in share prices themselves, If movements in share prices are characterised by speculative dynamics in the short run and a gradual return to equilibrium over time, one would expect to find that the lagged change in share prices had a positive and significant coefficient (capturing speculative dynamics) and that the error correction term (A) would be negative and significant (indicating a reversion to equilibrium). The error correction term does appear to be significant and of the right sign in most cases (Germany is the exception) and, in all cases, the long run coefficients on GDP and the bond rate have the expected sign. Furthermore, the first lag of the change in share prices was positive and significant in most cases. These results are consistent with those reported in Cutler *et al.* (1990*a*) which show that the gap between the actual and estimated equilibrium price seems to predict future movements in share prices.

Others have argued that the patterns evident in Figure 3 do not indicate inefficiency in stock markets. Rather, they may simply show that expected returns vary over time (Fama and French, 1988, and Fama, 1991). Thus, it is the assumed behaviour of expected returns, rather than the efficiency hypothesis that is violated. However, Cutler *et al.* (1990*a*) argue that time-varying expected returns are unlikely to account for this behaviour because it can be found across asset markets and across countries. Since the returns on the assets they considered were only weakly correlated they argue that it is unlikely that a common factor accounted for the common dynamics in the returns and conclude that it arises from the speculative process itself.

Evidence taken directly from surveys of market participants provides informal support for this view. Shiller (1987) surveyed investors soon after the stock market crash of 1987. Most thought that the decline was driven by investor psychology rather than by new information on fundamentals such as profits or interest rates. The subsequent increase of the equity prices in the United States would suggest that this was the case. Also, Seyhun (1990) examined the behaviour of corporate insiders following the 1987 crash. Corporate insiders bought shares in their own firm in record numbers immediately following the crash, believing that the profitability of their firm had not changed and thus that its shares were underpriced. This was confirmed by subsequent price changes. Those shares that were purchased more intensively by insiders tended to show the highest post-crash returns.

In sum, the question of whether stock markets are efficient and whether prices reflect the expected profitability of firms remains open. It is clear that simple models which assume constant expected returns do not explain the behaviour of share prices.

It is not clear, however, whether this is due to market inefficiencies that result in prices being driven away from their equilibrium or whether it is due to the variation in expected returns over time. Indeed, recent, extensive surveys of the literature draw different conclusions from the available evidence – with Scott (1991) suggesting that the evidence reveals that share prices deviate from fundamental values and Fama (1991) emphasising the joint nature of the hypothesis and leaning towards an explanation that incorporates variation in returns. Reflecting these differences in interpretation, Lehman (1991) concludes that belief in the efficient markets model is "destined to remain a largely theological question".'

II. INVESTMENT AND SHARE PRICES

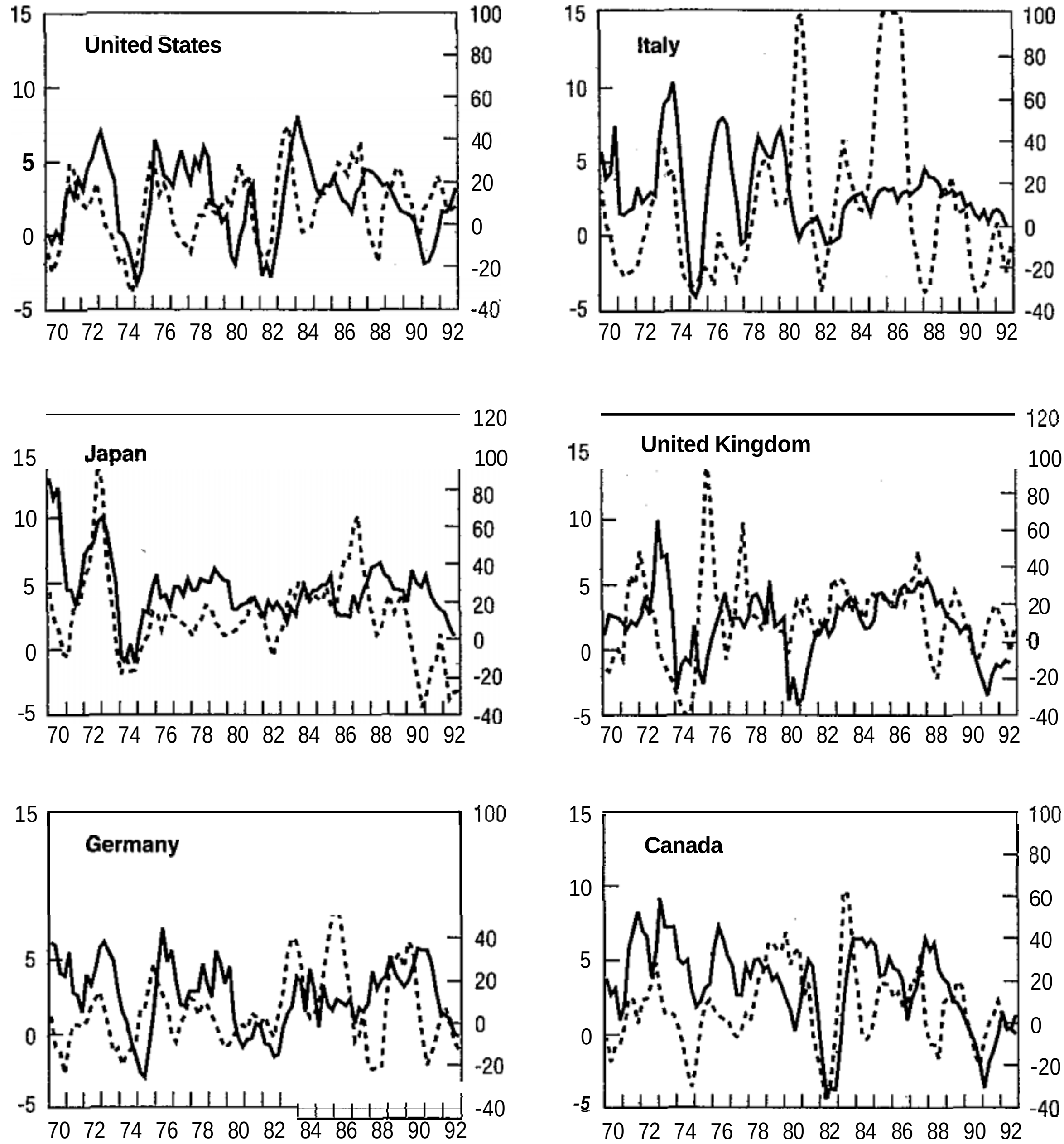
Evidence suggesting that market-driven phenomena can influence share prices in the short term coupled with the large fluctuations in share prices during the 1980s have led some to argue that various rules or "circuit breakers" should be placed on markets to limit their volatility. Implicit in these arguments is the view that inefficiencies in equity markets can lead to a misallocation of resources. The following section will attempt to shed some light on this issue by examining the relationship between share prices and business investment.

