WHAT MOVES THE STOCK MARKET? — AN EXAMINATION OF THE CO-MOVEMENT BETWEEN STOCK PRICES AND AGGREGATE ECONOMIC ACTIVITY

by

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Title of Project *What Moves The Stock Market? - An Examination Of The Co-movement Between Stock Prices And Aggregated Economic Activity.*

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Abstract

This paper investigates whether there is a long run co-movement between the stock market and aggregate economic activity. Following the testing framework suggested by Cheung and Ng (1998), the paper examines six major countries including United States, United Kingdom, Canada, Germany, Japan and Australia. Quarterly data from 1969 to 1998 are used to estimate the long run relationship between a country's stock market and its aggregate economic activity. From a Vector Error Correction model including a cointegration term, the stock return is explained by the deviation of the stock price index from its long run equilibrium level and other macroeconomic variables. A significant cointegration term implies that aggregate economic activity is one of the forces that influence the long run stock market behavior. However, the empirical results from this paper do not provide strong support for this long run equilibrium between the stock prices and aggregate economic activity. Possible explanations are provided for this mixed international evidence.

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1. Introduction

The Random Walk Theory in asset pricing is a famous one. It states stock market's price movements will not follow any patterns or trends and that past price movements cannot be used to predict future prices movements. This assertion can be traced back to 1900, French mathematician Louis Bachelier's Ph.D. dissertation titled "The Theory of Speculation". Unfortunately, this remark was not published in English until 1964 when his thesis was rediscovered. Since then, there are hot debates on this theory. The latter part of the theory that past price movements cannot be used to predict future price movements, arouses another notable theory: Efficient Market Theory[1] in asset pricing. This paper will focus instead on the first part of the Random Walk Theory, that is, whether stock prices movements will follow any patterns or not.

Much existing literature examines the linkage between the movements of the stock market and real activity. Schwert (1990) analyzes the relation between real stock returns and real activity from 1889 to 1988 and concludes that there is a strong positive relationship between real stock returns and proxies for real economic activity. He strengthens the point that stock returns are related to future real activity using 100 years of data. It is believed there are systematic economic forces that affect the long run return of financial assets, but a lack of identifiable state variables poses an embarrassing gap in the research. Realizing this gap, Chen, Roll and Ross (1986) explore a set of economic state variables as systematic influences on stock market. Through their study, it is found that the spread between long term and short term interest rates, expected and unexpected

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[1] Eugene F. Fama, "Random Walks in Stock Market Prices," *Financial Analysts Journal*, September/October 1965

inflation, industrial production, and the spread between high- and low- grade bonds significantly affect in the stock market, which seems to be consistent with Fama (1981). Fama (1990)'s three sources of annual stock return variation are: a) shocks to expected cash flows, b) predictable return variation due to variation through time in the discount rates that price expected cash flows, and c) shocks to discount rates. They further test whether real consumption and real oil price influence the stock prices and assert those two factors have little power to explain the prices movements in the stock market. Pindyck and Rotemberg (1993) suggest that the underlying macroeconomic variables help to explain the stock prices through testing the co-movement of stock prices. They include five macroeconomic variables: real GNP, GNP deflator, an index of the exchange value of the dollar against ten other currencies, the ratio of aggregate corporate profits before tax to nominal GNP and the three-month Treasury bill rate. The unfavorable finding from their paper is that macroeconomic variables explain very little of the variation in ex post returns and they attribute this result to the possibility of omitting some important macroeconomic variables in their specification. There are other observations and empirical evidence showing macroeconomic variables can help to explain the stock prices. Barro (1990) and Ferson and Harvey (1991) find U.S. stock return and its aggregate real activity are correlated. Asprem (1989), Beckers et al. (1992), Cheung et al. (1997) obtain the similar results from international evidences.

As Cheung and Ng (1998) suggested, those studies mainly focus on the short run relationship among stock returns, macroeconomic variables and financial variables. There is relatively less literature on the long run relationship between the stock returns and macroeconomic variables. Three questions arise from this observation. First, does long run co-movement between the stock prices and macroeconomic activity really exist? If there is no such a relationship, the Random Walk Theory seems to be supported as a good description of the stock market and attempts to find the underlying long run macroeconomic forces would fail. Second, suppose empirical results show that there exists long run equilibrium between the stock price and aggregate economic activity, what are the real variables that influence the stock market in the long run? Can we find a good specification to represent this long run relationship? Third, how do those identified macroeconomic variables influence the stock market? Can we find any hints from those variables if we want to examine the long run behavior of the stock prices? This paper focuses on the first question, which is the most fundamental one, while the second and third question will be addressed as a byproduct.

Cheung and Ng (1998) adopt an error correction model to investigate the long run relationship and short run dynamics from examining five national stock markets. They compute the Johansen cointegration test to estimate the long run equilibrium. The two-step cointegration analysis is first developed by Engle and Granger (1987). Johansen (1991) further develops a more efficient procedure. If several I(1) variables are cointegrated, they tend to move together in the long run, while allowing the possibility of short run deviations from the long run equilibrium. Kasa (1992) investigates the common stochastic trend in international stock markets. He uses a cointegration system to study whether there is a long-term common trend in the international stock markets. Other papers by R. Masih and A. Masih (2001), and Manning (2002) use the cointegration approach to explore the long run behavior of the international stock markets. All those studies demonstrate that cointegration analysis is a better specification compared to the ordinary VAR, which ignores an important component of linkages displayed purely over the long run. The merit of the error correction model is that it includes both the short run dynamics, which is considered to be important by Box-Jenkins approach in time series analysis, and the long run economic forces, which is considered to be favorable by macro economists.

