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Can macroeconomic variables explain long term stock market movements? A comparison of the US and Japan

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ABSTRACT

Within the framework of a standard discounted value model we examine whether a number of macroeconomic variables influence stock prices in the US and Japan. A cointegration analysis is applied in order to model the long term relationship between industrial production, the consumer price index, money supply, long term interest rates and stock prices in the US and Japan. For the US we find the data are consistent with a single cointegrating vector, where stock prices are positively related to industrial production and negatively related to both the consumer price index and a long term interest rate. We also find an insignificant (although positive) relationship between US stock prices and the money supply. However, for the Japanese data we find two cointegrating vectors. We find for one vector that stock prices are influenced positively by industrial production and negatively by the money supply. For the second cointegrating vector we find industrial production to be negatively influenced by the consumer price index and a long term interest rate. These contrasting results may be due to the slump in the Japanese economy during the 1990s and consequent liquidity trap.

Keywords: Stock Market Indices, Cointegration, Interest Rates.
JEL Classifications: C22, G12, E44.

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I. Introduction.

A significant literature now exists which investigates the relationship between stock market returns and a range of macroeconomic and financial variables, across a number of different stock markets and over a range of different time horizons. Existing financial economic theory provides a number of models that provide a framework for the study of this relationship.

One way of linking macroeconomic variables and stock market returns is through arbitrage pricing theory (APT) (Ross, 1976), where multiple risk factors can explain asset returns. While early empirical papers on APT focussed on individual security returns, it may also be used in an aggregate stock market framework, where a change in a given macroeconomic variable could be seen as reflecting a change in an underlying systematic risk factor influencing future returns. Most of the empirical studies based on APT theory, linking the state of the macro economy to stock market returns, are characterised by modelling a short run relationship between macroeconomic variables and the stock price in terms of first differences, assuming trend stationarity. For a selection of relevant studies see *inter alia* Fama (1981, 1990), Fama and French (1989), Schwert (1990), Ferson and Harvey (1991) and Black, Fraser and MacDonald (1997). In general, these papers found a significant relationship between stock market returns and changes in macroeconomic variables, such as industrial production, inflation, interest rates, the yield curve and a risk premium.

An alternative, but not inconsistent, approach is the discounted cash flow or present value model (PVM)[1]. This model relates the stock price to future expected cash flows and the future discount rate of these cash flows. Again, all macroeconomic factors that influence future expected cash flows or the discount rate by which these cash flows are discounted should have an influence on the stock price. The advantage of the PVM model is that it can be used to focus on the long run relationship between the stock market and macroeconomic variables. Campbell and Shiller (1988) estimate the relationship between stock prices, earnings and expected dividends. They find that a long term moving average of earnings predicts dividends and the ratio of this earnings variable to current stock price is powerful in predicting stock returns over several years. They conclude that these facts make stock prices and returns much too volatile to accord with a simple present value model.

Engle and Granger (1987) and Granger (1986) suggest that the validity of long term equilibria between variables can be examined using cointegration techniques. These have been applied to the long run relationship between stock prices and macroeconomic variables in a number of studies, see *inter alia* Mukherjee and Naka (1995), Cheung and Ng (1998), Nasseh and Strauss (2000), McMillan (2001) and Chaudhuri and Smiles (2004). Nasseh and Strauss (2000), for example, find a significant long-run relationship between stock prices and domestic and international economic activity in France, Germany, Italy, Netherlands, Switzerland and the U.K. In particular they find large positive coefficients for industrial production and the consumer price index, and smaller but nevertheless positive coefficients on short term interest rates and business surveys of manufacturing. The only negative coefficients are found on long term interest rates. Additionally, they find that European stock markets are highly integrated with that of Germany and also find industrial production, stock prices and short term rates in Germany positively influence returns on other European stock markets (namely France, Italy, Netherlands, Switzerland and the UK).

