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

by Eli M. Remolona

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.

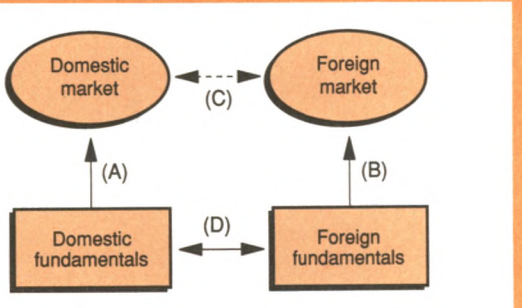
Superficially, the substantial residual explanatory power of foreign market movements might appear ipso facto evidence that domestic markets overreact to movements in foreign markets. But there is a further possibility, namely that the movements in foreign markets convey additional information relevant 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.

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.

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.

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-

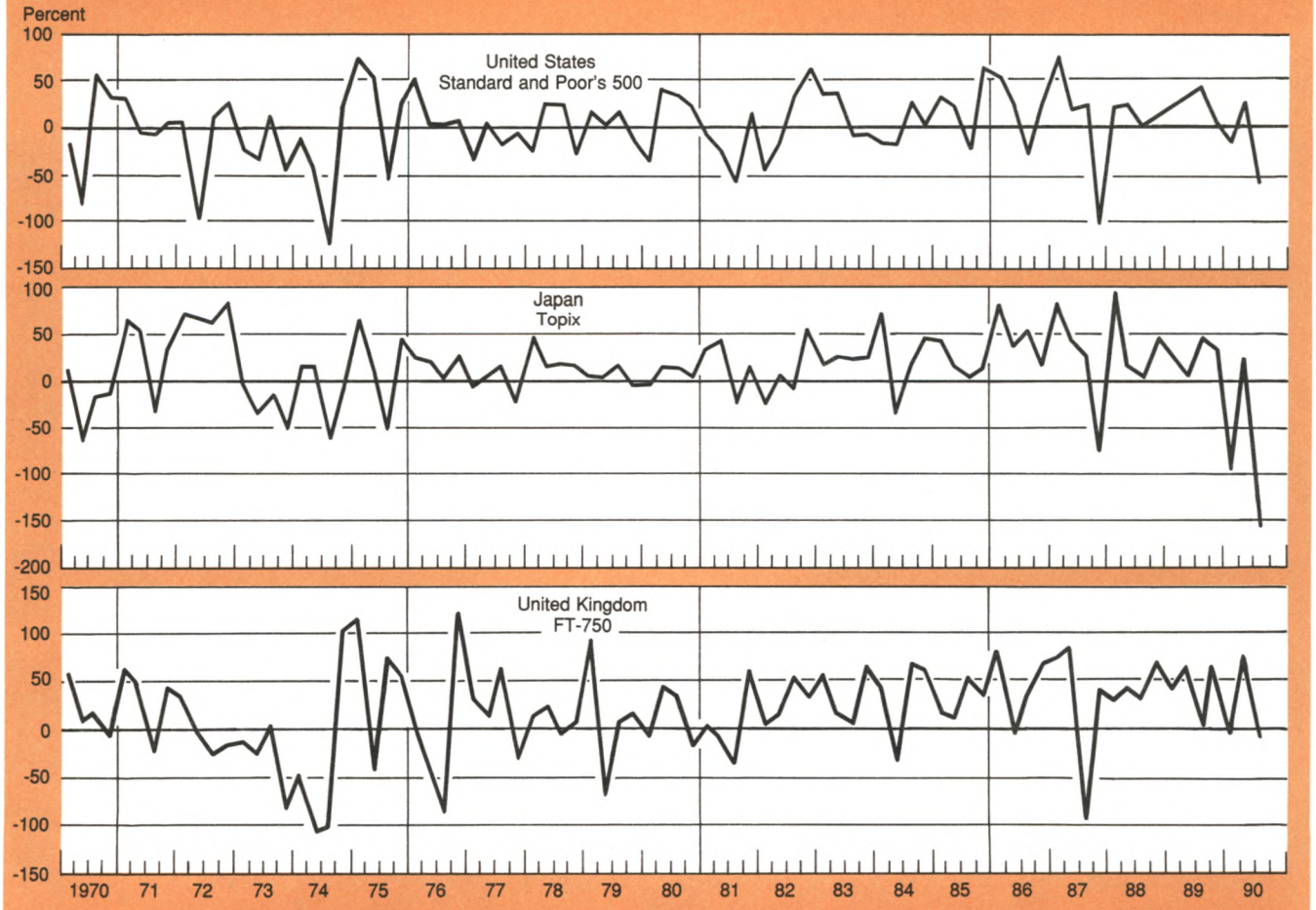
[10]The analysis looks at stock and bond returns only up to the third quarter of 1989 because these returns are related to leads of macroeconomic variables that go up to the third quarter of 1990.

[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

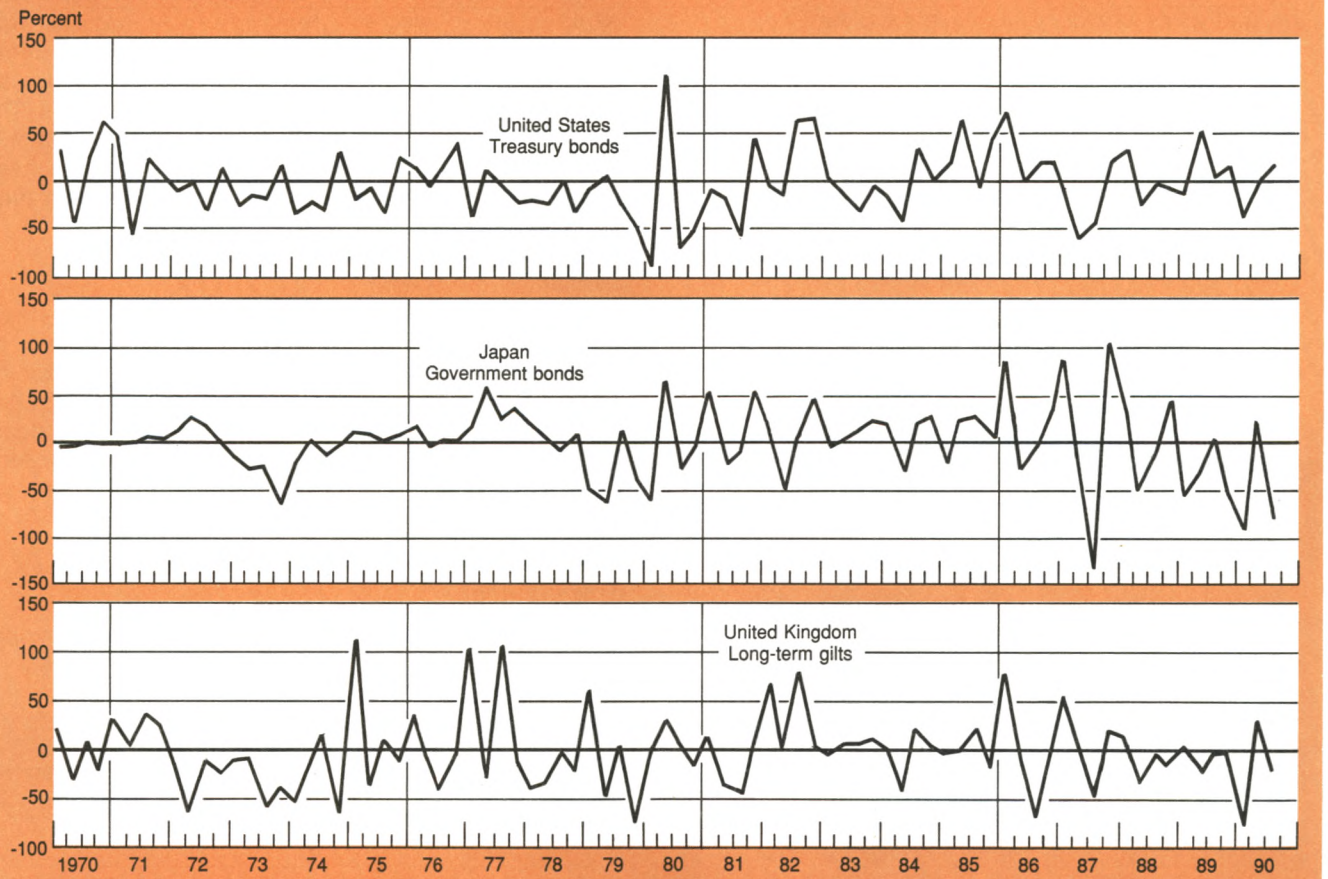
To identify the significant links among stock markets and fundamentals, this analysis evaluates the degree to which macroeconomic variables and foreign stock market movements explain domestic stock market movements. Table 2 reports adjusted R-squared statistics as measures of the explanatory power of 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 b, because the residual term u_t contains e_{t+1}, which would be correlated with y_{t+1}.

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

[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^i and other fundamentals z_t^i 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.

The Cost of Capital for Securities Firms in the United States and Japan

by Robert N. McCauley and Steven A. Zimmer

Recent studies of international differences in capital costs have focused on industry and banks. In the 1980s U.S. firms seemed to be losing ground internationally, whether measured by semiconductor trade, industrial investment, manufacturing trade, or market share in U.S. commercial lending. This slipping competitiveness prompted economists to investigate whether U.S. industry and banks were laboring under a cost of capital disadvantage.

By contrast, the cost of capital for U.S. securities firms received little attention during the last several years because these firms appeared to perform more creditably. They defended their home turf, mounted major expansions into foreign markets, and staked out market share and profit in trading government bonds and equities abroad.[1] U.S. securities firms invested much more abroad that their foreign competitors invested in the United States. In other industries, especially banking, foreign direct investment into the United States dominated U.S. investment abroad (Table 1).[2]

Reversing the procedure of earlier studies, this article takes the respectable performance of U.S. securities firms as its rationale for exploring cost of capital differences between countries. If U.S. firms achieved some degree of success in spite of higher capital costs, then this disadvantage is clearly not a decisive one. But if the disadvantage faced by securities firms is smaller than that faced by U.S. industry and banks, then capital costs may *help* to explain differences in competitive outcomes.

Our investigation begins with a comparison of the capital costs faced by U.S. and Japanese securities firms in the 1982-91 period. We measure the cost of capital to five U.S. and four Japanese securities firms as the multiple that their respective stock exchanges assigned to the economic earnings of the firms. Our findings indicate that U.S. equity investors placed a lower value on a given stream of earnings of U.S. securities firms than Japanese equity investors placed on a comparable stream of earnings of Japanese securities firms. As a result, U.S. securities firms needed to earn more on a given sum of capital underpinning any line of business.

The gap in valuation of securities firms' earnings in the New York and Tokyo stock exchanges nevertheless appears to be narrower than the gaps we found between U.S. and Japanese industries and banks in our own earlier studies of cost of capital differences.[3] If

[1]The firms showed best results in trading Japanese and German government bonds in Tokyo and London, respectively, and in trading Japanese equities and equity derivatives in Tokyo. See John J. Ruocco, Maureen LeBlanc, and Patrick Dignan, "Competitiveness in Government Bond Markets," and Martin Mair, Michael Kaufman, and Steven Saeger, "Competitiveness in Equity Markets," in *International Competitiveness of U.S. Financial Firms: A Staff Study* (New York: Federal Reserve Bank of New York, 1991), pp. 130-72.

[2]Perhaps as a result, the public policy discussion of the securities industry has focused on ensuring that U.S. firms enjoy equal access to foreign financial markets. See, for instance, Department of the Treasury, *National Treatment Study, 1990 Update*, pp. 225-41; Staff of the Board of Governors of the Federal Reserve System and the Federal Reserve Bank of New York, *Report on Implementation of the Primary Dealers Act*, memorandum, August 15, 1989; and

Footnote 2 (continued)
"Japan, U.K. and Switzerland: Primary Dealers Act Update," memorandum, December 3, 1990.

[3]Robert N. McCauley and Steven A. Zimmer, "Explaining International Differences in the Cost of Capital," this *Quarterly*

U.S. securities firms carry a smaller disability in capital costs than other U.S. firms, then it makes sense that any advantages in other dimensions of competition, such as experience with derivative products or application of technology, could be decisive in overall competitive outcomes.

In seeking to explain capital cost differences, we emphasize general factors accounting for a lower Japanese cost of equity in the latter 1980s. These include higher household savings and smoother economic growth.

Our analysis also clarifies why the gap between measured equity costs in New York and Tokyo might be smaller for securities firms than for banking and other industries. On the one hand, Japanese securities firms' cost of equity may be higher than that of Japanese nonfinancial firms or banks because the market perceives a relatively severe threat to the securities firms' revenues and earnings in the ongoing trend toward financial deregulation. On the other hand, the lower equity costs for U.S. securities firms relative to other U.S. companies may be influenced by the choice of sample period. The mid-1980s were boom years for the securities business, and U.S. investors, seized with the growth possibilities created by the financial innovators and engineers of Wall Street in increasingly global markets, may have priced U.S. securities firms' earnings at a premium.

Footnote 3 (continued)
Review, vol. 14 (Summer 1989), pp. 7-28; and Steven A. Zimmer and Robert N. McCauley, "Bank Cost of Capital and International Competition," this *Quarterly Review*, vol. 15 (Winter 1991), pp. 33-59.

Measuring the cost of capital

Securities firms provide products and engage in activities of varying risk against which they must hold equity capital. The required return on this equity capital will be important in determining the commission or fee that a firm must charge for a service or the return it must earn arbitraging markets or investing on its own account. We define the cost of capital for a securities firm as the minimum required fee the firm must charge, or the return it must make, to cover the required return on the equity capital allotted to an activity.

Our definition of cost of capital for a securities firm, like our definition of the cost of capital for a bank, excludes debt costs. The reason for this exclusion is that internationally active securities firms face similar borrowing costs. For instance, Japanese firms' subsidiaries in New York should be able to finance themselves at much the same rates as U.S. firms. Indeed, this argument may be more firmly grounded for securities firms than for banks. The most important source of borrowed funds for a large securities firm is the sale and forward repurchase of securities. The secured nature of this financing technique lessens creditor demands for substantial differences in interest rates based on the creditworthiness of the borrower. Repurchase agreements have generally permitted securities firms in the United States to finance themselves at rates below interbank rates.[4]

Our definition of cost of capital for securities firms follows the definition of bank cost of capital presented in our earlier studies, and we will proceed in a similar fashion. The first step in assessing cost of capital differ-

[4]For the last year, the overnight repurchase rate has on average exceeded the federal funds rate in the U.S. money market.

Table 1

Foreign Direct Investment Flows into and out of the United States, 1985-89

(In Billions of Dollars)

	Inflow	Outflow	Ratio of Inflow to Outflow
Total	232.9	90.5	2.6
Manufacturing	110.4	45.2	2.4
Banking	9.1	0.1	109.6
Finance (except banking)	6.9	12.6	0.5

Source: "Foreign Direct Investment in the United States" and "U.S. Direct Investment Abroad," *Survey of Current Business*, vol. 70 (August 1990), pp. 54, 55, 97, 98.

Notes: Manufacturing, banking, and finance do not sum to total. Direct investment flows relating to the Netherlands Antilles and to the U.K. Caribbean Isles are subtracted from U.S. direct investment abroad and foreign direct investment in the United States, respectively. These adjustments are made because outflows to the Netherlands Antilles in this period essentially reflect repayments of Eurobonds sold through shell finance affiliates and because outflows to the U.K. Caribbean Isles reflect onlending of the proceeds of commercial paper and bond sales by U.S. finance affiliates of nonfinancial foreign corporations via tax havens in the Caribbean. The removal of these flows reduces cumulative U.S. direct investment outflows by $20.3 billion and boosts foreign direct investment inflows by $2.2 billion for both the total and the finance component.

ences is to estimate the required return on equity—the "cost of equity"—to securities firms in the United States and Japan. Our analysis of a small sample of key publicly traded firms suggests that Japanese securities firms enjoy a substantial cost of equity advantage over U.S. firms.

The second step is to show how differences in the cost of equity translate into differences in the cost of capital. Because securities firms, unlike banks, do not have uniform international capital requirements, this step requires care. One complication is that both observed and required shareholder-equity-to-asset ratios of Japanese securities firms are higher than those of U.S. securities firms.

The cost of equity

We define the cost of equity as the ratio of a firm's sustainable profits to the market value of its equity. We cannot observe sustainable profits, but we can observe reported profits for a sample of firms and make adjustments to them. In addition to making reported profits better reflect economic profits, these adjustments make the stated profit measures internationally comparable.

Our sample of firms for the United States is necessarily limited to those whose shares have been publicly traded throughout the sample period. First Boston and Shearson-Lehman are thus excluded because their public shareholders were bought out by their respective parents, Credit Suisse and American Express; Goldman Sachs, Drexel, and Prudential-Bache are excluded by virtue of their private ownership. That leaves Merrill Lynch, Morgan Stanley, and Salomon Brothers of the "bulge bracket," or lead underwriter, firms and Bear Stearns and Paine Webber of the remaining top ten firms. The selection of Japanese securities firms is quite obvious in light of their dominant status: Daiwa, Nikko, Nomura, and Yamaichi, the so-called Big Four.

The sample period runs from 1982 to 1991. The nine and one-half fiscal years covered cannot be synchronized across the two countries. For all U.S. firms except Bear Stearns and Paine Webber, fiscal years correspond to calendar years and the 1991 observation covers only the first half.[5] For the Japanese firms, the half year covers October 1988 to March 1989, an accounting period that permitted their fiscal years to be aligned with general practice in Japan. Because Bear Stearns and Morgan Stanley made their initial public offerings in October 1985 and March 1986, respectively, 1985 is the first sample year for each (Morgan Stanley's public offering price is taken to be its December 1985 price). Altogether, this study's cost of equity calculations rely on forty-three observations of U.S. securities firms' share prices, earnings statements, and balance sheets and forty corresponding observations for Japanese securities firms.

We adjust reported profits for the following:[6]

depreciation—stated earnings are lowered to offset the upward bias introduced when depreciation expenses are based on historical cost during a period of inflation;

equity/inflation—the increase in the nominal value of shareholder equity necessary to maintain the real value of shareholder equity is subtracted from stated profits;

crossholding—the undistributed profits associated with equity shares held by Japanese firms are consolidated into income; and

restructuring charges—U.S. firms' restructuring charges are spread out over three years.

The crossholding adjustment is performed for Japanese securities firms but not for U.S. securities firms even though both hold significant amounts of equities. The reason for the asymmetry in this adjustment is that U.S. firms mark their equities to market, while Japanese firms do not. Over time, U.S. firms' marked-to-market equity values reflect retained earnings on equity holdings insofar as these earnings are embodied in share prices. Japanese firms not only value their equity holdings at historical cost, but also hold and rarely realize large and growing stakes in their investment accounts for strategic purposes. It is this combination of low turnover and historical cost accounting that requires the crossholding adjustment.

Taken together, the adjustments performed on the raw observed ratios of after-tax earnings to market capitalization narrow the differences between the U.S. and Japanese firms significantly (Table 2).[7] Making

[5]For Bear Stearns, data for fiscal years ending in April through 1987 and in June from 1988 on are aggregated with the other firms' data for the previous December. For Paine Webber, data for the fiscal year ending in September are aggregated with the other firms' data for the following December through 1986; in 1987 the firm switched to fiscal years ending in December.

[6]Compare the adjustments to bank profits in Zimmer and McCauley, "Bank Cost of Capital," pp. 36-42.

[7]The rows do not sum for U.S. firms in the years 1984, 1988-90, and the average owing to our constraining the cost of equity to be nonnegative. This constraint adds 0.4 percentage point to the average cost of equity. Excluding firm-years of computed negative cost of equity would yield an average cost of equity of 8.6 percent. Treatment of the industry as a single firm—adding earnings across firms in a given year and comparing the total with summed market capitalizations—results in an average cost of equity of 7.4 percent.

allowances for inflation's erosion of depreciation expenses and of shareholders' equity reduces U.S. securities firms' earnings to a greater extent than their Japanese counterparts' earnings, largely because of the higher rate of inflation experienced in the U.S. economy in the sample period. Spreading out U.S. firms' extraordinary reserves should in principle simply smooth their cost of equity but in practice this adjustment interacts with share price movements to widen the gap a bit.

The crossholding adjustment narrows the gap substantially, a finding in line with previous work on differences in equity valuations in the two markets.[8] The crossholding adjustment for Japanese securities firms in the late 1980s is more consistent than for Japanese banks, especially city banks, in the same period. Because the city banks came under pressure to meet new international capital standards and responded in part by realizing massive gains on crossheld shares, the crossholding adjustment actually subtracted earnings in the three fiscal years to March 1990.[9] In the same period, Japanese securities firms, acting like their corporate customers, tended to eschew realizing gains on equities in their investment portfolios—and thereby avoided the taxes associated with such realizations.

The resulting cost of equity series show some volatility but carry a clear message (Chart 1). The Japanese securities firms in our sample face an average cost of equity of 5.1 percent in the sample period as against 7.8 percent for the U.S. securities firms. Such a difference is unlikely to be without implications for international competition. At the same time, the advantage of Japanese securities firms is smaller than that enjoyed by Japanese banks (3.1 percent compared with 11.9 percent for U.S. banks)[10] or Japanese industrial firms (4.5 percent compared with 11.2 percent for U.S.

[8]See James M. Poterba, "Comparing the Cost of Capital in the United States and Japan: A Survey of Methods," this *Quarterly Review*, vol. 15 (Winter 1991), pp. 20-32, and references contained therein.

[9]Zimmer and McCauley, "Bank Cost of Capital," p. 40.

[10]Zimmer and McCauley, "Bank Cost of Capital," p. 42.

Table 2

Summary of Adjustments to Cost of Equity

(Cross-Firm Averages in Percent)

U.S. Firms	Profit/ Market Capitalization	Adjustments				Cost of Equity
		Depreciation	Equity/ Inflation	Cross-Holding	Restructuring	
1982	10.01	−0.98	−1.72	0	0.21	7.51
1983	11.57	−0.97	−1.55	0	0.02	9.07
1984	3.67	−1.00	−1.77	0	0.94	1.90
1985	8.30	−0.69	−1.14	0	−0.25	6.22
1986	10.74	−0.73	−1.23	0	−0.17	8.62
1987	13.55	−1.57	−1.96	0	0.78	10.80
1988	12.37	−1.44	−2.25	0	−0.26	8.57
1989	8.28	−1.39	−2.35	0	0.97	6.79
1990	3.31	−1.71	−2.16	0	3.02	4.77
1991	19.30	−1.21	−1.94	0	−2.34	13.82
Averages	10.11	−1.17	−1.81	0	0.29	7.81
Japanese Firms	Profit/ Market Capitalization	Adjustments				Cost of Equity
		Depreciation	Equity/ Inflation	Cross-Holding	Restructuring	
1982	5.12	−0.10	−0.77	1.66	0	5.91
1983	5.43	−0.08	−0.22	1.18	0	6.30
1984	6.31	−0.08	−0.72	1.15	0	6.66
1985	5.28	−0.05	−0.65	0.84	0	5.42
1986	3.81	−0.02	−0.04	0.43	0	4.18
1987	3.98	−0.02	−0.04	0.56	0	4.47
1988	3.61	−0.02	−0.16	0.48	0	3.91
1989	4.51	−0.02	−0.48	0.34	0	4.35
1990	7.37	−0.03	−1.16	0.60	0	6.78
1991	3.06	−0.05	−1.17	0.76	0	2.60
Averages	4.85	−0.05	−0.54	0.80	0	5.06

Sources: Annual reports; Toyo Keizei Inc., *Japan Company Handbook*; Federal Reserve Bank of New York staff estimates.

industry).[11]

These findings are consistent with managers' actions in the 1980s. Consider the match between the observed pattern of fund-raising in the equity markets and the pattern of absolute and relative advantage in equity costs of U.S. and Japanese firms across industry. First, the absolute advantage of Japanese firms in equity costs in 1985-89 was reflected in the contrasting behavior of nonfinancial corporations in the United States and Japan: U.S. nonfinancial corporations retired (net) $500 billion while their Japanese counterparts issued ¥11.4 trillion, or $80 billion, net.[12] Second, particularly low equity costs help explain why Japanese banks raised more equity than any other industry in Japan,[13] although capital regulation also played a role. (U.S. banks were constrained by regulation from joining their corporate customers in share repurchases.) Finally, the U.S. securities industry stood out as an issuer of new equity in the 1980s: Bear Stearns, Morgan Stanley, and others made initial public offerings,[14] and Goldman Sachs, Shearson Lehman, and Paine Webber sold equity to Sumitomo Bank, Nippon Life, and Yasuda Trust, respectively. Moreover, the issues of the U.S. firms clustered in the mid-1980s, when our measured cost of equity was most favorable.

