Do International Reactions of Stock and Bond Markets Reflect Macroeconomic Fundamentals?

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Much of the movement in stock and bond markets appears to be independent of changes in fundamental economic conditions. Stock prices in particular often fluctuate more sharply than would be justified by shifts in the underlying fundamentals. Such market volatility may distort the economy's allocation of capital and on occasion lead to liquidity crises and macroeconomic instability. This article investigates one possible source of the volatility: a tendency of market participants to overreact to developments in other markets. The analysis yields some evidence that stock and bond markets move together to an extent not easily explained by changes in macroeconomic fundamentals.

Empirical work by Campbell and Shiller, Poterba and Summers, West, and Bulkley and Tonks supports the notion that the volatility of U.S. and U.K. stock prices exceeds the volatility implied by fundamentals.[1] Schwert finds that the timing of volatility in the U.S. stock market often fails to coincide with that of macroeconomic fundamentals.[2] A related finding by Bennett and Kelleher is that high volatility in stock markets tends to be associated with high return correlations across the markets.[3] This result may arise because stock markets have overreacted to one another. When one market departs from fundamentals, the mistake is propagated to other markets, thus giving rise to the excess volatility. Moreover, Shiller and Beltratti find that domestic stock markets often overreact to domestic bond markets.[4] Hence, unaccountable movements in one market can be compounded as they spread to other markets at home and abroad.

Consider an extreme example of high volatility: the October 1987 stock market break. The global nature of the event could be seen as evidence that stock markets were overreacting to one another. Alternatively, some would argue that stock investors at the time were simply responding to information contained in price changes in other markets, particularly information on expectations of real activity abroad.[5] But conclusions based on a

[1]For U S. stocks, see John Y Campbell and Robert J Shiller, "Cointegration and Tests of Present Value Models," *Journal of Political Economy*, vol 95 (1987), pp 1062-88, James M Poterba and Lawrence H Summers, "Mean Reversion in Stock Prices Evidence and Implications," *Journal of Financial Economics*, vol 22 (1988), pp 27-59, and Kenneth D West, "A Specification Test for Speculative Bubbles," *Quarterly Journal of Economics*, vol 102 (1987), pp 553-80 For U K stocks, see George Bulkley and Ian Tonks, "Are U K Stock Prices Excessively Volatile? Trading Rules and Variance Bound Tests," *Economic Journal*, vol 99 (1989), pp 1083-98

[2]G William Schwert, "Why Does Stock Market Volatility Change over Time?" *Journal of Finance*, vol 44 (December 1989), pp 1115-53

[3]Paul Bennett and Jeanette Kelleher, "The International Transmission of Stock Price Disruption in October 1987," this *Quarterly Review*, Summer 1988, pp 17-33 See also Paul Kupiec, "Financial Liberalisation and International Trends in Stock, Corporate Bond, and Foreign Exchange Market Volatilities," OECD Department of Economics and Statistics Working Papers, no 94, February 1991

[4]Robert J Shiller and Andrea E Beltratti, "Stock Prices and Bond Yields Can Their Comovements Be Explained in Terms of Present Value Models?" National Bureau of Economic Research, Working Paper no 3464, 1990

[5]See Richard W Roll, "The International Crash of October 1987," in Robert Kamphuis, Roger Kormendi, and J W Henry Watson, eds , *Black Monday and the Future of Financial Markets* (Mid-America Institute, 1988), pp 35-70, and Mervyn A King and Sushil Wadhani, "Transmission of Volatility between Stock Markets," *Review of Financial Studies*, vol 3 (1990), pp 5-36

single event are unconvincing, and for this reason, it is important to consider whether the broader experience of stock and bond market co-movement is consistent with movements in real activity, interest rates, and inflation

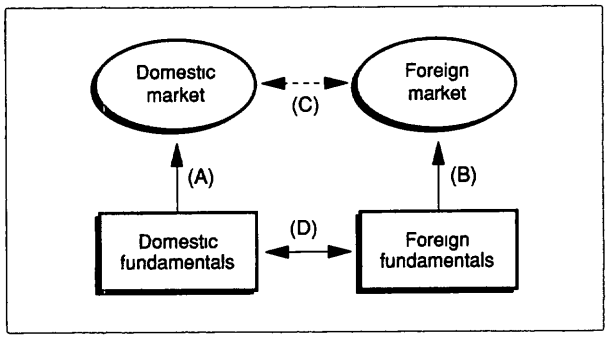
This article examines nearly two decades of market experience in the United States, Japan, and the United Kingdom. The discussion first focuses on the degree to which macroeconomic fundamentals and foreign market movements explain domestic market movements It then asks whether a hypothesis based on market movements conveying information about fundamentals can explain the strong international reactions markets have to one another.

Of the domestic fundamentals, future real activity is found to be the main force driving the stock markets, and future inflation, the main force driving the bond markets Foreign fundamentals appear to exert no direct impact on domestic markets After taking account of the effects of both domestic and foreign fundamentals, the analysis finds that foreign market returns still explain much of the remaining variance of domestic returns

Superficially, the substantial residual explanatory power of foreign market movements might appear ipso facto evidence that domestic markets overreact to movements in foreign markets. But there is a further possibility, namely that the movements in foreign markets convey additional information relevant to the domestic markets This information may bear on those domestic fundamentals that influence domestic markets. Thus, before a verdict of "overreaction" by domestic markets to foreign markets can be brought, this possibility must be examined

Chart 1

Links among Markets and Fundamentals



Note (A) and (B) represent the links between markets and fundamentals, (C) represents the markets' reactions to each other, and (D) represents the links between domestic and foreign fundamentals

The significant relationships found to exist among domestic and foreign fundamentals and domestic and foreign securities markets are illustrated in Chart 1. The link (A) represents the impact of domestic fundamentals on the domestic market and (B) the impact of foreign fundamentals on the foreign market The link (C) represents the reactions of the markets to each other. Because fundamentals in one country are found to have no direct bearing on the market in the other country, appropriate reactions of domestic markets to foreign markets should reflect links between domestic and foreign fundamentals, shown as (D) The hypothesis implied by these relationships is that the domestic market tries to infer information about foreign fundamentals from foreign markets to better predict domestic fundamentals.