In this paper, we will draw upon theory and existing empirical work as a motivation to select a number of macroeconomic variables that we might expect to be strongly related to the real stock price. We then make use of these variables, in a cointegration model, to compare and contrast the stock markets in the US and Japan. In contrast to most other studies we explicitly use an extended sample size of most of the last half century, which covers the most severe stock market booms in US and Japan. While Japans' hay days have been in the late 1980s, the US stock market boom occurred during the 1990s and ended in 2000. Japans' stock market has not yet fully recovered from a significant decline during the 1990s, and at the time of writing, trades at around a quarter of the value it saw at its peak in 1989.[2]

The aim of this paper is to see whether the same model can explain the US and Japanese stock market while yielding consistent factor loadings. This might be highly relevant, for example, to private investors, pension funds and governments, as many long term investors base their investment in equities on the assumption that corporate cash flows should grow in line with the economy, given either a constant or slowly moving discount rate. Thus, the expected return on equities may be linked to future economic performance. A further concern might be the impact of the Japanese deflation on real equity returns. In this paper, we make use of the cointegration methodology, to investigate whether the Japanese stock market has broadly followed the same equity model that has been found to hold in the US.

In the following section, we briefly outline the simple present value model of stock price formation and make use of it in order to motivate our discussion of the macroeconomic variables we include in our empirical analysis. In the third section we briefly outline the cointegration methodology, in the fourth section we discuss our results and in the fifth section we offer a summary and some tentative conclusions based on our results.

II. Data and motivation

In order to motivate our variable selection, a simple PVM may be formulated as follows:

$$P_t = \frac{E_t(d_{t+1})}{1+E_t r} + \frac{E_t(P_{t+1})}{1+E_t r} \quad (1)$$

Where $E_t(.)$ denotes the expectations operator conditional upon on all information available at time t, P_t is the fair (real) price of the stock at time t, $E_t(d_{t+1})$ is the expected annual (real) dividend per share at the end of the first year, $E_t(P_{t+1})$ is the expected (real) price of the share at the end of the first year and finally $E_t r$ is the expected (constant) market determined (real) discount rate or cost of capital. By noting that

$$E_t P_{t+i} = \frac{E_t(d_{t+i+1})}{1+E_t r} + \frac{E_t(P_{t+i+1})}{1+E_t r}, \quad (2)$$

for $i = 1, \ldots, N-1$, by substituting (2) into (1) and repeatedly substituting for the expected future price term we get:

$$P_t = \sum_{i=1}^{N} \frac{E_t(d_{t+i})}{(1+E_t r)^i} + \frac{E_t(P_N)}{(1+E_t r)^N}. \quad (3)$$

As T $\rightarrow \infty$, (3) becomes:

$$P_t = \sum_{i=1}^{\infty} \frac{E_t(d_{t+i})}{(1+E_t r)^i} \quad (4)$$

Therefore, the share price depends upon the expected stream of dividend payments and the market discount rate. Hence, any macroeconomic variable that may be thought to influence expected future dividends and/or the discount rate could have a strong influence on aggregate stock prices.[3]

As suggested by Chen, Roll and Ross (1986), the selection of relevant macroeconomic variables requires judgement and we draw upon both on existing theory and existing empirical evidence. Theory suggests, and many authors find, that corporate cash flows are related to a measure of aggregate output such as GDP or industrial production[4]. We follow, Chen, Roll and Ross (1986), Maysami and Koh (1998) and Mukherjee and Naka (1995) and make use of industrial production in this regard.

Unanticipated inflation may directly influence real stock prices (negatively) through unexpected changes in the price level. Inflation uncertainty may also affect the discount rate thus reducing the present value of future corporate cash flows. DeFina (1991) has also argued that rising inflation initially has a negative effect on corporate income due to immediate rising costs and slowly adjusting output prices, reducing profits and therefore the share price. Contrary to the experience of the US, Japan suffered periods of deflation during the late 1990s and early part of the 21st century, and this may have had some impact on the relationship between inflation and share prices

The money supply, for example M1, is also likely to influence share prices through at least three mechanisms: First, changes in the money supply may be related to unanticipated increases in inflation and future inflation uncertainty and hence negatively related to the share price; Second, changes in the money supply may positively influence the share price through its impact on economic activity; Finally, portfolio theory suggests a positive relationship, since it relates an increase in the money supply to a portfolio shift from non-interest bearing money to financial assets including equities. For a further discussion on the role of the money supply see Urich and Wachtel (1981), Rogalski and Vinso (1977) and Chaudhuri and Smiles (2004).

