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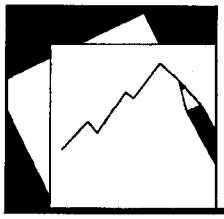

IMF Working Paper

New Economy Stock Valuations and Investment in the 1990s

Hali Edison and Torsten Sløk

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Research Department

New Economy Stock Valuations and Investment in the 1990s

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Authorized for distribution by Tamim Bayoumi

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Abstract

This paper investigates whether there is a different impact from changes in "new" and "old" economy stock valuations on private investment for seven OECD economies. A vector autoregressive model is estimated for each individual country, using quarterly data over the period 1990-2000. We find that the impact from changes in valuations of new economy stocks to investment is roughly the same in North America and in the United Kingdom as in continental Europe. By contrast, the impact from changes in old economy stock valuations on investment is, in general, larger in North America and in the United Kingdom than in continental Europe. Finally, the results suggest that in continental Europe the impact on investment from changes in the valuation of new economy stocks is bigger than for old economy stocks, whereas for North America and the United Kingdom, the impact is more similar.

JEL Classification Numbers: E20, E44

Keywords: real investment, new economy, stock markets

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I. Introduction

The dramatic increase in stock market valuations in the 1990s has in the major OECD economies—except Japan—been associated with an increase in private investment (Table1). What has been particularly striking is the performance of Technology, Media, and Telecommunication (hereafter TMT) equities. Over the 1990s stock market capitalization for the new economy stocks (TMT) increased over 200 percent—again except for Japan—whereas old economy stocks (hereafter non-TMT) increased slightly more than 100 percent. The different performance of different stock market segments begs the question if there is a different relationship between real private investment and different segments of the stock market. The analysis is also motivated by the dramatic increase in IPOs and venture capital in the 1990s and the associated easier access to capital for firms in the TMT sector.

Despite these trends, there have been relatively few studies of the impact from changes in equity valuations on investment drawing upon the developments shown in Table 1.[2] In fact, we are unaware of any studies distinguishing between the impact from changes in new economy and old economy stock valuations to investment, and this paper is an attempt to fill this gap using data for seven OECD countries.

Table 1. Change in Real Investment, Income, and Market Capitalization, 1990-2000 (in percent)

	GDP	Investment	Total market	TMT market	Non-TMT market
Canada	30.6	52.7	146.5	223.8	116.0
France	19.1	15.5	194.5	296.3	177.7
Germany	14.8	15.6	131.7	329.1	110.7
Japan	14.3	-10.7	-34.7	62.5	-56.3
Netherlands	33.4	36.1	175.7	269.9	165.7
United Kingdom	24.5	58.7	125.6	206.7	106.7
United States	38.9	97.9	159.7	233.7	131.2

Note: Real GDP and real gross fixed capital formation are annual numbers and real stock market capitalization is from January 1990 to October 2000. For Germany the change is calculated relative to 1991 in order to avoid assumptions about the unification in 1990.

Amongst our findings in this paper is the result that investment is affected by changes in stock market wealth and that the type of wealth matters for the size of the impact. Further, we find differences in the reaction of investment behavior between countries. For example, the impact from changes in non-TMT stock valuations on investment is in general larger in Canada and the United States (hereafter North America) and the United Kingdom than in continental Europe. Meanwhile, we find that the impact from changes in TMT stock valuations to

[2] In contrast, the relationship between stock valuations and consumption has been studied extensively in the literature; see Edison and Sløk (2001) for a recent survey.

investment is roughly the same in all countries, excluding Japan where the transmission mechanism between stock markets and investment appears different. We find that the TMT effect is larger in continental Europe relative to the non-TMT effect; and the reverse is true for North America and the United Kingdom. The large impact from TMT valuations in continental Europe suggests that developments in the valuation of TMT companies play a significant role in affecting and transmitting the business cycle in continental Europe.

The paper is organized as follows. Section 2 provides a description of the theoretical background and related literature. Section 3 presents the empirical results and Section 4 augments the results with a series of robustness tests. Finally, Section 5 presents the conclusions.

II. Theoretical Background and The New Economy Cycle

Broadly speaking, the literature on the relationship between stock markets and investment points to the main channel being the cost of new capital relative to the cost of existing capital.[3] If the ratio of market valuation of existing capital to the cost of acquiring new capital (Tobin's q) rises, so will investment (Tobin,1969). Since there are adjustment costs when changing the capital stock, the optimal amount of current investment depends on the current and lagged values of Tobin's q (Barro, 1990 and Abel and Blanchard, 1986).