To determine whether the actual market reactions are consistent with this hypothesis, each of the identified links is estimated Testing the hypothesis involves comparing estimates of the actual market reactions with the reactions implied by the estimates of the links between fundamentals and the links between markets and fundamentals. The analysis focuses on real activity as the main fundamental for stock markets and on inflation as the corresponding fundamental for bond markets The estimates suggest that the U.S and Japanese stock markets react to each other's movements on average more than would be justified by the information these markets convey about real activity, while the U S., Japanese, and U K bond markets react to one another's movements more than would be justified by the information these markets convey about inflation.

Explaining stock and bond returns

Identifying the fundamentals

Market prices of stocks and bonds can be specified as the present discounted values of streams of expected cash flows. Hence stock and bond returns should be affected by macroeconomic factors that reflect discount rates or expected cash flows At the same time, the strength of these effects should differ between stock and bond markets, particularly the effects of expected real activity and expected inflation. Differences between the markets allow us to isolate the effects of one fundamental on one market by using the other market to control for the effects of other fundamentals

For stocks, cash flows may take the form of dividend payments, proceeds from stock buybacks by the issuing firm, or proceeds from stock purchases by takeover firms.[6] Previous studies show that several mac-

[6]Cash flows from stock buybacks and takeovers became important in the United States in the 1980s

roeconomic variables—the dividend yield, the spread between long and short interest rates, inflation, and real activity—significantly influence returns.[7] The dividend yield and term spread should reflect discount rates and business conditions. Expected inflation should affect real discount rates, but it may also affect cash flows. Of these macroeconomic variables, future real activity should exert the strongest influence on stock cash flows.

Unlike stocks, bonds in this study have cash flows that are fixed in nominal terms. Changes in the short-term real interest rate affecting the discount rate should have a stronger effect on bond returns than on stock returns.[8] Expected inflation should exert an even stronger influence on bond returns because of its direct effect on the real value of interest and principal payments. By contrast, real activity should have relatively little effect on bond cash flows, particularly in the case of government bonds not subject to default risk, although it may affect discount rates.

Description of key variables

The key variables for this study are excess stock returns, excess bond returns, real activity growth, and inflation rates (Table 1). Excess returns are the returns over a quarter minus a three-month interest rate at the beginning of the quarter.[9] The analysis relies on quar-

[7]See in particular Nai-Fu Chen, Richard Roll, and Stephen A. Ross, "Economic Forces and the Stock Market," *Journal of Business*, vol. 59 (1986), pp. 383-403, and Eugene F. Fama, "Stock Returns, Expected Returns, and Real Activity," *Journal of Finance*, vol. 45 (1990), pp. 1089-1108. Chen, Roll, and Ross also identify the yield spread between low-grade and high-grade bonds as a significant variable, but Fama finds that the dividend yield does just as well as the the risk spread. The estimates presented here will use the dividend yield because data for this variable are available for foreign markets. Shiller sometimes uses the price-earnings ratio instead of the dividend yield.

[8]See John Y. Campbell and John Ammer, "What Moves the Stock and Bond Markets? A Variance Decomposition for Long-Term Asset Returns," paper presented at the annual meeting of the American Finance Association, Washington, D.C., December 1990.

[9]Stock returns are measured as the dividend yield plus the change in the log stock price index. Bond returns are approximated by the yield at the beginning of the quarter minus the change in log yields.

Table 1

Statistical Characteristics of Key Variables

(Quarterly Data at an Annual Rate, June 1973 to September 1989)

	Excess Stock Returns[†]		Excess Bond Returns[‡]	
	Mean	Standard Deviation	Mean	Standard Deviation
United States	5.27	37.56	0.23	30.30
Japan	15.65	32.64	3.97	38.66
United Kingdom	19.98	50.30	0.82	40.10

	Stock Return Correlations		Bond Return Correlations	
	United States	Japan	United States	Japan
Japan	0.62		0.45	
United Kingdom	0.38	0.35	0.20	0.42

	Real Growth[§]		Inflation	
	Mean	Standard Deviation	Mean	Standard Deviation
United States	2.50	4.08	6.42	3.89
Japan	3.79	3.24	5.26	6.19
United Kingdom	1.88	8.90	9.84	7.26

	Real Growth Correlations		Inflation Correlations	
	United States	Japan	United States	Japan
Japan	0.30		0.57	
United Kingdom	0.05	0.07	0.55	0.52

[†]Excess stock returns are stock returns minus a three-month interest rate.

[‡]Excess bond returns are bond returns minus a three-month interest rate.

[§]Log change in real GNP or GDP.

terly data from June 1973 to September 1990 for the United States, Japan, and the United Kingdom [10] Chart 2 shows the behavior of excess stock returns and Chart 3 the behavior of excess bond returns over the period.[11] Using excess returns allows us to abstract from possible effects of crossborder short-term interest-rate arbitrage and to focus on the macroeconomic variables most relevant to stock and bond markets. Real growth is measured by GNP or GDP, inflation by the consumer price index.

As measured by their standard deviations, excess stock returns are only somewhat more volatile than excess bond returns. Stock returns, however, seem more correlated across markets than bond returns, except between Japan and the United Kingdom Real growth and inflation seem about equally volatile, but they are clearly less volatile than stock and bond returns Real growth also tends to be much less corre-