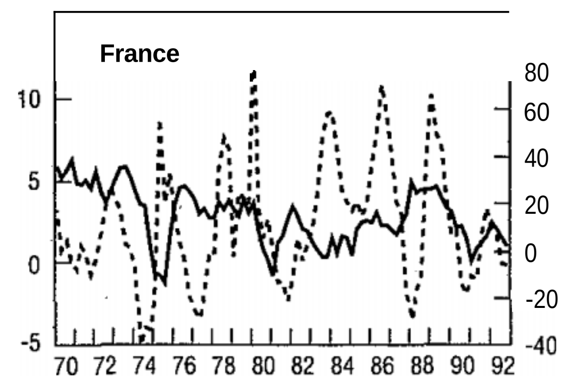
A. Theoretical considerations

There are a number of reasons to believe that share prices may influence investment. Theoretically, stock market valuation plays a key role in Q-type models of investment determination. When the market value of an additional unit of capital exceeds its replacement cost a firm can raise its profit by investing. A link between investment and share prices could also arise if there are information asymmetries in financial markets. A rise in share prices will improve the balance sheet position of a firm, increasing its ability to directly fund projects or to provide collateral for external finance. In either case, the risk that lenders face is reduced, thus reducing the cost and/or increasing the availability of external funding (Bernanke and Gertler, 1986). The importance of the link between balance sheet positions and the real economy can be seen in the sluggish recovery in many OECD countries from the downturn of late 1990/early 1991. The corporate sectors' desire to improve weak balance sheet positions has been an important constraint on business investment. Another recent constraint on investment, which is partly linked to stock prices, has been the availability of bank lending. Falling stock prices, particularly in Japan, may have limited the banking systems' capacity to extend new loans (see O'Brien and Browne, 1992 for a discussion of the recent behaviour of credit).

Empirically, share prices seem to provide useful leading information about investment and the economy more generally (Figures 1, 2, and Table 3). The impression