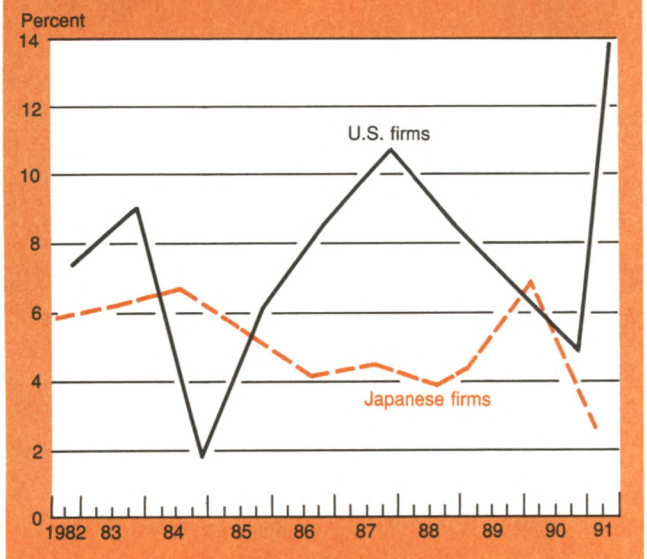
[11]McCauley and Zimmer, "Explaining," p. 12.

[12]Margaret Hastings Pickering, "A Review of Corporate Restructuring Activity, 1980-90," Board of Governors of the Federal Reserve System Staff Study, no. 161, May 1991; and Bank of Japan, flow of funds data in *Economic Statistics Monthly*.

[13]Robert Zielinski and Nigel Holloway, *Unequal Equities: Power and Risk in Japan's Stock Market* (Tokyo: Kodansha International, 1991), pp. 184-86.

Chart 1

Cost of Equity for U.S. and Japanese Securities Firms



Sources: Annual reports; Toyo Keizai Inc., *Japan Company Handbook*; Federal Reserve Bank of New York staff estimates.

Allocating equity to financial activities

The required fee or return on a given product or activity is determined by the required return on equity and by the amount of equity allotted to the product or activity. If both a U.S. and a Japanese securities firm allot the same equity to a given product or activity, then the required fee or return will be an equal fraction of each firm's cost of equity. Any difference in the cost of equity is then reproduced in the cost of capital for the product or activity.

If U.S. securities firms lever up their shareholders' equity with more assets than Japanese securities firms, it might seem safe to conclude that they allot less equity to a given activity than does their competition. This conclusion does not follow, however. At the outset, it is easy to overstate the difference in leverage because U.S. accounting standards leave securities sold under agreements to repurchase on the balance sheet, while Japanese accounting takes them off. Even if one adjusts for this discrepancy, however, Japanese securities firms remain less leveraged, whether measured at book or market value (Table 3, lines 5 and 7).

To some extent, Japanese securities firms' lower leverage offsets the higher risk of their assets. By historical accounting, U.S. and Japanese securities firms have 3 to 4 percent of their assets invested in equities. By market value, however, the Japanese firms have almost twice the equity (Table 3, lines 1 and 2). Still, a different mix of equities in assets does not provide a full account of the leverage difference. If equity holdings are subtracted from shareholders' equity, Japanese firms remain significantly less leveraged (Table 3, line 6).

Even the remaining difference in leverage need not imply that Japanese firms allocate more equity to a given activity *in a given market.* The lack of international coordination in the regulation of the securities business must be recognized. Securities firms in Japan must hold shareholders' equity equal to 10 percent of assets. Despite the application of this standard to both domestic and foreign firms operating in Tokyo, U.S. firms have complained that so high a capital require-

[14]Chris J. Muscarella and Michael R. Vetsuypens, "A Simple Test of Baron's Model of IPO Underpricing," *Journal of Financial Economics*, vol. 24 (1989), pp. 125-35.

ment is restrictive.[15] Whatever the weight of this contention, U.S. and Japanese firms in Tokyo require the same equity in a given activity to, say, arbitrage between cash and futures markets in stock.

In New York the subsidiaries of Japanese securities firms are not bound by Japanese capital standards but need only satisfy U.S. Treasury and Securities and Exchange Commission capital requirements. Indeed, the Big Four's U.S. subsidiaries operate with leverage more like that of U.S. firms than that of their parents (Table 4; Table 3, line 5). When in New York, these firms do as New Yorkers do.

The overall difference in leverage, therefore, can be ascribed largely to differences in capital requirements and in the geographical mix of business. Indeed, capital requirements better explain the differences in leverage than the degree of leverage of either U.S. or Japanese firms since firms in both countries tend to hold capital in excess of requirements.

Similar leverage within a market makes for cost of capital differences that reflect cost of equity differences. Given that a 10 percent equity-to-asset ratio is required in Japan, if U.S. firms face a required return on equity of 10 percent while Japanese firms face a required return of 5 percent, then the former need to earn 1 percent on assets in Tokyo while the latter can get away with ½ percent. If the capital requirement works out to 2 percent in the U.S. market, then the U.S. firm needs to earn 20 basis points per annum on its assets while the Japanese firm needs to earn only 10 basis points. In this manner the cost of equity differences carry over into cost of capital differences.

[15]Foreign securities firms have faced the same capital requirements as Japanese firms since the mid-1980s. See U.S. Treasury, *National Treatment Study: 1986 Update*, p. 78; and Report on Primary Dealers Act, Attachment 3, Summary of Public Comments, pp. 7-8.

Table 3
Selected Balance Sheet Characteristics of U.S. and Japanese Securities Firms
(Percent)

	Japanese Firms	U.S. Firms
Equity holdings in perspective		
1. Equity portfolio/total assets (security holdings at book value)	3.0	3.7
2. Equity portfolio/total assets (security holdings at market value)	6.9	3.7
3. Equity portfolio/shareholder equity (security holdings at book value)	26.3	87.4
4. Equity portfolio/shareholder equity (security holdings at market value)	44.5	87.4
Leverage		
5. Shareholder equity/total assets (security holdings at book value)	11.7	4.3
6. Shareholder equity less equity holdings/ total assets less equity holdings (security holdings at book value)	9.0	0.38
7. Shareholder equity/total assets (security holdings at market value)	14.7	4.3

Sources: Annual reports; Toyo Keizai Inc., *Japan Company Handbook*; Federal Reserve Bank of New York staff estimates.

Notes: Data are averages for 1986-89. Assets for Japanese firms include gensaki and repurchase agreements. For Daiwa, Nikko, and Yamaichi, the market value of securities portfolio is estimated from net assets at market value less unconsolidated shareholder equity from the *Japan Company Handbook*. For Nomura, whose annual reports detail the market value of securities, this difference overstates unrealized gains on securities by an average of 6 percent, with a range of 1 to 9 percent. Unrealized gains on Daiwa's, Nikko's, and Yamaichi's equity holdings alone are estimated as the product of the difference above and .905.

Explaining cost of capital differences for securities firms

The findings so far raise two questions: Why do Japanese securities firms claim an advantage in the cost of equity over their U.S. counterparts? And why is the advantage smaller than that found for Japanese nonfinancial firms and banks?

Macroeconomic explanations for U.S.-Japanese differences[16]

Japanese securities firms share in the relatively low equity costs that characterized the whole Japanese corporate sector in the latter 1980s. These low costs are traceable in large part to macroeconomic factors. Even though the international mobility of capital increased in the 1980s (as evidenced by substantial crossborder transactions in equity), capital costs were far from equalized across countries and national factors still played a predominant role. In Japan, higher household savings made for lower equity costs. In addition, smoother growth in Japan, resulting in part from successful macroeconomic policy, meant lower risk in profits, and lower risk in profits meant lower cost of equity.

Safety net differences between U.S. and Japanese securities firms

We have argued elsewhere that the risk faced by investors in the equity of banks depends on the nature of the safety net provided by officials of various countries to their banks. Investors in the shares of securities firms also face systematically different risks owing to national differences in safety-net characteristics. In particular, investors in Japanese securities firms have more reason

[16]Macroeconomic explanations of U.S.-Japanese cost of capital differences are discussed at length in McCauley and Zimmer, "Explaining," pp. 16-20.

to suppose that their downside risk is substantially lessened by the possibility of government intervention than do investors in the shares of U.S. securities firms.

Potential investors trying to imagine the worst that might happen to the value of their shares in a securities firm are liable to conjure up different scenarios for losses in Japanese and U.S. securities firms. If they are considering investing in shares of a Japanese firm, they may well call to mind the distress of Yamaichi Securities in the 1960s; if they are considering investment in a U.S. firm, they may readily recall the bankruptcy filing of Drexel in 1990.

The essential features of Yamaichi's difficulties may be related briefly: losses on stock market holdings impaired the firm's capital; customers withdrew liquidity; the Bank of Japan worked with the Ministry of Finance to pursue a rescue plan involving largely unsecured advances by the Bank of Japan; eventually Yamaichi recovered and repaid the loans over four years.[17]

The essential features of Drexel's difficulties may be related with equal brevity: losses on junk bonds and bridge loans impaired the firm's capital; providers of wholesale funding withdrew liquidity; the Securities and Exchange Commission worked with the Federal Reserve Bank of New York to achieve an orderly reduction of the balance sheets of the registered broker-dealer and the government securities subsidiaries; the firm sought protection from its creditors under Chapter 11 of the Bankruptcy Code; and the fate of unsecured creditors, like that of holders of the firm's (untraded) equity, remains unclear at this juncture.[18]

The striking contrast between these two episodes, of course, provides no certain guide to how a troubled securities firm would be handled in the future. Certainly the contexts of the official actions differed: generally low share prices reflected general economic weakness in Japan in 1962, while Drexel's difficulties came late in an economic upswing. Nevertheless, market participants may well view the equity of a major U.S. securities firm as subject to one more risk than that of a major Japanese securities firm.

Market measures of risk

Market measures of risk show Japanese securities firms to be, if anything, a bit riskier than their U.S. counterparts. Because Japanese securities firms are much less leveraged than U.S. firms, they should exhibit lower stock betas, given equal riskiness of assets.[19] But in fact the stock betas of Japanese security firms have averaged 1.46 over the period 1987-91, as compared with 1.29 for U.S. securities firms over the period 1986-91, and the difference is even more striking for

[17]Appendix to statement of E. Gerald Corrigan, President of the Federal Reserve Bank of New York, in *Deposit Insurance Reform and Financial Modernization*, Hearings before the Senate Committee on Banking, Housing, and Urban Affairs, 101st Cong., 2d sess. (Washington, D.C.: Government Printing Office, 1990), pp. 82-86, reprinted as "How Safety Nets Work," *Central Banking*, Autumn 1990, pp. 61-63.

[18]Christopher Byron, "Drexel's Fall: The Final Days," *New York*, March 19, 1990, pp. 32-38.

[19]Starting with the relationship

$$b_a = w \times b_e + (1-w) \times b_d,$$

where

b_a = asset beta
w = equity/asset ratio
b_e = equity beta
b_d = bond beta,

we have $db_e/dw = w^{-1} \times \{ b_d - b_e + [(1-w) \times db_d/dw]\}$.

Given that b_d and db_d/dw are small and of opposite sign, we have $db_e/dw < 0$. If we further assume that bond betas are generally negligible, we have $db_e/dw = -b_e/w$.

Table 4

Shareholders' Equity as a Share of Total Assets for U.S. Affiliates of Japanese Securities Firms

(Percent)

Date	Daiwa	Nikko	Nomura	Yamaichi	Average
September 1985			5.91		5.91
September 1986	1.38		2.30		1.84
September 1987	1.05	2.96	1.48	2.45	1.99
September 1988	0.92	2.90	2.00	1.84	1.92
March 1989	0.99	2.22	1.57	0.90	1.42
March 1990	0.85	1.64	1.38	0.92	1.20
March 1991	1.17	1.90	1.41	0.96	1.36
Period average	1.06	2.32	2.29	1.41	1.77

Source: Annual reports.

Note: For Nomura and Yamaichi, March figures for 1989 and 1990 are averages of September 1988 and September 1989 and September 1989 and September 1990, respectively.

years other than 1990 (Tables 5 and 6).

Financial deregulation and the insecurity of Japanese securities firms' earnings

Investors in the Big Four's shares may well perceive a risk of more concern than bankruptcy or the shares' exaggerated response to general market movements. Prospective deregulation is widely viewed as a threat to the firms' revenues, and the risk of an adverse change in the rules can boost the measured cost of equity for Japanese securities firms relative to Japanese firms in general. In addition, if investors anticipate a decline in the profitability of Japanese securities firms, then the current relation of their earnings to the market valuation of their shares will tend to overstate their cost of equity unless the stock market is very myopic. Evidence suggests that investors in the shares of the Big Four securities firms do fear lower profitability going forward.

Japanese securities firms resemble U.S. securities firms in the mid-1970s in their dependence on equity commissions as a source of revenue. U.S. securities firms drew about half of all revenues from equity commissions when they were liberalized in May 1975 (Chart 2). Since then, the share of commissions in industry revenues has fallen below a fifth. By contrast, the large Japanese securities firms have depended and continue to depend on equity commissions for about half of their revenue (Chart 3).

Investors need only extrapolate a trend to foresee that these revenues will shrink over the medium term. The Japanese authorities have been reducing equity commission rates gradually (Chart 4). Over the last decade, commission rates fell at an annual rate of 1 percent for trades of 1 million yen (about $7000), 1.6 percent for trades of 10 million yen ($70,000), 5.5 percent for trades of 100 million yen ($700,000), 13.4 percent for trades of 1 billion yen ($7 million), and 18.9 percent for trades of 10 billion ($70 million).

Table 5

Relation of U.S. Securities Firms' Share Returns to Returns on the Standard and Poor's 500 Index

	Merrill Lynch			Morgan Stanley			Salomon Brothers		
Period	Beta	Standard Error	R^2	Beta	Standard Error	R^2	Beta	Standard Error	R^2
1986-91	1.30*	0.085	.45	1.14	0.088	.38	1.44*	0.089	.48
1986	0.81	0.19	.26	1.17	0.21	.45	1.64*	0.21	.56
1987	1.29	0.15	.60	1.30	0.17	.53	1.55*	0.20	.55
1988	0.88	0.15	.40	0.87	0.20	.27	1.33	0.21	.45
1989	2.09*	0.23	.61	0.88	0.25	.19	1.06	0.22	.33
1990	1.45	0.24	.41	1.06	0.22	.32	1.31	0.20	.47
1991 (26 weeks)	1.67	0.34	.50	1.37	0.36	.38	1.61	0.38	.43

Source: Standard and Poor's.

Note: Data are weekly.

*Beta is significantly different from one on a two-tailed test at 5 percent significance.

Table 6

Relation of Japanese Securities Firms' Share Returns to Returns on the TOPIX Index

	Daiwa			Nikko			Nomura			Yamaichi		
Period	Beta	Standard Error	R^2	Beta	Standard Error	R^2	Beta	Standard Error	R^2	Beta	Standard Error	R^2
1987-91	1.62*	0.09	.57	1.34*	0.09	.50	1.42*	0.07	.62	1.44*	0.09	.55
1987	2.07*	0.21	.68	1.53*	0.21	.53	1.63*	0.16	.70	1.79*	0.22	.59
1988	2.79*	0.27	.69	2.44*	0.24	.66	1.99*	0.21	.63	2.53*	0.23	.71
1989	2.03*	0.27	.54	1.99*	0.25	.55	1.68*	0.22	.53	1.89*	0.26	.52
1990	1.05	0.13	.58	.91	0.11	.56	1.10	0.12	.64	.98	0.11	.61
1991 (25 weeks)	2.05*	0.28	.71	1.33	0.31	.45	1.95*	0.19	.82	1.39	0.24	.60

Source: Daiwa and Dow Jones Tradeline International.

Note: Data are weekly.

*Beta is significantly different from one on a two-tailed test at 5 percent significance.

Note that liberalization of commissions hurts the securities firms more than the liberalization of interest rates ever hurt Japanese banks. Competition among the banks for borrowers kept the spread between average deposit rates and prime lending rates fairly narrow by international standards. Regulation of commission rates proved much more effective in protecting the revenues of the securities firms.

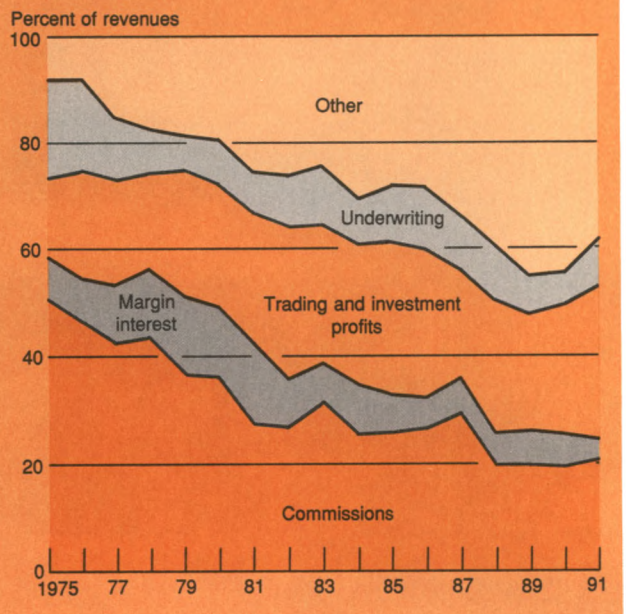
Reinforcing the trend toward commission deregulation was a 1988 regulation that shrank the Big Four's share of equity brokerage. The Ministry of Finance was reported to have advised securities firms not to perform more than 30 percent of daily trading in any single share. This guidance, aimed at excesses associated with thematic promotions of the Big Four, contributed to a decline in their share of equity brokerage from 60 percent in 1981 to 46 percent in the middle of the decade to 33 percent at the end of the decade.[20] As a result of commission cuts and lost market share, Big Four commissions showed little of the buoyancy of the trading value of Japanese equities (Chart 5). Note that the value of share turnover on the Tokyo Stock Exchange reflected not only the performance of share prices but also the clear downward trend in share volume from the beginning of 1988.

Further analysis of the Big Four commission income confirms the erosion of their revenue base in the midst of the boom market of the late 1980s. We relate the log of annual commission income for each of the Big Four for 1983-91 to a time trend and to the log of the value of shares traded on the Tokyo Stock Exchange. The estimated coefficient for time suggests that when the value of trades on the Tokyo Stock Exchange is held constant, commission revenue tends to decline 4.7 percent per year. This rate lies within the spectrum of rates of decline for regulated commissions over the decade, as outlined above—1 percent to 18 percent—and is close to the rate of decline for commissions associated with

[20]Satoshi Takeuchi, "Big Four's Transaction Share No Longer So Big; 30% Cap on Trade Volume Hobbles Strategy to Promote Selected Issues," *Japan Economic Journal*, October 28, 1989, p. 2. The article notes that "the guidelines emerged after the U.S. government's special body on stock trading, the Brady Commission, sharply criticized the Big Four's oligopolistic control [and] accused the Big Four of manipulating stock prices by conducting concerted

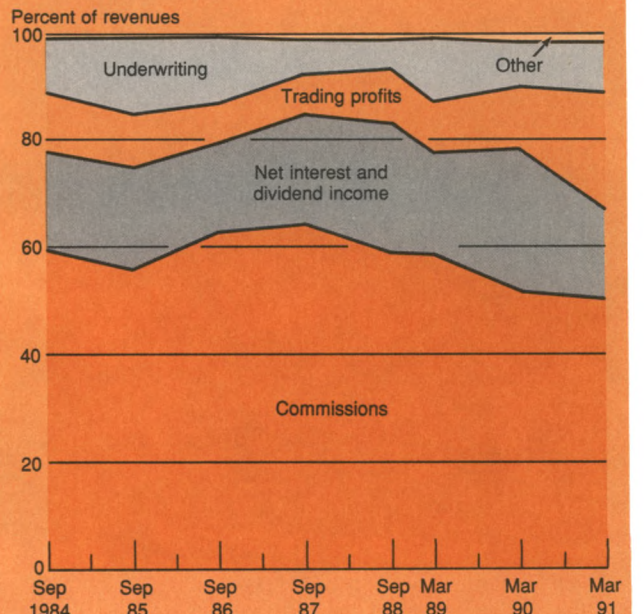
Footnote 20 (continued)
buying operations based on specific themes." See *Report of the Presidential Task Force on Market Mechanism* (Washington, D.C.: Government Printing Office, 1988), p. I-8.

Chart 2
Composition of Revenues of the U.S. Securities Industry



Source: Securities Industry Association.
Note: Data for 1991 cover first half of year only.

Chart 3
Composition of Revenues of the Japanese Securities Industry



Sources: Daiwa, Nikko, Nomura, and Yamaichi annual reports.

an 80 million yen trade. Allowing for 10 percent growth in trading value and other, noncommission revenues, investors may readily foresee commission income dropping to less than a quarter of the Big Four's revenues over the next fifteen years.[21]

The Big Four's commission income is quite responsive to the stock market's performance. Our regression analysis suggests that a 10 percent rise in the value of stock market trading yields a 7.1 percent increase in Big Four commission revenues (Table 7). Big Four commissions did not respond one-for-one to the value of trading because rising share prices tended to push transaction values along the declining schedule of commissions and because their market share was declining.