The interest rate directly changes the discount rate in the valuation model and thus influences current and future values of corporate cash flows. Frequently, authors have included both a long term interest rate (e.g a 10 year bond yield) and a short term interest rate (e.g. a 3 month T-bill rate)[5]. We do not use a short term rate as our aim here is to find a long term relationship between the stock market and interest rate variables. Changes in the short rate are mainly driven by the business cycle and monetary policy. In contrast, the long term interest rate should indicate the longer term view of the economy concerning the discount rate.

For our long term rate using the US data we have chosen a 10 year bond yield, however for Japan we instead use the *official* discount rate. This is due largely to data availability constraints and that the market for 10 year bonds (and similar maturities) in Japan has not been liquid for most of the time period covered. We should note that the discount rate is an official lending rate for banks in Japan, which implies it is generally lower than a market rate.

Unlike many studies; see *inter alia* Mukherjee and Naka (1995) and Maysami and Koh (2000); we do not include the exchange rate as an explanatory variable. We reason the domestic economy should adjust to currency developments and thus reflect the impact of foreign income due to firms' exports measured in domestic currency over the medium run. Additionally, in the white paper on the Japanese Economy in 1993, published by the Japanese Economic Planning Agency, it has been pointed out that the boom in the economy during the late 1980s has been driven by domestic demand rather than exports (Government of Japan, 1993).

In contrast to our study, many researchers have based their analysis on business cycle variables or stock market valuation measures such as the term spread or default spread for the former category or dividend yield or earnings yield for the latter. Examples of those papers include Black, Fraser and MacDonald (1997); Campbell and Hamao (1992); Chen, Roll and Ross (1986); Cochran, DeFina and Mills (1993); Fama (1990); Fama and French (1989); Harvey, Solnik and Zhou (2002) and Schwert (1990). These variables are usually found to be stationary and as we plan to model long term equilibrium using non stationary variables we do not included them in our model.

As McAdam (2003) has confirmed, the US economy has been characterized by more frequent but less significant downturns relative to those suffered by the Japanese economy. This might be explained by a higher capital and export orientated Japanese economy relative to the US. We might therefore expect higher relative volatility in corporate cash flows and hence also in Japanese share prices. *A priori*, therefore, share prices in Japan may be more sensitive to changes in industrial production, although the greater relative volatility may also influence the estimated coefficient standard errors in any regression equation. However, previous research (see Binswanger, 2000) has found that although both stock markets move positively with economic output, that the coefficient for output on equity returns tends to be larger for the US data relative the Japanese data. Campbell and Hamao (1992) also find smaller positive coefficients for the dividend price ratio and the long-short interest rate spread on stock market returns in Japan relative to the US in a sample covering monthly data from 1971 to 1990. Thus the intuitive expectation of higher coefficients in Japan due to higher capital and export exposure has not been confirmed empirically in existing research. Japan’s banking crisis and subsequent asset deflation during the 1990s could have changed significantly the influence of a number of variables, particularly the interest rate and money supply.

To our knowledge, there has not been any empirical study of the present value model in Japan after the early 1990s and thus the severe downturn with low economic growth and deflation. Existing studies of the Japanese stock market before 1990 include Brown and Otsuki (1990), Elton and Gruber (1988), and Hamao (1988), although these papers mainly consider stationary business cycle variables and risk factors and therefore cannot give an indication of the empirical relationships we might expect to find in our model.