In the 1990s, valuations of companies that produce technology goods have increased dramatically, while, more generally the price of new capital used in a range of industries—in particular the price of IT equipment—has decreased substantially. As a consequence, Tobin's q has in many countries increased throughout the 1990s to reach in 1999 and early 2000 it's highest levels ever.[4] The increase in the q-value has generated substantial increases in investment in the 1990s, of which a considerable part has been technology investment. Given the higher demand for new technology goods, stock prices in the TMT sector rose significantly through the 1990s. Especially in the United States, changes in TMT valuations have been highly correlated with changes in investment in IT products, presumably because TMT valuations reflected beliefs about the value of the new technology (Figure 1).

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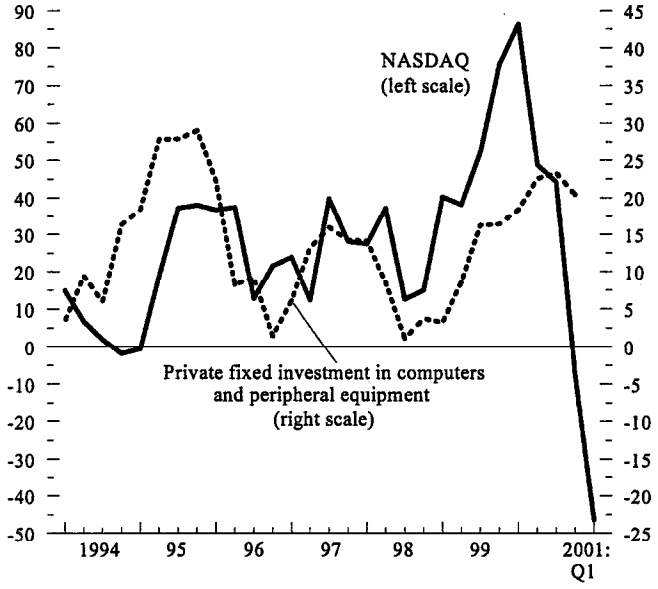
[3] In the investment literature, other channels such as the flexible accelerator channel (Jorgenson, 1963) and the credit channel (Bernanke, Gertler, and Gilchrist, 1996) are also mentioned. However, the purpose in the empirical analysis below is not to identify the exact channels of transmission and given the dramatic developments in stock prices over the last decade, it is the conjecture that the cost of new capital relative to the cost of old capital has been the key determinant of investment. Furthermore, there exists a large literature discussing to what extent the additional channels can be derived from Tobin's q theory (see for example Abel, 1979 and Galeotti, 1987).

[4] For the United States, see for example Smithers and Wright (2000).

Figure 1. NASDAQ Stock Price and Private Fixed Investment in Computers and Peripheral Equipment
(Quarterly percent change from a year earlier)

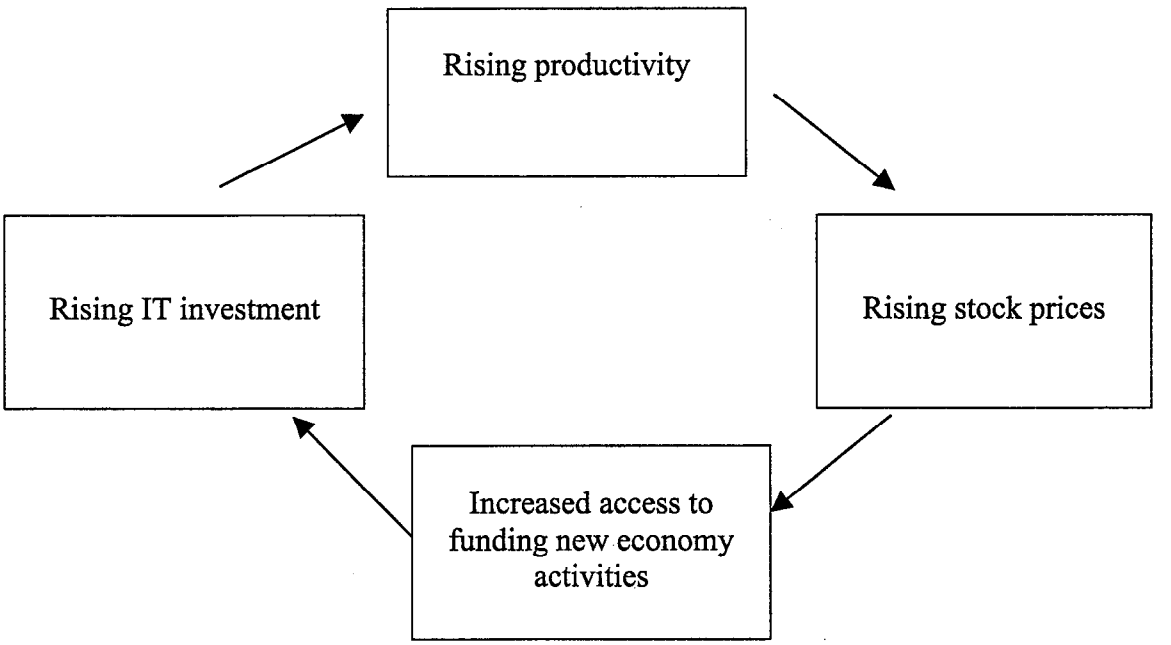
NASDAQ has been highly correlated with information technology investment in the late 1990s.