Investors in the shares of Japanese securities firms must pay attention to the larger agenda of deregulation that includes a reconsideration of the Article 65 barriers between securities and banking businesses. Already the Japanese city banks have equity stake-outs in smaller securities firms that could be capitalized upon were Article 65 repealed or modified to permit bank entry into brokering Japanese shares. Even if the change in the law now thought most likely will not permit banks to broker shares, investors nevertheless will have borne the risk that a more sweeping deregulation poses to securities firms' revenues and profits.[22]

Finally, investors may perceive that the entry of foreign securities firms may present a threat to the commission revenue of the large Japanese securities firms. Foreign firms have brought well-developed technical trading tactics and more critical research to their bidding for institutional trades. With these advantages, they have raised their share of trading on the Tokyo Stock Exchange from 1.5 percent in 1986 to 5.4 percent in 1989 and 7.3 percent in the first half of 1990.[23]

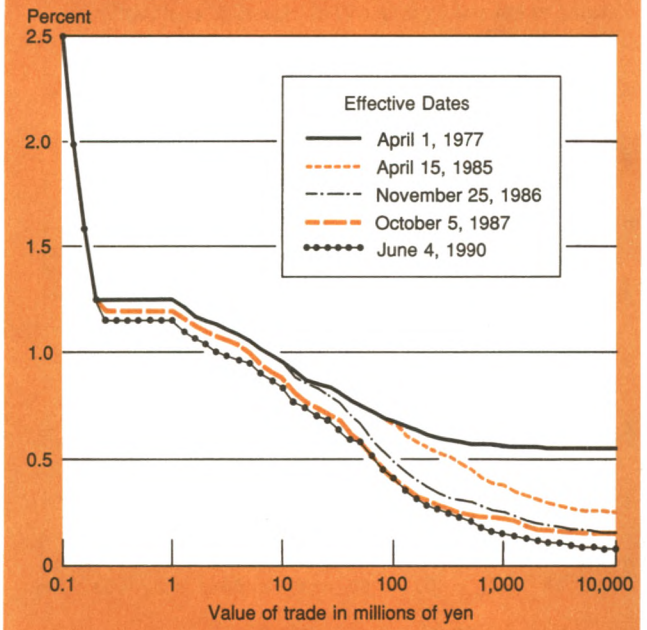
[21] If trading value rises at 10 percent per annum, if the elasticity of commissions with respect to trading value is .71, and if deregulation continues to put a 4.7 percent per annum drag on commissions, then commissions will grow at 2.1 percent per annum. If other revenues start off equal to commissions and grow at 10 percent per annum, then it will take fifteen years for commissions to fall to a quarter of revenues. In other words, $(1.021)^x = (1.1)^x/3$; solving for x, we have fifteen.

[22] "While the entry of the banks into certain areas of securities business is now a foregone conclusion, the speed with which such reforms will be implemented, the scope of the banks' new businesses, the form which entry will take, and the new questions surrounding the banks' ability to expand aggressively while international capital adequacy requirements still seem a problem for them, all combine to suggest a picture which is not as black as originally perceived" (Alicia Ogawa, "Daiwa Securities," S. G. Warburg Securities, March 26, 1990, p. 12).

[23] *Business Week*, July 9, 1990, p. 60. In *National Treatment Study, 1990*, p. 236, the U.S. Treasury cites the "market power" of the Big

Chart 4

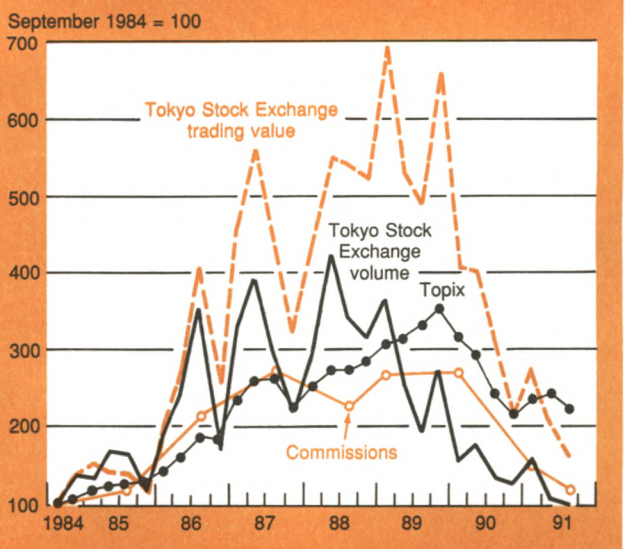
Equity Commission Rates in Japan



Source: *Tokyo Stock Exchange Fact Book*, various issues.

Chart 5

Tokyo Stock Market Performance and Big Four Commissions



Sources: *Tokyo Stock Exchange Fact Book* and annual reports.

One measure of the loss of franchise value of the Japanese securities firms is the ratio of market value to book value. These firms' market-to-book ratio has declined as commissions have been reduced (Chart 6). Note that the spate of public share offerings in late 1985 and early 1986 by U.S. securities firms, including Bear Stearns and Morgan Stanley, were well timed by this measure.

The possibilities of additional commission cuts, Japanese bank competition, and further penetration by foreign firms all represent risks that investors in Big Four shares take into account. It is understandable if investors in the shares of the Big Four discount current earnings somewhat to allow for cheaper stock trading for Japanese households and institutions.[24] As a result of the Big Four's problematic growth prospects, the measured cost of equity for these firms may be higher than that of Japanese firms in general.

Industrial organization

Another factor jeopardizing the earnings of the Japanese security firms is the peripheral position of the Japanese security firms in the country's industrial organization. A Japanese city bank is at or near the center of a *keiretsu*, a network of firm affiliations that approximate a cross-section of the economy. This arrangement affects the cost of equity directly through the stock market: extensive cross shareholding within the keiretsu may stabilize and perhaps even elevate share prices. Indirectly, the keiretsu structure assures steadier business flows and provides implicit guarantees of assistance to troubled members, benefits that in turn help to stabilize profit flows.

The peripheral position of the Big Four securities firms is evident in the reference work *Industrial Groupings in Japan*.[25] Three of the Big Four appear only once each and no group affiliation is given. By contrast, nine of the eleven Japanese banks examined in our study of bank cost of capital anchor well-defined industrial groups.

Even the exceptional Japanese securities firm broadly conforms to the pattern. Nikko Securities is listed as associated with the Mitsubishi group, but the affiliation is described as weak. The aggregate equity stake in Nikko held by Mitsubishi group companies, measured against the overall concentration of shareholdings in the securities firm, supports that charac-

Footnote 23 (continued)
Four to account for the minimal shares accorded foreign firms in underwriting syndicates in Tokyo. In underwriting carve-outs of U.S. firms, however, U.S.-based underwriters have played important roles. See Ted Fikre, "Equity Carve-Outs in Tokyo," this *Quarterly Review*, vol. 15 (Winter 1991), pp. 60-64.

[24]A major rating firm cited "concerns about future profitability in light of structural changes that are currently taking place in the domestic Japanese financial market," including "lower domestic equity brokerage commission rates and ongoing discussions about financial reforms," in warning investors of possible downgradings. Standard and Poor's *Credit Week*, May 13, 1991, p. 19.

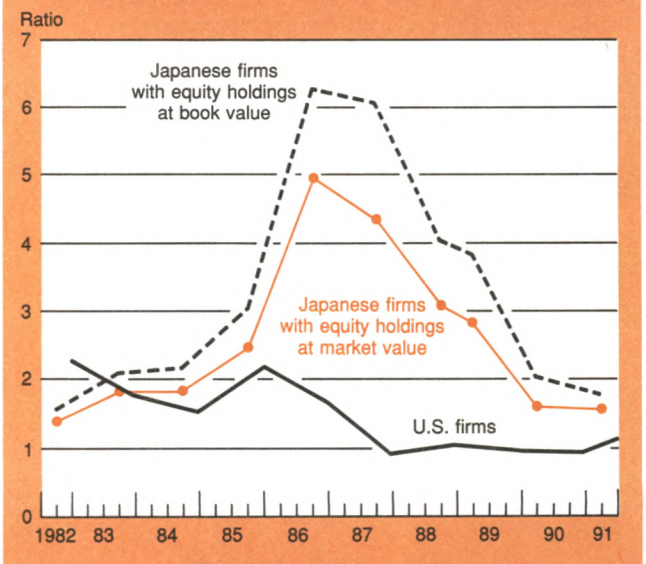
[25]Eighth ed. (Tokyo: Dodwell Marketing Consultants, September 1988), pp. 34-35, 49, 128, 304, 306, 506, 512.

Table 7
Regression Analysis of Japanese Securities Firms' Commission Income September, 1984-91

Dependent variable	Natural Log of Commission
Independent variables	
Time	−.047
	(.012)
Natural log of Tokyo Stock Exchange trading value	.713
	(.050)
Intercept	9.31
	(.146)
R^2	.87
Degrees of freedom	33

Note: Standard error of coefficients is given in parentheses.

Chart 6
Ratio of Market to Book Value for U.S. and Japanese Securities Firms



Sources: Annual reports; Toyo Keizai Inc., *Japan Company Handbook*; and Federal Reserve Bank of New York staff estimates.

terization. The Mitsubishi group's aggregate holding of Nikko's equity amounts to no more than a third of the top ten shareholders' collective stake. By contrast, the Mitsubishi group's holding of Mitsubishi Bank's shares bulks much larger: almost two-thirds of the top ten shareholders' stake.[26] Only 13 of the 128 firms in the Mitsubishi group show lower group "influence" ratios than does Nikko Securities. Moreover, Nikko has no directors from Mitsubishi group companies while Mitsubishi Bank has two.

Reversing the perspective to examine financial firms' holdings of equities confirms that securities firms remain much less well connected than Japanese banks. The securities firms channeled part of their strong flow of retained earnings during the boom years of the 1980s into accumulating equity stakes. As a result, securities firms increased their strategic share of exchange-listed firms faster than banks did in the 1980s, especially if "most of the increase in bank equity ownership" was "not ... for stable share-owning purposes [but rather] for short-term investment purposes."[27] In March 1990, almost four-fifths of Nomura's equity holdings by value were held in the investment account; such shares "are acquired for the Company's operating purposes and are rarely sold under a Company policy."[28] Still, Japanese banks' stake in firms listed on the Tokyo Stock Exchange remains about ten times deeper than that of Japanese securities firms (Table 8).

At the firm level, examination of the securities firms' major holdings in Japan's top companies shows the holdings to be fewer and more concentrated than those of the banks. Although some observers contend that "Nomura is actively building its own keiretsu of nonindustrial companies in a variety of sectors including real estate, insurance, distribution, research, training, and advertizing,"[29] Nomura has not broken into the top tier of ownership of firms traded in the first section of the Tokyo Stock Exchange. A search of the top eight or ten shareholders in each of the 1254 firms listed on the Tokyo Stock Exchange's first section found only thirty-three shareholdings of the Big Four securities firms (Table 9). Nomura accounted for half of these, but its holdings were quite concentrated in financial firms, including the shares of two of its own major shareholders, Daiwa Bank and Toyo Trust. By contrast, the other 3 securities firms were not represented among the top shareholders of any of their own top shareholders. Whatever the differences among the major securities firms, none of them has holdings approaching the near cross-section of corporate Japan owned by the city banks.

The usefulness of the limited equity stakes that the Big Four do possess is suggested by their role as underwriters for 22 out of 24 of the firms in which they hold major shareholdings. In all but two cases for which an underwriter is listed, the securities firm with the equity stake is at least co-lead underwriter, usually main underwriter, and often sole underwriter. This strong pattern suggests that equity stakes cement business relations and consequently underscores the threat to underwriting income arising from expanded powers for banks.

Combined with prospective deregulation, the more central position of banks in the structure of corporate networks renders the earnings of the securities firms insecure. If banks are allowed to enter the wholesale securities markets, corporations may well favor their banks in the face of roughly comparable pricing of prospective deals. For this reason, underwriting revenues could be particularly at risk.

A comparison of the responses to Yamaichi's distress

[26]Mitsubishi group companies held 8.8 percent of Nikko Securities' shares, while the top ten held 26.4 percent. Mitsubishi group companies held 18.8 percent of Mitsubishi Bank's shares, while the top ten held 29.5 percent.

[27]W. Carl Kester, *Japanese Takeovers* (Boston: Harvard Business School Press, 1991), p. 207.

[28]Nomura Securities Company, *Annual Report* 1990, p. 23.

[29]Richard W. Wright and Gunter A. Pauli, *The Second Wave* (New York: St. Martin's Press, 1987), p. 71. Martin French, "Japan's Great Finance Plan," *Asiamoney*, July-August 1991, p. 35, also suggests that Nomura might establish itself at the center of a major industrial group. The article also associates Daiwa Securities with the Sumitomo group and Yamaichi Securities with the Fuyo group.

Table 8

Share of Tokyo Stock Market Owned by Japanese Securities Firms and Banks

	1982	1983	1984	1985	1986	1987	1988	1989	1990
Securities firms	1.6	1.7	1.7	1.8	1.9	2.1	2.3	2.3	2.0
Banks	17.5	18.0	17.7	17.4	18.4	19.3	19.8	21.3	21.3

Source: Tokyo Stock Exchange.

and the troubles of a well-connected automobile maker highlights the greater risk attendant on the securities firms' relatively peripheral position (although the sheer size of Yamaichi's problem may have had something to do with the difference in handling the two cases). While the automobile firm Mazda was helped through a period of distress by its main bank and affiliated companies,[30] Yamaichi had to resort directly to the government.

Conclusions

U.S. securities firms must clear a higher cost of equity hurdle in pricing their products and services than their Japanese counterparts. Higher capital requirements in Japan may put U.S. firms at a particular disadvantage in competing there.

Factors contributing to lower costs for Japanese firms in the 1980s were higher household savings and smoother economic growth. In addition, a comparison of the experience of troubled securities firms in the United States and Japan suggests a wider safety net in Japan that may lower equity costs.

Japanese securities firms seem to have a smaller cost of equity advantage over their U.S. counterparts than Japanese nonfinancial firms and banks have over their respective counterparts. In part, Japanese investors bear a risk of lower earnings for Japanese securities firms in a deregulated environment, and this risk

[30]Richard Pascale and Thomas P. Rohlen, "The Mazda Turnaround," *Journal of Japanese Studies*, vol. 9 (Summer 1983), pp. 219-63.

Table 9

Japanese Securities Firms' Equity Stakes in Firms Listed on the Tokyo Stock Exchange First Section

				Underwriter Status				
Securities Firm	Sector	Firm	Percent Stake	Sole	Main	Co	Sub	Not
Nomura	Financial	Daiwa Bank	3.1		X			
		Toyo Trust	6.9		X			
		Dai-Tokyo Fire & Marine	9.2	X				
		Chiba Bank	1.7		X			
		Osaka Securities Finance	17.0	X				
		Japan Securities Finance	3.4					
		Kokusai Securities	32.5					
		Sanyo Securities	8.1					
	Nonfinancial Manufacturing	Hokko Chemical	4.9	X				
		Nissho (medical equipment)	1.4				X	
		Toyo Denki, Seizo (railroad equipment)	2.4	X				
	Retail trade	Sogo (department store)	3.9		X			
	Communications	Nippon Television Network	4.3	X				
	Construction	Nissan Construction	2.1		X			
		Daiwa Danchi	6.5			X		
	Transport	Hitachi Transport	0.8		X			
	Fishing	Hoko	5.1	X				
Nikko	Financial	Tokyo Securities	33.6					
		Toyo Securities	6.4					
		Maruman Securities	4.9					
		Kosei Securities	4.1					
		Japan Securities Finance	5.0					
	Manufacturing	Tateho Chemical	4.2		X			
		Ikegai (machine tools)	1.7	X				
		Nissan Nohrin Kogyo (plywood)	4.2		X			
Daiwa	Manufacturing	Kyodo Printing	2.5					X
		Nippon Conveyor	1.8		X			
		Nihon Matai (food containers)	3.8		X			
	Retailing	Senshukai	3.5		X			
	Construction	Morimoto	3.5	X				
Yamaichi	Financial	Nippon Trust Bank	1.6		X			
		Kita-Nippon Bank	4.1		X			
		Taiheiyo Securities	4.1					

Source: Toyo Keizai Inc., *Japan Company Handbook—First Section*, Winter 1990.

Notes: Nomura comprises Nomura Securities and Nomura Land and Building, and Nikko comprises Nikko Securities, Nikko Building, and Nikko Investment Trust. No underwriters are listed for the securities firms in which the Big Four own stakes.

boosts their measured cost of equity. In addition, the distance of Japanese securities firms from corporate networks of mutual support may render their shares more risky than the shares of firms secure within such networks.

Financial Liberalization and Monetary Control in Japan

by Bruce Kasman and Anthony P. Rodrigues

The last fifteen years have witnessed a substantial liberalization of Japan's financial markets. Controls on cross-border capital flows have been gradually dismantled and restrictions affecting competition and price flexibility in domestic financial markets have been relaxed. As a result, the range of free market assets has grown significantly, as has the range of credit sources available to domestic borrowers.

The experience of other industrial countries indicates that changes in financial structure can have important implications for the conduct of monetary policy. A number of countries substantially revised their operating procedures during the past decade as financial market changes altered the relationships between policy tools and objectives.

This article examines the effects of financial reforms on Japanese monetary policy. In the first section of the article we discuss how the Bank of Japan has altered its operating strategy in response to the evolving financial environment. We focus in particular on changes in the intermediate objectives of monetary policy and in the instruments used to implement policy. Our analysis suggests that the complex system of controls prevailing in the mid-1970s supported an operating strategy designed to influence the supply of bank credit. With the relaxation of these controls, monetary policy authorities shifted their strategy away from the control of credit aggregates and, in recent years, have increasingly emphasized interest rates as an agent of policy transmission.

The article's second section offers an empirical assessment of the monetary control mechanism in the current liberalized environment. Specifically, we evaluate the degree to which the Bank of Japan has been able to influence market interest rates and broad money through interbank interest rates, its chief operating target. We find that monetary policy changes have elicited strong and consistent interest rate responses across the term structure in recent years. In particular, long-term bond yields are much more responsive to monetary policy actions than in the past. In contrast, our analysis of the relationship between money and interest rates indicates that as financial reform has reduced policy makers' direct influence over banks, the link between policy and broad money may have weakened.

Our results do not address the extent to which monetary policy actions have been transmitted to real activity or prices. Nonetheless, our findings suggest that the Bank of Japan has successfully adapted its operating strategy to the changing financial environment.

Evolution of monetary control in Japan

In Japan, as in most countries, the ultimate goals of monetary policy are output growth and inflation management. The authorities typically tighten monetary policy to reduce inflationary pressures and ease policy to stimulate activity. Output and prices are controlled only indirectly and with lags, however. Policy actions first affect financial markets and only over time can be expected to influence real activity and prices.

Because financial markets play a central role in transmitting monetary policy, policy makers generally base

their operating strategy on financial variables.[1] In particular, a financial variable subject to a high degree of control by authorities usually serves as the target for day-to-day operations. Borrowed reserves and the fed funds rate are generally viewed as the current operating targets employed by the Federal Reserve in the United States.[2] In Japan, the reserve progress ratio, the ratio of reserves accumulated within a monthly maintenance period to total required reserves, and interbank interest rates have served a similar function since the mid-1970s.

Financial variables are also employed as intermediate targets or indicators. As the term "intermediate " suggests, these variables fit between the instruments and operating targets of policy, on the one hand, and the ultimate policy goals, on the other. To be effective, an intermediate variable should provide information about policy goals and bear some relation to operating targets. In the late 1970s and early 1980s a number of central banks used a monetary aggregate as a key intermediate variable, in many cases setting explicit targets for its annual growth. In recent years, reliance on monetary aggregates as explicit intermediate targets has diminished and attention has shifted to a wider set of financial market variables.

[1]A more complete description of the role of targets and indicators in the implementation of monetary policy can be found in Richard G. Davis, "Intermediate Targets and Indicators for Monetary Policy: An Introduction to the Issues," this *Quarterly Review*, Summer 1990.

[2]Borrowed reserves are obtained by banks directly from the Federal Reserve discount window. The federal funds rate is the rate depository institutions charge one another to borrow reserves.

The movement away from monetary targeting has largely stemmed from changes in the financial environment. The remainder of this section considers how deregulation, globalization, and innovation in Japan's financial markets over the past two decades have shaped the Bank of Japan's policy and operating strategy.

The monetary control mechanism: mid-1970s

Until the mid-1970s, the Japanese financial system was highly regulated. A complex system of controls had evolved, limiting interest rate movements and the activities of market participants.[3] This system ensured that large personal sector surpluses were transferred through banks to large corporations to promote high rates of domestic capital formation.[4]

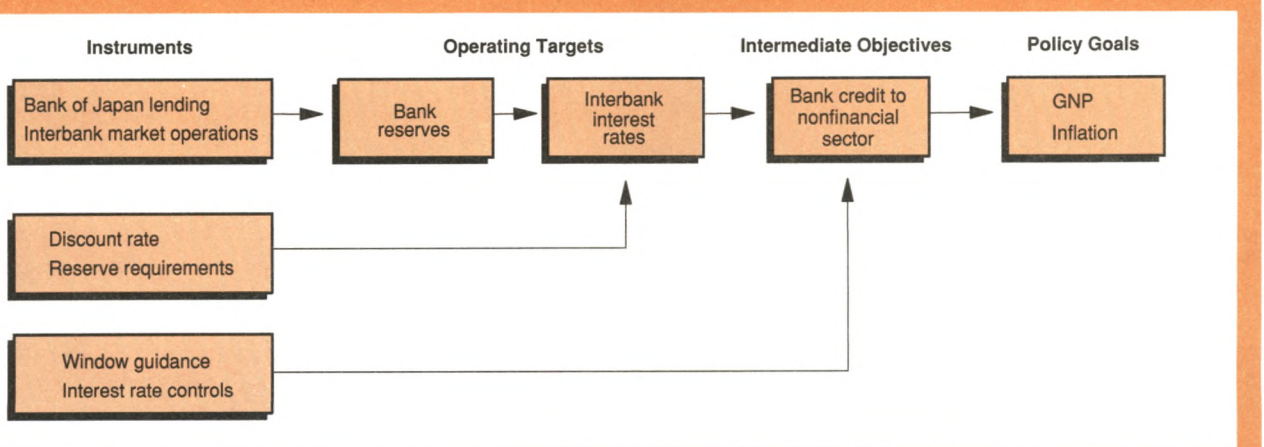
In this highly regulated environment, the Bank of Japan's operating strategy was designed to control bank credit to the nonfinancial private sector. The monetary policy control mechanism during the mid-1970s is summarized in Chart 1. Day-to-day policy operations

[3]For a detailed discussion of the structure and evolution of the Japanese financial system, see Robert A. Feldman, *Japanese Financial Markets: Deficits, Dilemma, and Deregulation* (Cambridge: MIT Press, 1986); and Yoshio Suzuki, ed., *The Japanese Financial System* (London: IFR Books, 1987).

[4]Generally, households were able to invest their savings only in bank deposits, and banks had few alternatives to lending these funds to corporations. Neither the corporate nor the banking sector had significant direct recourse to raising funds in open capital markets, which consequently remained undeveloped. Because interest rates were administratively controlled and often held below market-clearing levels, major corporations could borrow cheaply, while smaller firms and individuals faced stringent credit constraints.

Chart 1

Japan's Monetary Control Mechanism: Mid-1970s



took the form of interbank market activities or Bank of Japan lending to banks. These operations affected the rate at which banks accumulated reserves during a maintenance period as measured by the reserve progress ratio.[5] Because lending by the Bank of Japan made up a large component of bank reserves and banks were almost exclusively limited to the interbank market as an alternative source of funds, the response of interbank interest rates to changes in bank reserves was strong and highly predictable.[6]

Changes in interbank interest rates, in turn, influenced the quantity of credit provided by banks. Administrative controls on loan (and deposit) rate movements limited banks' ability to pass on interbank rate changes to their customers.[7] Thus, higher interbank rates led banks to ration credit and, given the heavy dependence of the corporate sector on bank lending, prompted cutbacks in expenditures. The Bank of Japan actively used several other supplementary instruments, including quantitative lending limits on individual banks (window guidance), discount rate changes, and adjustments in reserve requirements, to secure a desired level of bank lending, particularly in periods of tightening.

Financial liberalization: 1974-89

Economic growth slowed markedly after 1973 and was accompanied by a sharp decline in the share of output devoted to investment. Net corporate borrowing as a share of GNP fell by more than half from its 7 percent average share over 1965-74 (Table 1). At the same time, the demand for borrowing by the public sector more than doubled during the 1970s, and Japan's tendency to run persistent current account surpluses, interrupted only by oil price shocks, became more pronounced.