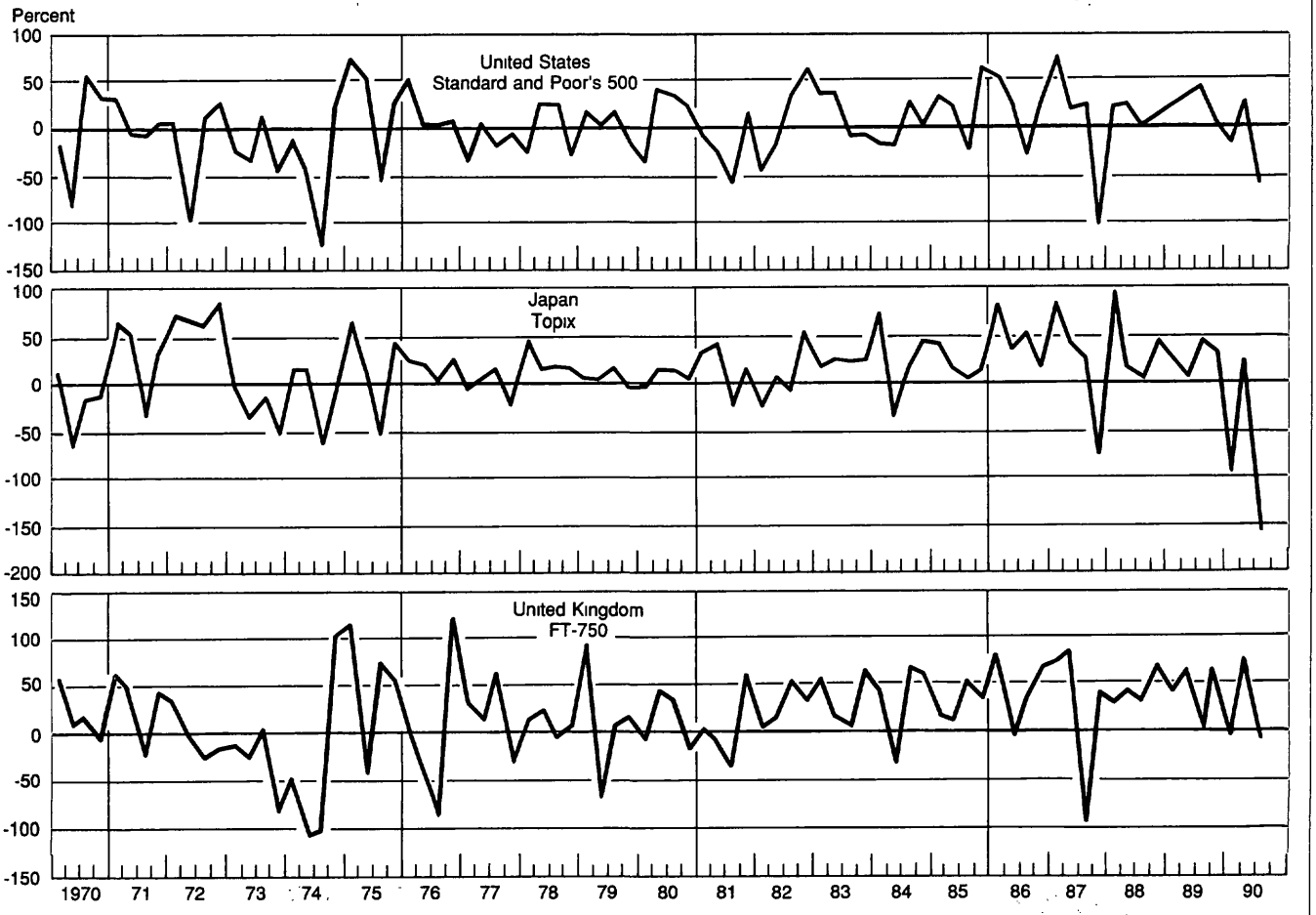
[10]The analysis looks at stock and bond returns only up to the third quarter of 1989 because these returns are related to leads of macroeconomic variables that go up to the third quarter of 1990

[11]The lack of movement in excess bond returns in Japan in the early 1970s seems to reflect a market subject to "guidance" by the monetary authorities Efforts to take account of this period with the use of dummy variables did not alter the analysis

Chart 2

Stock Market Excess Returns

Quarterly Returns at an Annual Rate



Sources: U.S. data, Standard and Poor's, Japanese data, Tokyo Stock Exchange, U K data, Bank for International Settlements.

Note Excess returns are stock returns over a quarter minus a three-month interest rate at the start of the quarter

lated across countries than does inflation Stock returns tend to be significantly more correlated than real growth across countries, while bond returns tend to be less correlated than inflation.