From their data, Cheung and Ng conclude that there is long run co-movement between the stock prices and the aggregate economic variables, and that the short run fluctuations in the stock markets tend to adjust back to the long run equilibrium level. The macroeconomic variables they include are real oil price, real gross national product, real money supply and real consumption. Their error correction model indicates real consumption has a positive relationship with stock price, while the influence of GNP is ambiguous. The real oil price is considered as a source of exogenous supply shock that will influence production and the price level. It is negatively related to the stock prices in most of the sample countries, which provides a piece of contrary empirical evidence to Chen, Roll and Ross (1986). Real money supply seems to have an ambiguous effect on the stock price and the authors list potential interpretations of this finding. To further explore the use of the long run equilibrium, they add the cointegration term that reflects the short run deviations from the long run relationship in Fama (1990)'s estimation equation and find that the cointegration term is statistically significant. That implies adding the long run equilibrium increase the explanatory power for the stock returns.

Based on the existing studies, I will consider real GDP, real money supply, real household consumption, and real oil price as the candidates for key macroeconomic variables. Theoretically, real money supply should not have any influence on the stock prices in the long run because money is neutral in a long horizon, which means the influences of money supply on people's wealth and interest rates are only evident in the short run. The change in real money supply does not influence the long run real variables. However, in empirical work there is no clear definition of short run and long run base on the length of time. As Cheung and Ng include real money supply in their specification, I also consider that variable as an aggregate variable in my specification. All of these variables are supposed to be integrated of order one and thus possible to be cointegrated with the stock price. Popular macroeconomic variables to explain the stock return include dividend yields, the default spread and the term structure of interest rate. They are suspected to be integrated of order zero, which implies that they cannot be good candidates for the cointegrating relationship. However, they are still useful explanatory variables to account for the stock return variation. Collecting six national stock markets' data and their corresponding macroeconomic data, I will follow the test procedure that is used by Cheung and Ng (1998) to examine whether there is a long run co-movement between the stock prices and aggregate economic activity. From the cointegration equation, likely candidates for macroeconomic variables can be identified. The sign of each explanatory variable in the cointegration equation indicates the effect of that variable on the stock prices. A significant cointegration term in the error correction model can provide some insights for policy makers regarding of the stock market.

2. Methodology

The model in this paper is an error correction model. The regression equation consists of lagged macro variables and lagged error correction term, and lagged stock price indexes to exploit the feature of time series data (past performance is powerful in explaining current performance). Before estimating the model equation, I should test whether the variables I use in the error correction model are stationary. The mixed order of integration will cause the failure of the model. An ADF test will be used to test the unit roots in the time series. The null hypothesis of ADF test is that there is a unit root. The test has a bias to conclude that there is a unit root.

If as expected, those macro variables and stock price indexes display I(1) property, then the Johansen cointegration test can be applied. The logic of Johansen test starts from a Var(j) specification:

$$X_t = A_0 + A_1 X_{t-1} + A_2 X_{t-s} + \ldots + A_j X_{t-j} + \varepsilon_t$$

where X_t is a vector of the variables that will enter into the cointegrating relationship. $A_i, i = 1,\ldots, j$ are parameters in this VAR specification. ε_t follows i.i.d. If we subtract from both sides of the equation X_{t-1}, after rearranging, the equation looks like:

$$\Delta X_t = A_0 + (A_1 - I)\Delta X_{t-1} + (A_1 + A_2 - I)\Delta X_{t-2} + \ldots + (A_1 + A_2 + \ldots + A_{j-1} - I)\Delta X_{t-j+1}$$
$$+ \Pi X_{t-j} + \varepsilon_t$$

If all the Xs are I(1), then the ΔXs are I(0). The only way to make this equation work is either $\Pi = 0$ or ΠX_{t-j} represents the long run impacts. The rank (r) of the matrix Π implies the number of cointegrating relationships among the elements of X_t. Π can be decomposed as $\Pi = \alpha\beta'$, where α is the speed of adjustment to the long run equilibrium, β is the cointegration vectors. In practice, we do not know r, but fortunately we can use the available information to use either Trace Statistic or the $\lambda_{\max}$ statistic to test the number of cointegrating relationships. Trace Statistic tests the hypothesis that there are at most r cointegrating relationships against at most n cointegrating relationships, where n is the number of variables included in the X_t vector. The $\lambda_{\max}$ statistic tests that there are r cointegrating relationships against $r+1$ cointegrating relationships.