In this paper we compare the US and Japan over the period January 1965 until June 2005. The use of monthly data gives the opportunity to analyse a very rich data set, to our knowledge earlier papers have only analysed shorter periods or have made use of a lower data frequency. This allows us to include the impact of the historically high volatility of both stock markets. The US stock market showed very high returns between 1993 and 1999, while from 2000 until 2003 returns have been very large and negative. In the Japanese stock market during the period from 1980 through to 1990, returns have in the main been large and positive while they tend to have been large negative for most of years between 1990 and 2003. The impact of recent problems to the Japanese banking sector is also captured in our data (see Government of Japan, 1993). Most existing research has been applied to US data and very little is known about the differences between US and Japanese stock market valuation. This paper investigates the differences and common patterns in both countries in order to verify whether the same variables that explain aggregate stock market movement in the US can also be used to do so in Japan.

III. Empirical Methodology

As we are interested in modelling a long term relationship between macro variables and the stock market, cointegration analysis is the ideal tool. We use the

Johansen (1991) procedure since it has been shown to have good finite sample properties. The Johansen (1991) procedure is based on a vector error correction model (VECM) to test for at least one long run relationship between the variables. For the VECM we first determine the order of integration of the variables, making use of Augmented Dickey-Fuller and the Phillips-Perron tests, and then apply the Johansen procedure as follows: Consider a general Vector Autoregressive model with Gaussian errors written in the following error correction form:

$$\Delta X_t = \mu + \sum_{i=1}^{k-1} \Gamma_i \Delta X_{t-i} + \Pi X_{t-k} + \phi D_t + \varepsilon_t \tag{5}$$

Where ε_t is a sequence of zero-mean p-dimensional white noise vectors and D_t are seasonal dummies. The term X_t includes our variables and is a p x 1 vector. The parameters are the p x p matrix Γ and Π denotes a p x p matrix that contains the information about the rank and hence the long term relationship among the variables. There are three possible cases to be considered: Rank (Π) = p and therefore vector X_t is stationary; Rank (Π) = 0 implying absence of any stationary long run relationship among the variables of X_t or Rank (Π) < p and therefore r determines the number of cointegrating relationships. The equation has an error correction representation where $\Pi = \alpha\beta'$. The columns of matrix α are called adjustment (or loading) factors and the rows of matrix β are the cointegrating vectors with $\beta' x_t$ being stationary even if X_t consists individually of I(1) processes. Johansen developed two different tests of the hypothesis that there are at most r cointegrating vectors; the trace statistic which tests the null hypothesis of at most r cointegrating relationships against a general alternative in a likelihood ratio framework and the maximum eigenvalue statistic which tests the hypothesis of r cointegrating relationships against the defined alternative of $r+1$ cointegrating relationships.

IV. Empirical results

As a first step, unit root tests for the US and Japanese dataset have been applied to the data. For brevity, we do not present the full results here[6]. We find all series to be I(1) when we use the Phillips-Peron test and we proceed under the assumption that all series (US and Japanese) have a unit root.

Our next step is to estimate the appropriate cointegrating vector using both the US and Japanese data as follows:

<u>US</u>

$$SP500 = \beta_1 C + \beta_2 IP + \beta_3 CPI + \beta_4 M1 + \beta_5 TB \qquad (6)$$

<u>Japan</u>

$$NKY\ 225 = \beta_1 C + \beta_2 IP + \beta_3 CPI + \beta_4 M1 + \beta_5 Disco \qquad (7)$$

Note that all series are in natural logarithms. SP500 is the real S&P 500 price, C represents a constant term, IP is real Industrial Production, CPI is the consumer price index, M1 represents real M1, the real ten year US T-Bond yield is given by TB, NKY is the real Nikkei 225 and Disco is the real official discount rate (lending rate) in Japan. For the US, Industrial Production, CPI and the ten year bond yield has been taken from the IMF, M1 is taken from OECD while the S&P500 is downloaded from Bloomberg. Japanese Industrial Production, CPI and the discount rate are taken from the IMF, Japanese M1 and the Nikkei 225 are taken from the OECD and Datastream respectively. Our data has a monthly frequency and our sample runs from January 1965 until June 2005. As industrial production, M1 and the CPI time series show strong seasonality, seasonally adjusted data is used.