Explaining stock returns

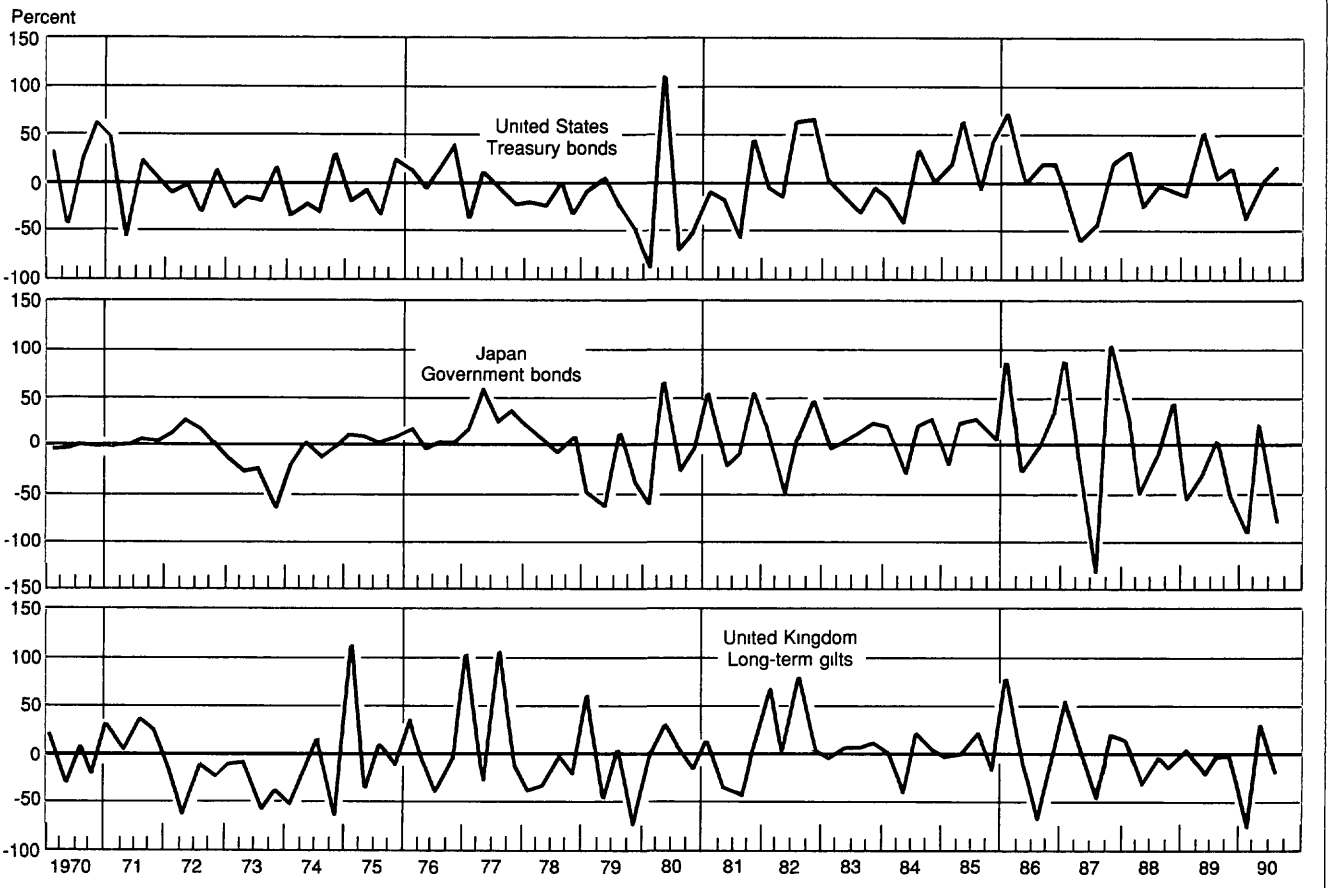
To identify the significant links among stock markets and fundamentals, this analysis evaluates the degree to which macroeconomic variables and foreign stock market movements explain domestic stock market movements Table 2 reports adjusted R-squared statistics as measures of the explanatory power of reduced-form stock return equations. The dependent variable is excess stock returns, or the returns minus a three-month interest rate The explanatory variables common to all the equations are the lagged dividend yield, excess bond returns, and four quarterly leads of real growth The adjusted R-squared statistics for the basic equation are 20 percent for the U S. market, 16 percent for the Japanese market, and 25 percent for the U.K. market Although these statistics show that a large proportion of the movement of stock returns is left unexplained, the explanatory variables used here are somewhat more successful than variables used in previous studies.[12]

[12]Using U S data for 1953-87, Fama estimates a similar equation that gives an unadjusted R-squared of 23 percent for quarterly stock

Chart 3

Bond Market Excess Returns

Quarterly Returns at an Annual Rate



Source Japanese and U K. data, Bank for International Settlements

Note Excess returns are bond returns over a quarter minus a three-month interest rate at the start of the quarter

To evaluate the importance of future real activity relative to other fundamentals, a second equation is estimated for each market, this time including the change in the short-term real interest rate and four leads of inflation. The short-term real rate is based on ex post inflation The additional variables produce a significant gain in explanatory power for the Japanese and U K. markets. But for U.S. stock returns, the inclusion of inflation reduces the adjusted R-squared statistic, indicating only a weak effect. Subsequent estimates include inflation leads for the Japanese and U.K. markets but not for the U S market

The use of leads for real growth and inflation allows for the extra information market participants may have [13] However, the equations in effect leave out forecast errors by participants, an omitted variable problem that would bias the coefficient estimates. Although this omission would not affect the evaluation of explanatory power, the analysis of the informational consistency of market reactions in the next section requires a procedure that gives unbiased coefficient estimates [14]

Footnote 12 (continued)
returns, compared with 27 percent here The explanatory power is lower for monthly returns and higher for annual returns See Fama, "Stock Returns "

[13]See Fama, "Stock Returns," and Campbell and Ammer, "What Moves the Stock and Bond Markets?"

[14]Suppose we have the relationship $r_t = a + bE_t(y_{t+1})$, where the return r_t depends on the current expectation of a future value y_{t+1} The realized value would be $y_{t+1} = E_t(y_{t+1}) + e_{t+1}$, where e_{t+1} is the expectational error Since expectations are unobservable, we might run the regression on the realizations, estimating $r_t = a + by_{t+1} + u_t$ Unfortunately, doing so would give a biased estimate of

Table 2
Explaining Stock Market Excess Returns: Adjusted R-Squared Statistics

	United States	Japan	United Kingdom
Equation with real growth leads[†]	0 20	0 16	0 25
Addition of inflation leads[†]	0 18 (0 1)	0 24 (2 3**)	0.42 (4 5**)
Addition of foreign real growth leads	0 18 (0 8)	0 18 (0 5)	0 45 (1 3)
Addition of foreign excess returns	0 42 (12 2**)	0 42 (10 0**)	0 46 (1 8)

Notes Parentheses contain F-statistics indicating how each addition affects the explanatory power Double asterisks indicate significant addition to explanatory power at the 5 percent level compared with the previous equation

[†]Equations include lagged dividend yield, domestic excess bond returns, and four leads of real growth

Next let us test the possible relevance of foreign fundamentals to domestic stock returns. Foreign real activity, for example, may influence domestic stock returns to the extent that some of the firms traded in the market conduct an important part of their business abroad. Table 2 reports the adjusted R-squared statistics for equations that take account of foreign fundamentals, here consisting of four leads of real growth in each of the two other countries In no instance is the gain in explanatory power statistically significant, a finding that indicates little direct relevance of foreign real activity to domestic markets.[15] This means that if foreign markets do convey information relevant to the fundamental determinants of movements in domestic markets, the path of influence must link movements in foreign fundamentals to domestic fundamentals, with movements in foreign markets serving as the channel through which this information is conveyed.