Figure 1. Real GDP and stock prices growth
Growth year on year

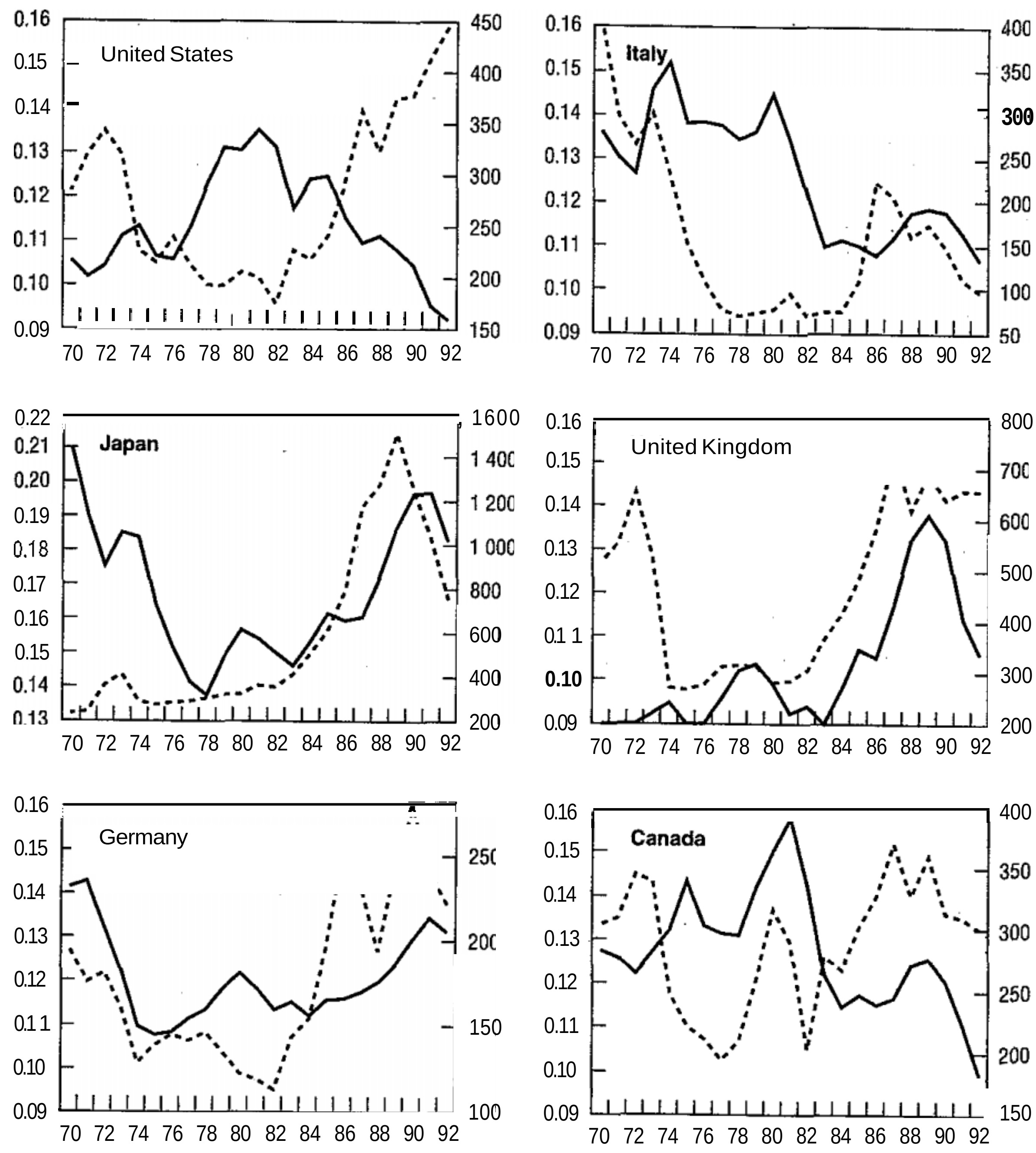


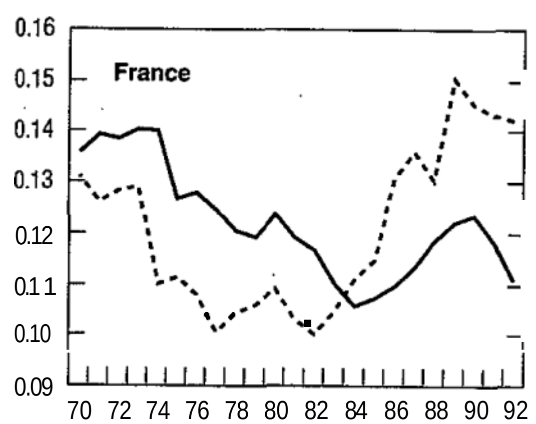


Real GDP growth (left scale)
Stock prices growth (right scale)

Sources: Stock prices: United States: Standard and Poor; Japan: Tokyo Stock Exchange; Germany and France: Industrials; Italy: Milan Stock Exchange; United Kingdom: F.T. actuaries; Canada: Toronto Stock Exchange.
Real GDP: OECD National Accounts.

Figure 2. Stock prices and investment1





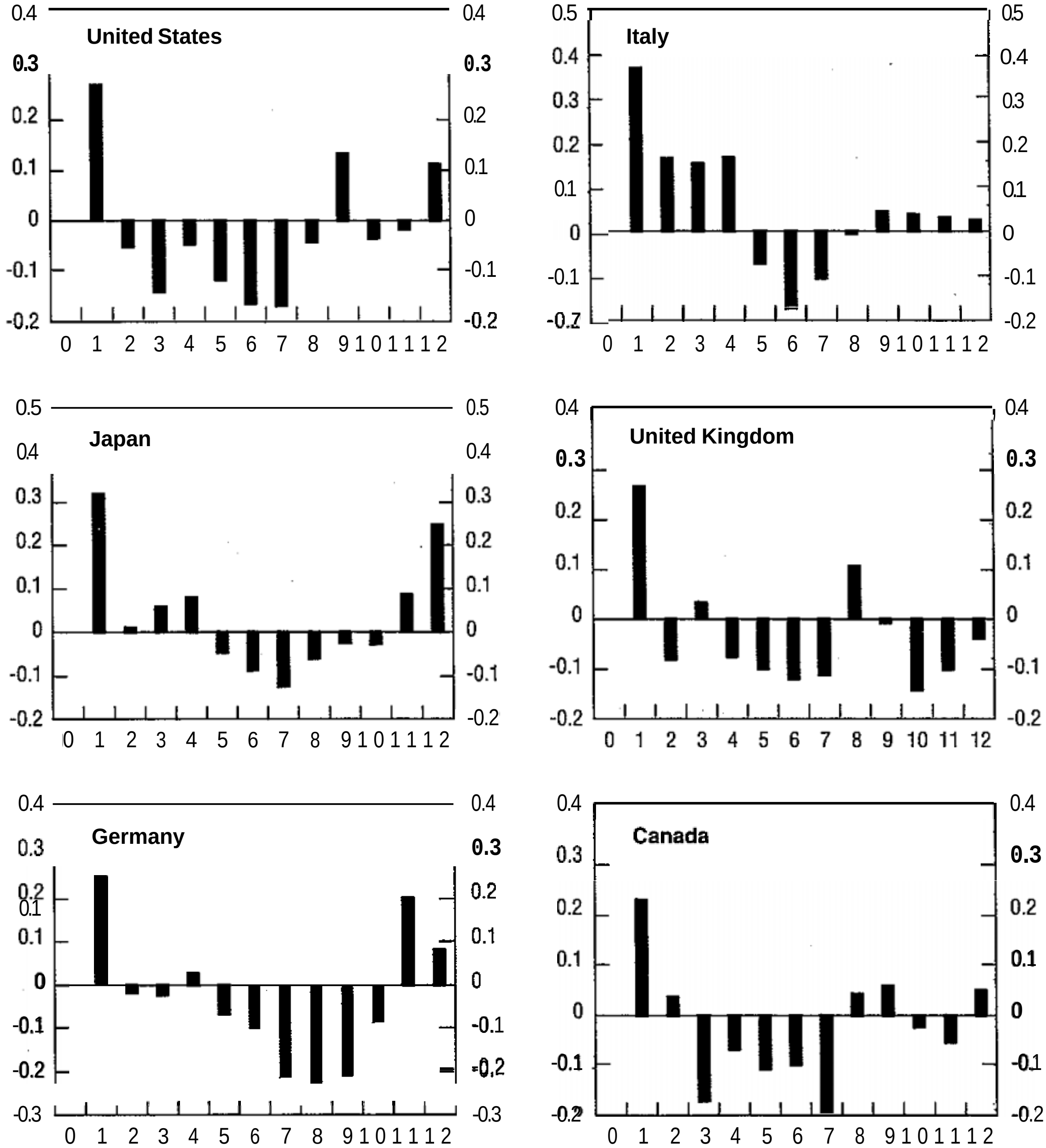
Business fixed investment (left scale)