To implement the Johansen test procedure, we need to estimate the following equations:

$$\Delta X_t = B_0 + \sum_{i=1}^{j-1} B_i \Delta X_{t-i} + \mu_1$$

$$X_{t-j} = B_0' + \sum_{i=1}^{j-1} B_i' \Delta X_{t-i} + \mu_2$$

The trace statistic is:

$$t_r = -T \sum_{i=j+1}^{n} \ln(1-\lambda_i), 0 \le r \le n,$$

where λ_i is the eigenvalue of the problem:

$$\left|\lambda\Omega_{22} - \Omega_{21}\Omega_{11}^{-1}\Omega\right| = 0$$

with $\Omega_{kl} = T^{-1}\sum_{t=1}^{T} \hat{\mu}_{kt} \hat{\mu}_{lt}'$ for $k,l = 1,2$. The estimated cointegration vectors $\hat{\beta}_i, i = 1,\ldots,r$ can also to be computed as the eigenvctors. The $\lambda_{\max}$ statistic is:

$$\lambda_{r|r+1} = -T\ln(1-\lambda_{r+1})$$

Empirical evidence shows that the Johansen test has good large and finite sample properties. In finite samples, the asympototic critical values tabulated by Johansen and Juselius (1990) tend to reject the null of no integration relationship too often.

In this paper, X_t should be a vector of stock price index and macroeconomic variables for one country. The number of cointegrating relationships suggested by the Johansen test would be the number of long run relationships between stock market and aggregate activity. The product of $\hat{\beta}_r$ and X_t is the error correction term, which represents the short run deviation from the long run equilibrium. One important point of the error correction term is that it should follow an I(0) process.

Based on the cointegration terms we derived from the Johansen test for each country, we can estimate a vector error correction model with the vector including the stock return as the dependent variable.

$$\Delta s_t = c_t + \sum_{i=a}^{p} \gamma_{i,} x_{i,t-1} + \sum_{i=1}^{q} \theta_i \Delta s_{t-i} + \sum_{i=a}^{m} \delta_i \Delta Y_{t-i} + \omega_t$$

Δs_t is the stock return at time period t. $x_{i,t-1}$ is lagged cointegration term. ΔY_{t-i} is the first differenced vector of macro variables. $c_t, \gamma_{i,} \theta_i, \delta_i$ are coefficients' matrices that the model will estimate. p, q, m are the proper order of lags in the corresponding terms. A significant error correction term will imply the existence of long run co-movement between stock prices and aggregate economic activity.

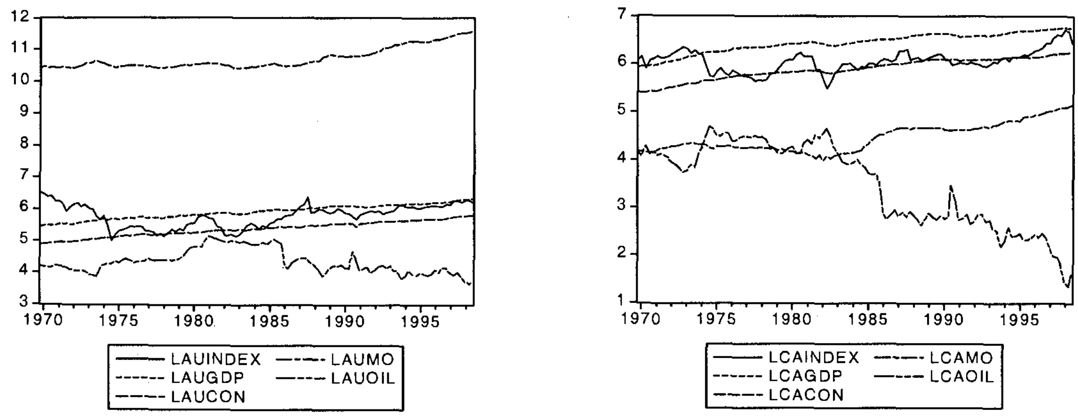
3. Data

I focus on the stock markets from Australia, Canada, Japan, Germany, United Kingdom, and United States. The frequency of the data is quarterly data that is often adopted in macroeconomic time series analysis. To estimate the long run equilibrium, a large sample size is preferable. The time period extends from 4th quarter 1969 to 3rd quarter 1998. There are two considerations for this time length. First, the available data for stock price indices only starts from 4th quarter in 1969. Second, the money supply in Germany ends in 1998 because the Euro was introduced in several European countries including Germany.

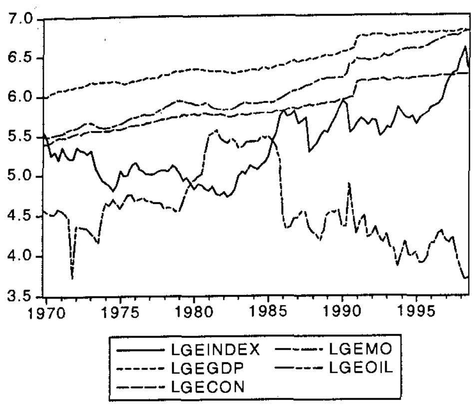
The stock price index for each country is from Morgan Stanley Capital Perspective, except for the U.S., which is from CRSP tape. The stock price index is dividend exclusive. The stock price index is evaluated in local currency and they are end of quarter prices. The macroeconomic data include: GDP, money supply, exchange rate, consumer price index, consumption, and crude oil price index. As introduced above, variables such as dividend yields, the risk premium and the term structure of interest rates are helpful to explain the stock return variation. However, those variables normally have no unit root, which make those variables ineligible to be chosen to explain the long run equilibrium. International Financial Statistics (supported by International Monetary Fund) provides macroeconomic data including GDP, money supply, exchange rate index, Consumer Price Index, and Households' consumption. Crude oil price is from CITIBASE. The original data is the crude oil price index in U.S. dollars. As is known, the world crude oil markets tend to move together. With the exchange rate index obtained from IFS, I converted the crude oil price for each country into its own local currency. Money supply for Australia, Germany and United States is measured by seasonally adjusted M1. For Japan and Canada, I use seasonally adjusted Money instead of M1 due to the data availability. The definition of Money is similar to the definition of M1 provided by IFS. For the United Kingdom, the money supply is seasonally adjusted M4. From the Bank of England database, it seems the measure of money in United Kingdom includes only M0 and M4, while M0 is too narrow to represent the money stock.