A preliminary test for market overreaction is to determine whether returns in foreign markets add significant explanatory power to stock return equations that already take account of macroeconomic fundamentals.[16] Table 2 reports adjusted R-squared statistics for equations that include foreign excess stock returns. The gain is quite impressive for the U S and Japanese stock markets, suggesting that participants in these markets may often overreact to developments in markets abroad.[17]

Explaining bond returns

To identify the significant links among bond markets and fundamentals, the analysis now evaluates the degree to which macroeconomic variables and foreign bond market movements explain domestic bond market movements Table 3 reports adjusted R-squared statistics as measures of explanatory power for reduced-form bond return equations. The dependent variable is

Footnote 14 (continued)
b, because the residual term u_t contains e_{t+1}, which would be correlated with y_{t+1}

[15]The finding is consistent with the conclusion that domestic factors dominate international factors in explaining stock returns of individual firms, even of multinationals See Bruno Solnik, *International Investments*, 2d ed (Reading, Massachusetts Addison-Wesley, 1991), pp 135-40

[16]Robert Pindyck and Julio Rotemberg use this approach to conclude that there is overreaction in markets for internationally traded commodities See "The Excess Comovement of Commodity Prices," *Economic Journal*, vol 100 (1990), pp 1173-89

[17]As to the effects of the individual foreign stock markets, the Japanese market is significant for the U S market, as is the U S market for the Japanese market In the case of bond markets, the Japanese market matters significantly for the U S market, the U S and U K markets for the Japanese market, and the Japanese market for the U K market

excess returns on long-term government bonds, that is, the returns minus a three-month rate. The common explanatory variables are excess stock returns, the change in the real short-term rate, and four quarterly leads of inflation As with stocks, the explanatory power of these variables is good by the standards of the literature. The addition of four leads of real growth does not help significantly for any of the bond markets. Subsequent estimates of bond return equations leave out real growth leads. The analysis confirms that future inflation is a more important fundamental for bond markets than is future real activity, while future real activity is more important for stock markets.

When foreign fundamentals in the form of four inflation leads in each of the two other countries are included, the gain in explanatory power is statistically insignificant in every case. Again foreign fundamentals seem to have little direct relevance to domestic markets This finding means that if foreign markets convey information about fundamentals, the relevance to domestic markets is likely to arise from links between foreign fundamentals and domestic fundamentals.

Table 3 also reports the adjusted R-squared statistics for equations incorporating foreign excess bond returns The substantial gain for all three bond markets suggests that participants in these markets could be overreacting to market movements abroad

Interpretation

The strong explanatory power of foreign market returns by itself does not mean that market overreaction exists. It is easy to imagine the markets moving together in response to common or correlated information about fundamentals not captured by our macroeconomic variables. Such information may sometimes cause the different markets to make similar mistakes about the future, so that the explanatory power of foreign returns may arise simply from the correlation of forecast errors In particular, foreign stock and bond markets may throw out signals about foreign macroeconomic fundamentals that in turn help predict domestic fundamentals The signals may at times turn out to be false, so that the implied future developments do not show up in the data, but the domestic markets will have been right to respond to the signals. The analysis in the next section asks whether actual market behavior can be so justified.

Table 3

Explaining Bond Market Excess Returns: Adjusted R-Squared Statistics

	United States	Japan	United Kingdom
Equation with inflation leads†	0 26	0 14	0 24
Addition of real growth leads†	0 23 (0 6)	0 11 (0 6)	0 23 (0 7)
Addition of foreign inflation leads	0.28 (1 2)	0 12 (0 9)	0 19 (0 5)
Addition of foreign excess returns	0 37 (4.6**)	0 33 (9.0**)	0 25 (3 0**)

Notes Parentheses contain F-statistics indicating how each addition affects the explanatory power Double asterisks indicate significant addition to explanatory power at the 5 percent level compared with the previous equation

†Equations include change in real short-term rate, domestic excess stock returns, and four leads of inflation

Testing for informational consistency

Analytical approach

If markets are in fact reacting to information related to fundamentals and if, as the data indicate, foreign fundamentals have little direct relevance to domestic markets, then the markets must be reacting to one another's movements largely because of recognized links between domestic and foreign fundamentals The domestic market will be trying to infer information about foreign fundamentals from the other markets in order to make better forecasts of domestic fundamentals. If the actual reaction is consistent with the links between fundamentals and with the links between fundamentals and market returns, then informational consistency holds.[18]

The empirical analysis below proceeds by estimating the various specified links among markets and fundamentals to test for informational consistency[19] The discussion focuses on real activity as the fundamental most important to stock markets and on inflation as the fundamental most important to bond markets Three questions are addressed. How closely would stock markets move together if the domestic markets were relying on foreign stock markets simply for information about foreign real activity? How closely would bond markets move together if the domestic markets were relying on foreign bond markets simply for information about foreign inflation? How closely do the markets actually move together?

Stock returns and real growth

To obtain unbiased estimates of the effect of real growth on stock returns, we can reestimate the stock return equations by replacing the four leads of real growth and

[18]The appendix offers a formal model for this analysis

[19]Unlike a test based on statistical explanatory power, this test does not require complete data on the markets' information, only enough data to produce good coefficients on the various links

inflation with their predicted values.[20] The dividend yield and excess bond returns are kept in the equations to control for other fundamentals, particularly the effects of changes in the real discount rate Inflation is omitted from the U S estimates because it lacks additional explanatory power

The estimates in Table 4 suggest that the Japanese stock market is the most sensitive to predicted real growth and the U K market the least sensitive The sum of the coefficients on real growth indicates that when expected domestic real growth over the next four quarters increases by a point, U.S. excess stock returns rise 2.5 percentage points on average, Japanese excess returns rise 4.3 points, and U K excess returns rise 0.6 of a point

International real growth links

If real growth abroad has no direct effect on domestic stock returns, a reaction to foreign markets should indicate a link between growth abroad and growth at home To estimate this link, an index of real growth leads is constructed for each market using weights proportional to the real growth coefficients in the estimated stock return equations.[21] The movements in this index for other countries are presumably what domestic market participants can infer from movements in foreign stock prices