Source: WEFA Inc.

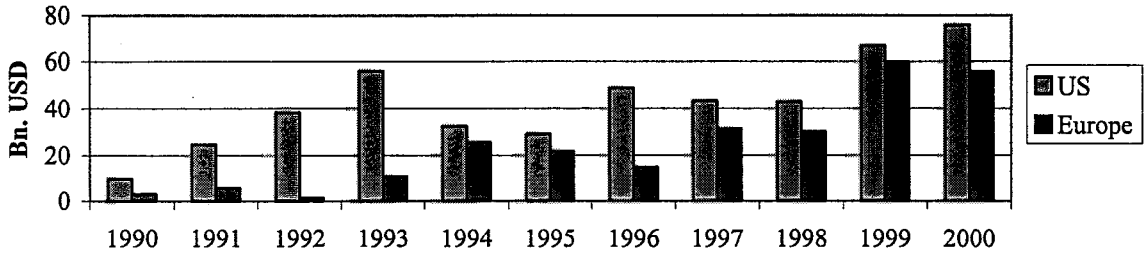
Generally speaking, higher investment in IT in turn affected productivity, again affecting stock market valuations, giving rise to a virtuous cycle of an expanding economy, rising investment, rising productivity, and a rising equity market (Figure 2).

Figure 2. The "New Economy" Cycle Of The Late 1990s



This cycle, which has been more pronounced for the IT sector than the telecom and media sectors, has been documented best in the United States, where many TMT companies with limited access to bond markets or bank finance used stock markets as a source of funding. In Europe, stock prices also went up which increased access to funding new economy activities. Figure 3 shows that in the last part of the 1990s, funds raised at IPOs were to a large extent similar in the United States and Europe (including the United Kingdom). In Europe, however, the link from investment to productivity has been much less pronounced than in the United States. Or put differently, to date the "rising productivity" part of the new economy cycle was somewhat absent in the European case. Nevertheless, stock prices continued increasing, apparently based on the belief that the new economy would generate substantial streams of profits for an extended period of time.

Figure 3. Funds raised by IPOs



Source: Deutsche Bank (2001)

Galeotti and Schianterelli (1994) have formalized one version of the new economy cycle. They build an optimizing framework of firms' behavior when adjustment costs are present, and show that if investors follow irrational trading rules (Shiller, 1984 and Poterba and Summers, 1988), then fads and bubbles can exist for extended periods of time.[5] Consequently, not only fundamentals matter for investment decisions but also the volatility of the stock market is important. In their empirical approach Galeotti and Schianterelli (1994) split up the explanatory variables into fundamentals and non-fundamentals, and using data for the United States they find clear evidence that non-fundamentals are significant explanatory factors of investment.

A main reason why the new economy cycle is more pronounced in the United States is the market-based financial system used in the Anglo-Saxon countries, which is different from the bank-based financial system used in continental Europe, and Japan. Traditionally, in the United States financial system firms primarily raise capital through stock markets or other asset markets. In continental Europe, firms—especially old economy firms—go to banks to borrow funds. Consequently, capital is allocated differently in a market-based system relative to a bank-based system. This is an important difference, for example, in a situation where stock markets are over-valued for an extended period of time.