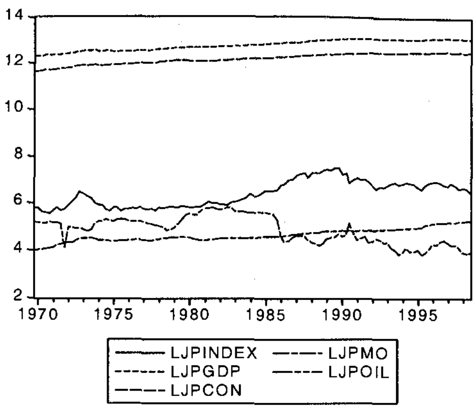
All the data are transformed into natural logarithm and real terms, in which 1995 is taken as the base year. Figure 1 plots each country's stock price index and macro variables[2].

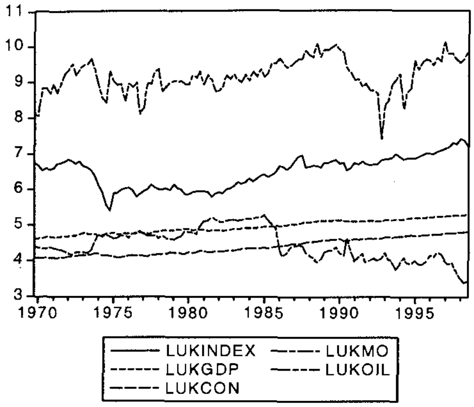
Figure 1: Plots of data

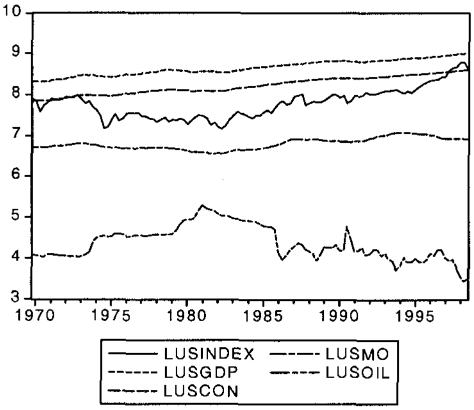


[2] The table that contains the glossary and definitions of variables is provided in the appendix.









From these figures, we can roughly see that except for the oil price, all the other macro variables seem to be positively correlated with the stock price index[3]. The positive relationship between consumption and the stock price index can be traced to consumption-based CAPM. Much literature finds that future growth in GDP can represent the equity's expected return. Theoretically, the influence of current GDP on the stock price index is ambiguous. GDP is positively correlated with consumption, so its influence on the stock price index should be similar to the influence of consumption described above. The wealth effect of increasing the money supply tends to support the

[3] This can be also seen from their contemporary correlations' table in appendix.

idea that money supply is positively related to the stock price. Oil price[4] is often considered as a proxy for exogenous supply shock. An increase in the oil price will increase production costs and thus negatively influence the stock price.

The above descriptions of the data provide us with a first-sight impression about how those macro variables influence the stock market. However, those descriptive statistics cannot represent the true long-run equilibrium between the stock price index and aggregate economic activity. The interactions among those macro variables may change the conclusions from bivariate analysis.

[4] Jones, Charles M., and Kaul, Gautam (1996) has detailed examination of the impact of oil price on the stock market.

4. Empirical Results

4.1 Unit root test

As described in the introduction, the first step is to test if there is unit root in the time series data. Only I(1) variables can be included in the cointegration system. The test statistic we employ is Augmented Dickey-Fuller (1979) test. The null hypothesis is that there is a unit root in the data. Considering different options about an intercept and a linear trend when doing the test, I try both including an intercept, and including an intercept and a linear trend. With only an intercept, the alternative hypothesis of the test is that the time series has constant fluctuations around a constant mean. With both an intercept and a linear trend, the alternative hypothesis is that the time series has fluctuations around a deterministic linear trend. The results from the tests are reported in Table1 and Table 2.

Table 1: Unit root tests with an intercept

	Stock Price	GDP	Consumption	MoneySupply	Oil Price
Australia	-2.131715	-0.992425	-0.844463	0.936390	-1.408054
Canada	-1.914620	-2.477217	-2.633441	0.552788	0.055439
Germany	-0.272890	-0.558342	-0.679031	0.559180	-1.395750
Japan	-1.304524	-2.062477	-2.796092	-0.599918	-1.170954
U.K.	-0.817920	-0.212458	0.746543	-4.086031	-0.655520
U.S.	-0.188692	-0.466285	-0.265662	-1.485729	-0.936824

*Critical value at 5% is –2.886732. Critical value at 10% is –2.580281.