The upper section of Table 5 reports the estimated effects of foreign future real growth on domestic future real growth.[22] The estimates are based on the constructed indexes and control for currently observable variables that may also help predict domestic real growth To allow for the joint determination of real growth in different countries, instruments are used for the foreign real growth indexes.[23] The estimates indicate that when U S. real growth over the next four quarters rises a percentage point, Japanese real growth can be expected to rise 0 15 of a point and U.K. real growth 0 60 of a point When future Japanese real growth rises a point, U.S. real growth can be expected to rise 0.60 of a point and U K real growth to fall 0.36 of

[20]The instruments used to predict real growth and inflation are the dividend yield, excess bond returns, contemporaneous real growth and inflation, and four lags each of domestic inflation, real growth in each of the three countries, the change in log dollar oil prices, and the changes in the two relevant log exchange rates

[21]For example, the index for U S real growth would have a 60 percent weight for the first lead because the coefficient on this lead is 60 percent of the sum of the four lead coefficients (Table 4)

[22]The control variables are the current values and four lags each of domestic real growth and inflation

[23]The instruments are four lags of real growth and inflation in each of the three countries

Table 4

Stock Return Equations Estimated by Two-Stage Least Squares

(Dependent Variable Is Excess Stock Return)

	United States		Japan		United Kingdom	
Constant	−19 50	(−1 29)	−20 25	(−0 58)	17 66	(0 51)
Dividend yield	2 88	(1 31)	2 73	(1 09)	0 87	(1 21)
Excess bond return	0 38*	(2 71)	0 15	(1 21)	0 49*	(3 02)
Predicted real growth						
First lead	1.51	(0 74)	3 32	(1 45)	0 79	(0 79)
Second lead	3 76	(1 55)	1 54	(0 74)	0 51	(0 51)
Third lead	−3 39*	(2 69)	−0 94	(−0 45)	−0 91	(−0 98)
Fourth lead	0 64	(0 32)	0 34	(0 17)	0 24	(0 24)
Sum of coefficients	2 52		4 27		0 63	
Predicted inflation						
First lead			−1 12	(−0 87)	2 10	(1 47)
Second lead			1 83	(1 31)	2 76*	(1 70)
Third lead			−3 41*	(−2 44)	−4 72*	(−3 04)
Fourth lead			1 81	(1 14)	−1 89	(−1 32)
R-squared	0 14		0 28		0 48	
Adjusted R-squared	0 05		0 15		0 38	

Notes Instruments are dividend yield, excess bond returns, contemporaneous real growth and inflation, and four lags each of domestic inflation, real growth in each of the three countries, percentage change in dollar oil prices, and percentage change in the two dollar exchange rates T-statistics are in parentheses Asterisks indicate significance at 10 percent level

a point.[24] U.K. real growth seems to have little effect on real growth in the other economies.

The large standard errors indicate that these estimates are not very precise. The usual significance tests would suggest that there are no real growth links. Nonetheless, this analysis must give the markets the benefit of the doubt by allowing them a reason to react to one another's movements. Market participants presumably do not limit their responses to only those influences that survive stringent statistical tests. Hence the analysis will proceed on the assumption that the estimates of real growth links in Table 5 are our best estimates.

Implied stock market reactions

The middle section of Table 5 shows the magnitudes of stock market interactions implied by the links between markets and real activity and the links between domestic and foreign real activity. The strongest implied reactions are between the U.S. and Japanese markets. The various links among markets and fundamentals imply that if U.S. market participants saw Japanese stock returns rise 1 percentage point while other factors remained unchanged, they would infer a rise in expected Japanese real growth of 0.23 of a point (1 divided by 4.3) and thus a rise in expected U.S. real growth of 0.14 of a point (0.23 times 0.60), so that U.S. stock returns would rise 0.35 of a point (0.14 times 2.5). Similarly, if Japanese market participants saw U.S. stock returns rise 1 point, they would react so that Japanese stock returns rise 0.25 of a point. The various links do not imply strong positive reactions in the case of the U.K. market.

Actual stock market reactions

The test of informational consistency used here involves extracting that part of foreign stock market returns reflecting movements in foreign expected real activity. To this end, the estimated foreign stock return equations are cleansed of the effects of other fundamentals to create predictors of foreign real activity growth.[25] The predictors of foreign real activity growth are substituted into the real growth link equations, and the resulting predictions of domestic real growth are in turn substituted into the domestic stock return equations. In principle, these equations control for the movements of fundamentals other than real activity, particularly those reflected in excess bond returns. The estimated coefficients on the foreign real growth predictors in the modified stock return equations provide measures of stock market reactions to the relevant foreign market movements.[26]

[24]Because real growth is correlated across countries, the sum of the coefficients provides better estimates than do the individual coefficients. In the case of U.K. growth, for example, the sum of the estimated effects of U.S. and Japanese growth of 0.24 is more reliable than the individual effects of 0.60 and -0.36, respectively.

[25]From the excess stock return equations in Table 4, the terms involving the dividend yield, excess bond returns, and inflation are subtracted, so that only the real growth terms are left.

[26]The regression is based on equation A.5 of the model developed in the appendix.

Table 5

Real Growth Links and Implied and Actual Stock Market Reactions

	United States		Japan		United Kingdom	
Effect on domestic real growth of real growth in:						
United States			0.15	(0.13)	0.60	(0.78)
Japan	0.60	(0.50)			−0.36	(1.72)
United Kingdom	0.03	(0.08)	−0.08	(0.05)		
Implied domestic stock market reaction to stock market in:						
United States			0.25	(0.22)	0.15	(0.20)
Japan	0.35	(0.30)			−0.05	(0.25)
United Kingdom	0.12	(0.32)	−0.54	(0.34)		
Actual domestic stock market reaction to stock market in:						
United States			0.38*	(0.08)	0.14	(0.17)
Japan	0.62*	(0.13)			0.29	(0.21)
United Kingdom	0.04	(0.09)	0.08*	(0.07)		

Notes: Standard errors are in parentheses. Asterisks indicate significantly greater actual over implied reaction at the 10 percent level.