For the US data, the trace statistic suggests two, and the maximum eigenvalue statistic one, cointegrating vector at the 5% significance level (see Table 1). Given the evidence in favour of at least one cointegrating vector, we normalise the cointegrating vector on the stock price and find a significantly positive coefficient on Industrial Production, an insignificantly positive coefficient on M1 and a significantly negative relationship between the stock price and both the 10 year T-Bond yield and CPI (Table 2). A test of the zero restriction confirms M1 does not have any explanatory power and we re-estimate the cointegrating relationship without M1. One cointegrating relationship is then confirmed for the four remaining variables and the signs of the cointegration coefficients remain the same (Tables 3 and 4). Thus, the US stock market shows a significantly positive relationship with industrial production, while bond yields and CPI have a statistically significant negative relationship. The error correction model shows that the S&P 500, the consumer price index as well as industrial production contribute to the error correction process.

For the Japanese data, the trace statistic and the maximum eigenvalue statistic test indicate two cointegrating vectors at the 10% significance level (see Table 5). Thus we allowed for two cointegrating relationships in the Japanese data. We normalised one cointegrating vector on the stock price and, as for the US data, found a positive and significant relationship with industrial production, but in contrast to the US results, a negative and significant relationship with the money supply. Surprisingly, we found both the CPI and the discount rate to have an insignificant influence over the stock price in this cointegrating vector. We normalised the second cointegrating vector on industrial production and found a significantly negative relationship with both the CPI and the discount rate (Table 6).[7]

The results using US data are broadly in line with existing theory and evidence. As expected and in common with most existing research (see *inter alia* Chen, Roll and

Ross, 1986, Cheung and Ng, 1998 and McMillan, 2001) we find a positive relationship between industrial production and the stock price. In the case of CPI, the US shows a negative coefficient for the stock price. This result is also supportive of previous research (see *inter alia* Chen, Roll and Ross, 1986, Geske and Roll, 1983 and Fama and Schwert, 1977). Also, as expected, and in common with previous research, the US long-term interest rates show a negative influence on share prices. Finally, in common with McMillan (2001), we find the money supply, M1, does not contribute significantly to the stock price in the US. This perhaps suggests that the various influences the money supply has on the stock price (discussed above) may 'cancel' each other out.

The interpretation of the Japanese results is a little less straightforward. For the Japanese data there is also a positive relationship between industrial production and the stock market, although the coefficient is higher, suggesting as discussed above, a higher sensitivity of stock prices to industrial production.

However, when using the Japanese data, CPI is only significant in the second cointegration vector, normalised on industrial production, where it yields a negative relationship. Thus the influence of the CPI upon stock prices is negative only indirectly, via the coefficient on industrial production. This finding is surprising and differs from that of Mukherjee and Naka (1995), who find a negative coefficient on CPI for a cointegrating vector normalised on the stock price.[8] One reason for this difference may be due to the larger sample size in our study. Mukherjee and Naka make use data from the period 1971 to 1990. This corresponds to a period of relatively high inflation in Japan and stable (after the impact of the 1973 oil price shock) growth in industrial production. Our sample includes the period of strong disinflation (in the early 90s during the Japanese stock market downturn) and deflation in the late 90s and early 21st century, falling stock prices and stagnant but volatile industrial production.

During periods of low inflation its impact upon stock prices, via unexpected inflation, inflation uncertainty and a 'Defina effect' (as discussed above) is likely to be low. The period of deflation and falling stock prices is also likely to reduce the magnitude of any negative relationship over the rest of the sample.