** Schwartz information criterion is used to determine the number of lags.

*** All the variables in this table are in logged real terms.

Table 2: Unit root tests with an intercept and a linear trend

	Stock Price	GDP	Consumption	MoneySupply	Oil Price
Australia	-2.900259	-3.298786	-4.640248	-0.862513	-1.735273
Canada	-1.937763	-2.654457	-2.122632	-0.977683	-2.096927
Germany	-2.469309	-1.550476	-1.826167	-1.410368	-1.839660
Japan	-1.165646	-1.774093	-2.237955	-2.335784	-2.122347
U.K.	-2.271638	-2.647685	-2.360591	-4.293647	-1.557986
U.S.	-0.1884633	-2.633939	-3.353852	-2.138998	-1.591417

*Critical Value at 5% is –3.449365. Critical Value at 10% is –3.149922.

**Schwartz information criterion is used to determine the number of lags.

*** All the variables in this table are in logged real terms.

The test results suggest except for the money supply in United Kingdom (both in Table 1 and Table 2) and the consumption in Australia (only in Table 2), all the other variables exhibit the I(1) character, although some of them only marginally have unit root. One explanation concerning the money supply in United Kingdom is that the measure of money M4 is a broader one, which may exhibit different order of integration from M1. There is no obvious reason for the I(0) process of consumption in Australia. Besides the above tests, first-difference of all the variables are tested against the I(0) process. To conserve space, I do not report the test results, but first-difference of all I(1) variables have no unit root.

4.2 Johansen cointegration test and error correction model

Cheung and Ng (1998) use real stock index, real GNP, real consumption, real money supply and real oil price as the endogenous variables in the VAR system. They carry out the Johansen cointegration test based on the VAR. Their results show there are cointegrating relationships among those variables with the stock index normalizing to 1 in each country, which provides evidence of the existence of long run equilibrium exists between stock prices and aggregate economic activity.

Following Cheung and Ng (1998), I use their specification[5] and try to replicate their results. Their cointegration tests[6] show there is one cointegrating relationship in Canada, Japan and U.S. and there are two cointegrating relationships in Germany and Italy, which tend to support the idea that there is long run co-movement between stock market and macro variables. Table 6 summarizes my Johansen test results.

Table 3: Johansen cointegration test (following Cheung and Ng's specification)

Country	Trace Statistic			$\lambda-\max$ Statistic		
H_0:	$r \leq 2$	$r \leq 1$	$r = 0$	$r \leq 2$	$r \leq 1$	$r = 0$
Australia	7.724395	20.45478	42.07983	7.666930	12.73039	21.62505
Canada	21.48473	43.14280	86.82348*	12.13691	21.65807	43.68069*
Germany	24.78305	46.73992	101.1645*	14.86162	21.95687	54.42459*
Japan	17.34997	37.82916	74.70426*	9.362153	20.47919	36.87510*
U.K.	7.691980	21.04487	43.71991	7.651274	13.35289	22.67504
U.S.	12.66776	35.53030	66.75576	9.657667	22.86254	31.22546

* The Statistic with* indicates the rejection of the null hypothesis.

** The 5% critical values of Trace Statistic are: $r \leq 2$, 29.68; $r \leq 1$, 47.21; $r = 0$, 68.52. The 5% critical values of $\lambda-\max$ statistic are $r \leq 2$, 20.97; $r \leq 1$, 27.07; $r = 0$, 33.46.

*** The number of lags in each cointegration test is determined by the Schwartz Criteria. Number of the lags included for all the cointegraion tests in this table is one.

From my data, cointegration is evident only in Canada, Germany and Japan. One explanation for Australia and U.K. not having a cointegrating relationship is that due to the unit root test results from my data, real consumption is dropped in the Australia VAR and real money supply is dropped in the U.K. VAR. This specification is a deviation from Cheung and Ng's original specification. Surprisingly, there is no cointegrating

[5] I exclude real consumption for Australia VAR and real money supply for U.K. VAR because those two series follow I(0) process.

[6] I use specification 3, which include an intercept in both the cointegration part and the VAR, for cointegration test in Eviews. The rationale is that those logged variables seem to have nonzero mean, which suggests including an intercept in the cointegration part. To account for the trending property of the time series, an intercept in the VAR system should be included to represent the stochastic trend.

[6] All the variables are logged.

relationship in U.S. between the stock market and aggregate activity. The next table presents those estimated cointegration vectors, in which the stock price index is normalized to 1.

Table 4: Estimated cointegration vectors from Johansen test

	Stock price	GDP	Consumption	Money	Oil price
Canada	1.000000	-6.711461	7.566862	0.961233	0.858661
		(1.04154)	(1.09887)	(0.21631)	(0.08630)
Germany	1.000000	-8.611773	13.06121	-4.009114	-0.140094
		(1.81986)	(1.74772)	(0.58778)	(0.08822)
Japan	1.000000	-8.762734	8.096550	-0.846937	0.441717
		(1.80948)	(2.02387)	(0.65354)	(1.14331)

*The cointegration vectors are estimated from the cointegrated system reported in Table3.
** Standard deviations are in parentheses.