The bottom section of Table 5 reports the estimates of actual stock market reactions. The estimates show significant overreaction by the U.S. and Japanese stock markets to each other In response to a 1 point rise in Japanese stock returns, U S. stock returns rise 0 62 of a point on average, an increase nearly twice the magnitude justified by the information about real activity conveyed by the Japanese stock market. Similarly, the size of the Japanese stock market reaction to U.S. stock market movements is half again as great as the size implied by informational consistency Although the Japanese stock market is shown to have a statistically significant overreaction to the U K market, this result is based on an implausibly large negative implied reaction.

Bond returns and inflation

To obtain unbiased estimates of the effect of inflation, the bond return equations are reestimated by replacing the inflation leads with their predicted values.[27] Excess stock returns are kept as a separate variable in the equations to control for other fundamentals, particularly for the possible effects of future real growth on the discount rate. The estimates reported in Table 6 show that the U.S and Japanese bond markets are very sensitive to inflation, while the U.K market inexplicably responds positively to inflation A 1 point rise in expected inflation over the next four quarters reduces U.S bond returns 3 8 points and Japanese bond returns nearly 3 0 points

[27]The instruments used to predict inflation are excess stock returns, current real growth and inflation, and four lags each of domestic real growth, inflation in each of the countries, oil price inflation, and currency depreciation rates

International inflation links

To estimate the inflation links, an index of inflation leads is constructed for each country. The weights are derived from the bond return equations in the same way that they were drawn from the stock return equations for the real growth indexes The movements in this inflation index are what can be inferred from bond market movements. Based on these indexes, the estimates in the upper section of Table 7 measure the effects of foreign on domestic future inflation. The estimates control for other factors and for the joint determination of inflation in the different countries [28] Here a 1 point rise in the Japanese inflation rate over the next four quarters raises the expected U S. rate 0 29 of a point, and a 1 point rise in the U S. rate raises the Japanese rate 0 43 of a point. A 1 point rise in both the U.S. and Japanese rates raises the U K. rate 1 46 points. These estimated international inflation links tend to be statistically significant and thus more reliable than the estimated real growth links.

Implied bond market reactions

The various links among bond markets and expected inflation rates imply the market reactions calculated in the middle part of Table 7. Hence, if U.S. bond market participants saw Japanese bond returns rise a percentage point, they would infer a fall in the expected Japanese inflation rate of 0 34 of a point (1 divided by 2.98) and a fall in the expected U S rate of nearly 0.10 of a point (0 34 times 0 29), so that U.S bond

[28]The control variables are current and four lags each of domestic real growth and inflation in the three countries To allow for the joint determination of inflation, four lags each of real growth and inflation in the three countries are used as instruments

Table 6

Bond Return Equations Estimated by Two-Stage Least Squares

(Dependent Variable Is Excess Bond Return)

	United States		Japan		United Kingdom	
Constant	23 39	(2 45)	12 86	(1 47)	−18 79	(−1 48)
Excess stock return	0 17	(1 45)	0 16	(0 92)	0 47*	(4 02)
Predicted inflation						
First lead	−4 49*	(−2 32)	0 84	(0 54)	1 79*	(1 74)
Second lead	3 19	(1 62)	0.32	(0 20)	−3 75*	(−3 64)
Third lead	−2 08	(−1 00)	0 40	(0 21)	3 38*	(2 81)
Fourth lead	−0 44	(−0 21)	−4 54*	(−2 36)	−0 41	(−0 43)
Sum of coefficients	−3 83		−2 98		1 01	
R-squared	0 32		0 18		0 21	
Adjusted R-squared	0 26		0 11		0 14	

Notes Instruments are excess stock returns, contemporaneous real growth and inflation, and four lags each of domestic real growth, inflation in each of the three countries, percentage change in dollar oil prices, and percentage change in the two dollar exchange rates T-statistics are in parentheses Asterisks indicate significance at the 10 percent level

returns would rise 0.37 of a point (about 0.10 times 3.8). The implied reaction of the Japanese bond market to the U.S. market of 0.33 is almost as strong. The implied reactions involving the U.K. market are much weaker, if not negative.

Actual bond market reactions

The bottom section of Table 7 reports estimates of the relevant actual bond market reactions. To extract the part of foreign bond market returns that reflects movements in foreign expected inflation, the estimated bond market equations are used to construct predictors of foreign inflation.[29] These predictors are then substituted into the inflation link equations, which in turn are substituted into the domestic bond return equations. The domestic bond return equations are then reestimated, with the foreign bond market movements in effect helping predict domestic inflation. The equations control for the movements of fundamentals other than inflation, particularly those reflected in excess stock returns. The estimated coefficients on the foreign bond market variables then measure the actual bond market reactions to the relevant movements in the foreign markets.

The estimates show a significant overreaction by the Japanese bond market to movements in the U.S. market. Japanese returns rise 0.54 of a point instead of 0.33 of a point in response to a 1 point rise in U.S. returns. The estimates also show significant overreactions by the U.K. and Japanese bond markets to each other's movements. The apparent overreactions involving the U.K. market should be treated with more skepticism, however, because they reflect an inexplicably positive effect of U.K. inflation on U.K. bond returns.

[29]Specifically, we subtract from the excess bond return equations in Table 6 all the terms but those for inflation

Conclusion

The behavior of stock and bond markets is of concern to economists because these markets set prices affecting the cost of capital for the corporate sector and because excess market volatility may lead to financial strains and macroeconomic instability. Those who worry about excess volatility have recommended such policies as taxing securities transactions, taxing short-term capital gains more than long-term capital gains, and raising margin requirements on stock purchases.[30] This study asks whether excess correlations across markets are a likely source of excess volatility.