[5] The intuition in their model is to a large extent the same as in the new economy cycle shown in Figure 2; if markets in certain periods are overvalued, financing possibilities increase and there are opportunities for companies to increase investment. Using data for the United States, Hu (1995) finds that stock market volatility and its changes are negatively related to investment growth which is the opposite conclusion found in the work by Galeotti and Schianterelli (1994). The difference is the way in which volatility is calculated and if it is associated with an underlying increasing trend (which makes it a fad or bubble instead of high frequency noise).

III. QUANTIFYING THE EFFECT OF CHANGES IN STOCK VALUATIONS ON INVESTMENT

We will now turn to an empirical investigation of the new economy cycle, focusing on the relationship between stock markets and investment. The traditional empirical approach when modeling private investment is to estimate a specification where investment is a function of Tobin's q. In the investment literature there has been an extensive discussion (e.g. Hayashi, 1982) of how to measure the price of new capital relative to the price of old capital (Tobin's q). Barro (1990) shows empirically that, "the stock market dramatically outperforms a standard q-variable because the market equity component of this variable is only a rough proxy for stock market value". This is also the general conclusion from the literature; constructed q-variables do not perform very well in empirical implementations, whereas simple stock valuation measures seem to have more success explaining investment.

Typically, the investment equation is specified as follows:

$$\text{Investment} = F(\text{Wealth}, \text{Income}, \text{Usercost}) \qquad (1)$$

Identifying the exact channels of transmission is difficult and, given the endogenous nature of the new economy cycle, it seems natural to use an empirical method that allows all the involved variables to be endogenous and to interact as freely as possible. One method, which meets this requirement, is the vector autoregressive model and below we apply this to quantify the relationship between stock prices and investment in seven OECD economies in the 1990s.[6]

To test the effects of changes in TMT and non-TMT stock valuations on investment a five variable vector autoregressive (VAR) model is employed, using quarterly data from 1990:1 to 2000:2 for Canada, France, Germany, Japan, the Netherlands, the United Kingdom, and the United States.[7] The five variables that make up the VAR are as follows: real private gross fixed capital formation (hereafter investment), real TMT stock market capitalization, real non-TMT stock market capitalization, industrial production, and the real short interest rate.[8] The lag length is three and all the variables except the interest rate are in logs. TMT and non-TMT stock market capitalization are proxies for wealth and access to funding new activities. Industrial production is a proxy for income and the real short interest rate is a proxy for usercost. The

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[6] Trace-tests for cointegration suggest that for all countries at least one cointegration vector exists, which can be interpreted as an investment function. The reduced form VAR was chosen since it does not impose potentially faulty restrictions on the system (due to the short period analyzed), and in addition, calculating confidence intervals for impulse-response functions when cointegration is imposed, requires additional restrictive assumptions.

[7] For Germany the data ends in 1999:4.

[8] The real interest rate is defined as the interest rate minus the twelve-month change in the consumer price index. See data appendix for the sources of the data.

estimation period is relatively short, therefore no restrictions, such as underlying long run relationships between the variables, are imposed. Rather it is assumed that there is super-consistency and hence the VARs can be estimated in logged levels.

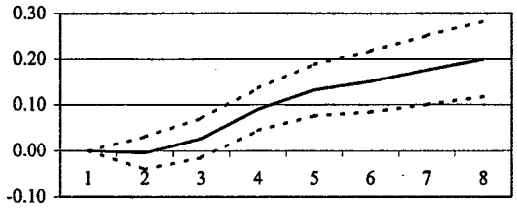
The reduced-form VARs are used to assess the differences in the response of private investment to changes in real TMT and non-TMT stock market capitalization. In order to investigate this, impulse-response analyses were carried out, analyzing how changes in TMT and non-TMT stock market valuations change private investment over time. The VARs were identified using the choleski recursive scheme. In the ordering, investment - the variable of main interest - was placed first, then the stock market variables (TMT stock market capitalization and non-TMT stock market capitalization), and then industrial production and finally the interest rate. Using this ordering, a change in the proxies for wealth and income will have no contemporaneous impact on investment, which seems a plausible assumption. The results reported below were, however, in general not sensitive to the ordering of the variables.