In contrast to Cheung and Ng's result, in this sample, GDP has a positive influence on the stock market but Consumption has a negative influence on the stock market. By inspecting my data[7], it is found that the contemporaneous correlation between real consumption and real GDP is almost 1. Macroeconomic theory suggests if consumption is regressed on income, the estimated slope coefficient should be a positive number, which is called marginal propensity to consume. Other empirical work finds that there is a cointegrating relationship between income and consumption. This finding can account for the contradictory result in Cheung and Ng (1998). In their empirical result, the estimated coefficients of real consumption always have the opposite sign as the estimated coefficients of real GDP in one cointegrating relationship. Specifically, most of the cointegrating relationships show that real consumption has a positive effect on the stock market. The influence of real GNP is a negative in most of the cointegrating relationships. In six out of seven cointegrating relationships, the estimated coefficients of

[7] Appendix provides the table of contemporaneous correlations.

real GNP have the opposite sign compared to the estimated coefficients of real consumption. Their result is contradictory. If consumption has a positive effect on the stock price index, income should positively influence stock price index as well. Doing the bivariate cointegration test[8] can confirm that guess.

Table 5: Estimated cointegration vectors from Johansen test (bivariate)

	Real stock price	Real GDP	Real stock price	Real consumption
Japan	1.000000	-2.477252	1.000000	-3.035959

* The coefficients are from the Johansen cointegration tests in the appendix.

If we put both consumption and real GDP as factors explaining the long run stock market, the nearly perfect correlation between consumption and income will make it difficult to separate the effect of one of them from the other, also the variance of those estimated coefficients would be spuriously high, leading to incorrect statistical inference. To avoid the problem caused by this perfect correlation, I will drop real GDP[9] from the long run equilibrium equation. Besides the consideration of high multicollinearity, there are two other reasons for dropping real GDP. First, lots of literature, such as Fama (1990), finds it is future GDP growth that is useful to explain the short run stock return variation. There is less literature documenting the influence of current GDP on the stock market. Second, keeping real consumption in the equation is to reflect a very important asset pricing theory, CCAPM, in which individual's consumption decision plays an important role in determining the asset return. Wheatley (1988) reports that consumption risk is significantly present in the asset price.

[8] I try the bivariate cointegration test and it implies there is one cointegrating relationship between Japan's stock price index and its GDP, and between Japan's stock price index and consumption. The Johansen cointegration test results are provided in the appendix.

[9] For Australia, I drop real consumption because real consumption does not have unit root based on the ADF test.

The next step is to include all macro variables in the long run equation except real GDP to see whether there is a long run co-movement between the stock market and the aggregate economic activity when allowing those macro variables to interact with each other.

Table 6: Johansen cointegration test (modified specification)

Country	Trace Statistic			$\lambda-$max Statistic		
H_0:	$r \leq 2$	$r \leq 1$	$r = 0$	$r \leq 2$	$r \leq 1$	$r = 0$
Australia	7.724395	20.45478	42.07983	7.666930	12.73039	21.62505
Canada	11.12714	28.74809	60.03691*	10.44153	17.62096	31.28882*
Germany	11.29484	25.28599	65.18110*	10.75924	13.99115	39.89511*
Japan	8.214234	26.35199	46.86511	7.484475	18.13775	20.51313
U.K.	0.227124	7.404967	22.80107	0.227124	7.177844	15.39610
U.S.	4.678146	17.33208	36.11814	4.652922	12.65394	18.78605

* The Statistic with* indicates the rejection of the null hypothesis.

** The 5% critical values of Trace Statistic are: $r \leq 2$, 29.68; $r \leq 1$, 47.21; $r = 0$, 68.52. The 5% critical values of $\lambda-\max$ statistic are $r \leq 2$, 20.97; $r \leq 1$, 27.07; $r = 0$, 33.46.

*** The number of lags in each cointegration test is determined by the Schwartz Criteria. Number of the lags included for all the cointegraion tests in this table is one except in US VAR two lags are included.

Under the new specification, cointegration is only evident in Canada and Germany. In all the other countries, there is no long run equilibrium between the stock market and aggregate economic activity in the sample. The estimated cointegration vectors are reported in the next table.

Table 7: Estimated cointegration vector from the Johansen test

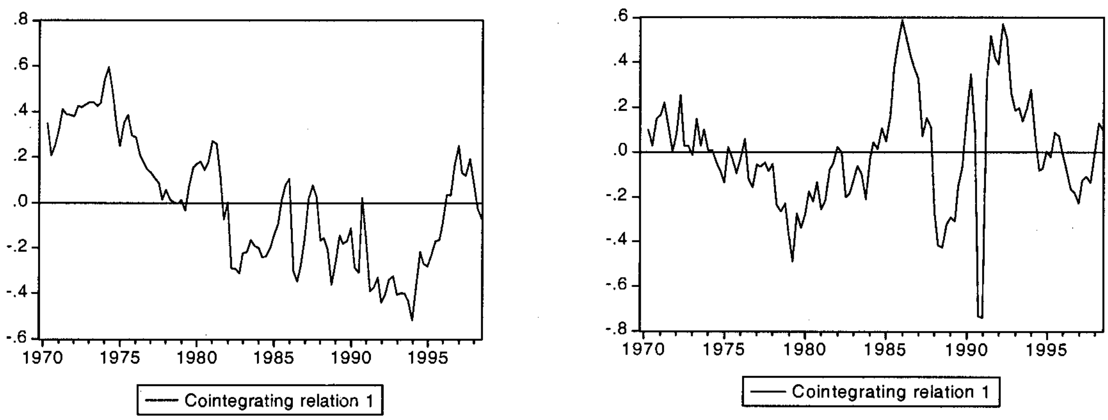
	Stock price	Consumption	Money	Oil price
Canada	1.000000	-0.541015	1.416368	0.858661
		(0.33756)	(0.48869)	(0.17238)
Germany	1.000000	6.500550	-5.117860	-0.009006
		(1.00379)	(0.70081)	(0.009511)

*The cointegration vectors are estimated from the cointegrated system reported in Table 6.