These macroeconomic changes dramatically altered the flow of funds in the Japanese economy, creating pressures that eroded the tight restrictions on financial activity.[8] In particular, the large increase in government borrowing was pivotal in the development of active secondary markets in securities. During the 1960s and early 1970s, initial issues of government bonds were bought by a syndicate of financial institutions at prices fixed by the Bank of Japan. These initial fixed prices, combined with the Bank of Japan's promise to repurchase the bonds, significantly limited the development of secondary securities markets.[9] After 1975, however, the large scale of government bond issues threatened to undermine monetary control (because of the Bank of Japan promise to repurchase) and forced banks to raise the share of bonds in their portfolios at a time when attractive alternative investment opportunities were becoming available. These developments led to a number of reforms liberalizing bond issue rates, removing restrictions on the sale of bonds in secondary markets, and expanding the bonds' maturity range.[10] By

[5]If banks fulfill their requirements along an average path, the reserve progress ratio increases by 3.3 percentage points each day. The Bank of Japan adjusts aggregate reserves to determine this ratio and transmit actions to the interbank market.

[6]Banks and securities corporations exchange funds in two interbank markets: the call market, a short-term market analogous to the U.S. federal funds market; and the bill discount market, where commercial bills are rediscounted. Interest rates in the interbank market are theoretically free from control. Nevertheless, because money market brokers have until recently set interbank rates in close consultation with the Bank of Japan, the Bank has had considerable short-term influence on interbank rates.

[7]Higher interbank interest rates were passed on to corporate borrowers in the form of higher deposit-to-loan ratios and of increases in loan rates tied to the Bank of Japan's discount rate. Although these rate movements allowed policy to affect expenditure decisions through financial price changes, they were less significant than the effects of credit rationing.

[8]Good discussions of Japanese financial reform through the mid-1980s can be found in the *OECD Economic Survey—Japan* (Paris: OECD, 1984); Suzuki, *The Japanese Financial System*; and Thomas F. Cargill, "Japanese Monetary Policy, Flow of Funds, and Domestic Financial Liberalization," Federal Reserve Bank of San Francisco *Economic Review*, Summer 1986, pp. 21-32. For analysis of the more recent liberalization process, see K. Osugi, "Japan's Experience of Financial Deregulation since 1984 in an International Perspective," *BIS Economic Papers*, no. 26, January 1990; Masaaki Nakao and Akinari Horii, "Changes in the Monetary Control Techniques and Procedures by the Bank of Japan," Bank of Japan Research and Statistics Department, Special Paper no. 195, 1991; and Kumiharu Shigehara, "Japan's Experience with the Use of Monetary Policy and the Process of Liberalization," *Bank of Japan Monetary and Economic Studies*, vol. 9, no. 1 (March 1991).

[9]The high commissions promised to the syndicate upon resale of the bonds after the holding period raised the effective interest rate earned by subscribers.

[10]For a more detailed discussion of these issues, see Suzuki, *The Japanese Financial System*, or Michael Dotsey, "Japanese Monetary

Table 1
Net Lending by Sector
(As a Percentage of Nominal GNP)

	1965-74 Average	1975-84 Average	1985-90 Average
Corporate business	−7.1	−2.9	−4.3
Personal sector	9.4	10.3	9.0
Public sector	−2.6	−7.1	−1.3
Rest of world	−0.7	−0.8	−2.9
Memo			
Real GNP growth	8.1	4.0	4.8

Sources: "Flow of Funds in Japan in 1990," Bank of Japan Research and Statistics Department, Special Paper no. 204, July 1991; "Flow of Funds in Japan in 1989," Bank of Japan Research and Statistics Department, Special Paper no. 191, August 1990.

the early 1980s, turnover in Japan's secondary government bond market had become the second largest in the world.[11]

The increased supply of government bonds also encouraged the development of short-term money markets. In the late 1960s, the gensaki market, involving repurchase transactions largely using government bonds, arose as a vehicle for nonbank short-term financing. Liquidity in this market was significantly boosted by the growth in government bond issuance, and by the mid-1970s, the gensaki market had become a major unregulated short-term money market for nonfinancial corporations.

The growth of the gensaki market made it difficult for the Bank of Japan to maintain deposit rate ceilings. Attracted by rising market interest rates in the late 1970s, corporations were shifting their bank deposits to gensaki assets. Pressure by banks led authorities, in May 1979, to permit banks to issue certificates of deposits (CDs).[12]

The emergence of freer domestic capital markets coincided with the loosening restrictions on international capital transactions. Capital outflows were gradually liberalized to contain upward pressure on the yen after 1973 while capital inflows remained highly restricted throughout the decade. However, after the second oil price shock placed downward pressure on the yen, a more general relaxation of controls was implemented under the Foreign Exchange and Foreign Trade Control Law in December 1980.[13]

The rise in Japan's global surpluses in the first half of the 1980s, particularly its bilateral surplus with the United States, placed increased international pressure on Japan to accelerate financial liberalization. In 1984, a package based on the findings of a special committee set up by the U.S. Treasury and Japanese Ministry of Finance was announced. Most notably, new measures reduced restrictions on Euroyen activities, including Japanese resident borrowing and bond issues by Japanese and foreigners. In addition, limits on forward foreign exchange transactions and swap limit rules on Japanese banks were abolished. Subsequently, limits on the purchase of foreign securities by Japanese nonbank institutional investors were lifted.

The second half of the 1980s saw continued efforts to deregulate domestic markets. The liberalization of interest rates on bank time deposits began in 1985 and is expected to be completed in 1993. Money market certificate deposits were introduced in 1985; restrictions on the minimum denomination, length of maturity, and amounts issued have been steadily relaxed on these accounts as well as on CDs and time deposits.[14]

The changing financial market environment

Financial liberalization and the associated process of financial innovation have had far-reaching effects on Japan's financial system. Many constraints on portfolio and expenditure choices have been removed, altering the tightly controlled flow of funds patterns that supported the monetary control mechanism of the mid-1970s. Three changes have been particularly significant in the evolution of the Bank of Japan's operating strategy: First, the importance of bank loans as a source of funds has greatly declined. Second, the range of instruments used by banks to raise funds has expanded dramatically. Third, assets with market-determined prices now predominate in the portfolios of all sectors of the economy.

We have seen that bank credit was employed as an intermediate target of policy in the mid-1970s largely because of its central role in channeling funds between lenders and borrowers. Before 1974, bank lending accounted for close to three-quarters of intermediated funds in Japanese markets (Table 2). In the second half of the 1970s, however, the importance of bank lending declined sharply as public sector bond issues increased and corporate sector capital spending growth slowed.

Recent years have seen a further decline in the size of domestic loans in Japan's flow of funds. The internationalization of Japan's financial activities has combined with the corporate sector's steady move towards securitization to reduce the share of domestic loans to less than half of all intermediated funds flowing through

Footnote 10 (continued)
Policy, A Comparative Analysis," *Bank of Japan Monetary Economic Studies*, vol. 4, no. 2 (1986).

[11]According to the *OECD Economic Survey–Japan*, turnover in the Japanese bond market reached 200 trillion yen in 1981, about one-quarter the size of the turnover in U.S. bond markets and almost three times the turnover in the U.K. bond market.

[12]Secondary market trading in CDs did not begin until May 1982.

[13]The lifting of these capital controls resulted in large increases in both inward and outward capital flows. In addition, the lifting of controls on nonresident transactions in Japanese money markets led to considerably closer integration of Japanese money markets with those in Europe and the United States. As a number of studies have shown, interest rates in Euroyen markets and in the domestic gensaki market became virtually equalized by 1982. For example, see Bruce Kasman and Charles Pigott, "Interest Rate Divergences among the Major Industrial Nations," this *Quarterly Review*, Autumn 1988, pp. 28-44; and Jeffrey Frankel, "International Financial Integration: Relations among Interest Rates, Exchange Rates, and Monetary Indicators," in *International Financial Integration and the Conduct of Monetary Policy*, Federal Reserve Bank of New York, 1990.

[14]A number of actions have also been taken to promote deepening of short-term money markets. A yen-denominated bankers' acceptance market was launched in June 1985 and a commercial paper market opened in 1987. In addition, a variety of short-term government bond issues have been introduced, and measures have been taken to expand the maturity structure in the interbank market.

Japan.[15]

At the same time that domestic credit declined in importance, the Bank of Japan's control over bank lending decisions weakened. The gradual removal of restrictions on bank behavior enabled banks to expand their funding sources (both at home and abroad) and to adjust prices of their services more independently. As a result, banks' reliance on Bank of Japan credit declined significantly, along with the Bank's leverage in using window guidance or other administrative controls to affect bank behavior.

The development of Euroyen and CD markets in recent years has been particularly important in this process (Table 3). Both markets, free from official controls, have expanded dramatically: Euroyen liabilities have grown more than fourfold and outstanding CDs more than doubled since 1985. Currently, they represent nearly half of Japanese money markets and exceed the size of domestic interbank markets.

The increased availability of market-priced assets extends beyond the financial sector. Investments in instruments with market-determined interest rates by the private nonfinancial sector have risen significantly, particularly since 1984, when bank deposit rates began to be liberalized (Table 4).

The rising share of market-priced instruments in portfolios has undoubtedly increased the importance of interest rates in expenditure decisions. Moreover, potential disintermediation between administered and market-priced assets has weakened the Bank of Japan's ability to transmit policy by altering spreads between interbank rates and (administered) loan and

[15]Corporate issues of securities, which accounted for roughly 10 percent of the funds raised by the corporate sector before 1973, rose close to 15 percent over 1975-79, and in recent years have risen to more than a third of corporate fund raising.

Table 2

Funds Intermediation in Japan

(Fiscal Year Average)

	1965-74	1975-84	1985-90
Total funds supplied (trillions of yen)	20.4	58.6	122.91
Composition (percentage of total)			
Funds raised by domestic sectors	92.1	89.1	72.3
Loans from domestic banks	70.2	54.6	47.5
Securities	19.2	32.0	19.7
Government bonds	12.9	26.6	7.2
Foreign funds	2.7	2.5	5.1
Funds supplied to overseas market	7.9	10.9	27.7

Sources: "Flow of Funds in Japan in 1990," Bank of Japan Research and Statistics Department, Special Paper no. 204, July 1991; "Flow of Funds in Japan in 1989," Bank of Japan Research and Statistics Department, Special Paper no. 191, August 1990.

Table 3

Major Japanese Money Markets

(Trillions of Yen, End of Period Data)

	1975	1980	1985	1989
Interbank market				
Domestic interbank yen liabilities	6.7	9.8	19.8	45.3
Euroyen interbank liabilities	—	2.5	9.9	41.8
Open markets				
Bond gensaki	1.8	4.5	4.6	6.3
CDs	—	2.4	9.7	21.1
Commercial paper	—	—	—	13.1
Total	8.5	19.2	44.0	127.6
Memo				
Domestic interbank market as a share of total money markets (percentage points)	78.9	51.0	45.0	35.5

deposit rates. Comparing interbank interest rates with two rates subject to administrative control—time deposit and loan rates—during three episodes of monetary tightening provides evidence of the reduced importance of this channel (Chart 2). In both 1973-74 and 1979-80, wide differentials opened between overnight call rates and administered loan and deposit rates when policy tightened. However, in 1990, the most recent episode of tightening, spreads between these rates remained roughly unchanged.

Recent structure of the monetary control mechanism

In response to these developments, the Bank of Japan has gradually moved away from a control mechanism aimed at regulating the quantity of bank credit. Instead, it has increasingly sought to affect expenditure decisions through operations designed to affect market interest rates. The current policy control mechanism, outlined in Chart 3, shows a dramatic change from the mid-1970s.

On the level of policy instruments, the shift away from bank credit is reflected in the elimination of controls that directly affected banks' abilities to extend credit. In particular, window guidance, in the form of Bank of Japan instructions to individual banks regarding lending plans, was ended in 1982, and at about the same time, the active use of reserve requirements as a policy tool was dropped.[16] As shown earlier, the use of interest rate controls as a means of rationing credit has also slowly diminished, particularly following the major push towards deregulating bank loan and deposit rates begun in 1985.

The Bank of Japan has replaced these instruments with activities outside the interbank market. It has undertaken operations in short-term government bills (1981), CDs (1986), gensaki (1987), and commercial paper (1989). Although operations outside the interbank market have increased in frequency in recent years, the Bank of Japan continues to rely largely on its lending policies and operations in interbank markets to alter reserves.

Along with the reserve progress ratio, interbank interest rates remain the primary operating target of the Bank of Japan. Significant steps have been taken, however, to link interbank and other money markets more closely, a development that reflects the greater importance placed on financial prices in the monetary control mechanism. In 1979, the Bank acted to allow interbank rates to adjust more rapidly to open market conditions, and in subsequent years, it continued to reform its procedures for intervening in interbank markets. When the Bank became concerned that actions taken to lower interbank interest rates during 1987-88 were not being transmitted to money markets, it implemented a major

[16] A more limited form of window guidance, in which the Bank of Japan clarified its policy orientation and discussed aggregate lending plans with individual banks, continued after 1982 and was finally abolished in 1991.

Table 4

Financial Investments of the Domestic Nonfinancial Sector

	1975-79 Average	1984	1988	1990
Total investments (trillions of yen)	43.9	62.5	106.0	113.8
Composition (percentage of total)				
Assets with market-determined interest rates	30.0	50.7	86.0	147.1
Bank deposits†	—	4.2	50.7	94.7
Trust and insurance deposits	15.8	23.2	32.8	25.7
Domestic securities	12.6	13.4	−5.1	16.9
Foreign credits	1.6	9.9	7.6	9.8
Assets with regulated interest rates‡	70.0	49.3	14.0	−47.1

Memo

	March 1984	September 1989
Bank liabilities with market-determined interest rates (share of total liabilities)	13.5	50.3

Sources: "Flow of Funds in Japan in 1990," Bank of Japan Research and Statistics Department, Special Paper no. 204, July 1991; "Flow of Funds in Japan in 1989," Bank of Japan Research and Statistics Department, Special Paper no. 191, August 1990.

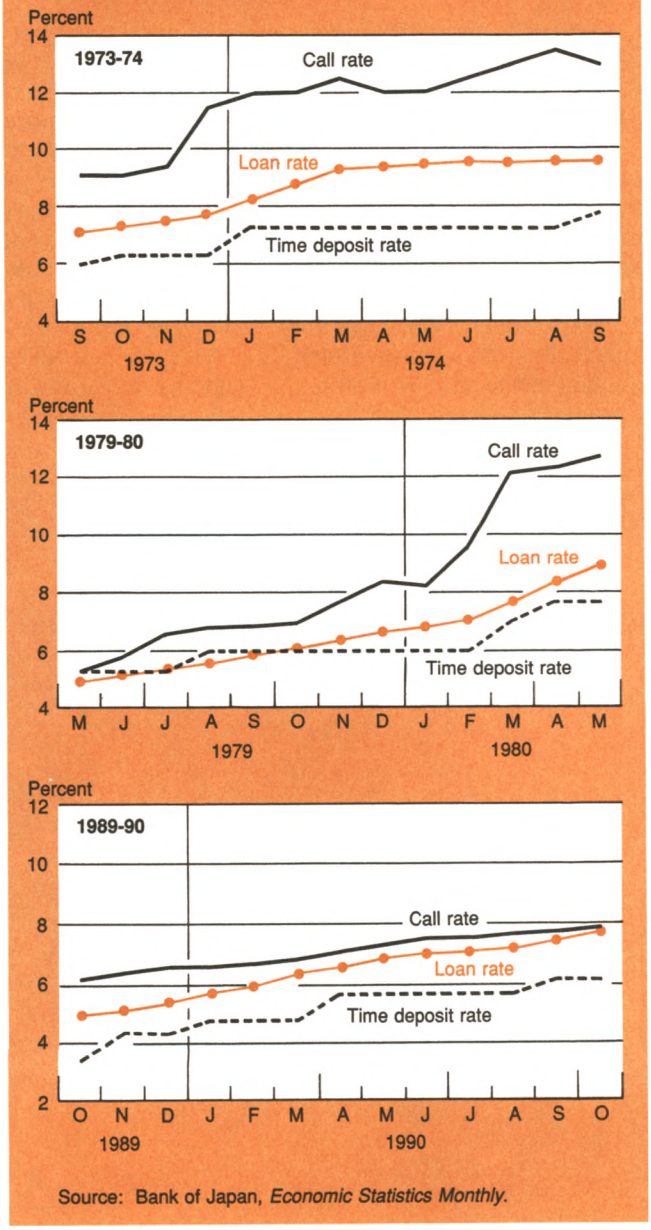
†Includes unregulated time deposits, certificates of deposit, and money market certificates.
‡Includes currency, demand deposits, regulated time deposits, postal savings deposits, and trust fund bureau deposits.

set of interbank market reforms in November 1988.[17] These reforms involved shifting interbank operations to shorter maturities and replacing the quotation system in the interbank market by an offer-bid system to promote greater arbitrage between markets.

[17]For details on the evolution of Bank of Japan operations in interbank markets, see Toshihiko Fukui, "Recent Developments of the Short-Term Money Market in Japan," Bank of Japan Research and Statistics Department, Special Paper no. 130, January 1986; and Nakao and Horii, "Changes in the Monetary Control Techniques."

Chart 2

Interest Rate Movements during Periods of Monetary Tightening



Source: Bank of Japan, *Economic Statistics Monthly.*

The change in Japan's monetary control methods over the past fifteen years is most evident in the use of financial variables in the intermediate stage of the policy process. As early as 1975, the Bank of Japan began its shift away from bank credit as an intermediate target and increased its emphasis on the role of broad money in its policy operations. In a sense, credit and money targets had been equivalent up until this time because of their close relationship on bank balance sheets. But with the large-scale flotation of government bonds, substantially underwritten by banks, the channels of money creation were no longer limited to increases in lending. Money thus became viewed a better indicator of levels of aggregate expenditure and assumed a leading role in the monetary control mechanism.

The Bank probably never actively employed broad money (M2 + CDs) as an intermediate target, however. Instead, broad money became the primary indicator among a group of financial variables that provided information on activity and the stance of policy.[18] Indeed, the Bank of Japan refrained from setting explicit targets for broad money and instead chose to publish quarterly forecasts for M2 + CDs from 1978 onward.

By the mid-1980s, financial liberalization had begun to blur the boundaries of specific financial assets in Japan. The wealth-holding properties of bank liabilities in the form of CDs or deregulated time deposits were enhanced, while the liquidity characteristics of securities packaged in the form of trust and insurance fund accounts increased. The removal of controls on international capital movements furthered these trends because investors were able to treat assets issued in Japan or in foreign markets more interchangeably.

In recent years, the Bank of Japan has responded to these developments by gradually reducing its emphasis on broad money in implementing policy. The diminished importance of broad money was highlighted in 1987 when M2 + CDs grew above Bank of Japan forecasts for three consecutive quarters without provoking a policy response.

Although several variables, including exchange rates and asset prices, have been employed along with broad money as key intermediate variables over the past decade, market interest rates have become increasingly

[18]For studies supporting this view, see Michael M. Hutchinson, "Japan's 'Money Focused' Monetary Policy," Federal Reserve Bank of San Francisco *Economic Review*, Summer 1986, pp. 33-46; Koichi Hamada and Fumio Hayashi, "Monetary Policy in Postwar Japan," in Albert Ando, Hidekazu Eguchi, Roger Farmer, and Yoshio Suzuki, eds., *Monetary Policy in Our Times* (Cambridge: MIT Press, 1985); and Shigehara, "Japan's Experience with Use of Monetary Policy."

central for policy operations. Market interest rates are an indicator of economic conditions and help to transmit interbank rate movements to real activity. Concerns that actions in interbank markets were not strongly connected to other open market rates prompted reforms in the interbank market in 1988. Moreover, in 1989 and 1990, the Bank of Japan consistently cited the rising level of market interest rates as a motivation for tightening monetary policy.[19]

Monetary control of interest rates and broad money: empirical evidence

We have seen that financial liberalization has led to significant changes in the Bank of Japan's operating strategy. Market-determined financial prices, interest rates in particular, play a more important role as both a target and an indicator of policy. In contrast, attempts to control bank credit or other financial aggregates have gradually diminished.

While financial market changes have increased the attention given to interest rates in policy formulation, they may also have made interpretation and control of interest rates more complex. In the 1970s, market segmentation and restrictions on portfolio activities ensured that central bank actions would result in a predictable pattern of substitution between the interbank market and the gensaki money market. In the current environment, agents have a greater choice of money market instruments (both domestic and foreign) and can more easily move between these instruments and long-term securities. These linkages may produce a closer connection among interest rates. Nevertheless, they allow interest rates to be influenced by a wider variety of factors, a possibility that can undercut the ability of monetary authorities to influence interest rates in a predictable way.

For similar reasons, the usefulness of monetary aggregates in the monetary control mechanism may now be limited. The role of M2+CDs as an indicator of activity was largely tied to restrictions that made it the principal means of liquidity in the Japanese economy. In this environment, M2+CDs tended to reflect activity fairly closely. As the wealth-holding properties of M2+CDs and liquidity characteristics of other financial assets have increased, all financial aggregates may have become less accurate indicators of activity because their short-run behavior has become sensitive to movements in relative rates of return. Moreover, as the lines between financial assets have become blurred, policy changes affecting general economic conditions or interest rates may have a weaker link to any specific aggregate, particularly in the short term.

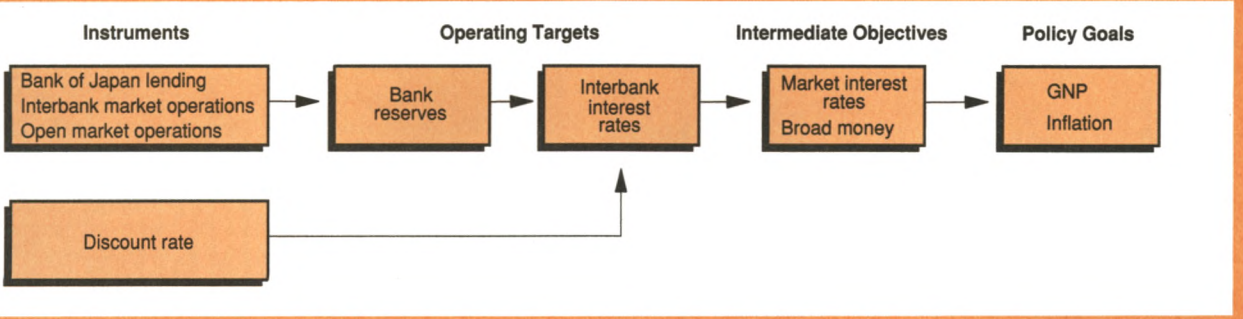
In this section, we assess the Bank of Japan's ability to transmit policies to financial market variables in the current liberalized financial market environment. Specifically, we examine the relationship between movements in interbank interest rates, the Bank's main operating target, and the intermediate variables viewed as key in the monetary control mechanism: market interest rates and broad money M2+CDs.

Our earlier discussion suggested that by the mid-1980s financial liberalization had caused significant changes in the functioning of Japanese financial markets. Thus we focus our attention on the post-1984 experience to assess how closely Bank of Japan actions are being transmitted to interest rates and monetary aggregates in a liberalized environment. In addition, this period is contrasted with 1974-84 to provide insight into changes in these relationships over time.

[19] See Nakao and Horii, "Changes in the Monetary Control Techniques," for a more detailed discussion of the factors determining monetary policy changes during the 1980s.

Chart 3

Japan's Monetary Control Mechanism: Late 1980s



Econometric analysis

Our econometric analysis, explained in greater detail in the appendix, attempts to integrate short-term relationships among Japanese interest rates and monetary aggregates with models governing their longer term behavior. This empirical strategy is motivated by the tendency of all the variables analyzed to drift over time without converging toward a unique long-term level.