Figure 4 shows the impulse-response functions for each of the seven countries. The left panels display the response of investment of shocks to TMT market capitalization and the right hand panels give the non-TMT response. For six out of the seven countries (Japan is the exception) an increase in TMT valuations appear to have a significant impact on private investment after two years. The path and the amount of the impact vary across countries with Canada and the United States experiencing the largest effect followed by France. For Germany and the Netherlands the two-year effect from an increase in TMT valuation to investment is also positive and significantly different from zero. The path for Japan is choppy, after two and six quarters there appears to be a positive impact on investment, but by eight quarters the impact becomes negative.

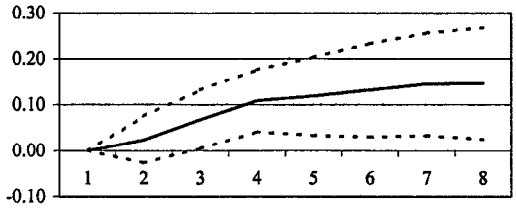
The overall results for non-TMT changes are mixed across countries and the standard error bands widen suggesting more general uncertainty. However, the results for the non-TMT impact seem to partly mirror the different financial systems (market-based/bank-based) described above. Changes in non-TMT valuations on investment are significantly positive for North America and the United Kingdom, whereas for France and Germany the effect is not significantly different from zero. For the Netherlands the effect is positive and significant, and the results for Japan are also positive suggesting that the old economy wealth has an impact on investment.

Figure 4. Impulse response reactions for investment (in percent)

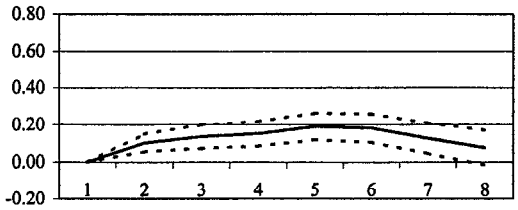
United States: Impact on investment of a 1 pct. shock to TMT valuation



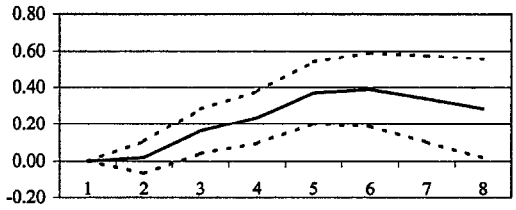
United States: Impact on investment of a 1 pct. shock to non-TMT valuation



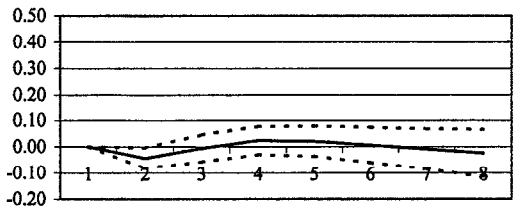
Canada: Impact on investment of a 1 pct. shock to TMT valuation



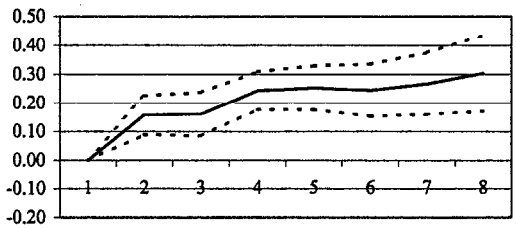
Canada: Impact on investment of a 1 pct. shock to non-TMT valuation



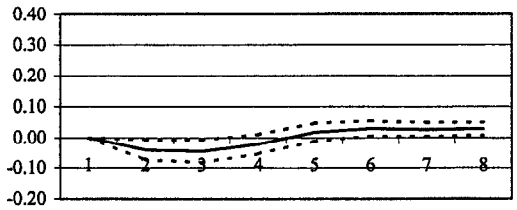
UK: Impact on investment of a 1 pct. shock to TMT valuation



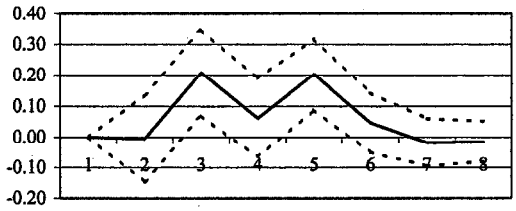
UK: Impact on investment of a 1 pct. shock to non-TMT valuation