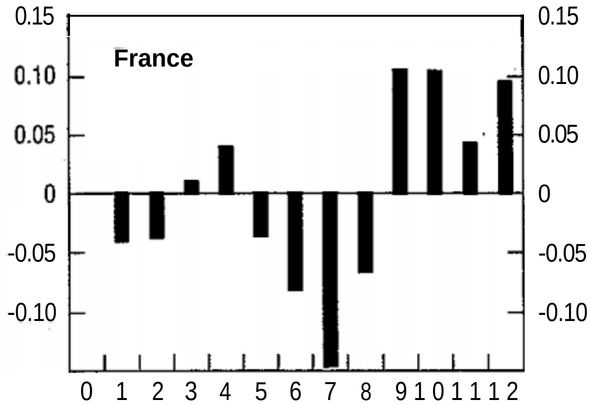
Real stock prices (right scale)

1. Nominal business fixed investment divided by nominal GDP, share price index divided by GDP deflator.

Sources: Stock prices: United States: Standard and Poor; Japan: Tokyo Stock Exchange; Germany and France: Industrials; Italy: Milan Stock Exchange; United Kingdom: F.T. actuaries; Canada: Toronto Stock Exchange.

Figure 3. Correlograms of stock returns[1]





1. Correlogram of quarterly changes in the log of the stock price index.
Figures along the horizontal axis refer to lag length.
Sources: See Figure 1.

Table 3. Granger-causality of investment, GDP and stock prices'

	Causality from stock prices to:		Causality from:	
	Investment	GDP	Investment to stock prices	GDP to stock prices
United States	0.0005**	0.0136*	0.0092”	0.2910
Japan	0.0320'	0.0151*	0.1761	0.4990
Germany	0.1959	0.0011**	0.1353	0.0263*
France	0.3773	0.7667	0.6837	0.4794
Italy	0.7295	0.9149	0.9992	0.6074
United Kingdom	0.0904*	0.0193*	0.3468	0.8587
Canada	0.0966*	0.0271'	0.3475	0.7244

*(**) Rejection of the null hypothesis that X does not cause Y at the ten ie) per cent level.
1. The table reports the marginal significance levels for the null hypothesi f no causality. A variable X is said to Granger cause Y if in the equation:

$$Y_t = \alpha_0 + \sum_{i=1}^{j} \alpha_i X_{t-i} + \sum_{i=1}^{j} \beta_i Y_{t-i}$$

The joint restriction $\alpha_1 = \alpha_2 = \dots = \alpha_j = 0$ can be rejected.
Stock prices, investment and GDP refer to the first difference of the log of these variables.
Sample period: see Table 1.
Sources: Share prices: see Figure 1. Real GNP, real business fixed investment: OECO National Accounts

from Figure 1 is that share prices sometimes lead GDP. This impression is confirmed by the statistical tests in Table 3, which indicate that share prices provide significant, leading information on output and investment in a number of countries but that, in general, neither output nor investment provides information on future share prices. (It is interesting to note that share prices do not appear to have much information content in continental European countries.) As well as this short-run correlation, share prices and investment also seem to move together over the longer term (Figure 2). Once again the link is not close and the behaviour in the United States appears to be a striking exception.

Given the theoretical and apparent empirical link between share prices and investment, it seems reasonable to suppose that inefficient pricing in equity markets could influence investment. However, Bosworth (1975) has argued that if management is concerned about the long-run market value of the firm then it will, when making investment decisions, ignore short-run changes in share prices if they do not reflect the firm's longer-term prospects. However, if the role of management is to maximise the wealth of existing shareholders then it can be argued that it should respond to market valuation even when this deviates from the true value of the firm. This is because the role of the stock market is not only to value the firm but also to provide a source of funds. Fluctuations in share prices will thus alter the cost of capital to the firm. If investors in the stock market are willing, for example, to accept lower returns than justified by the true value of the firm (*i.e.* stock prices are too high) then firms should issue new shares and invest until the marginal product of capital equals that lower cost of capital (Fischer and Merton, 1984). Such a strategy could maximise the wealth of existing shareholders.

A problem with this argument is that it assumes that firms will only invest the proceeds of the new share issue in physical capital. This need not be the optimal strategy because investing in physical capital reduces its marginal product. Firms could, alternatively, invest the funds in financial assets or, equivalently, reduce reliance on other sources of financing. Thus, it may be optimal for the firm to respond to fluctuations in stock prices by simply restructuring its financing patterns without altering investment (Blanchard, Rhee and Summers, 1990).

The following sections attempt to identify whether share price movements that are suggestive of inefficiencies do influence investment. Three approaches are taken: the approach reported in section *i)* examines whether share prices explain investment once other macroeconomic factors thought to be important determinants of investment are controlled for. In section *ii)*, estimates of the fundamental and non-fundamental components of stock prices are obtained in a number of different ways. These variables are then added to a general investment equation and their explanatory power considered. The third approach is a form of "event analysis" looking at episodes that, *ex post,* appear to show stock prices deviating from fundamentals.