The evidence presented suggests some tendency by participants in the U.S. and Japanese stock markets and in the U.S., Japanese, and U.K. bond markets to overreact to one another's market movements. Although the estimates are imprecise, they indicate that the two

[30]Lawrence Summers and Victoria Summers support the securities transactions tax; see "When Financial Markets Work Too Well: A Cautious Case for a Securities Transactions Tax," *Journal of Financial Services Research*, vol 3 (1989), pp 261-86 Gikas Hardouvelis advocates raising margin requirements; see "Margin Requirements and Stock Market Volatility," this *Quarterly Review*, Summer 1988, pp 80-89

Table 7

Inflation Links and Implied and Actual Bond Market Reactions

	United States		Japan		United Kingdom	
Effect on domestic inflation of inflation in:						
United States			0.43*	(0.18)	−0.54	(1.04)
Japan	0.29*	(0.12)			2.00*	(0.96)
United Kingdom	−0.06	(0.02)	0.00	(0 03)		
Implied domestic bond market reaction to bond market in:						
United States			0.33	(0.14)	0.14	(0.27)
Japan	0.37	(0.15)			−0.68	(0.33)
United Kingdom	0.23	(0.08)	−0.01	(0 09)		
Actual domestic bond market reaction to bond market in:						
United States			0.54*	(0.13)	−0.08	(0.14)
Japan	0 42	(0.10)			0.24*	(0.11)
United Kingdom	−0.07	(0.10)	0.22*	(0.11)		

Notes: Standard errors are given in parentheses Asterisks on inflation links indicate significantly positive coefficients, and asterisks on market reactions indicate significantly greater actual over implied reaction at the 10 percent level.

stock markets move together more closely than would be expected from the information the markets convey about future real activity and from the links between domestic and foreign real activity. The evidence on bond markets is less consistent, but the three markets seem to move together more closely than would be expected from the information they provide on inflation and from the links between domestic and foreign inflation.

An important limitation of the present study is that it analyzes market reactions on the basis of average behavior over the period. In fact, the stock markets sometimes move very closely together, while at other times they move independently. When the Japanese stock market plunged in the spring of 1990, the U.S. and U.K. stock markets shrugged off the event; by contrast, in October 1987 the three markets fell as one. It is as if the markets have "moods," so that a shock is sometimes transmitted to other markets more forcefully than at other times.

If overreaction helps drive market prices away from fundamental values with some frequency, the resulting market volatility may pose needless risks to investors and raise the cost of financing in the form of publicly traded debt or equity.[31] International comparisons of the cost of capital suggest that U.S. corporations are placed at a competitive disadvantage by the relatively high costs of equity financing in the United States, costs that some observers attribute in part to stock market volatility.[32] Worse, the high volatility may make markets vulnerable to a global crash. In a world where market prices can occasionally take on a life of their own, the various markets may at times inflate together and then burst like enormous bubbles.

[31]The underlying behavior might be characterized as a form of international noise trading. Bradford De Long, Andrei Shleifer, Lawrence Summers, and Robert Waldmann show that in general the presence of noise traders can make the markets too risky for investors who rely on fundamentals, so that prices may deviate from fundamentals for extended periods of time. See "Noise Trader Risk in Financial Markets," *Journal of Political Economy*, vol. 98 (1990), pp. 703-38.

[32]Robert N. McCauley and Steven Zimmer, "Explaining International Differences in the Cost of Capital," this *Quarterly Review*, Summer 1989, pp. 7-28.

Appendix: A Model of Domestic Stock Markets' Reactions to Information from Foreign Markets

This model formalizes a possible role for foreign stock markets as conveyors of information about real activity relevant to domestic stock markets. Real activity can be thought of as determining the cash flows of publicly traded firms. With stock prices assumed to be the present values of the future streams of cash flows, we can write the stock market return as a function of future real activity growth and of variables tracking the discount rate

$$(A\,1)\quad r_t^i = \gamma^i z_t^i + \sum_{k=1}^{N^i} \delta_k^i y_{t+k}^i + v_t^i,$$

where z_t^i is the vector of discount rate variables, y_{t+k}^i is the kth lead of real activity growth, and v_t^i is noise in returns. The number of leads is N^i.

Real activity in one country could affect real activity in other countries through international trade. To construct an index of real activity that reflects stock market behavior, we can derive the weights from the lead structure implicit in the returns equation. The index collapses real growth in several periods into a single variable.

$$(A\,2)\quad \tilde{y}_t^i \equiv \sum_{k=1}^{N^i} \Theta_k^i y_{t+k}^i,$$

where $\Theta_k^i \equiv \delta_k^i/\delta^i$ and $\delta^i \equiv \sum_{k=1}^{N^i} \delta_k^i$ come from the parameters in equation A 1. The returns equation reduces to

$$(A.3)\quad r_t^i = \gamma^i Z_t^i + \delta^i \tilde{y}_t^i + v_t^i,$$

and the co-variation of returns and real activity is measured by a single parameter, δ^i.

We now measure the links in real activity across countries by estimating

$$(A.4)\quad \tilde{y}_t^i = \alpha^i(L)x_t^i + \sum_{j \neq i} \beta^{ij}\tilde{y}_t^j + u_t^i,$$

where $\tilde{y}_t^i$ is our index of future real activity growth in country i as of time t, $\tilde{y}_t^j$ our index of future real activity growth in country j, $\alpha^i(L)x_t^i$ a vector polynomial in the lag operator L, x_t^i a vector of observable variables helping to predict $\tilde{y}_t^i$, and u_t^i the unpredictable part of real activity growth. The β^{ij} coefficients measure the co-movement with real activity growth in other countries after we have controlled for other macroeconomic variables.

The hypothesis of rational expectations allows us to assume that stock market investors in country i know equations A 2, A.3, and A.4. At time t, they observe the returns r_t^j and other fundamentals z_t^j in the other countries as well as x_t^i and z_t^i in their own country. The hypothesis gives

$$(A.5)\quad r_t^i = \gamma^i z_t^i + \delta^i \alpha^i(L)x_t^i + \delta^i \sum_{j \neq i} \frac{\beta^{ij}}{\delta^j}(r_t^j - \gamma^j z_t^j) + v_t^i,$$

in which investors infer $\tilde{y}_t^j$ from $\frac{1}{\delta^j}(r_t^j - \gamma^j z_t^j)$.

Once δ^i and δ^j are estimated from equation A 1 and β^{ij} is estimated from equation A.4, a regression of stock market returns in country i on stock market returns in other countries, as in equation A 5, should yield a coefficient not significantly different from $\delta^i\beta^{ij}/\delta^j$ for country j. Otherwise, we can conclude that international stock market correlations fail to reflect macroeconomic fundamentals.