** Standard deviations are in parentheses.

In the long run equilibrium, the estimated coefficients of each macro variable demonstrate different signs in its corresponding country. The role of macro variables is ambiguous from this cointegration analysis. The explanatory power of each macro variable also differs in different countries, which is evident by viewing the t-statistics. Real oil price is not statistically significant in Germany in the long run equilibrium. Given the cointegration vectors and the system variables, cointegration terms can be estimated by multiplying the two. The economic interpretation of the cointegration term is the short run deviation from the long run equilibrium. Figure 2 plots these estimated cointegration terms for Canada and Germany.

Figure 2: Plots of cointegration terms



Canada Germany

In Canada, the short run deviations are mainly positive deviations from 1969 to 1981. Afterwards, negative deviations dominate. The volatility of the deviations does not change much over the years. In contrast, Cheung and Ng (1998) find that the volatility of the deviations increases slightly over time. Given the number of cointegrating relationships, we can estimate the error correction model to test whether short run deviations tend to adjust back to the long run equilibrium. Also, the dependent variable of the ECM is the difference between the logged current stock price index and logged stock index in the previous period. This difference can be viewed as the stock return. Table 8 reports the estimated ECM.

Table 8: Error correction model

	CointEq1	$D(index)_{-1}$	$D(con)_{-1}$	$D(money)_{-1}$	$D(oil)_{-1}$	constant
Canada	-0.062573	0.173257	0.831682	0.118506	0.062454	-0.00397
	(0.03346)	(0.12608)	(0.94428)	(0.29920)	(0.07002)	(0.01065)
Germany	-0.089408	0.112244	0.585849	-0.183745	-0.068091	0.003950
	(0.04169)	(0.10037)	(0.49366)	(0.53055)	(0.06000)	(0.01100)

* Standard errors are in parentheses

In both Canada and Germany, the estimated coefficient of the cointegration term is negative and statistically significant. This result implies that the short run deviation in the stock price index has a tendency to revert back to its empirical long run equilibrium level. It also implies that if long run equilibrium exists, short run deviation can help to explain the short run stock return variation. The estimated coefficient of the cointegration term is –0.062573 in Canada equation and –0.089409 in Germany equation. The interpretation is that in Canada, if the stock price index deviates from its long run equilibrium level by 1 unit, it will adjust back by 6% of the deviation after a quarter. We can see the speeds of adjustment are quite slow. The stock markets in Canada and Germany should be very inefficient from this empirical evidence. The estimated coefficients of all the other lagged macro variables and lagged stock price index are not statistically significant, which means they only have weak power to explain the stock return. This observation seems indirectly supporting the latter part of the famous Random Walk Theory, which states past stock price movements are not useful to explain future price movements.

Overall, the above analysis shows that long run co-movement between the stock market and aggregate economic activity exists in some countries, such as Canada and Germany; but there is not such a typical long run co-movement in every country. Also, for one macro variable, its long run influence on the stock price index seems to be different in different countries. These findings do not provide us with much help to predict the long run stock market movements. There are possible reasons that may account for those findings.

First, the focus of this paper is on the relationship between aggregate economic variables and the stock market, which means other variables might be omitted from the analysis. Campbell and Shiller (2001) use updated data and conclude that fundamental values of corporations such as the price-earnings ratio and the dividend-price ratio are primarily useful in forecasting future stock price changes. Moreover, stock prices tend to adjust to move the ratios to their mean levels, which to some extent supports the mean-reversion theory. Other variables that are documented to explain the stock return variation include bond yield, risk premium and term structure of interest rate. As they do not have the same integration order as the stock price, we cannot take them as candidate variables to explain the stock prices. Omitting those important variables may decrease the explanatory power of the specification in this paper.

Second, the purpose of this paper is to examine the long run behavior of the stock market. Due to data inavailability, international stock market index data only go back to 1970 or so. Thirty years of data may not be a good representative of the long horizon stock market. Macro data that are used in the above empirical work also pose some problems. In the sample, there is no unit root in Australia's real consumption and U.K.'s real money supply, thus we cannot include those two variables in the Johansen cointegration test. We actually lose some information to explain the long run stock price index in those two countries. The Johansen test gives us the number of cointegrating relationships based on the specific sample of data.

Third, to explain the stock market, we should take the institution of each country's financial market into account. Different financial regulations, industrial structures, stock trading systems, and the fiscal and monetary policies across countries may account for the mixed international evidence. Within one country, for example in U.S., the economy and the financial markets have experienced structural changes in recent decades. Services have become the leading sector in most industrialized countries. The secondary market is more developed than before. All those exogenous forces can influence the stock market, but we do not model those factors in our specification. A possible candidate variable to account for the financial market structure is the ratio of stock market capitalization to GDP. Mehra (1998) finds that there was significant movement in the value of the stock market as a share of national income. Hobijn and Jovanovic (2000) also observe that the capitalization/GDP ratio has varied by a factor of 5 since 1968. Further, they find that the ratio responds to the change in the structure of the economy and then show that leading

OECD countries experienced similar movements in this ratio except for Japan. This empirical evidence suggests that capitalization/GDP ratio may represent the underlying economic structural changes within one country as well as across countries.