B. Empirical evidence

A caveat should be noted before considering the results of some of the empirical exercises below particularly those in section *ii)*. The fundamental value of the stock market, and deviations from this value are not observable. This means that the fundamental value needs to be proxied or controlled for in some way. Because of the possibility that an important, fundamental determinant of share prices has been excluded from the analysis there is a bias towards finding a role for non-fundamentals in the investment decision. Thus, the null hypothesis that stock market inefficiency does not affect investment cannot be rejected *per se*.[8] However, the results can put an upper limit on the role of non-fundamentals.[9] From this perspective, the results reported below suggest that the potential influence of stock market inefficiency on investment is limited.

i) Incremental explanatory power

The correlation between share prices and investment in some countries (Table 3) could be grounds for concern that sentiment-driven share prices may influence investment. This need not be the case, however, since the correlation may simply be due to the fact that movements in share prices anticipate trends in variables that determine the profitability of investment. In this sense, the stock market may simply reveal to economists what corporate managers already know or believe and are thus only a passive predictor rather than causal determinant of investment. A straightforward way to examine whether share prices are simply a passive predictor of corporate investment has been proposed by Morck *et al.* (1990). They regress data on investment in the United States on variables thought to be its important determinants – which, in their study, include cash flow, sales and private consumption – and changes in stock prices, with stock prices appearing in the equation at longer lags. This specification should reveal if movements in share prices explain investment beyond their ability to predict determinants of it. Thus, Morck *et al.* estimate:

$$\Delta I_t = \alpha + \sum_{i=1}^{k} \beta_i \, \Delta F_{t-i} + \varepsilon_t \qquad [2]$$

and, then:

$$\Delta I_t = \alpha + \sum_{i=1}^{k} \beta_i \, \Delta F_{t-i} + \sum_{j=k+1}^{n} \gamma_j \, \Delta S_{t-j} + \varepsilon_t \qquad [3]$$

where: AI = change in business fixed investment;
AF = change in the determinants of investment; and
AS = change in share prices.

The change in R^2 between the two equations is then taken as the upper bound on the incremental explanatory power of the change in share prices. If this is large then share prices may have an important, independent influence on investment and therefore inefficiencies in equity markets could potentially influence investment decisions. Morck *et al.* examine both firm-level and aggregate investment data and find that share prices add little explanatory power when other determinants of investment are controlled for. They conclude that the stock market simply reflects information that people already know and does not directly influence investment. Hence, the extent to which resources can be misallocated due to the stock market may be limited.

The results in Table 4 follow this approach for the seven largest OECD countries. The variables chosen as determinants of investment in the equations in Table 4 were real GNP and a long-term real interest rate.[10] Other variables, such as profits, could also have been used. However, Ford and Poret (1991) have shown that profits add little to investment equations when output is also included. They also show that investment, output and the cost of capital are not cointegrated. Therefore, no attempt was made to estimate the Morck et *al.* equation in error correcting form.

The equations which include output and the real interest rate alone perform poorly and explain relatively little of the variance of investment. Adding the lagged change in share prices to the equations does not increase their explanatory power much.

The incremental R^2's are small in all cases. They indicate that once other influences on investment are controlled for, share prices account for about 0.5 to 3.6 per cent of the variation of investment.

	incremental R^2
United States	0.011
Japan	0.029
Germany	0.036
France	0.005
Italy	0.006
United Kingdom	0.011
Canada	0.024

Furthermore, the share price variable is statistically significant at the ten per cent level in only one of the seven cases (see the marginal significance levels in Table 4). An alternative equation, including lagged changes in investment, was also estimated and yielded similar results (Table 4). Experimenting with the lag structure of the variables – increasing the number of lags or even making share prices contemporaneous

Table 4. **Contribution of stock prices to explaining investment**

	R^2 from equation (a)	$\bar{R}^2$ from equation (b)	Restriction:	
			Oriainal equation[2]	Auamented equation[3]
United States	0.344	0.355	0.3807	0.4398
Japan	0.317	0.346	0.0892'	0.0723'
Germany	0.019	0.055	0.1150	0.1740
France	0.071	0.076	0.7330	0.8877
Italy	0.158	0.164	0.6654	0.5821
United Kingdom	0.023	0.034	0.5437	0.6896
Canada	0.118	0.142	0.2084	0.5224

* Rejection of the null hypothesis at the ten per cent level.

1. The equations used to generate these statistics are:

$$\Delta I_t = \alpha_0 + \sum_{i=1}^{2} \alpha_i \Delta Y_{t-i} + \sum_{i=1}^{2} \beta_i r_{t-i} + \epsilon_t \qquad (a)$$

and:

$$\Delta I_t = \alpha_0 + \sum_{i=1}^{2} \alpha_i \Delta Y_{t-i} + \sum_{i=1}^{2} \beta_i r_{t-i} + \sum_{i=3}^{4} \gamma_i \Delta S_{t-i} + \epsilon_t \qquad (b)$$

Where I_t = log of real business fixed investment
Y_t = log of real GNP
r_t = long-term real interest rate
S_t = log of share prices.

2. The statistics are the marginal significance levels for the null hypothesis that the share price terms could not be excluded from equation (b).
3. The marginal significance levels for the null hypothesis that the share price terms could not be excluded from the following equation:

$$\Delta I_t = \alpha_0 + \sum_{i=1}^{2} \alpha_i \Delta Y_{t-i} + \sum_{i=1}^{2} \beta_i r_{t-i} + \sum_{i=1}^{2} \delta_i \Delta I_{t-i} + \sum_{i=3}^{4} \gamma_i \Delta S_{t-i} + \xi_t$$

Sample period: see Table 1.
Sources: Share prices, real GNP, real business fixed investment as in other tables. Real interest rates – DAFFE (except for Japan): United States: 10-year government bonds; Japan: government bonds, benchmark 119th; Germany: 7-15 year public sector bonds; France: public and semi-public sector bonds; Italy: treasury bonds; United Kingdom: 10-year government bonds; Canada: over 10 years Federal government bonds.

with the other variables – does not qualitatively alter these results. In the latter case, share prices become significant in a number of countries (Germany, the United Kingdom and Canada) but the incremental R^2 remain small, ranging from 0.019 (the United States) to 0.072 (the United Kingdom). The response of investment to share prices, even when statistically significant, does not appear to be economically important. The coefficients on the share price terms suggest that a 10 percentage point rise in the growth rate of stock prices will raise the growth rate of investment by 0.2 percentage points in Italy and by one percentage point in Germany, with the other countries falling within this range. These results are similar to those of Morck *et al.* (1990).[11] They suggest that the stock market has little role in explaining investment over and above its ability to predict determinants of investment.