Although interest rates and monetary aggregates may drift, economic theory suggests that common underlying factors may determine their movement. The expectations theory of the term structure, for example, suggests that long-term interest rates approximately equal an average of current and expected future short-term rates. Thus, if short-term interest rate changes are persistent (because of permanent changes in inflationary expectations or real interest rates), these changes should be reflected across the term structure. Similarly, common factors may explain the evolution of broad money and the monetary base. Interest rates may also be an important part of this relationship if the sources of persistent interest rate changes have a systematic effect on broad money independent of changes in the monetary base.

The first part of our analysis searches for links between Japanese interest rates or monetary aggregates and interbank interest rates. The resulting "cointegrating" regressions describing these links capture the long-term response of variables to those persistent changes in monetary policy indicated by sustained changes in the interbank call rate.

Unfortunately, the regressions do not provide information on these linkages at a horizon relevant to the workings of monetary policy. Thus, the second part of the analysis develops a model of the dynamic response of interest rates and monetary aggregates to changes in the call rate consistent with these cointegrating relationships.

Before turning to our statistical analysis, we present in Table 5 some descriptive evidence on interest rates, broad money, and economic activity.[20] Specifically, the table shows mean levels of monthly interest rates and twelve-month changes in M2+CDs, consumer prices, and industrial production, along with standard deviations for the periods 1975-84 and 1985-90.

Substantial declines in both the level and the variability of money market interest rates are apparent since 1984. Over 1985-90 money market interest rates averaged roughly 5 to 5½ percent, 200 basis points below their 1975-84 levels. Their variability, as measured by the standard deviation, declined by roughly one-third.

[20]The data in this section are drawn from various issues of Bank of Japan, *Economic Statistics Monthly*, and include the unconditional call rate (month end), the bond repurchase—or gensaki—rate (month end), the benchmark government bond rate (month end), the bank certificate of deposit rate (80-179 days, month average), the average rate on short-term bank loans (month end), the rate on one-year time deposits (month end), the monetary base (month end, seasonally adjusted by the authors), and M2+CDs (seasonally adjusted, month end).

Table 5

Descriptive Statistics for Economic Activity and Interest Rates

(Period Averages)

	1975-84		1985-90	
	Mean	Standard Deviation	Mean	Standard Deviation
Money market rates				
Interbank call rates	7.1	2.2	5.1	1.5
Gensaki rates	7.2	1.9	5.2	1.3
Certificate of deposit rates†	7.6	1.7	5.6	1.3
Regulated rates				
Short-term loans	6.8	1.2	5.1	1.1
Short-term time deposits	4.1	0.9	2.5	0.8
Long-term government bonds	7.9	1.1	5.4	1.2
Growth in broad money (M2 +CDs)‡	10.5	2.6	10.0	1.6
Economic activity				
Industrial production growth‡	3.7	6.6	4.5	3.7
Consumer price inflation‡	5.6	3.5	1.4	1.2

†Because certificates of deposit were not introduced until 1979, the values in the first two columns are averages for 1979-84.
‡Twelve-month percentage changes.

These declines are consistent with overall macroeconomic developments. Japanese consumer price inflation averaged less than 1½ percent over 1985-90, a drop of more than 4 percentage points from its 1975-84 average. Moreover, a sharp fall in the variability of consumer price inflation, broad money growth, and industrial production growth since 1985 suggests that economic activity has become considerably more stable in recent years.

Interest rates on other financial assets have also declined but, in contrast to money market rates, exhibit no significant change in their variability. From 1975 to 1984, loan and deposit rates as well as long-term bond yields were considerably less variable than money market rates. The lower variability in these rates probably reflected restrictions limiting their responsiveness to market conditions. Although financial liberalization has undoubtedly allowed these rates to adjust to changing market conditions, overall economic conditions appear to have become more stable. As a result, the effects of liberalization are seen not in the increased variability of these interest rates but rather in a convergence in interest rate variability throughout the economy.

Long-term relationships

The results of three tests for common trends, or cointegrating relations, between the overnight call money interest rate and various other interest rates are presented in Table 6 along with parameter estimates for specific equations. These tests detect whether a single underlying factor explains the drift in the regression variables (see appendix).

Overall, this evidence indicates that the linkages between the Bank of Japan's operating target and money market interest rates have been quite strong throughout the 1974-91 period. The call rate appears to have been cointegrated with both the gensaki rate and the CD rate during 1974-84 and 1985-91. During the earlier period, a 100 basis point increase in the call rate was associated with a roughly equal change in the gensaki rate. In the later period, the response of the gensaki rate was somewhat smaller, estimated at 82 basis points.

In contrast, neither loan rates nor long-term government bond yields were cointegrated with the call rate between 1974 and 1984. This result is consistent with our earlier contention that administrative controls on loan rates and restrictions on the development of a secondary market in long-term government bonds may have partially isolated these markets from interbank and short-term money markets.

Financial liberalization does appear to have integrated long-term bond markets and money markets. Between 1974 and 1984 the call rate did not have a consistent long-run connection to government bond yields. After 1984, however, strong evidence of a cointegrating relation between long-term bond yields and call rates emerges: long-term bonds increase by 69 basis points in response to a 100 basis point rise in the call rate.

There is little evidence, however, that financial reform has tightly integrated money markets with loan markets. Although the loan rate reacted more strongly to call rate changes after 1984, bank loan rates were not cointegrated with the call rate between 1985 and 1991, suggesting that there has not been a consistent long-term relation between the rates.

Table 6

Cointegration Relationships for Monthly Interest Rates

Response to Call Rate of	1974-84	1985-91†
Gensaki	1.00	.82
R^2	.84	.97
Cointegration tests		
ADF	−3.28*	−2.71
SW	−51.67***	−33.90***
PP	−32.37***	−44.20***
CD‡	.90	.85
R^2	.97	.96
Cointegration tests		
ADF	−2.97	−2.42
SW	−29.75***	−35.26***
PP	−25.22**	−43.33***
Long-term bond	.34	.69
R^2	.65	.83
Cointegration tests		
ADF	−1.78	−3.33*
SW	−10.82	−23.77***
PP	−12.42	−20.79**
Loan rate	.49	.73
R^2	.75	.88
Cointegration tests		
ADF	−2.40	−1.33
SW	−7.87	−9.62
PP	−5.98	−11.14

Notes: ADF is the augmented Dickey-Fuller statistic (using seven lags). PP is the Phillips-Perron Z_α statistic (using seven autovariance lags). SW is the Stock-Watson statistic (using seven lags). Critical values for the Dickey-Fuller and Phillips-Perron statistics were obtained from P.C.B. Phillips and Sam Ouiliaris, "Asymptotic Properties of Residual-Based Tests for Cointegration," *Econometrica*, vol. 58, no. 1 (January 1990), pp. 165-91. Critical values for the Stock and Watson statistic are from James Stock and Mark Watson, "Testing for Common Trends," *Journal of the American Statistical Association*, vol. 83 (December 1988), pp. 1097-1107.

†Sample covers January 1985-May 1991.
‡Earlier sample covers 1980-84.
*Significant at 10 percent level.
**Significant at 5 percent level.
***Significant at 1 percent level.

Our model connecting monetary policy actions to broad money is based on a standard view of the money supply process.[21] Bank of Japan operations in interbank markets are accompanied by changes in both reserves available to the banking system and interbank interest rates. Given unchanged asset allocations by banks and depositors, changes in reserves can be expected to alter broad money (M2 + CDs) in a predictable manner. Interest rate movements can alter portfolio choices, thus influencing the money supply independently of changes in the monetary base. Higher market interest rates, all else equal, raise the cost of holding bank reserves and consequently may increase the money multiplier (the ratio of broad money to the monetary base). At the same time, an increase in central bank lending rates or interbank rates relative to market rates could increase demand for reserves and thus lower the money multiplier. We suggested earlier that Bank of Japan actions associated with higher interbank interest rates, including window guidance and changes in reserve requirements, may have reinforced a decline in the money multiplier in the past.[22]

Nonetheless, interest rate effects on the money multiplier might be transitory, particularly because regulatory restraint on bank behavior was applied only temporarily. Thus, we first model the longer term behavior of M2 + CDs as a function of the monetary base alone, including a time trend term to allow for technological factors that may have altered the money multiplier over time.

The cointegrating regressions for this model, presented in the upper half of Table 7, provide no evidence of a cointegrating relation between the base and M2 + CDs before 1985. This result suggests that factors leading to persistent movements in the money multiplier were an important determinant of the long-term behavior of broad money during this period. In contrast, between 1985 and 1991, evidence of a cointegrating regression is present, and thus money base changes, through a stable multiplier, adequately explain the long-term evolution of M2 + CDs.

To assess whether the persistent movement in the money multiplier before 1985 was associated with interest rate movements, we add the call and gensaki rate to our regression model. In this context, the gensaki rate captures alternative bank investment opportunities that became available beginning in the second half of the 1970s. Call rate movements measure the cost of reserve shortfalls to banks and also proxy for the effects of policy actions not related to changes in the monetary base. The coefficient on the monetary base is restricted to equal one in this framework because, by definition, base changes are fully reflected in the money supply when the multiplier is unchanged.

Including interest rates in the model yields strong evidence of cointegration for the 1974-84 period. Moreover, the parameter estimates are of the correct sign and suggest a large effect of call rate changes on broad money. Specifically, when market rates and the monetary base are held constant, a 100 basis point increase in the call rate is associated with a permanent decline of nearly 2 percentage points in M2 + CDs.

Nevertheless, these call rate effects decline substantially after 1984. Indeed, the small size of the interest

[21] Money demand is also important in money stock determination. Because we do not explicitly model money demand, our analysis should not be viewed as a full behavioral model for the determination of interest rates and the money stock.

[22] In particular, Japanese banks were forced to constrain lending activities when policy tightened because loan rates were regulated and the Bank of Japan imposed quantitative restrictions on lending. These restrictions, together with the Bank's active use of reserve requirement changes to implement monetary policy, forced banks to increase their reserve-deposit ratios as policy tightened, an outcome that lowered the money multiplier and broad money for a given monetary base.

Table 7
Cointegrating Money Models

Response of M2 + CDs to:	1974-84	1985-91†
ln (base)	.554	.412
Trend	.005	.005
R^2	.993	.998
Cointegration tests		
ADF	−2.091	−3.138
SW	−8.174	−36.469***
PP	−6.212	−45.227***
Response of M2 + CDs to		
ln (base)	1.000‡	1.000‡
Gensaki rate	.009	.007
Call rate	−.019	−.004
Trend	.002	.000
R^2	.997	.993
Cointegration tests		
ADF	−2.342	−2.324
SW	−39.704***	−45.738***
PP	−49.081***	−56.650***

Notes: R^2 is the square of the correlation coefficient between actual and predicted *ln* (M2) for the two regressions with base coefficients equal to one. ADF is the augmented Dickey-Fuller statistics (using seven lags). PP is the Phillips-Perron Z_α statistic (using seven autovariance lags). SW is the Stock-Watson statistic (using seven lags). Critical values for the Dickey-Fuller and Phillips-Perron statistics were obtained from Phillips and Ouiliaris, "Asymptotic Properties of Residual-Based Tests." Critical values for the Stock and Watson statistic are from Stock and Watson, "Testing for Common Trends."

†Sample covers January 1985-May 1991.
‡Constrained to equal 1.
*Significant at 10 percent level.
**Significant at 5 percent level.
***Significant at 1 percent level.

rate coefficients in the money supply equations suggests that interest rate movements, independent of the monetary base, may no longer have any lasting effect on broad money.

Dynamic relations

The evidence of long-term linkages between call rates and other financial variables does not, by itself, clarify how monetary policy changes are transmitted over a horizon relevant for policy makers. To address this question, we estimate a dynamic error-correction model for Japanese financial market variables. The model, presented in detail in the appendix, captures in a fairly unrestricted way the observed time series relationships among these variables by imposing the condition that the dynamic behavior converge to the long-term cointegrating regressions estimated above.

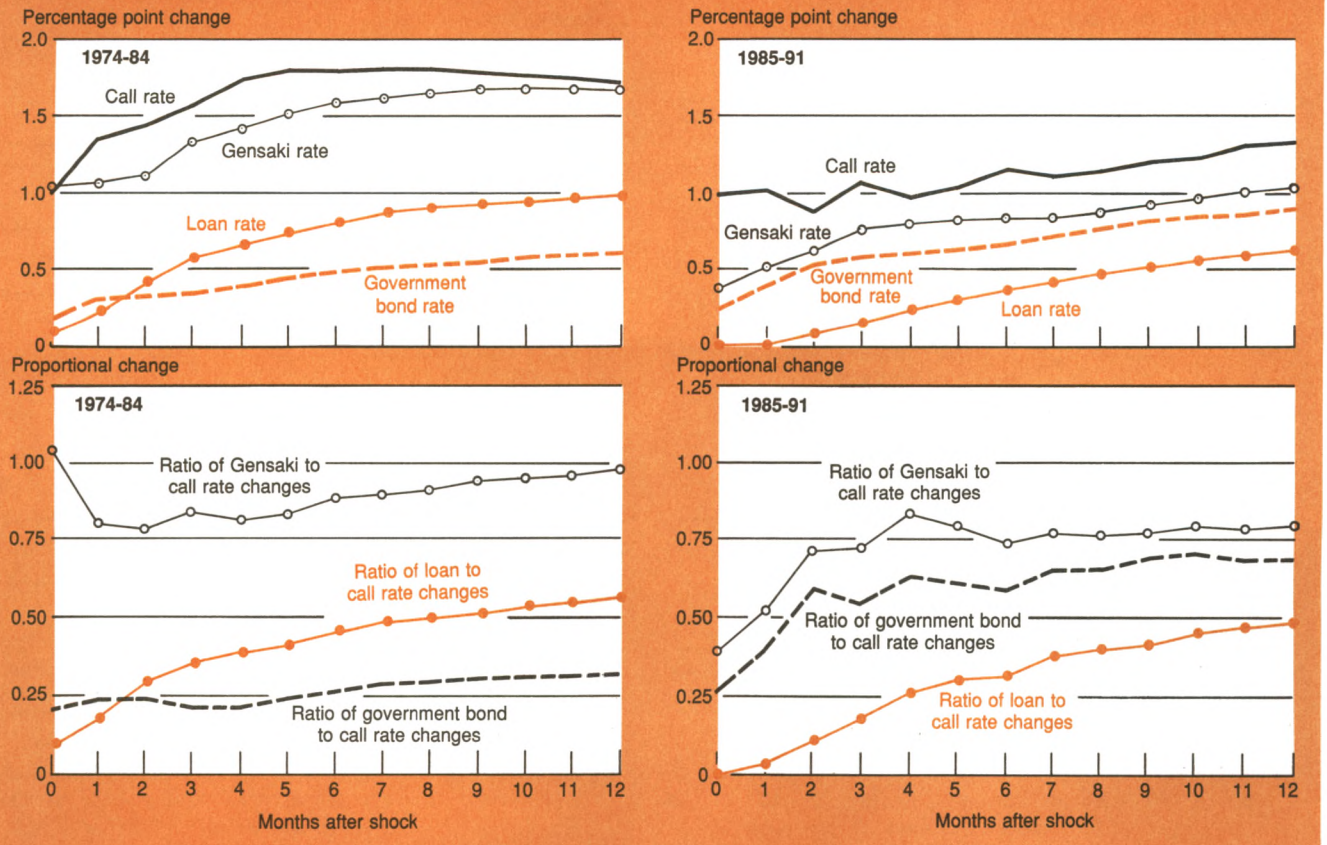
Assuming that the Bank of Japan has considerable control over the interbank call rate, we use the model to assess the monetary control mechanism by comparing the responses of interest rates and broad money to an initial 100 basis point increase in the call rate.[23] These responses, presented in Charts 4 and 5, can be interpreted as the average response of interest rates and broad money to policy changes over the sample. The simulations also track subsequent call rate movements generated by the model; these movements capture the tendency of Bank of Japan policy shifts to occur gradually as well as the typical response of call rates to changes in other financial variables.

The evidence in Chart 4 suggests somewhat stronger transmission of call rate shocks to interest rates after

[23]Although the results of this analysis are presented separately for interest rates and monetary aggregates, they are derived from a single model that accounts for the interrelationship among these variables.

Chart 4

Interest Rate Responses to a Call Rate Increase



Note: Chart shows the predicted response to an increase of 100 basis points in the call rate.

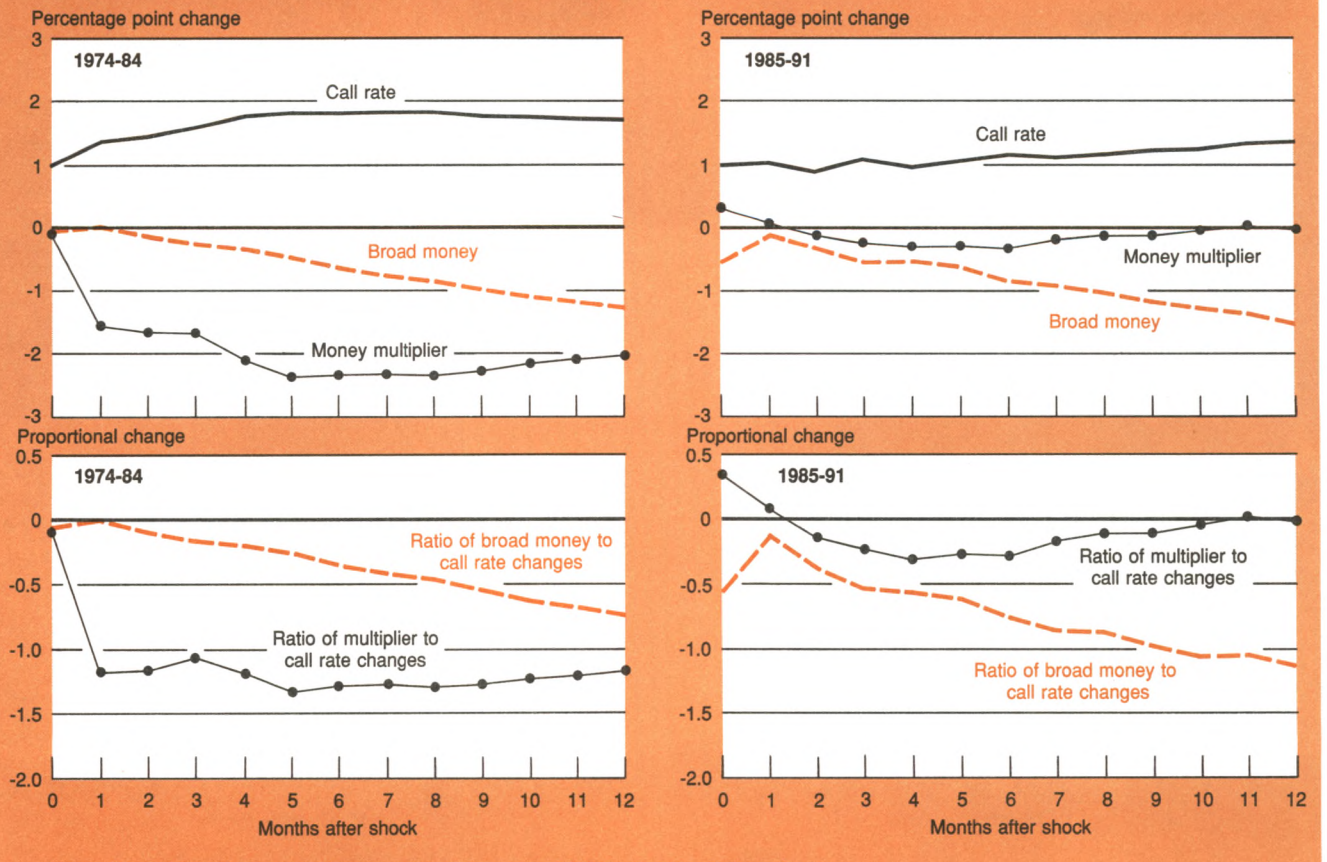
1984, primarily because of the increased responsiveness of long-term bond yields. From 1975 to 1984 only the gensaki rate responded strongly and immediately: a 100 basis point increase in the call rate prompted an immediate and equal rise in the gensaki rate. In contrast, the immediate responses of long-term bond yields and loan rates were quite small. Three months following the shock only about one-third of the cumulative increase in call rates had been passed through to loan rates, and less than one-fourth of this increase was transmitted to bond yields. Over time, loan rates continued to rise, in part reflecting administrative decisions by the Bank of Japan. But even after a year only about one-third of the call rate increase was reflected in long-term bond yields.

During 1985-91, the gensaki rate responded more slowly to the call rate shock, rising about 40 basis points at the time of the shock. Nonetheless, three months after call rates increased, the response of the gensaki rate was close, in proportional terms, to both its estimated long-term response and that observed in the earlier period. Long-term bond yields, in contrast, reacted much more strongly to call rate shocks after 1984. Three months after the initial shock, nearly 60 percent of the call rate shock was passed through to bond yields, a response nearly three times as great as during the earlier period. The loan rate response showed little change across the two periods.

Simulation results for broad money and the money multiplier in Chart 5 support the view that the money multiplier was an important part of the policy transmission mechanism before 1985. In the 1974-84 period, increases in the call rate caused a sharp fall in the money multiplier. In the first three months following a call rate increase, the multiplier declined by nearly 2 percent, indicating large portfolio shifts by banks.

Chart 5

Response of Broad Money and Money Multiplier to a Call Rate Increase



Note: Chart shows the predicted response to an increase of 100 basis points in the call rate.

The immediate effect of a call rate increase on broad money was quite small, but over time, broad money steadily declined. At three months, broad money fell by about .4 percent; a year after the shock, broad money declined by more than 1 percent.

During 1985-91, the response of broad money to a call rate increase has been roughly similar to that seen in the earlier period. Nonetheless, the channel of transmission appears to have changed dramatically. Call rate movements no longer alter the money multiplier, which remains roughly unchanged over the forecast horizon. Thus, monetary policy influences broad money through its effect on the supply of reserves rather than through its influence on bank asset allocation.

Predictability of dynamic responses

To assess monetary control, we must consider not only the size of the response of financial market variables to policy but also the predictability of these responses. Evidence on predictability of responses can be obtained by computing the forecast standard errors of our variables at different horizons. These standard errors, presented in Table 8, indicate the degree to which the actual responses of financial variables to interbank rate movements are likely to fall near the estimated responses presented in Charts 4 and 5.[24] In computing these standard errors, we have excluded the uncertainty attributable to fluctuations in call rates. In our framework, call rate movements represent monetary policy actions, and these estimates should capture the uncertainty in financial market variables arising from factors other than monetary policy.[25]

The estimated forecast variances for interest rates present a mixed picture. Standard errors for the gensaki rates declined substantially after 1984, possibly reflecting the emergence of more stable economic conditions. In contrast, the standard errors for long-term bond yields and loan interest rates showed little or no

[24]Note that these forecast standard errors only represent the uncertainty arising from unpredictable shocks affecting the system. In computing the standard errors, we ignore uncertainty due to imprecision in our coefficient estimates. Thus, the forecast standard errors in Table 8 probably underestimate the total uncertainty surrounding these responses.

[25]Despite this adjustment, a comparison of forecast variances for 1974-84 and 1985-91 is likely to be influenced by changing policy objectives as well as changes in the general degree of economic stability.