Germany: Impact on investment of a 1 pct. shock to TMT valuation



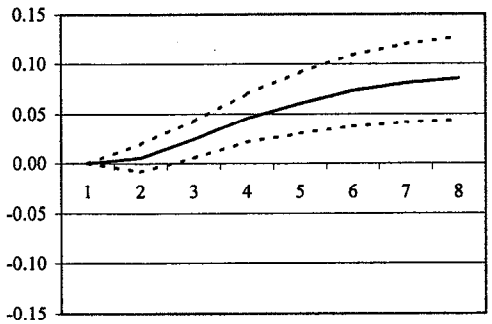
Germany: Impact on investment of a 1 pct. shock to non-TMT valuation



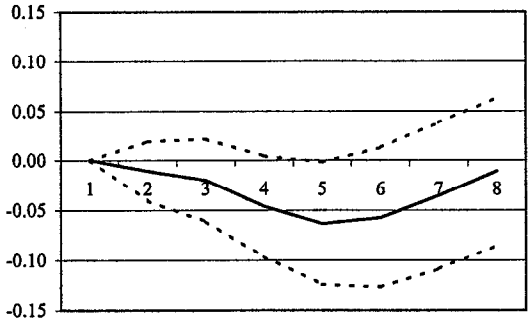
Note: Authors' calculations. One standard error confidence intervals shown.

Figure 4 contd. Impulse-response reactions for investment (in percent)

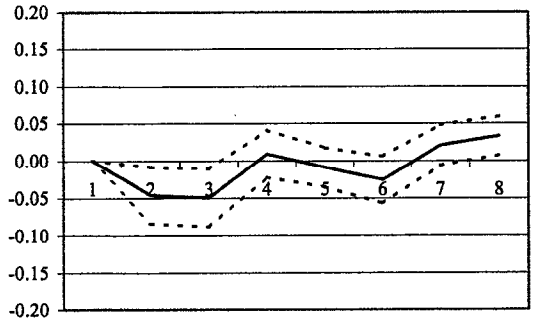
France: Impact on investment of a 1 pct. shock to TMT valuation



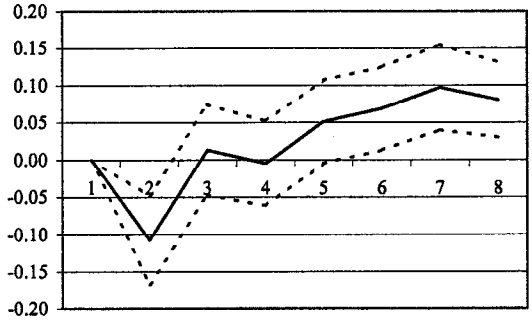
France: Impact on investment of a 1 pct. shock to non-TMT valuation



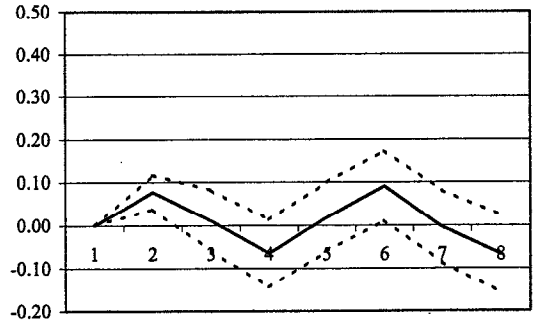
Netherlands: Impact on investment of a 1 pct. shock to TMT valuation



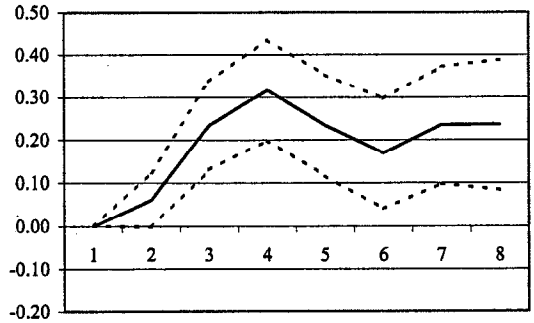
Netherlands: Impact on investment of a 1 pct. shock to non-TMT valuation



Japan: Impact on investment of a 1 pct. shock to TMT valuation



Japan: Impact on investment of a 1 pct. shock to non-TMT valuation



From the impulse-response analysis it is possible to quantify the effect after two years of a ten percent increase in stock market values on investment in the seven countries (Table 2).