A potential problem with this approach is that in not distinguishing between fundamental and non-fundamental movements in share prices the largely negative results may underestimate the role of the stock market in investment decisions. If there were two sources of variation in stock prices (fundamentals and sentiment), management might respond to the former and ignore the latter.[12] To examine this possibility, and to place more structure on the investigation, the next sub-section provides some rudimentary estimates of the effects of the fundamental and non-fundamental components of stock prices on investment.

ii) A decomposition of the explanatory power of stock returns

Blanchard *et al.* (1990) examine whether non-fundamental variations in market valuation influence investment by decomposing a measure of Tobin's Q – the ratio of the market value to the replacement value of capital – into components reflecting fundamentals and those reflecting market perceptions. They do this by proxying fundamentals by either dividends or an estimate of the projected discounted present value of profits. Their results suggest a role for both sources of variation in stock prices in the United States. However, when acknowledging the bias towards non-fundamentals, they conclude that the evidence in favour of investment responding to non-fundamentals is weak.

This section follows a slightly different approach. In one set of tests (Table 5*a*) it takes the long-run relationship implicit in the error correction model in equation [1] as a measure of the long-run fundamental value of share prices and uses this to calculate the deviation from fundamentals.[13] The fundamental term ($\hat{S}_t$) and the non-fundamental term (ξ_t) are then included in an equation of the form:

$$\Delta I_t = \alpha + \sum_{i=1}^{4} \beta_i \Delta Y_{t-i} + \sum_{i=1}^{4} \gamma_i r_{t-i} + \sum_{i=1}^{4} \delta_i \Delta I_{t-i} + \sum_{i=1}^{4} \Phi_i \Delta \hat{S}_{t-i} + \sum_{i=1}^{4} \rho_i \Delta \xi_{t-i} + \mu_t \qquad [4]$$

where Y is the log of real GDP and r is the real long-term interest rate. The significance of the fundamental and non-fundamental term is presented in Table 5*a.*

The results in Table 5*b* are an alternative measure of the fundamental and non-fundamental terms which are derived from a simple forecasting equation in which the change in share prices is regressed on four lags of: itself; nominal GDP and the nominal long-term bond rate. Once again the estimated share price was taken as the equilibrium value and the residual as a measure of the deviation from equilibrium.

The results provide a little more support to the hypothesis that non-fundamentals influence investment than those reported earlier. The apparent effects of non-fundamentals are strongest for the United States and the United Kingdom. However, once again, the equations overall do not explain much of the variation in investment. Furthermore, in this test the bias towards ascribing any correlation between investment and stock prices to fundamentals rather than non-fundamentals is quite strong given the limited set of prospective fundamentals included in the equation.

Table 5a. **Decomposition of the influence of stock prices on investment**

	Sum of coefficients on:		$\bar{R}^2$	Marginal significance levels on[1]:	
	Fundamental component	Non-fundamental component		Fundamental component	Non-fundamental component
United States	0.085	0.174	0.38	0.232	0.024′
Japan	0.073	0.088	0.37	0.567	0.122
Germany	0.231	0.107	0.02	0.060′	0.442
France	0.073	0.048	0.82	0.438	0.824
Italy	0.009	0.034	0.20	0.097*	0.533
United Kingdom	0.196	0.220	0.09	0.003**	0.053*
Canada	0.047	0.104	0.17	0.765	0.188

iii) Event analysis

An alternative, less formal, way to examine the issue is to focus on the behaviour of share prices and investment in particular periods where stock prices appear to have deviated most widely from fundamentals. If investment responds only to the fundamental component of share prices, then the ability of share prices to explain investment will depend on the size of the non-fundamental term. When this is large, investment will apparently be less closely linked to share prices than usual. Thus, in a regression of the rate of change in investment on the rate of change in share prices one would expect negative (positive) residuals when share prices seem to be "irrationally high" (low) (Blanchard *et al.,* 1990).

Table 5b. **Decomposition of the influence of stock prices on investment**

	Sum of coefficients on:		$\bar{R}^2$	Marginal significance levels on[1]:	
	component	Non-fundamental comoonent		Fundamental component	Non-fundamental component
United States	0.161	0.099	0.38	0.270	0.002**
Japan	0.217	0.063	0.39	0.184	0.268
Germany	0.221	0.032	0.04	0.026*	0.988
France	0.128	0.043	0.04	0.057*	0.597
Italy	–0.092	-0.036	0.14	0.303	0.855
United Kingdom	–0.044	0.191	0.09	0.211	0.161
Canada	-0.026	0.198	0.17	0.999	0.135

Note: The fundamental and non-fundamental component of share prices are, respectively, the estimated value (S_t) and residual (ξ_t) from the following regression:

$$\Delta S_t = \alpha + \sum_{i=1}^{4} \beta_i \, \Delta PY_{t-i} + \sum_{i=1}^{4} \gamma_i \Delta i_{t-i} + \sum_{i=1}^{4} \delta_i \, \Delta S_{t-i} + \xi_t$$

These are then substiuted into the following equation:

$$\Delta I_t = \alpha + \sum_{i=1}^{4} \beta_i \, \Delta y_{t-i} + \sum_{i=1}^{4} \gamma_i r_{t-i} + \sum_{i=1}^{4} \delta_{t-i} \, \Delta I_{t-i} + \sum_{i=1}^{4} \Phi_i \hat{S}_{t-i} + \sum_{i=1}^{4} \rho_{t-i} \, \xi_{t-i} + \mu_t$$

The sum of coefficients on the fundamental component equals

$$\sum_{i=1}^{4} \Phi_{t-i}$$

while that for the non-fundamental component is

$$\sum_{i=1}^{4} \rho_{t-i}$$

1. Marginal significance levels on the restrictions
$\Phi_1 = \Phi_2 = \ldots \Phi_4 = 0$ and $\rho_1 = \rho_2 = \ldots = \rho_4 = 0$.