Table 8

Predictability of Response to Call Rate Increases

		Forecast Standard Error† (Percentage Points)	
	Months after Shock	1974-84	1985-91
Gensaki rate	3	.68	.38
	6	.92	.55
	12	1.39	.81
Long-term bond rate	3	.57	.63
	6	.72	.72
	12	.98	.92
Loan rate	3	.21	.20
	6	.37	.41
	12	.65	.80
M2 + CDs	3	1.45	1.61
	6	2.56	2.79
	12	4.97	5.53
Monetary base	3	2.11	2.16
	6	2.98	3.06
	12	5.18	5.55
Money multiplier	3	1.74	1.65
	6	1.91	1.67
	12	2.18	1.71

Notes: The forecast standard errors are derived for three-, six-, and twelve-period-ahead forecasts conditional on a predetermined call rate path. Our calculation uses the unconditional forecast standard error and subtracts the portion due to call rate shocks.

†Excludes fraction of variance attributable to call rate changes.

systematic change, with the possible exception of increased uncertainty attending loan rate responses at longer horizons.

The small pre-1985 standard errors for bond yields and loan rates reflect the restrictions on rate movements in effect at the time. As liberalization has proceeded, gensaki and other rate forecast errors have converged. Together with the decline in gensaki forecast errors, this evidence suggests that the Bank of Japan has been able to influence the broad spectrum of market-determined interest rates with somewhat greater certainty.

The forecast standard errors for monetary aggregates unambiguously point to greater uncertainty for the estimated responses after 1984. Both broad money and the monetary base responded less predictably to call rate changes, despite evidence of a more stable economic environment. This increased uncertainty in broad money responses may in part reflect the declining use of monetary aggregates in policy determination.

Conclusions

We have argued that the substantial liberalization of Japan's financial system has profoundly affected both the functioning of the Japanese economy and the conduct of monetary policy by the Bank of Japan. The tightly restricted financial system in the mid-1970s promoted a monetary policy strategy that used bank credit to influence activity. Financial liberalization has, however, reduced the importance of banks in Japan's flow of funds and eliminated a number of policy tools that restricted bank behavior. In response, the Bank of Japan has gradually become more dependent on its ability to influence market interest rates to transmit its policies.

Our analysis of the monetary control mechanism suggests that in the current liberalized environment, the Bank of Japan has been able to transmit its policies effectively through market interest rates. In particular, interbank interest rate movements, the key operating targets of the Bank of Japan, have produced strong and consistent interest rate responses across the Japanese term structure since 1984. The increased responsiveness of long-term bond yields in recent years is particularly notable. Moreover, some evidence suggests that the linkage between policy and interest rates has become more predictable.

In contrast, the linkage between monetary policy and broad money has probably weakened. In the past, policy actions were largely transmitted to broad money through the money multiplier as the Bank of Japan directly influenced banks' portfolio decisions. Now, however, financial liberalization has reduced the Bank of Japan's leverage over bank behavior, and policy's influence on broad money works more closely through changes in the monetary base. Although the average response of broad money to policy changes remains about the same, a greater degree of uncertainty accompanies the transmission of policy to broad money.

Appendix: Cointegrating Money and Interest Rate Models

This appendix expands on the arguments in the text for cointegration between interest rates and for cointegration in the money supply relation. It also presents the dynamic error correction models used to predict the responses of interest rates and monetary aggregates to monetary shocks.

Cointegration

To investigate the relation between Japanese interest rates and monetary aggregates, we utilize the cointegration methodology made popular by Engle and Granger.† This methodology presupposes that a time series containing a unit root can only be explained over long periods by other series with a unit root. Series with a unit root (also called integrated series) are predicted well by their own lagged values. Typically, regression models for this type of series have substantial residual autocorrelation because other variables cannot explain the unit root component in the outcome variable.

Testing for a unit root in a time series, r_t, is commonly carried out by testing whether the coefficient in a regression on r_{t-1} equals one. The literature uses tests based on the coefficient α in the regression $\Delta r_t = \alpha r_{t-1}$. The coefficient will be zero if the series has a unit root and negative otherwise (unless the series is explosive). The augmented Dickey-Fuller test uses the t-statistic for α in the regression, adding lagged changes in r_t to account

†See Robert Engle and C.W.J. Granger, "Co-integration and Error Correction: Representation, Estimation, and Testing," *Econometrica*, vol. 35 (1987), pp. 251-76.

Appendix: Cointegrating Money and Interest Models *(continued)*

for possible stationary autocorrelation in r_t. The Stock-Watson statistic, as used in this article, is based on filtering r_t to eliminate stationary autocorrelation before computing the t-statistic. The Phillips-Perron statistic, Z_α, corrects for stationary autocorrelation by applying a nonparametric correction to $T\alpha$, where T is the sample size. In each case, the distribution of the test statistic is nonstandard and requires specially calculated critical values.

Several series with unit roots may be linked through a cointegrating model—that is, a model whose residual does not contain a unit root. The regressors in this type of model explain the permanent or unit root component of the dependent variable. Although the variables in the regression may deviate from the regression line in the short run, they return to the regression relationship over time in the absence of additional shocks. In fact, the cointegrating model does not specify the dynamic adjustment to the model in the long run. This adjustment is specified by auxiliary equations in the error correction model that give the dynamic behavior of the variables.

The error correction models are a series of dynamic equations relating the current change in each variable in a cointegrated system to the lagged residual from the cointegrating model and to lagged changes in the variables. The coefficient of the lagged residual in our models measures the speed of adjustment to long-run equilibrium. Lagged changes appear as explanatory variables in the models to allow variables to have differing short-term effects.

Thus, we carry out a two-step procedure in our empirical work: First, we test the time series for the presence of a unit root. If a unit root is found, we proceed to test for cointegration between those sets of series that could, in theory, be linked. The unit root tests are shown in Table A1 and the cointegration tests are discussed in the text of the article. Second, we use the cointegrating equations to formulate an error correction model for the dynamics in the model. This error correction model, examined in more detail below, is used to compute the impulse response functions reported in the text.

Cointegration in interest rate and money models

The expectations hypothesis of the term structure provides one model where short and long rates will be cointegrated.‡ We assume the existence of the following (approximate) relationship connecting short- and longer term asset returns:

$$(A.1)\quad r^l(1,D) = (1/D)\,[r^s(1,2) + f(2,3) + \ldots + f(D-1,D)],$$

where $r^l(1,D)$ is the yield to maturity, in D periods, of the longer term asset; $r^s(1,2)$ is the return from period one to two on the shorter term asset; and $f(j,j+1)$ is today's forward rate between periods j and $j+1$. The expectations hypothesis connects the forward rate from j to $j+1$ to the expected future spot rate from j to $j+1$ as follows:

$$(A.2)\quad f(j,j+1) = E_t\, r^s(j,j+1) + \alpha(j),$$

where α is a risk premium and E_t represents expectations at period one. Finally, we suppose that the short rate follows a simple random walk:

$$(A.3)\quad r^s(j+1,j+2) = r^s(j,j+1) + e(j+1),$$

where e is the unexpected component of the short rate. Since expected future short rates will be directly related to the current spot rate, $E_t r^s(j) = r^s(1)$, the current long rate will follow:

$$(A.4)\quad r^l(1,D) = r^s(1,2) + (1/D)\,\Sigma\alpha(j).$$

Table A1: Unit Root Tests
(Monthly, January 1974 to May 1991)

Series	ADF	SW	PP
Call rate	−3.36	−14.01*	−8.72
Gensaki rate	−3.73*	−18.38**	−13.09
Long-term bond rate	−1.65	−4.45	−4.54
CD rate†	−2.34	−8.26	−8.10
Loan rate	−2.55	−9.01	−6.62
ln (M2)	−2.26	−.62	−.49
ln (Base)	−.25	−.14	−.44
ln (M2)‡	−2.81	−9.69	−5.00
ln (Base)‡	−2.21	−18.37*	−15.54

Notes: ADF is the augmented Dickey-Fuller statistic (using seven lags). PP is the Phillips-Perron Z_α statistic (using seven autovariance lags). SW is the Stock-Watson statistic (using seven lags). Critical values for the Dickey-Fuller and Phillips-Perron statistics were obtained from Phillips and Ouiliaris, "Asymptotic Properties of Residual-Based Tests." Critical values for the Stock and Watson statistic are from Stock and Watson, "Testing for Common Trends."

†First sample covers 1980-84.
‡Includes time trend.
*Significant at 10 percent level.
**Significant at 5 percent level.
***Significant at 1 percent level.

‡See Thomas Sargent, "A Note on Maximum Likelihood Estimation of the Rational Expectations Model of the Term Structure," *Journal of Monetary Economics*, vol. 5 (1979), pp. 133-43; and John Campbell and Robert Shiller, "Cointegration and Tests of Present Value Models," *Journal of Political Economy*, vol. 95 (1987), pp. 1062-88.

Appendix: Cointegrating Money and Interest Models *(continued)*

The short rate may have a unit root if it is influenced by either inflation or the real interest rate and if changes in these variables tend to be permanent. Under these conditions, equation A.4 implies that the long rate should be cointegrated with the short rate. Of course, if the risk premium has a unit root, then the long rate will be cointegrated with the (measurable) short rate and the (not directly measurable) risk premium term, and we would not expect the short rate–long rate pair to be cointegrated by themselves.[§]

[§]Because we do not restrict the term spread to be stationary, our interest rate models are more general than those strictly implied by the expectations hypothesis. Although some of our coefficient estimates in the cointegrating interest rate models seem far enough from one to cast doubt on the expectations hypothesis, our assets have different issuers and potentially quite different risk characteristics, complicating the risk terms in our earlier formulation.

In our money model, we assume that the broad money aggregate is connected to base money through a money multiplier, $M2 = m\ Base$, where *M2* is the broad aggregate, *Base* is base money, and *m* is the money multiplier. Broad money and base money would be cointegrated if the influences on bank and depositor asset allocation typically only have transitory effects on the money multiplier. To obtain a cointegrating relationship between the base and broad money during 1974-84, we find it necessary to allow for both trend and interest rate effects. These modifications suggest that the multiplier has a unit root arising from trends in asset choice and permanent interest rate effects.

Dynamic models

The cointegrating models in the text are incorporated into dynamic models for the call, gensaki, and ten-year

Table A2: Error Correction Models

	Dependent Variables					
Independent Variables	Call Changes	Gensaki Changes	Bond Changes	Loan Changes	M2 Changes	Base Changes
January 1974 to December 1984						
Sum of						
lagged call changes	.56(.28)	.35(.21)	.08(.08)	.10(.04)	.002(.002)	.01(.004)
lagged gensaki changes	−.06(.09)	−1.11(.43)	.01(.06)	.05(.03)	.000(.001)	.001(.003)
lagged bond changes	.31(.15)	.57(.22)	.02(.21)	.11(.03)	−.001(.002)	.001(.005)
lagged loan changes	.28(.55)	1.54(.73)	−.07(.24)	.58(.07)	−.008(.006)	−.02(.01)
lagged M2 changes	4.73(4.69)	2.37(0.93)	.67(3.17)	−1.06(.69)	.90(.08)	.33(.18)
lagged base changes	−1.58(3.36)	3.86(4.75)	−2.36(2.09)	.32(.46)	−.04(.05)	.16(.24)
Residual (gensaki)	.24(.09)	.01(.14)	−.13(.06)	—	—	—
Residual (money)	1.12(2.63)	1.43(3.87)	—	—	−.06(.04)	.20(.08)
R^2	.30	.22	.12	.87	.01	.26
January 1985 to May 1991						
Sum of						
lagged call changes	−.72(.31)	−.18(.10)	.02(.17)	.03(.05)	−.000(.003)	−.002(.007)
lagged gensaki changes	.89(.27)	.39(.26)	−.23(.30)	.02(.07)	.004(.006)	.006(.013)
lagged bond changes	.10(.11)	.06(.08)	.17(.38)	.09(.03)	.005(.003)	.006(.006)
lagged loan changes	.76(.40)	.14(.36)	.53(.46)	.82(.06)	−.02(.01)	.009(.018)
lagged M2 changes	4.84(3.77)	2.32(2.39)	3.14(4.28)	.22(.49)	1.08(.14)	.18(.25)
lagged base changes	−2.87(2.26)	−.93(1.43)	−2.80(2.34)	−.25(.27)	−.21(.06)	.48(.32)
Residual (gensaki)	.19(.18)	−.25(.11)	−.24(.21)	—	—	—
Residual (long-term bond)	—	.13(.06)	−.18(.15)	—	—	—
Residual (money)	−2.69(2.49)	−1.83(1.58)	—	—	−.10(.07)	.60(.15)
R^2	.45	.44	.17	.91	.26	.40

Notes: Standard errors are shown in parentheses. The residual for the gensaki rate is obtained from the cointegrating model connecting the gensaki and call rates; the residual for the long-term bond rate is obtained from the cointegrating model connecting the long-term government bond and gensaki rates; the residual for money is the residual from the cointegrating model for money supply.

government bond rates as well as the monetary base and the M2+CDs aggregate. Since we do not detect a long-term relationship between the loan rate and other interest rates, our cointegrating equations do not include the loan models presented in Table 6 of the text. The cointegrating, or long-run, interest rate models are:

$$(A.5)\quad G = \alpha_0 + \alpha_1 C + \epsilon^G$$

and

$$(A.6)\quad L^J = \alpha_2 + \alpha_3 G + \epsilon^{L^J},$$

where C represents the call rate, G is the gensaki rate, and L^J is the Japanese benchmark long-term government bond yield.‖ Our cointegrating equation for broad money supply relates broad money, *M2*, to the base, *Base*, the gensaki rate, G, the call rate, C, and a time trend t, restricting the coefficient on the base so that the interest rates and time trend affect the money multiplier:

$$(A.7)\quad ln(M2) = \kappa_0 + ln(Base) + \kappa_1 G + \kappa_2 C + \kappa_3 t + \epsilon^{M2}.$$

Our estimates of these models are given in text Tables 6 and 7.

The dynamic equations have a general error correction form that relates the current change in each variable to lagged changes in all of the variables and to the residuals from the cointegrating coregressions.†† Estimates of these dynamic models are shown in Table A2. We typically include four lags of the dependent variable and one lag of the other variables.§§ In most cases, we only include residuals from cointegrating equations that contain the dependent variable. The general form of the model is illustrated by the call rate equation below:

$$\begin{aligned}(A.8)\quad \Delta C(t) = &-\delta_1\epsilon^G(t-1) - \delta_2\epsilon^{L^J}(t-1) - \delta_3\epsilon^{M2}(t-1)\\ &+ \sum_{i=1}^{4} \beta_i \Delta C(t-i) + \gamma_1 \Delta G(t-1) + \Psi_1 \Delta L^J(t-1)\\ &+ \theta_1 \Delta Loan(t-1) + \zeta_1 \Delta lnM2(t-1) + \phi_1 \Delta lnBase(t-1).\end{aligned}$$

The lagged residuals in this equation ensure that the short-run behavior in the dynamic model will converge to the long-run behavior embodied in equations A.5, A.6, and A.7. The lagged changes of the variables allow the short-run impacts of interest rate shocks to differ from the long-run behavior in the cointegrating equations. Analogous to the call rate equation are the equations for the gensaki rate, the Japanese long-term government bond yield, and bank loan rate given below:

$$\begin{aligned}(A.9)\quad \Delta G(t) = &-\delta_1\epsilon^G(t-1) - \delta_2\epsilon^{L^J}(t-1) - \delta_3\epsilon^{M2}(t-1)\\ &+ \beta_1 \Delta C(t-1) \sum_{i=1}^{4} \gamma_i \Delta G(t-i) + \psi_1 \Delta L^J(t-1)\\ &+ \theta_1 \Delta Loan(t-1) + \zeta \Delta lnM2(t-1) + \phi_1 \Delta lnBase(t-1),\end{aligned}$$

$$\begin{aligned}(A.10)\quad \Delta L^J(t) = &-\delta_1\epsilon^G(t-1) - \delta_2\epsilon^{L^J}(t-1)\\ &+ \beta_1 \Delta C(t-1) + \gamma_1 \Delta G(t-1) + \sum_{i=1}^{4} \psi_i \Delta L^J(t-i)\\ &+ \theta_1 \Delta Loan(t-1) + \zeta_1 \Delta lnM2(t-1) + \phi_1 \Delta lnBase(t-1),\end{aligned}$$

and

$$\begin{aligned}(A.11)\quad \Delta Loan(t) = &\sum_{i=0}^{3} \beta_i \Delta C(t-i) + \sum_{i=1}^{3} \gamma_i \Delta G(t-i)\\ &+ \sum_{i=1}^{3} \psi_i \Delta L^J(t-i) + \sum_{i=1}^{3} \theta_i \Delta Loan(t-i)\\ &+ \zeta_1 \Delta lnM2(t-1) + \phi_1 \Delta lnBase(t-1).\end{aligned}$$

These equations allow us to estimate the dynamic response of Japanese interest rates to shocks in the call rate (our proxy for Japanese monetary policy actions).

The dynamic error correction equations for the monetary base, *Base*, and broad money, *M2*, have the follow-

‖ The main text presents a cointegrating model connecting the government bond yield to the call rate. Our modeling strategy uses the equation A.6 connecting the bond yield and the gensaki rate as the long-term relation for the bond yield. The corresponding equations are:
1974-84 L^J = .275 + .28G, R^2 = .51
1985-91 L^J = 1.01 + .84G, R^2 = .86.
There is strong evidence of cointegration in the second period and essentially none in the first.

†† For details, see Engle and Granger, "Co-integration and Testing," and James Stock, "Asymptotic Properties of Least Squares Estimators of Cointegrating Vectors," *Econometrica*, 1987, pp. 1035-56.

§§ Our choice of lag structure is motivated by the autocorrelations of first differences of the data. These generally seem consistent with fourth-order autoregressive models. We include more lags of other interest rates in the loan equation to allow for possible effects over several periods.

Appendix: Cointegrating Money and Interest Rate Models *(continued)*

ing forms, in which the lagged residual is obtained from equation A.7:

$$\text{(A.12)}\qquad \Delta lnM2(t) = -\delta\epsilon^{M2}(t-1) + \beta_1\Delta C(t-1) + \gamma_1\Delta G(t-1) + \psi_1\Delta L^J(t-1) + \phi_1\Delta Loan(t-1) + \sum_{i=1}^{4}\zeta_i\Delta lnM2(t-i) + \phi_1\Delta lnBase(t-1)$$

and

$$\text{(A.13)}\qquad \Delta lnBase(t) = -\delta\epsilon^{M2}(t-1) + \beta_1\Delta C(t-1) + \gamma_1\Delta G(t-1) + \psi_1\Delta L^J(t-1) + \phi_1\Delta Loan(t-1) + \zeta_1\Delta lnM2(t-1) + \sum_{i=1}^{4}\phi_1\Delta lnBase(t-i).$$

To simulate the models and to compute forecast standard errors, we have to impose a structure on the current disturbances in the error correction equations. We use an ordering of the disturbances (call, base, gensaki, long-term bond, M2 + CDs, loan) in which current shocks to each variable in the list affect contemporaneous shocks in variables listed later. Our ordering allows the current call rate shocks to affect shocks in all the other variables in the system. When we analyze predictability of policy responses, we remove the component attributable to call rate shocks from the forecast standard errors to exclude uncertainty related to policy changes. Although these standard errors correctly measure uncertainty when monetary policy is designed to minimize the variance of a single variable, the interpretation of the errors may be more difficult when monetary policy has multiple objectives.

Expected Inflation and Real Interest Rates Based on Index-linked Bond Prices: The U.K. Experience

by Gabriel de Kock

Recently some analysts have suggested that the Treasury finance part of the federal deficit by floating indexed bonds.[1] One of the claims made for this strategy is that it would yield significant monetary policy benefits. In particular, the prices of indexed bonds could offer timely and accurate market measures of expected inflation and ex ante real interest rates. As such they could provide the Federal Reserve System with valuable information about market perceptions of, and reaction to, its policies. The argument has also been made that a real-time market measure of expected inflation might provide the Federal Reserve System with a valuable indicator of the future course of inflation and offer the public a ready means of monitoring the Fed, thereby encouraging public interest in better policies.

A market measure of expected inflation may be useful in the formulation of policy even if is not a good gauge of the actual future inflation performance of the economy. It may be a poor indicator of future inflation because private sector inflation expectations are, in fact, not realized. Even in this case, however, the associated real interest rate should nevertheless be a good measure of ex ante real interest rates faced by the private sector. That is, at the macroeconomic level, indexed bond prices should contain useful information about real economic activity.

The potential value of a real-time market measure of expected inflation to policy makers can only be assessed indirectly because no "true" alternative measure of private sector inflation expectations exists. This article evaluates the usefulness of a market measure of expected inflation by applying two closely related tests: first, whether the market measure of expected inflation is a good indicator of inflation developments; and second, how well the market measure captures private sector inflation expectations even if the expectations do not reflect actual inflation performance.

The second of these tests is based on two propositions. The first proposition is the familiar Fisher hypothesis that nominal interest rates should equal expected inflation plus the ex ante real interest rate; the second, a prediction shared by all standard dynamic macroeconomic models, is that true real interest rates should provide information about future economic activity.[2] If the market-expected real interest rate, measured as the difference between a long-term nominal rate and the market measure of expected inflation, has no significant effect on future real economic activity, it seems likely that it is also a poor measure of the true real interest rate. Under these circumstances, the market measure of expected inflation would then seem likely to be a poor measure of "true" private sector inflation expectations. If a real-time measure of inflation expectations neither anticipates future inflation developments nor conveys useful information about real economic activity, it is probably of only limited use to policy makers.

Drawing on this framework, this article examines the U.K. experience with indexed gilts (IGs) to assess whether indexed bond prices convey information useful in formulating and monitoring monetary policy.

[1] See, for example, Robert Hetzel, "A Better Way to Fight Inflation," *The Wall Street Journal*, April 25, 1991.

[2] In theory, higher real interest rates do not necessarily lead to lower real economic activity (GNP); in fact, the two variables may be positively associated with each other. In the context of standard macroeconometric models, however, real interest rates and economic activity are, ceteris paribus, negatively related to each other.

More specifically, the article evaluates whether the expected inflation rate derived from the prices of indexed and nominal bonds predicts future inflation and whether the corresponding expected real interest rate provides information about real economic activity not obtainable from more traditional information variables and measures of policy stance. Although several countries have experimented with indexation since World War II, the experience of the United Kingdom, where marketable index-linked gilts have been issued since March 1981, is likely to be the most relevant to the United States.

While the market for index-linked gilts does provide a real time measure—accurate or not—of expected inflation and ex ante real interest rates, this information does not appear to be of much practical value in formulating and evaluating monetary policy. This general interpretation of the data derives from two specific conclusions: First, the expected inflation rate embodied in nominal bond yields is no better than simple measures of inflation expectations based on past inflation alone. It is a biased predictor of the future level of inflation, although it does provide minimal information about acceleration and deceleration of inflation. Second, indexed gilt prices do not seem to provide information about future movements in real economic activity, suggesting that the real interest rate on indexed gilts is unlikely to be a good measure of ex ante real interest rates faced by the private sector in the markets for goods and services. The expected inflation rate embodied in U.K. bond yields, therefore, appears to be a poor measure of true inflation expectations, given our empirical results. By contrast, lagged inflation and nominal interest rates often used to derive real interest rates that may measure monetary policy *do* have predictive content for U.K. real GNP growth.

The first section of the article summarizes the development of the U.K. indexed gilt market. More specifically, it focuses on the particular circumstances surrounding the introduction of IGs in the United Kingdom and the main features of the IG market at present. There follows a brief discussion of the potential monetary policy role of indexed bonds and a review of the decomposition of nominal yields into expected real interest rate and expected inflation components. The article then examines the information about future inflation provided by indexed bonds and the ability of indexed gilt prices to predict developments in real economic activity.