The money supply M1 shows a significant negative coefficient on the cointegration vector normalised on the stock price, when using the Japanese data. We also find the coefficient, for the same vector, on the discount rate is insignificant. This is an unexpected result that may also be at least partly due to the difficulties faced by the Japanese economy since 1990[9]. Krugman (1998) has suggested the Japanese economy has suffered from a Keynesian liquidity trap during the late 1990s and early 21st century (see also Weberpals, 1997 and also Svensson, 2003), and our findings may be consistent with this. In particular our results are consistent with an increasing money supply during the period (particularly after 1995) and falling interest rates that were unable to pull the Japanese economy out of its slump, or prevent stock prices from falling.

V. Conclusion

In order to achieve a deeper understanding of long term stock market movements, a comparison of the US and Japanese stock market, using monthly data over the last 40 years has been conducted. Using US data we found evidence of a single cointegration vector between stock prices, industrial production, inflation and the long interest rate. The coefficients from the cointegrating vector, normalised on the stock price, suggested US stock prices were influenced, as expected, positively by industrial production and negatively by inflation and the long interest rate. However, we found the money supply had an insignificant influence over the stock price. In Japan, we found two cointegrating vectors. One normalised on the stock price provided evidence that stock prices are positively related to industrial production but negatively related to the money supply. We also found that for our second vector, normalised on industrial production, that industrial production was negatively related to the interest rate and the rate of inflation. An explanation of the difference in behaviour between the two stock markets may lie in Japan's slump after 1990 and its consequent liquidity trap of the late 1990s and early 21st century.

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Table 1:				
Sample US: 1965M06 2005M06 *Trend assumption: Linear deterministic trend* *Series: SP500 IP CPI M1 TB* *Lags interval (in first differences): 1 to 12*				
Unrestricted Cointegration Rank Test (Trace)				
Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	5% Critical Value	p-value
None	0.0865	95.007 *	69.819	0.0001
At most 1	0.0510	52.230 *	47.856	0.0183
At most 2	0.0307	27.453	29.797	0.0910
At most 3	0.0215	12.697	15.495	0.1264
At most 4	0.0051	2.405	3.841	0.1209
Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	5% Critical Value	p-value
None	0.0865	42.777 *	33.877	0.0034
At most 1	0.0510	24.778	27.584	0.1098
At most 2	0.0307	14.755	21.132	0.3064
At most 3	0.0215	10.292	14.265	0.1934
At most 4	0.0051	2.405	3.841	0.1209
Notes: Asterik denotes coefficient significance at 5% level, critical values are from MacKinnon, Haug and Michelis (1999).				

Table 2:					
US Normalized cointegrating coefficients (standard error in parentheses)					
SP500	IP	CPI	M1	TB	C
1.000000	-2.475 *	0.976 *	-0.267	5.076	3.846
	(0.453)	(0.264)	(0.400)	(2.556)	
	[-5.467]	[3.704]	[-0.670]	[1.986]	
US Vector Error Correction with standard errors and t-values					
	D(SP500)	D(IP)	D(CPI)	D(M1)	D(TB)
ECM(-1)	-0.049 *	-0.007 *	-3.0E-05*	8.82E-05	0.004 *
	(0.016)	(0.002)	(8.3E-05)	(0.002)	(0.001)
	[-3.029]	[-2.979]	[-3.719]	[0.046]	[3.242]

Table 3:				
Sample US: 1965M06 2005M06 *Trend assumption: Linear deterministic trend* *Series: SP100 IP CPI M1 TB* *Lags interval (in first differences): 1 to 12*				
Unrestricted Cointegration Rank Test (Trace)				
Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	5% Critical Value	p-value
None	0.0924	71.815 *	47.856	0.0001
At most 1	0.0351	25.976	29.797	0.1294
At most 2	0.0128	9.088	15.495	0.3573
At most 3	0.0063	2.989	3.841	0.0838
Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	5% Critical Value	p-value
None	0.0924	45.839 *	27.584	0.0001
At most 1	0.0351	16.888	21.132	0.1774
At most 2	0.0128	6.099	14.265	0.6005
At most 3	0.0063	2.989	3.841	0.0838
Notes: Asterik denotes coefficient significance at 5% level.				