Table 2. Effect on Investment after Two Years of a ten percent change in TMT and non-TMT Stock Market Valuations (in percent)

	TMT	Non-TMT
Canada	0.8	**2.9**
France	**0.9**	-0.1
Germany	**0.3**	-0.1
Japan	-0.7	**2.4**
Netherlands	**0.3**	**0.8**
UK	-0.2	**3.0**
USA	**2.0**	**1.5**
North America and United Kingdom average	**0.9**	**2.5**
Continental Europe average	**0.5**	0.2

Note: Bold estimates denote that they are significantly different from zero (within the confidence intervals) in the impulse-response functions. The significance of the averages is based on a $X^2(3)$-distributed Wald test.

Table 2 illustrates that for the United States the elasticity from a ten percent increase in TMT and non-TMT on investment is more or less identical for the two sectors. For Canada and the United Kingdom the impact for the non-TMT sector is higher than from the TMT sector, whereas for France and Germany there is no effect from non-TMT to investment after two years. On average the impact from TMT is more or less the same in Canada, the United Kingdom, the United States, and continental Europe, whereas for non-TMT the effect is considerably larger in North America and the United Kingdom.

Stock markets are significantly different in size in different countries and hence the same elasticity could in two different countries imply different dollar impacts on investment. In other words, the ratio of private investment to market capitalization varies a lot between countries.[9] In order to compare how big an impact a one-dollar increase in wealth has on investment in these seven economies, the elasticities shown in Table 2 were used to calculate the cents-per-dollar effect of an increase in stock market valuations. Specifically, using the elasticities shown in Table 2 we calculated how much a ten percent increase in stock market valuation corresponds to in dollars and this was then put in relation to how big the impact on investment was measured in dollars. To do this calculation, we used market capitalization data

[9] Again, partly as a consequence of the different financial systems (market-based/bank-based).

from December 2000 and annual private investment figures from 2000. The results of this exercise can be seen in Table 3.[10]

Table 3. Impact after two years of a one-dollar increase in TMT and non-TMT Stock Market Valuations on Investment		
	TMT	**Non-TMT**
Canada	4.3 cents	**8.1 cents**
France	**6.0 cents**	-0.3 cents
Germany	**5.1 cents**	-0.1 cents
Japan	-6.4 cents*	**7.9 cents**
Netherlands	**3.0 cents**	**1.0 cents**
UK	-0.1 cents*	**3.5 cents**
USA	**8.2 cents**	**3.0 cents**
North America and United Kingdom average	**4.1 cents**	**4.9 cents**
Continental Europe average	**4.7 cents**	0.2 cents

Note: See notes to Table 2. A * denotes if the TMT estimate for a country is significantly different from the non-TMT estimate for the same country.

One possible explanation for the relatively smaller impact of non-TMT share prices on investment in France, Germany, and the Netherlands compared to Canada, the United Kingdom, and the United States, is the difference in corporate laws and traditions, as witnessed by less frequent takeovers, the greater importance accorded to employees in decision making, and the higher gearing ratios. These features might suggest that managers in continental Europe tend to be less responsive to the stock market relative to their counterparts in Canada, the United Kingdom, and the United States. What the results in Table 3 suggest, however, is that these differences apply less to the TMT market, possibly because the structure of these sectors is much more similar across countries. In particular, TMT sectors in continental Europe have relied more on stock markets instead of banks as a source of financing and as a result the TMT sector in continental Europe has also experienced the new economy cycle described above.

IV. Robustness tests

Some additional tests are conducted to evaluate the robustness of the results found above. In particular, three additional tests are considered: the substitution of stock prices for stock market capitalization as a measure of wealth, the sensitivity of the results to the sample period, and the replacement of aggregate stock prices for the TMT and non-TMT variables.

[10] Note, that there is no exchange rate conversion taking place and hence the numbers do not change if we instead write for example "cents per euro". Cents-per-dollar was used for all countries to keep the description of the results as simple as possible.

First, we replace our stock market wealth measure based on market capitalization with corresponding stock prices. Specifically, we use the related stock price index for TMT and non-TMT sector and rerun the VARs. It turns out that the elasticities of a ten percent change for prices turn out to be relatively similar to those reported for capitalization. In addition, the impulse-response functions have patterns that are more or less identical. In other words there is little extra information in using market capitalizations instead of price indices. This result is not too surprising, as much of the variation in the capitalization figures comes from changes in stock prices.