The evolution of the U.K. market for index-linked gilts

The Conservative government introduced IGs in 1981 as part of its anti-inflation program. Three reasons were given for the move: (1) the introduction of IGs would improve the Bank of England's control over monetary aggregates, (2) indexation would result in substantial savings to the Treasury if, as anticipated, inflation declined significantly as a result of the government's policies, and (3) indexing government debt would signal the government's determination to reduce inflation. These reasons reflected policy concerns specific to the United Kingdom in the early eighties, although the third is sometimes viewed as relevant to current U.S. policy, if only on a theoretical level.[3]

Issuing IGs was expected to bring about closer control over the monetary aggregates by ameliorating constraints on monetary policy imposed by the distinctive structure of the U.K. gilts market. Because market makers, considered essential to the smooth functioning of the market, were weakly capitalized, the authorities felt obliged to minimize fluctuations in gilt prices that would threaten the market makers' survival. Thus, the Bank of England was constrained to stabilize nominal interest rates, a policy that entailed loss of control over monetary aggregates.[4] Most notably, in the late seventies and early eighties, market expectations of rising inflation forced the Bank of England to follow a destabilizing expansionary policy to prevent gilts prices from falling too steeply. Index-linked gilts, which could be sold in times of market expectations of rising inflation, enabled the authorities to reestablish control over monetary aggregates. In this way, inflation expectations could be kept in check, thereby mitigating fluctuations in conventional gilts prices.

The second argument for issuing indexed bonds, that the real cost to the government of issuing index-linked debt would be lower than that of borrowing on conventional terms, is valid if the government expects an inflation rate lower than the market expectation of inflation embedded in nominal yields (assuming that the tax system is neutral with respect to inflation). These conditions were clearly fulfilled in the United Kingdom in early 1981: long-term bond rates were close to 14 percent and retail prices were still rising rapidly, but the government expected its firm anti-inflation policies to pay off in the near future. However, under the indexation scheme envisaged, the tax system would not be neutral with respect to inflation, because the inflation component of nominal rates would be fully taxable while only

[3]See Charles A. E. Goodhart, *Money, Information and Uncertainty* (Cambridge: M.I.T. Press, 1989), for a discussion of the policy debate surrounding the introduction of indexed gilts.

[4]The Bank of England could not use open market operations at the short end of the market because the stock of Treasury bills outstanding was very small by U.S. standards. At the end of March 1980, for example, Treasury bills accounted for only 2.9 percent of market holdings of government debt.

part of the inflation compensation on index-linked gilts would be taxed. Thus, although government interest outlays would be lower with indexed gilts, conventional gilts could be expected to produce much more tax revenue. Initial calculations suggested that inflation would have to decline very rapidly before the reduction in outlays brought about by indexation IGs would exceed the loss in revenue entailed.

The government's third reason for introducing indexed bonds—to enhance the credibility of its anti-inflation program—derives from the fact that index-linking reduces the benefits of unanticipated inflation. Investors will be justly skeptical of announced anti-inflationary policies if the government at the same time issues nominally denominated debt, because the government may always be tempted to resort to unanticipated inflation to reduce the real value of its debt. By contrast, unanticipated inflation does not promise any capital gains to the government if its debt is indexed. Consequently, by issuing indexed debt, the government could enhance its credibility.[5]

The advantages of IGs were partly offset by a number of possible disadvantages. First, there was concern that issuing an attractive long-term asset could have a negative impact on equity prices and corporate financing opportunities. Second, it was feared that foreign demand for IGs might put upward pressure on the pound, which was already overvalued as a result of tight monetary policies and the discovery of North Sea oil. Third, since capital gains were not yet indexed for tax purposes, issuing indexed debt would entail the taxation of purely inflationary capital gains on IGs—a step that could in turn stimulate political pressure for the indexation of taxes. Finally, the United Kingdom faced strong political pressure from other OECD governments concerned that any form of indexation would fuel OPEC pressure to index-link oil prices.

Indexed gilts were issued consistently throughout the 1980s at coupon rates mostly between 3 and 4 percent (compared with 2 percent for the first two issues). As early as end-March 1985, IGs made up 6.5 percent of total market holdings of U.K. public debt; by March 1990, the total amount of IGs outstanding was about £17.5 billion, or 10.9 percent of market holdings of British government debt and 19.3 percent of the value of gilts outstanding (Table 1).[6] The stock of IGs outstanding is made up of thirteen issues with maturities varying from two to thirty-three years. Long-dated issues make up the bulk of the value of IGs outstanding; only 7.3 percent of the amount outstanding are of maturities shorter than five years, and 16.5 percent of maturities shorter than ten years (Table 2).

Anecdotal evidence suggests that holdings of IGs remain concentrated and that the number of customers remains small.[7] The most important holders of IGs are pension funds, followed by insurance companies, while individual investors are largely confined to the short end of the market. These features match those of the gilt market as a whole. The IG market is thin in comparison with the market for conventional gilts. Although turnover varies, it only amounted to 2.9 percent of total gilt turnover in 1990 and 3.1 percent for the first four months of 1991 (Table 2). The demand for new issues of IGs has been disappointing when the ex post real yields on conventional gilts exceed those on IGs, as they did during the rapid decline of inflation in 1982-83 and 1985-86. (The issuance of IGs also resulted in substantial savings to the Treasury during this period for the same reason.)

The potential role of indexed bonds in monetary policy

Proponents of issuing indexed bonds in the United States have emphasized monetary policy benefits that depend critically on the informational role of indexed bond prices. This consideration figures importantly in the academic literature on indexed bonds although it did not arise in the U.K. policy debate.[8] Advocates argue

[5]Note, however, that indexation could also have an adverse impact on expectations (and thereby make it more difficult to reduce inflation) if it was interpreted as an effort by the monetary authorities to decrease the political cost of inflation before giving up the battle against inflation altogether. But such an adverse impact would be more likely if indexation covered a wide range of contracts—something the Conservative government had taken great pains to avoid. Issuing index-linked gilts probably also enhanced the government's credibility over time because it effected immediate cosmetic improvement in the Public Sector Borrowing Requirement: *Indexation was implemented in a way that pushed compensation for inflationary depreciation of principal into the future, whereas the government would have had to pay higher nominal interest rates immediately had it issued conventional bonds.*

[6]By the end of 1990 this percentage had risen to 20.5 percent because under the scheme of indexation used in the United Kingdom, the value of the IGs outstanding rises in line with inflation. Nonmarketable national savings certificates or "granny bonds," which have been issued since 1975, have had a limited impact, making up less than 2 percent of market holdings of British government debt as of end-March 1990.

[7]The Bank of England does not compile separate statistics on holdings of IGs and conventional gilts by type of institution. At the end of March 1990, pension funds and insurance companies held 57.5 percent of U.K. government debt outstanding, while individuals and private trusts held about 38 percent ("The Net Debt of the Public Sector: End-March 1990," *Bank of England Quarterly Bulletin*, November 1990, pp. 519-26).

[8]A theoretical literature on the relative efficiency of open market operations in indexed and nominal bonds dates back to James Tobin, "An Essay on the Principles of Public Debt Management," reprinted in *Macroeconomics*, vol. 1 of *Essays in Economics* (Markham Publishing Co., 1971). Tobin argued that open market operations in indexed bonds will affect real activity more strongly and with greater certainty than will open market operations in

Table 1
Composition of U.K. National Debt

	March 1985		March 1990	
	Billions of Pounds	Percentage	Billions of Pounds	Percentage
Market holdings	146.7	100.0	160.0	100.0
Sterling marketable debt	114.4	78.0	117.0	73.2
Government stock				
Index-linked	9.5	6.5	17.5	10.9
Other	103.7	71.5	90.5	56.6
Treasury bills	1.2	0.8	9.0	5.7
Sterling nonmarketable debt	29.3	20.0	36.5	22.8
National savings†				
Index-linked	3.6	2.4	3.0	1.9
Other	18.8	12.8	26.1	16.3
Other	6.9	6.8	7.4	4.6
Foreign currency debt	2.9	2.0	6.5	4.0
Official holdings	11.6		32.5	

Source: Bank of England.
†National savings include a variety of non-negotiable savings instruments issued by the government.

that indexed bond prices would provide policy makers and the public with information on inflation expectations and ex ante real interest rates on a real-time basis. In this view, the Federal Reserve System would gain valuable information about market perceptions of, and reaction to, its policies. Furthermore, this information could provide policy makers with a good predictor of inflation and a measure of the impact of monetary policy on both inflation and real economic activity. Hetzel has argued that the ready availability to policy makers and the public of an indicator of the inflationary consequences of monetary policies would have three benefits. First, it would increase public understanding of, and support for, anti-inflationary policies. Second, it would serve as a barometer of Fed credibility and consequently increase incentives for the Fed to commit itself to anti-inflationary policies. Finally, by exposing the true consequences of policies that trade off inflation for short-term output gains, it would strengthen the Fed's effort to focus attention on its long-term price stability objectives.

Table 2
Features of U.K. Market for Index-linked Gilts

Maturity Composition of IGs Outstanding		
	Millions of Pounds†	Percentage
Less than one year	865	4.2
One to five years	638	3.1
Five to ten years	1,920	9.2
Over ten years	17,365	83.5
Total	20,788	100.0

Contribution of IGs to Monthly Gilt Turnover			
	Total Turnover (Billions of Pounds)	IG Turnover (Billions of Pounds)	IG Turnover (Percentage of Total)
1990 average	75,445.5	2,196.6	2.9
January-April 1991 average	85,702.9	2,630.6	3.1

Source: Bank of England.
†Includes indexation of principal up to the beginning of 1991.

However, the benefits cited by Hetzel are only likely to materialize if the market measure of expected inflation is a reliable indicator of the effects of monetary policies and macroeconomic disturbances on inflation.[9]

Footnote 8 (continued)
nominal bonds because indexed bonds are likely to be a closer substitute for equity than nominal bonds. Tobin has been criticized by Stanley Fischer, "The Demand for Indexed Bonds," *Journal of Political Economy*, vol. 83, no. 3 (June 1975), pp. 509-34, and by Paul Beckerman, "Index-linked Government Bonds and the Efficiency of Monetary Policy," *Journal of Macroeconomics*, vol. 2, no. 4 (Fall 1980), pp. 307-31. Fischer suggested that open market operations in nominal bonds that are complements for equity in private portfolios may have a more pronounced impact on Tobin's q, and thus on real activity, than open market operations in indexed bonds that serve as substitutes for equity. Beckerman has pointed out that Tobin's conclusion requires a set of potentially inconsistent assumptions.

[9]Earlier advocates of indexation—for example, Alicia H. Munnell and Joseph B. Grolnic ("Should the U.S. Government Issue Index Bonds," *New England Economic Review*, September-October 1986, pp. 3-22)—have emphasized the provision of index-linked government liabilities that could be used to back indexed pension contracts.

To be sure, a market-based decomposition of nominal interest rates into their expected inflation and expected real interest rate components may be useful to policy makers, even if the market measure of expected inflation is not a good predictor of inflation. This would be especially true if the market measure of expected inflation were a good gauge of private sector inflation expectations. If so, it would provide a reliable measure of ex ante real interest rates and thus convey information on private decisions and future economic developments. More generally, indexed bond prices could offer policy makers and private agents up-to-date information about the sources of macroeconomic disturbances. In fact, Boschen, using a simple model, has shown that a market for indexed bonds could reduce the magnitude of business cycle fluctuations by allowing private agents to distinguish real and nominal disturbances more accurately.[10]

The empirical analysis in this section evaluates whether the U.K. market for index-linked gilts actually conveys the policy-relevant information about future inflation and real economic activity that advocates of indexed bonds have attributed to it. Data on IG and conventional gilt prices are used to construct a monthly series of expected inflation rates and expected real interest rates spanning the period from March 1982 to March 1991. As detailed below, these data indicate that the derived measure of expected inflation, termed the IG measure, is a poor predictor of inflation and that the IG market does not provide information about future real economic activity.

Inflation expectations and expected real interest rates derived from IG prices

The data on expected real interest rates and expected inflation are constructed by using an indexed bond's price to decompose the yield on a nominal bond into expected real interest rate and expected inflation components. The calculation assumes that the expected real yields of indexed and conventional bonds of the same maturity must be equal and consequently that the IG measure of the inflation rate expected by investors to prevail *over the remaining lifetime of the bonds* can be estimated as the difference between the redemption yields on the nominal and indexed bonds. In practice, the calculation and interpretation of the expected inflation rate and expected real rate are somewhat more involved, because IGs are not fully indexed, investors may be risk averse, and the indexed and conventional bonds may differ in liquidity and tax treatment. More detailed information on the nature of indexed gilts and the calculation and interpretation of expected inflation and real interest rates is given in the box.

Data on the IG measure of expected inflation and the corresponding long-term real interest rate are derived by decomposing the nominal yield on a conventional bond maturing in 1996. This calculation yields the longest data series because the first IGs issued mature in 1996. The top panel of Chart 1 illustrates the decomposition of this long-term yield into its expected real yield and expected inflation components. Note that there is a break in the series in 1986.[11] For reference, the lower panel of Chart 1 shows the nominal yield on the 1996 bond along with the yield on ten-year gilts. The yield on the 1996 bond moves closely with the yield on ten-year gilts, confirming that the 1996 bond (as well as the decomposition of its yield) is representative of the long-term government bond market in the United Kingdom.

Chart 1 suggests that changes in expected inflation account for the bulk of nominal interest rate movements. This result is the counterpart of the striking stability of the real interest rate measure, which varies between 2.36 percent and 4.37 percent per annum. The underlying stability of the real yield on IGs is confirmed by the Bank of England's calculations: although based on the assumption of a fixed 5 percent inflation rate over the remaining lifetime of the IG, the Bank's estimate of the real yield varies over a similar range.[12]

Chart 1 also illustrates the response of the IG measure of expected inflation and the corresponding real

[10]See John F. Boschen, "The Information Content of Indexed Bonds," *Journal of Money, Credit, and Banking*, vol. 18, no. 1 (February 1986), pp. 76-87.

[11]The data for the period from October 1986 to March 1991 pertain to a 10 percent coupon bond maturing in November 1996 and those for the period from March 1982 to September 1986 to a 14 percent coupon bond maturing in July 1996. The decomposition of the nominal yield is based on price data for a 2 percent indexed gilt maturing in September 1996. In both cases the maturity match is probably close enough not to affect the results. The decomposition is somewhat sensitive to the particular matched-maturity conventional bond used, presumably because the different bonds are not equally liquid. The yields on the 14 percent bond and the 10 percent bond differ by 29 basis points, on average, in the months for which overlapping observations are available. Our results nevertheless indicate that only the *levels* of calculated expected real yields and inflation rates are affected, not their movements over time. For example, the correlation coefficient of the two expected inflation rates calculated for the overlapping observations is 0.99. For the purposes of Chart 1 and the empirical analysis discussed below, the earlier observations were adjusted by the mean difference calculated from the overlapping observations. Specifically, the real rate increased about 6 basis points and the expected inflation rate declined by about 35 basis points.

[12]The Bank of England's real interest rate measure is somewhat higher, on average, than the measure reported here (3.64 percent compared with 3.54 percent) and somewhat less volatile; its standard deviation is about 40.5 basis points, compared with 42.6 basis points for the measure used here. The correlation coefficient of the two measures is 0.93. In "Sources of Fluctuation," Gaske documents that in the early part of the sample the co-movements between the Bank of England's series and macroeconomic variables are quite different from those of an ex ante real rate measure like the one used in this article.

Box: Extracting Ex Ante Real Yields and Expected Inflation from Indexed Gilts Prices

Features of U.S. index-linked gilts

The form of index-linking adopted in the United Kingdom may be called principal value indexation. The value of the principal of an IG is linked to the retail price index (RPI), and coupon payments, payable every six months, are calculated as a fixed percentage of this inflation-adjusted principal. Holders of IGs are not fully protected against inflation, and hence the real return on an IG is uncertain, because the principal—and consequently interest payments—are indexed to the RPI with an eight-month lag. That is, the value of the bond for the purpose of calculating the coupon payment for a given six-month interest period exceeds its initial face value by the increase in the RPI over the period starting eight months before the issue date and ending eight months before the date on which the coupon payment is made. For example, the principal in period t of a £100 bond issued on date I and paying a 2 percent coupon is $£100 \times (RPI_{t-8}/RPI_{I-8})$, and the coupon payment on date t will be $£1 \times (RPI_{t-8}/RPI_{I-8})$, where time is measured in months. Note also that, because of the lag in indexation, an IG is a pure nominal bond during the last eight months of its lifetime. The eight-month lag is needed to ensure that the rate of interest accrual in money terms for any six-month period is known before the start of that period so that purchasers can compensate sellers for interest accrued since the last coupon payment preceding the transaction. The period for which interest is due accounts for six of the eight months; the normal lag in availability of the RPI data for the seventh month; and the need to avoid problems that could arise if the publication lag exceeded one month, for the eighth month.[†]

Eligibility to take up the initial offerings of IGs in 1981 and early 1982 was restricted to domestic tax-exempt institutions (pension funds, life insurance companies taking pension business, and charitable societies) in order to forestall potential tax problems and to avoid repercussions for the exchange rate. These restrictions on the ownership of IGs became redundant and were removed when the government introduced indexation of capital gains for tax purposes in March 1982. Since that time, IGs have enjoyed a significant tax advantage relative to conventional gilts. While holders of conventional gilts are taxed at the income tax rate on nominal interest earnings—a rate that consists in part of compensation for depreciation of principal—holders of IGs pay no taxes at all on inflationary increases in the nominal value of the IGs. Consequently, an anticipated increase in inflation will tend to depress conventional gilts prices relative to IG prices by more than necessary to equate pretax nominal yields on conventionals and IGs.

Calculation method

The imperfect indexation of IGs makes it impossible to calculate an expected real redemption yield on the IG without making an assumption about inflation over the bond's remaining lifetime. Nevertheless, as long as investors are risk neutral, the prices of an IG and a nominal gilt of matched maturity can still be used to decompose the nominal yield on the conventional gilt into an expected real rate and an expected inflation rate. The procedure used to calculate the expected real yield and the expected inflation rate derives from work by Arak and Kreicher, Woodward, and Gaske.[‡] It can be explained by a simple example that captures the salient features of the U.K. gilt market. Consider a maturity-matched pair of nominal and indexed bonds with face values F^n and F^I (at issue) maturing in period T. Let P_t^n and P_t^I denote the (nominal) prices of the nominal and indexed bonds, respectively, at the beginning of period t, with time measured in months. Coupon payments are made every six months. The first payment after period t occurs in period $t+j$ ($j \leq 6$), and the last payment coincides with redemption in period T. The coupon payment on the nominal bond is denoted by C^n. If the IG was issued in period I, its redemption value will be $F_T^I = F^I \times (RPI_{T-8}/RPI_{I-8})$, and the nominal coupon paid in period $t+j$ will be $C_{t+j}^I = C^I \times (RPI_{t+j-8}/RPI_{I-8})$, where C^I is the face coupon ($C^I = F^I \times c$ = face value × coupon rate) on the index-linked bond. Finally, let i_t denote the period-t annual yield to maturity on the nominal bond, π_t^e the annual inflation rate expected to prevail from period t to period T, and r_t the annual expected real interest rate from period t to period T. Then i_t is the solution to

[†]For a discussion of institutional features of the indexed gilt market, see Patrick Phillips, *Inside the New Gilt-edged Market*, 2d ed. (Cambridge, England: Woodhead-Faulkner, 1987).

[‡]See Marcelle Arak and Lawrence Kreicher, "The Real Rate of Interest: Inferences from the New U.K. Indexed Gilts," *International Economic Review*, vol. 26, no. 2 (June), pp. 399-407; G. Thomas Woodward, "Comment: 'The Real Rate of Interest: Inferences from the New U.K. Indexed Gilts,'" *International Economic Review*, vol. 29, no. 3 (August), pp. 565-68, and Mary Ellen Gaske, "Sources of Fluctuations in Expected Long-term Real Rates: Evidence Extracted from U.K. Indexed Bond Rates," Unpublished Ph.D. Dissertation, University of Maryland.

Box: Extracting Ex Ante Real Yields and Expected Inflation from Indexed Gilts Prices *(continued)*

$$(A.1)\quad P_t^n = C^n \sum_{k=0}^{K} (1+i_t/12)^{-(6k+j)} + (1+i_t/12)^{-(T-t)}F^n,$$

where $K \equiv [T-(t+j)]/6$. The decomposition of i_t into π_t^e and r_t must satisfy

$$(A.2)\quad P_t^i = \sum_{k=0}^{K} [(1+r_t/12)(1+\pi_t^e/12)]^{-(j+6k)}C_{t+j+6k}^i] + [(1+r_t/12)(1+\pi_t^e/12)]^{-(T-t)}F_T^i$$

and

$$(A.3)(1+r_t/12)(1+\pi_t^e/12) = (1+i_t/12).$$

Since the expected nominal coupon on the indexed bond in period $t+j+6k$ is

$$C_{t+j+6k}^i = (1+\pi_t^e/12)^{6k}C_{t+j}^i = (1+\pi_t^e/12)^{6k} \times (RPI_{t+j-8}/RPI_{t-8}) \times C^i$$

and the expected nominal redemption value of the indexed bond is

$$F_T^i = (1+\pi_t^e/12)^{T-t-8} \times (RPI_t/RPI_{t-8}) \times F^i,$$

equation A.2 can be simplified to

$$(A.4)\quad P_t^i = (RPI_{t+j-8}/RPI_{t-8})[(1+\pi_t^e/12)(1+r_t/12)]^{-j}C^i + (RPI_t/RPI_{t-8})(1+\pi_t^e/12)^{-8}\left\{\sum_{k=0}^{K}(1+r_t)^{-(6k+j)}C^i + (1+r_t)^{-(T-t)}F^i\right\}.$$

The gilt prices provided by the Bank of England are clean prices: that is, they do not include accrued interest. For these calculations, accrued interest was added to the clean prices in proportion to the number of months that had elapsed since the previous interest payment.

Limitations of the IG measures of the expected inflation and real interest rates

The decomposition of the nominal long-term bond rate into its expected inflation and real interest rate components will be strictly correct if two requirements are met: (1) investors are risk neutral, and (2) nominal and indexed-linked bonds are identical in all respects other than indexation (specifically: risk, maturity, liquidity, and tax treatment). If investors are not risk neutral, interpreting the IG measure of expected inflation and the corresponding expected real yield is complicated by the existence of risk premia. Suppose, for expository purposes, that the indexed bond is fully indexed so that the ex ante real interest rate on the IG can be determined from its price alone. In this case, the expected real yield on the nominal bond will differ from that on the indexed bond by an inflation risk premium. Consequently, the estimate of expected inflation will be contaminated by an inflation risk premium that may vary systematically with expected inflation. It is difficult to predict the sign of this correlation on a priori grounds or to separate the contaminated measure of expected inflation into its two components because standard models of asset pricing under uncertainty fit real-world data very poorly. A further problem arises because holders of IGs are not fully compensated for inflation; the expected real return on the IG will also contain an inflation risk premium if investors are not risk neutral. This premium is likely to be negligible unless the IG is close to maturity, because the investor's exposure to inflation depends on the change in the RPI during the last eight months of the IG's lifetime. For a long-dated IG, this change is likely to have only a small impact on the average ex post real return over its lifetime. Thus, it would be safe to assume that the measure of expected inflation is much more likely to be contaminated by a risk premium than is the expected real interest rate.