Table 4:				
US Normalized cointegrating coefficients (standard error in parentheses)				
SP55	IP	CPI	TB	C
1.000000	-2.445 *	0.938 *	6.216 *	2.603
	(0.364)	(0.190)	(1.854)	
	[-6.711]	[4.945]	[3.353]	
US Vector Error Correction with standard errors and t-values				
	D(SP500)	D(IP)	D(CPI)	D(TB)
ECM(-1)	-0.036 *	-0.007 *	-3.4E-04*	0.004 *
	(0.015)	(0.002)	(7.7E-05)	(0.001)
	[-2.356]	[-3.544]	[-4.414]	[3.323]

Table 5:				
Sample Japan: 1965M01 2005M06 *Trend assumption: Linear deterministic trend* *Series: NKY225 IP CPI M1 Disco* *Lags interval (in first differences): 1 to 12*				
Unrestricted Cointegration Rank Test (Trace)				
Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	5% Critical Value	p-value
None	0.0873	91.104 *	69.819	0.0004
At most 1	0.0550	47.893 *	47.856	0.0496
At most 2	0.0272	21.128	29.797	0.3497
At most 3	0.0162	8.077	15.495	0.4572
At most 4	0.0007	0.344	3.842	0.5576
Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	5% Critical Value	p-value
None	0.0873	43.211 *	33.879	0.0029
At most 1	0.0550	26.764	27.584	0.0634
At most 2	0.0272	13.051	21.132	0.4475
At most 3	0.0162	7.733	14.265	0.4065
At most 4	0.0007	0.344	3.841	0.5576
Notes: Asterik denotes coefficient significance at 5% level.				

Table 6:					
Japan Normalized cointegrating coefficients (standard error in parentheses)					
NKY225	IP	CPI	M1	Disco	C
1.000	-6.110 *	0	1.389 *	0	21.745
	(0.556)		(0.291)		
	[-10.992]		[4.780]		
0	1.000	2.584 *	0	15.769 *	-21.194
		(0.399)		(5.131)	
		[6.482]		[3.073]	
Japan Vector Error Correction with standard errors and t-values					
	D(NKY225)	D(IP)	D(CPI)	D(M1)	D(Disco)
ECM(-1)	-0.015	0.006 *	-1.2E-04	-0.004 *	0.002
	(0.009)	(0.002)	(7.3E-05)	(0.001)	(0.001)
	[-1.728]	[3.332]	[-1.641]	[-2.815]	[1.536]
ECM(-2)	-0.021 *	0.003	-6.94E-05	-0.00685 *	9.4E-04
	(0.009)	(0.002)	(7.6E-05)	(0.00151)	(0.001)
	[-2.361]	[1.689]	[-0.911]	[-4.531]	[0.867]

[1] Chen, Roll and Ross (1986) use a PVM framework to investigate the impact of systematic risk factors upon stock returns, through factor influences on future cash flows or the discount rate of those cash flows. They found that the yield spread between long and short term government bonds, expected inflation, unexpected inflation, industrial production growth and the yield spread between corporate high and low grade bonds significantly explain stock market returns.

[2] In Japan the NIKKEI fell almost 75% over the 13 years from 1990.

[3] The derivation of the PVM could easily be extended to allow a time-varying expected discount rate.

[4] See *inter alia* Fama (1981), Chen, Roll and Ross (1986), Schwert (1990), Mukherjee and Naka (1995), Cheung and Ng (1998) and Binswanger (2000)

[5] For example see Chen, Roll and Ross, (1986)and Mukherjee and Naka, (1995)

[6] Full unit root test results are available on request. Note we use the SIC criterion in order to determine lag length in our tests.

[7] These restrictions identify the two cointegrating vectors and are found to be binding using a Lagrange Multiplier test. The relevant Chi-Square (2) test statistic is 0.079, which is insignificantly different from zero

[8] They also find two cointegrating vectors, although only report coefficients for the vector with the highest eigenvalue.

[9] For example, Mukerjee and Naka find a negative coefficient on the long term interest rate and a positive coefficient on the the money supply for their cointegrating vector

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