Second, it has been argued that these large differences in stock market sectors have become effective only recently. To investigate to what extent the estimated elasticities have changed through the 1990s we report estimated two-year impact effects, updating the data. Table 4 shows for Germany and the United States that in general elasticities have fallen through the 1990s. In particular, they appear to have fallen slightly more in the United States than Germany. The fall in the elasticities through the last part of the 1990s is a function of the dramatic increase in stock valuations. Or put differently, the sharp increase in stock prices in the late 1990s was substantially higher than the increase in investment and hence the correlation between the two has fallen.

Table 4. Robustness Test: The Impact after two years on Private Investment of a ten percent change in Market Values (in percent)

	Germany		United States	
	TMT	Non-TMT	TMT	Non-TMT
1990:1-1996:4	-1.6	0.1	5.3	5.8
1990:1-1997:4	0.7	-0.6	2.8	4.4
1990:1-1998:4	0.3	-0.3	4.6	0.8
1990:1-1999:4	0.3	-0.1	2.1	1.1
1990:1-2000:2	--	--	2.0	1.5

Note: The data for Germany ends in 1999:4.

Our third robustness test uses the broad stock market wealth, proxied by total stock market prices. We analyze the overall effect from stock markets to investment by including broad market indices rather than splitting stock markets up into TMT and non-TMT. Table 5 confirms the results found above; in the United Kingdom and the United States the impact on investment is higher than in Germany. Using the broad index for Japan moderates the impact, which suggests that the dynamics between TMT and non-TMT magnifies the effect in the results found above.

Table 5. Effect after two years on Investment of a ten percent change in Major Stock Market Index, Selected Countries (in percent)	
Germany (DAX100)	0.5
Japan (Nikkei225)	**0.4**
UK (FTSE100)	**2.7**
USA (Wilshire 5000)	**2.5**

Note: Bold figures denote that the estimates are significantly different from zero.

V. CONCLUSIONS

The analysis in this paper leads to three conclusions. First, the impact from a change in TMT stock valuations to investment is approximately the same in continental Europe compared with North America and the United Kingdom. Second, the impact of a change in non-TMT stock valuations is on average higher in Canada, the United Kingdom, and the United States compared with the continental European countries. Third, the results suggest that in continental Europe the impact on investment from changes in the valuation of new economy stocks is bigger than for old economy stocks, whereas for North America and the United Kingdom the impact is more similar.

The strong link found between private investment and changes in valuations of TMT companies. This can be explained by the fact that TMT companies tend to function and work in identical ways worldwide. Specifically, TMT firms worldwide have used stock markets to raise capital rather than going to the banks to borrow funds. As valuations of firms in the TMT sector went up in the 1990s, firms exploited part of this increase in valuations in order to increase investment and new economy activities in general.

The existence of a strong link between stock prices has significant implications for monetary policy and the continuous monitoring of the business cycle. Consequently, monetary authorities should watch closely stock market developments in order to identify how it affects the business cycle and subsequently inflationary pressures. The analysis also suggests that it is not sufficient to look at the broad indices but it is also necessary to look at individual segments of stock markets in order to identify if these segments have a tendency to initiate activity through IPOs or venture capitalists, which may enhance the link with the real sector.

Data Appendix

Private investment
For all countries private investment comes from the OECD Analytical Database. The code in is XXXIPV, where XXX is the country code.

Stock market variables
For all countries the TMT/non-TMT stock market variables come from Datastream. The codes are as follows: TMT market capitalization: TLMITXX(MV), TMT price index: TLMITXX(PI), non-TMT market capitalization: TOTXTXX(MV), non-TMT price index: TOTXTXX(PI), where XX is the country code. Data for Wilshire5000, Nikkei225, DAX100, and FTSE100 were taken from Bloomberg.

Industrial production
For all countries industrial production comes from International Financial Statistics, IMF. Code: Code: XXX66..CZF, where XXX is the country code.

Short interest rate
For Japan and Netherlands call money market rates were used: Code: XXX60B..ZF, where XXX is the country code.
For the remaining countries the 3-month Treasury Bill Rate was used and it was taken from International Financial Statistics, IMF. Code: XXX60C..ZF, where XXX is the country code.

Consumer price index
For all countries the data comes from International Financial Statistics, IMF. Code: XXX64...ZF, where XXX is the country code.

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