Sample period: See Table 1.
Sources: As in other tables.

The period of rising stock prices leading up to October 1987 and the fall that subsequently occurred provides a case where stock markets in many countries are thought to have deviated widely from fundamentals – either at the peak or the subsequent trough, if not both (see Seyhun, 1990 and Shiller, 1987).[14] Table 6 presents residuals from the following equation:

$$\Delta I_t = \alpha + \sum_{i=1}^{2} \beta_i \, \Delta S_{t-i} + \varepsilon_t \qquad [5]$$

for the period 1986 to 1988 for those countries (the United States, Japan and the United Kingdom) where earlier results suggested some role for non-fundamentals. The pattern of residuals from the equations for the United States and Japan are consistent with the hypothesis that these apparent excessive movements in stock prices were

Table 6. **Investment equations residuals**

Residual		United Sates	Japan	United Kingdom
1986	1	-0.0304	-0.0314	-0.0081
	2	-0.0345	-0.0165	-0.0170
	3	-0.0336	-0.0249	0.0518
	4	-0.0119	-0.0264	0.0050
1987	1	-0.0299	-0.0124	0.0024
	2	0.0104	-0.0116	0.0844
	3	0.0153	-0.0118	0.0178
	4	-0.0266	-0.0053	0.0463
1988	1	0.0048	0.0266	-0.0118
	2	0.0436	0.0325	0.0725
	3	-0.0055	0.0126	0.0259
	4	-0.0016	0.0063	0.0455
Sum of residuals				
1986		-0.1104	-0.0992	0.0317
1987		-0.0308	-0.0411	0.1509
1988		0.0413	0.0780	0.1321
$\bar{R}^2$		0.11	0.08	0.07
SE		0.02	0.03	0.04
F		4.96*	3.45*	3.04'
DW		1.09	1.06	2.20

*(**) Significant at the ten (one) per cent level.
Refer to equation [5] in the text.

Sample period: see Table 1.
Sources: As in other tables.

ignored – they tended to be negative through the period of rapidly rising stock prices 1986 and 1987 and positive after the decline in late 1987. Indeed, for Japan the residuals tended to remain positive through 1989 and 1990. This is consistent with Blanchard *et al.* (1990) findings for the United States. No such pattern is evident in the United Kingdom.

III. CONCLUSIONS

The evidence presented in the paper does not provide strong support for the view that stock market inefficiency, to the extent that it exists, has an economically significant influence on business investment. When other determinants of investment are controlled for, share prices do not seem to explain much of the variation in investment in any of the G7 countries. For some countries, there is evidence that an estimate of the component of share prices not related to available information is correlated with investment to a statistically significant degree. However, the magnitude of this relationship is too small to be meaningful economically, and the design of the tests are biased towards such a finding.

There are a number of potential explanations of these results. The first is that share prices may simply summarise information already available to managers. They will then be correlated with, but not a causal influence on, investment. Share prices will be high and investment growth more rapid in those times when investment prospects are good simply because this is good for both equity markets and investment. The second is that managers may simply ignore short-term changes in prices if they do not coincide with their view of underlying prospects. Stock markets may give false signals but these signals are ignored. Finally, management may respond to these false signals simply by restructuring their balance sheets rather than by altering real decisions. The Japanese experience prior to 1990, when a prolonged decline in Japanese equity markets began, seems to be an example **of** this (Bank of Japan, 1991). The rapid run-up of equity prices in 1988 and 1989 encouraged large-scale equity financing, both directly and indirectly in the form of equity warrants attached to bond issues. This was not, however, used solely to increase purchases of fixed investment. Rather, financial assets were acquired. It has been suggested that one reason for this was that corporations viewed high equity prices as temporary and thus did not factor them into calculations of the long-term cost of capital used for making decisions about fixed investment.

NOTES

1. Fama and French (1988), Poterba and Summers (1988), Cutler, Poterba and Summers (1990*a, b*).
2. Kupiec (1991) examines various proposals aimed at limiting the volatility of stock prices.
3. There are many different models of how equity should be valued, and thus of what represents the fundamental determinants of stock prices. Nevertheless, each emphasises expectations of future income flows, adjusted for risk. Thus, for example, in simple valuation models the price of equity in period t should be given by:

$$P_t = E_t \left[\sum_{j=1}^{\infty} \frac{D_{t+j}}{\prod_{i=0}^{j-1} (1 + k_{t+i})} \right]$$

where E is the expectation operator and D_t and k_t are the dividend and discount rate in period t. For a discussion of more sophisticated valuation models see Scott (1991).

4. That is in the Friedman (1953) sense of stabilising speculation (buying low and selling high).
5. Kremers, Ericsson and Dolado (1992) show that this one-step estimation of the long-run equilibrium and short-run dynamics has more power than alternative two-step procedures.
6. In most cases, share prices, nominal GDP and the 10-year bond rate appear to be I(1). In Japan nominal GDP and the bond rate appear to be I(0). The bond rate also appears to be I(0) in Germany.
7. Lehman (1991), p. 499.
8. Blanchard, Rhee and Summers (1990) and Morck, Shleifer and Vishny (1990).
9. It has been suggested that this may not be a good estimate of the upper bound of the influence of noise in stock prices. Some shocks, such as a fall in the price of capital goods, could push stock prices and investment in the opposite direction. Not controlling for these could lead to an underestimate of the effect of stock prices on investment. See Sims' comments following Morck, Shleifer and Vishny (1990).
10. Investment, GNP and stock prices were included in the equations as first differences in logs since they are I(1). The real interest rate was included in level form and was calculated by subtracting a centred three year moving average of inflation from the 10-year bond rate. Differencing the real interest rate did not qualitatively alter the results.
11. Stock and Watson (1990) have also shown that the predictive power of stock prices is eliminated once other variables are controlled for.
12. See Poterba's comments following Morck, Shleifer and Vishny (1990).