5. Conclusion

This paper attempts to examine whether there is empirical long run co-movement between the stock market and aggregate economic activity. A cointegration approach is adopted. By modifying Cheung and Ng's specification, cointegration is only evident in Canada and Japan. In the other four countries, there is no such evidence appeared. The long run influence of each macro variable appears to be different in different countries. Estimating the error correction model, it is found that if long run equilibrium exists, the short run deviations tend to adjust back to the long run equilibrium level. However, the speed of adjustment is far too slow and thus implies highly inefficient stock market in Canada and Germany. This mixed international evidence does not provide strong support to conclude stock market and aggregate economic activity exhibit long run equilibrium. Tentative explanations are offered for the findings. From this empirical evidence, we can see using only aggregate data is not enough to explain the long run movement in the stock market. Cheung and Ng's evidence of the existence of such long run equilibrium is suspected to be due to model misspecification. To model the long run stock market, we need rely on the financial variables and use aggregate data to get some supplementary information. The underlying structural change in the stock market appears to be important in determining the long run performance of the stock market. However, we have not found a good way to model this structural change. This difficulty may account for the existence of a vast literature explaining the short run stock return, while only a few researchers concentrate on the long run stock market.

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Appendix

Table 1: Glossary and Definition of Variables:

Symbol	Variable
LAUCON	Australia, log real consumption at 1995 price
LAUGDP	Australia, log real GDP at 1995 price
LAUINDEX	Australia, log stock price index at 1995 price
LAUMO	Australia, log real money supply at 1995 price
LAUOIL	Australia, log real crude oil price index at 1995 price
LCACON	Canada, log real consumption at 1995 price
LCAGDP	Canada, log real GDP at 1995 price
LCAINDEX	Canada, log stock price index at 1995 price
LCAMO	Canada, log real money supply at 1995 price
LCAOIL	Canada, log real crude oil price index at 1995 price
LGECON	Germany, log real consumption at 1995 price
LGEGDP	Germany, log real GDP at 1995 price
LGEINDEX	Germany, log stock price index at 1995 price
LGEMO	Germany, log real money supply at 1995 price
LGEMOIL	Germany, log real crude oil price index at 1995 price
LJPCON	Japan, log real consumption at 1995 price
LJPGDP	Japan, log real GDP at 1995 price
LJPINEX	Japan, log stock price index at 1995 price
LJPMO	Japan, log real money supply at 1995 price
LJPOIL	Japan, log real crude oil price index at 1995 price
LUKCON	UK, log real consumption at 1995 price
LUKGDP	UK, log real GDP at 1995 price
LUKINDEX	UK, log stock price index at 1995 price
LUKMO	UK, log real money supply at 1995 price
LUKOIL	UK, log real crude oil price index at 1995 price
LUSCON	US, log real consumption at 1995 price
LUSGDP	US, log real GDP at 1995 price
LUSINDEX	US, log stock price index at 1995 price
LUSMO	US, log real money supply at 1995 price
LUSOIL	US, log real crude oil price index at 1995 price

Table 2: Data Source

Stock Price Index:

	Source
U.S.	CRSP tape
Other 5 countries	IL series in Morgan Stanley International Perspective

Macro Variables: From IMF, International Financial Statistics

	CPI*	ERI**	GDP	Consumption	Money
Australia	193/64	193AHX	193/99B.C	193/96F.CZF	193/59MAC
Canada	156/64	156AHX	156/99B.C	156/96F.CZF	156/34..B
Germany	134/64	134AHX	134/99B.C	134/96F.CZF	134/39MAC
Japan	158/64	158AHX	158/99B.C	158/96F.CZF	158/34..B
U.K.	112/64	112AHX	112/99B.C	112/96F.CZF	M4***
U.S.	111/64	-	111/99B.C	111/96F.CZF	111/59MAC

* 1995 is the base year.

** ERI is exchange rate index and 1995 is the base year.

*** Money supply for United Kingdom refers to M4 and data is from Bank of England's website.

Oil Price Index: From CITIBASE

Table 3: Correlations between stock price index and each macro variable

Country	Index & GDP	Index & Con	Index & Money	Index & Oil	Con & GDP
Australia	0.286546	0.271397	0.548523	-0.628198	0.995590
Canada	0.320105	0.339549	0.640940	-0.691230	0.993987
Germany	0.745072	0.718941	0.784757	-0.685019	0.996574
Japan	0.840324	0.802002	0.731159	-0.666546	0.993844
U.K.	0.665503	0.732548	0.392761	-0.817301	0.988352
U.S.	0.691371	0.700930	0.812442	-0.820543	0.998398

Table 4: Johansen cointegration test(bivariate)

	null: # of cointegration	stock price index and real GDP		stock price index and real con	
		Trace Statistic	$\lambda-\max$ Statistic	Trace Statistic	$\lambda-\max$ Statistic
Japan	None	20.55658*	18.72793*	16.90977*	14.96015*
	At most 1	1.828656	1.828656	1.949621	1.949621

* The numbers with * indicate the rejection of the null hypothesis at 5% significance level.

** The 5% critical value of Trace Statistic is 15.41. The 5% critical value of $\lambda-\max$ statistic is 14.07.

*** The number of lags in each cointegration test is determined by the Schwartz Criteria. Number of lags for the other countries is 1.