13. Thus, the estimated value of share prices obtained from the following regression is taken as the long-run equilibrium and the residual is used as the deviation from fundamentals.

$$S_t = \alpha + \beta PY_t + \gamma i_t + \xi_t$$

14. Stock prices in the United States, Japan and the United Kingdom fluctuated widely in this period. In the United States, prices rose by 25.2 per cent between January 1987 and September 1987 before falling by 24.6 per cent between end-September and November. Prices subsequently rose by 14.1 per cent to December 1988. Corresponding figures for Japan are a rise *of* **25.9** per cent, a fall of 11.0 per cent and a rise of 24.2 per cent. For the United Kingdom they are a rise of 32.9 per cent, a fall of 29.6 per cent and a rise of 9.9 per cent.

BIBLIOGRAPHY

Bank of Japan, "Corporate Finance and Business Investment Under Financial Deregulation", *Special Paper,* No. 195, February 1991.

Bernanke, B. and Gertler, M., "Agency Costs, Collateral, and Business Fluctuations", *NBER Working Paper,* No. 2015, 1986.

Blanchard, O., Rhee, C. and Summers, L. H., "The Stock Market, Profit and Investment", *National Bureau of Economic Research Working Paper,* No. 3370, 1990.

Bosworth, B., "The Stock Market and the Economy", *Brookings Papers on Economic Activity,* No. 2, 1975.

Cutler, D. M., Poterba, J.-M. and Summers, L. H., "Speculative Dynamics" *National Bureau of Economic Research Working Paper,* No. 3242, 1990*a.*

Cutler, D. M., Poterba, J.-M. and Summers, L. H., "Speculative Dynamics and the Role of Feedback Traders", *National Bureau of Economic Research Working Paper,* No. 3243, 1990*b.*

De Long, J.-B., Shleifer, A., Summers, L. H. and Waldman, R. J., "Noise Trader Risk in Financial Markets", *National Bureau of Economic Research Working Paper,* No. 2385, 1987.

De Long, J.-B., Shleifer, A., Summers, L. H. and Waldrnan, R. J., "Positive Feedback Investment Strategies and Destabilising Rational Speculation", *Journal of Finance,* June 1990.

Dooley, M. and Shafer, J., "Analysis of Short-run Exchange Rate Behaviour: March 1973 to November 1981", in Bigman, D. and T. Taya (eds.) *Exchange Rate and Trade Instability,* Ballinger, Cambridge, Mass, 1983.

Fama, E. F., "Efficient Capital Markets: A Review of Theory and Empirical Work", *Journal of Finance,* No. 25, May 1970.

Fama, E. F., "Efficient Capital Markets: II", *Journal of Finance,* No. 5, December 1991.

Fama, E. F. and French, K. R., "Permanent and Temporary Components of Stock Prices", *Journal of Political Economy,* Vol. 92, No. 2, 1988.

Fischer, S. and Merton, R. C., "Macroeconomics and Finance", *Carnegie-Rochester Conference Series on Public Policy,* No. 21, 1984.

Ford, R. and Poret, P., "Business Investment: Recent Performance and Some Implications for Policy", *OECD Economic Studies,* No. 16, Spring 1991.

Friedman, M., "The Case for Flexible Exchange Rates" in Friedman, M. (ed.) *Essays in Positive Economics,* University of Chicago Press, Chicago, 1953.

Froot, K. A., Scharfstein, D. and Stein, J.-C., "Herd on the Street: Informational Inefficiencies in a Market with Short-Term Speculation", *Journal of Finance,* Vol. XLVII, No. 4, 1992.

Kremers, J.-M., Ericsson, N. R. and Dolado, J.-J., "The Power of Cointegration Tests", *Board of Governors of the Federal Reserve System International Finance Discussion Papers,* No. 431, 1992.

Kupiec, P., "Stock Market Volatility in OECD Countries: Recent Trends, Consequences for the Real Economy, and Proposals for Reform", *OECD Economic Studies,* Autumn 1991.

Lehman, B., "Asset Prices and Intrinsic Value", Journal *of* Monetary Economics, **No.** 28, 1991, **pp.** 485-500.

Morck, **R.,** Shleifer, A. and Vishny, R. W., "The Stock Market and Investment: Is the Market a Sideshow?", Brookings Papers on Economic Activity, **No.** 2, 1990.

O'Brien, P. F. and Browne, F., **"A** "credit crunch"? The Recent Slowdown in Bank Lending and Its Implications for Monetary Policy", OECD Economics Department Working Paper, No. 107, 1992.

Poterba, J.-M. and Summers, L. H., "Mean Reversion in Stock Prices: Evidence and Implications", Journal *of* Financial Economics, No. 22, 1988.

Scott, **L.** O., "Financial Market Volatility: A Survey", *IMF Staff* Papers, Vol. 38, No. 3, September 1991.

Seyhun, H. N., "Overreaction to Fundamentals: Some Lessons from Insiders' Response to the Market Crash of 1987", Journal *of* Finance, December 1990.

Shiller, R. **J.,** "Stock Prices and Social Dynamics", Brookings Papers on Economic Activity, No. 2, 1984.

Shiller, R. **J.,** "investor Behaviour in the October 1987 Stock Market Crash: Survey Evidence", National Bureau *of* Economic Research, Working Paper, No. 2446, 1987.

Taylor, **M.** P. and Allen, H., "The Use of Technical Analysis in the Foreign Exchange Market", Journal *of International* Money and Finance, 11, 1992, pp. 304-314.