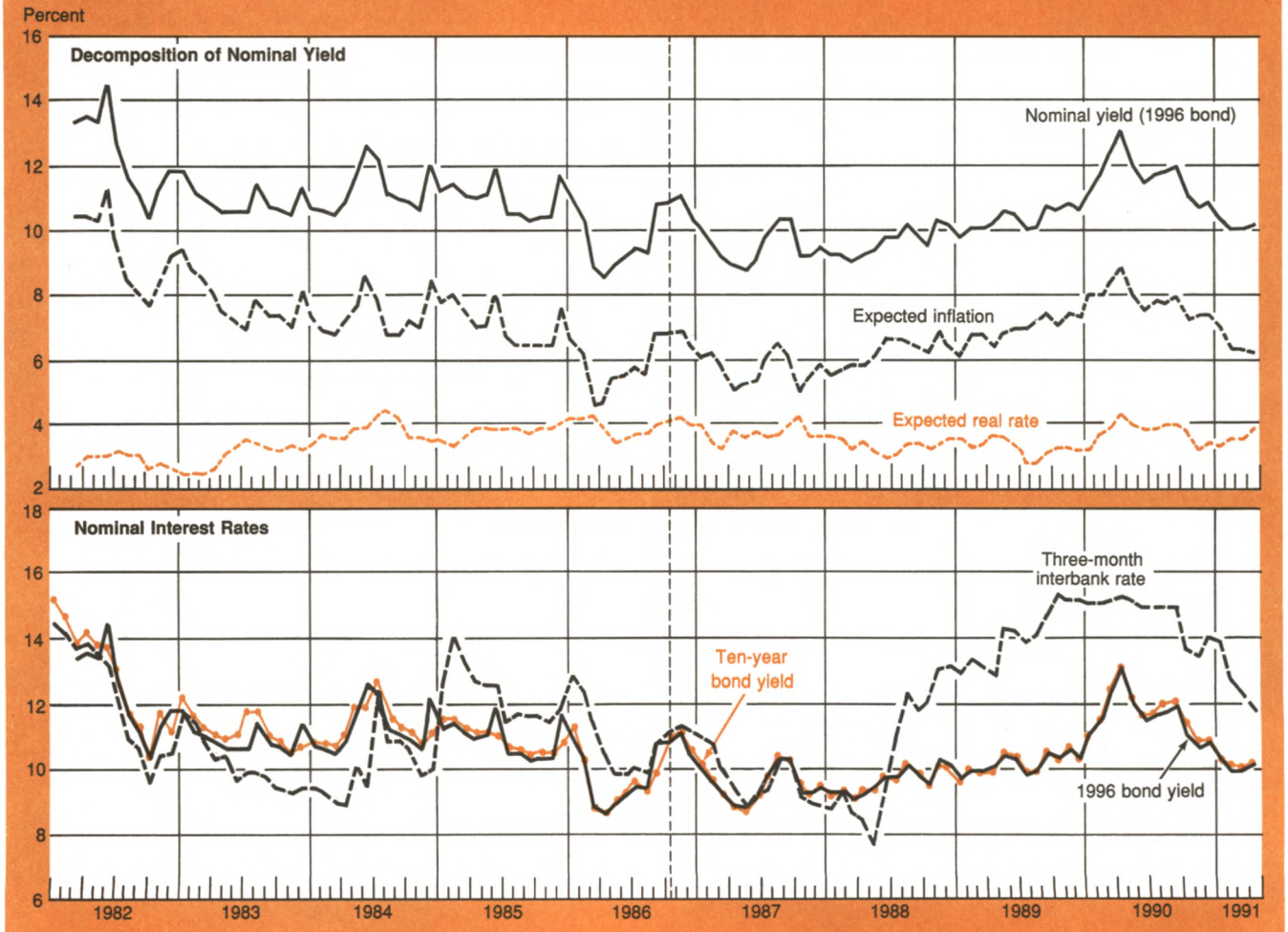
If the two bonds used for the calculations differ in their liquidity—say the indexed bond is less liquid—the measure of expected inflation will be further contaminated by a liquidity premium. As noted in the text, IG turnover is small relative to the turnover of conventional gilts, and thus IGs are presumably less liquid overall than conventional gilts. Nevertheless, because this general statement may not necessarily apply to a particular maturity-matched pair of index-linked and conventional gilts, it is difficult to determine whether a specific IG pays a liquidity premium. Finally, although index-linked gilts enjoy tax advantages compared with conventional gilts, the procedure for decomposing nominal yields ignores tax effects for two reasons. First, the difference in tax treatment may not be of much practical import because of the dominant role that tax-free institutions play in the gilt market. Second, Gaske found that taking tax effects into account did not change results qualitatively.

interest rate to changes in monetary policy. British monetary policy was tightened very sharply in the middle of 1988 and remained restrictive until September 1990. This tightening is reflected in the three-month interbank rate, which rose by more than 700 basis points from May 1988 to the end of 1989 and remained in the neighborhood of 15 percent until September 1990 (Chart 1, lower panel). The term structure, inverted since mid-1988, also shows the effects of monetary tightness. The sharp slowing of the U.K. economy in 1990 tends to confirm that high nominal rates did in fact reflect monetary tightness rather than a mere run-up of interest rates in anticipation of accelerating inflation; it also suggests that real rates probably rose from 1988 to 1990. However, the decomposition of the long-term bond yield indicates that this monetary tightening did not raise expected real long-term interest rates by much or, more implausibly, did not lower expected inflation at all.[13] In fact, the decomposition largely attributes the

[13]The real rate did rise somewhat from mid-1988 to mid-1989 and again from February 1990 to September 1990. However, the average real rate during the twenty-nine months of policy tightening was actually 30 basis points lower than the average real rate over the preceding twenty-nine months.

Chart 1

Expected Inflation and Real Interest Rates Derived from Index-linked Bond Prices



Sources: Bank of England data and author's calculations.

Note: Dashed vertical line denotes break in the data due to a change in the nominal bond used in the calculation.

steady rise in long-term government bond yields from early 1988 to mid-1990 to an increase in expected inflation. It is difficult not only to reconcile this pattern of real and nominal interest rate movements with the conventional view that monetary policy affects real economic activity through long-term real interest rates, but also to believe that private sector long-term inflation expectations were not adjusted downwards in the face of a very resolute tightening of policy.[14] These stylized facts suggest that, at least for the 1988-90 period, the IG measure was a poor measure of expected inflation and that the corresponding real interest rate did not accurately reflect ex ante real interest rates faced by the private sector.

The IG measure of expected inflation as a predictor of inflation

Chart 2 shows the IG measure of expected inflation along with actual inflation measured by the twelve-month percentage changes in the retail price index (RPI). Note that the expected inflation rate on a particular date is the average annual rate from that date to late 1996, while the actual inflation rate is the percentage change in the RPI over the past twelve months. Chart 2 generally contradicts assertions that the IG measure of expected inflation simply mimics the behavior of actual inflation.[15] The IG measure of expected inflation has remained above the actual rate for most of the sample period and is also rather less volatile than actual inflation. It has, however, been fairly close to the actual rate from late 1989 onwards.

Although the IG measure of expected inflation applies to an interval that is longer than the short- to medium-term horizon of primary concern to policy makers, it may nevertheless provide a good forecast of inflation over a horizon of immediate policy interest. To assess this possibility, the IG measure of expected future inflation was compared with three simple measures based on past inflation: the average rates of RPI inflation over the past twelve, twenty-four, and thirty-six months.[16] Each measure of expected inflation was evaluated as a

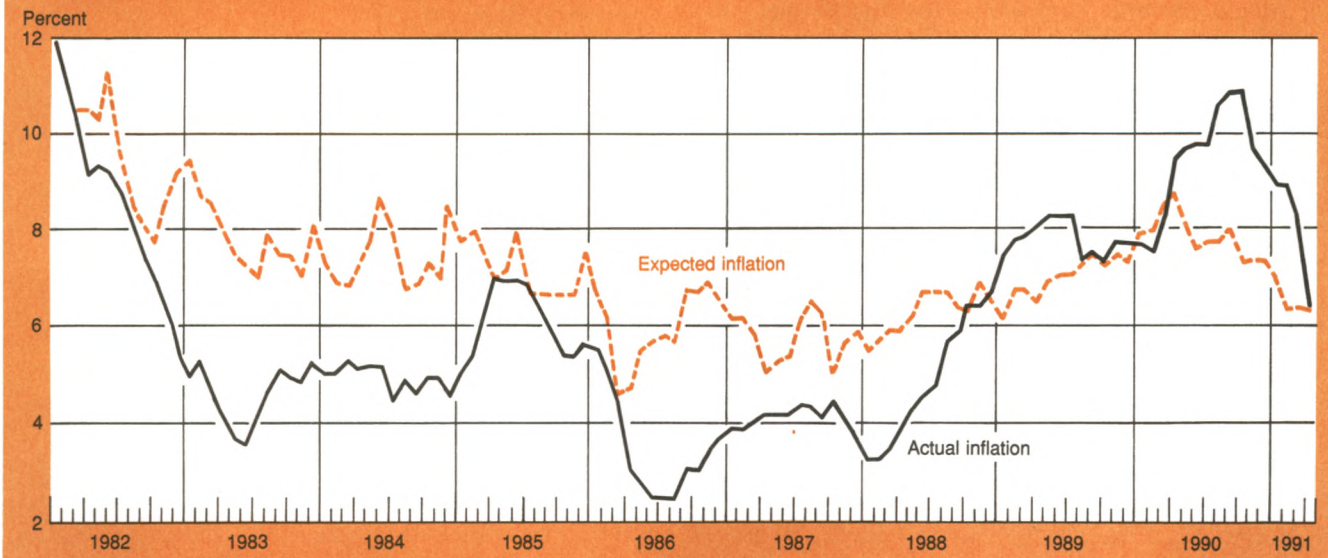
[14]Expectations of rising inflation could coincide with a monetary policy tightening if the tightening occurred at the same time as an exogenous increase in demand.

[15]See, for example, Anthony Harris, "Lessons from the Indexed Decade," *Financial Times*, April 29, 1991.

[16]A measure based on a shorter period of past inflation was not used because the RPI is not available on a seasonally adjusted basis.

Chart 2

Actual versus Expected Inflation



Sources: Bank of England data and author's calculations.

Notes: Actual inflation is measured by the percentage change in the retail price index over the preceding twelve months. Expected inflation is the measure derived from prices of index-linked gilts.

forecast of inflation over three horizons: twelve, twenty-four, and thirty-six months. The results of this exercise, reported in Table 3, rely on two yardsticks of forecast accuracy: the root mean squared forecast error, which measures average predictive accuracy over the forecast period, and the regression coefficient of actual inflation on the measure of expected inflation, which measures bias—that is, the tendency to over- or underpredict persistently. The average rate of inflation over the past twelve months is the most accurate predictor, on average, of the level of inflation over all three horizons considered (it has the smallest root mean squared forecast error). Although by no means unbiased, it has the smallest bias; the regression coefficient of actual inflation on this measure is closer to unity at the one- and two-year horizons than are those on the other measures. The performance of the IG measure of expected inflation is significantly better (over all three horizons) than that of the average inflation rate over the past thirty-six months and similar to that of the average inflation rate over the past twenty-four months. Note, however, that the IG measure is only moderately inferior to the best of the autoregressive measures (the twelve-month measure). For example, the root mean squared forecast errors indicate that about two-thirds of actual inflation rates over a one-year horizon will lie no further than 2.42 percentage points from the rate predicted on the basis of the past twelve months' inflation, and no further than 2.79 percentage points from the rate predicted by the IG measure.

It should come as no surprise that the IG measure fares no better than recent inflation in forecasting future inflation. As Chart 2 shows, the IG measure is a biased predictor of inflation, exceeding the actual inflation rate over most of the sample period.[17] A plausible interpretation of the upward bias in the IG measure of inflation expectations in the early part of the sample is that the U.K. monetary authorities were not credible in the early eighties. After a long period of fairly high inflation, several years of low inflation might have been necessary to convince market participants that the monetary authorities would maintain noninflationary policies. Alternatively, the bias may simply reveal that the IG measure is flawed.

One might ask whether the IG measure, if purged of bias, would predict inflation over a policy-relevant horizon more accurately than would naive measures based on past inflation. Using the monthly change in the IG measure, rather than its level, to forecast future inflation

[17]The poor forecasting performance of the IG measure relative to autoregressive measures is also to be expected from a purely statistical viewpoint. The RPI inflation rate is nonstationary; that is, changes in the inflation rate tend to be permanent and consequently the inflation rate does not tend to return to its long-run average after a change. Under these conditions, inflation over the recent past will generally be the best simple predictor of future inflation. Note, however, that using past inflation as a predictor of (the level of) inflation over longer horizons results in large expectations errors. That is, the variance of the forecast error, conditional on information available at the time the forecast is formed, is proportional to the length of the forecast horizon. Similarly, if the IG measure were an accurate predictor of future inflation, it would tend to move very closely with current inflation. Thus, from a purely statistical viewpoint, it might be considered surprising that the IG measure does not respond one-to-one to changes in actual inflation.

Table 3

Comparison of Indexed Gilt Measure and Naive Autoregressive Measures of Expected Inflation

Root Mean Squared Forecast Errors (Percentage per Year)

Measure of Expected Inflation	Forecast Horizon		
	One Year	Two Years	Three Years
IG measure	2.79	2.73	2.78
Inflation over past twelve months	2.42	2.41	2.52
Inflation over past twenty-four months	2.81	2.77	2.77
Inflation over past thirty-six months	3.58	3.57	3.57

Regression Coefficient of Actual on Expected Inflation

Measure of Expected Inflation	Forecast Horizon		
	One Year	Two Years	Three Years
IG measure	−0.07	−0.37	−0.44
Inflation over past twelve months	0.26	0.00	−0.32
Inflation over past twenty-four months	−0.02	−0.24	−0.28
Inflation over past thirty-six months	−0.18	−0.20	−0.16

Note: Sample periods are as follows: March 1982 to July 1990 for one-year forecasts, March 1982 to July 1989 for two-year forecasts, and March 1982 to July 1988 for three-year forecasts.

will eliminate bias that remains constant over time. But if the bias is in fact due to credibility problems, it has probably decreased over time, and consequently some bias is likely to remain in the data. Nevertheless, unless one knows the process whereby market participants change their views on the credibility of the monetary authorities, any method of eliminating bias will be imperfect. The results in Table 4 suggest that when purged of bias in this manner, the IG measure does marginally better than simple autoregressive measures in predicting future acceleration and deceleration of inflation. The table compares the performance of the monthly change in the IG measure in forecasting the change in the RPI inflation rate over the following twelve months with that of four naive autoregressive measures: the changes in the RPI inflation rate over the preceding one-, three-, six-, and twelve-month periods.[18] The monthly change in the IG measure is not only the most accurate predictor, on average, of the RPI inflation rate (it has the smallest root mean squared forecast error), but it is also appreciably closer than the naive measures to offering an unbiased forecast of changes in the RPI inflation rate (the regression coefficient of actual on predicted changes is the closest to unity).[19] It should be emphasized, however, that the difference in the forecasting performance of the IG measure and the change in the RPI inflation rate over the preceding month is so small as to be of no practical significance. Over longer data samples or different time periods, the ranking of the two measures could easily be reversed.

The preceding comparisons of the IG measure and naive autoregressive measures of expected inflation were designed to show whether the IG measure is a better predictor of inflation than are simple alternatives. The predictive value of the IG measure of expected inflation can also be assessed by determining whether it provides information that improves the forecasting ability of an autoregressive model based on past inflation. The test results reported in Table 5 provide evidence that the additional information contributed by the IG measure, while statistically significant, is too marginal to be of practical use. The test evaluates whether the IG measure of expected inflation can predict changes in the RPI inflation rate, measured as the monthly percentage change in the RPI, once thirteen lagged changes in the inflation rate (and seasonal dummies) have been taken into account in forming the predictions. The first four lagged values of monthly changes in the IG measure of expected inflation are jointly statistically significant at the 2.5 percent level, and eight lagged values are jointly significant at the 10 percent level. However, the addition of eight lagged changes in the IG measure only raises the adjusted R^2 of the forecasting equation from 0.8 to 0.82, too small an improvement to be of practical import. These results are not sensitive to the number of lagged changes in the inflation rate in the regression, although the number included (thirteen) is somewhat arbitrary. In addition, the limited predictive value of the IG measure

[18]The twelve-month forecast horizon was chosen somewhat arbitrarily for illustrative purposes. Although clearly of interest to policy makers, this horizon is not necessarily the most relevant.

[19]Comparing the ability of alternative measures of inflation expectations to predict changes in inflation is also advisable on purely statistical grounds. Because the inflation rate is nonstationary, the change in the inflation rate contains all the new information pertaining to the future course of inflation.

Table 4
Forecast Performance for Changes in Retail Price Index Inflation: Comparison of Indexed Gilt and Naive Measures

	Criterion of Forecast Accuracy	
Measure	Root Mean Squared Error (Percentage per Year)	Regression Coefficient of Actual on Predicted Inflation
One-month change in IG Measure	2.34	0.69
One-month change in RPI inflation	2.37	0.32
Three-month change in RPI inflation	2.57	0.03
Six-month change in RPI inflation	2.95	−0.01
Twelve-month change in RPI inflation	3.53	0.03

Notes: Changes in RPI inflation are measured as twelve-month changes in the twelve-month percentage change in the RPI. Sample period is April 1982 to July 1990.

Table 5
Contribution of Indexed Gilt Measure in Predicting Monthly Changes in Inflation

Lags of IG Measure of Expected Inflation	$\bar{R}^2$	Marginal Significance† (F-Test)
None	0.80	—
One to four	0.82	0.024
One to eight	0.82	0.094
One to thirteen	0.81	0.146

Notes: In the baseline regression, the monthly change in the RPI is regressed on thirteen own lags and a set of seasonal dummies. Sample period is May 1983 to April 1991.

†Measures the highest significance level at which one can reject the null hypothesis that the number of lagged changes in the IG measure of expected inflation does not contribute to forecasting the change in RPI inflation over the next month. The confidence level in the null hypothesis is given by 1- marginal significance.

may simply reflect the degree of predictability of the RPI that derives from purely mechanical aspects of its calculation. For example, changes in the banks' base interest rates have a foreseeable effect on mortgage interest rates because variable rate mortgages are the rule in the United Kingdom; consequently, these changes affect the RPI predictably through the effect of mortgage payments on the cost of housing.

Expected inflation and expected real interest rates as predictors of real economic activity

The IG market may convey information useful in the formulation of monetary policy even though the IG measure of expected inflation is no more successful in forecasting inflation than are simple measures based on past inflation. The IG measure may be an imperfect predictor of future inflation simply because it faithfully reflects the private sector's unrealized expectations of inflation. In this case, the IG market may provide policy makers with a reliable measure of ex ante real interest rates. If private sector spending is interest-sensitive, the market may also yield information about private sector spending plans and near-term economic developments. In sum, the IG measure of expected real long-term interest rates may be a potentially valuable indicator of macroeconomic developments.

One way to test the accuracy of the IG measure in gauging private sector inflation expectations is to determine whether the IG measure of ex ante real long-term interest rates provides information about future real economic activity. Compared with more direct tests such as correlating the IG measure with survey measures of inflation expectations, this test has a disadvantage: it can only provide information about the accuracy of the IG measure as a yardstick of private sector inflation expectations to the extent that private sector decisions are interest-sensitive. This shortcoming is also an important advantage, however, because the test measures the accuracy of the IG measure in terms of a goal variable of direct interest to policy makers. Furthermore, the test captures any potential leading indicator role of indexed bond prices and as such is of interest to policy makers.

To determine whether the indexed gilt market provides information about future real economic activity, real GNP growth is regressed on lagged GNP growth and various nominal interest rates and inflation rate measures, including those obtained from index-linked gilts. The results from these regressions are probably best appreciated in the context of the stylized facts established by similar regressions on U.S. data. In particular, although U.S. real GNP growth is typically very difficult to predict, Estrella and Hardouvelis and Stock and Watson have found that short-term nominal interest rates and measures of the slope of the term structure convey information about future movements in

Table 6

Predictive Value of Nominal Interest Rates for Real GNP Growth in the United States and the United Kingdom

	United States		
		Four Lags of	
Statistic	Real GNP Growth	Ten-Year Government Bond Yield	Six-Month Commercial Paper Rate
F	0.99	3.61***	6.48***
LR	4.27	15.04***	26.00***
$\bar{R}_2$	0.27		
	United Kingdom		
		Four Lags of	
Statistic	Real GNP Growth	Ten-Year Government Bond Yield	Three-Month Interbank Rate
F	3.45**	1.20	2.44*
LR	14.38***	5.35	10.65**
$\bar{R}^2$	0.12		

Notes: Sample period for the United States is 1954-II to 1991-I; for the United Kingdom, 1965-I to 1991-II. F and LR are the F statistic and likelihood ratio statistic for testing the null hypothesis that a particular variable has no explanatory power for future real GNP growth in a regression including the listed variables as regressors. One asterisk denotes significance at the 10 percent level; two, significance at the 5 percent level; and three, significance at the 1 percent level.

Interest rates are measured as quarterly averages of month-end observations. GNP growth is measured as quarterly percentage changes seasonally adjusted at an annual rate.

real output.[20] Table 6 provides benchmark regression results illustrating the predictive value of nominal short- and long-term interest rates for U.S. real GNP growth. It also shows that nominal interest rates are less informative in the United Kingdom than in the United States.

Results for the United Kingdom spanning the period since the inception of the index-linked market are presented in Table 7. The table illustrates how adding different variables in an equation to forecast real GNP growth affects the adjusted R^2 of the equation. Note that the components of the real interest rate are added separately, in part because the hypothesis that the nominal rate and the inflation rate have coefficients equal but opposite in sign is generally rejected by the data. The regression results support three specific conclusions: First, U.K. real GNP growth, like its U.S. counterpart, is hard to predict, but in contrast to the U.S. experience, long- and short-term nominal interest rates (and by implication measures of the slope of the term structure) do not forecast future movements in real GNP (columns 1 and 2). Second, the decomposition of long-term nominal rates based on indexed gilt prices provides no significant information about future real GNP growth in the United Kingdom. (The adjusted R^2 of the forecasting equation actually falls when the IG measure of expected inflation is added to the forecasting equation.) Finally, backward-looking measures of short- and long-term real interest rates, often used as indicators of the stance of monetary policy, do yield significant information about future real economic activity. Four lags of the three-month interbank rate together with four lags of the RPI inflation rate (the percentage change in the RPI over the preceding twelve months) raise the adjusted R^2 of a regression of real GNP growth on four lagged values of real GNP growth from 0.16 to 0.55 (column 4).

The results reported here show that the prices of index-linked gilts do not convey policy-relevant information about future trends in economic activity. If we accept that private sector decisions are sensitive to real interest rate movements, the results imply that the IG measure of ex ante real long-term interest rates does not accurately reveal real interest rates faced by the private sector. The limitations of the IG measure of expected inflation as a gauge of private sector inflation expectations could be due to any of three causes. First, limited participation in the U.K. indexed gilt market may have made the IG real interest rate relevant to only a very small part of the private sector. Second, the expected rate of inflation and the corresponding real interest rate in the bond market may not be relevant to the majority of participants in the goods and factor markets. Finally, the poor performance of the IG measure of expected inflation may derive from tax distortions or the fact that market participants are risk averse.

Two caveats to these conclusions deserve mention, however. First, the predictive power of IG prices will depend on the monetary policy rule followed by the authorities. If the Bank of England were stabilizing real interest rates, one would not expect the IG measure of the real interest rate to have predicted real GNP changes. Second, the conclusions are tentative, because the U.K experience with indexed bonds is comparatively short. The addition of only a few years' data may very well lead to conclusions more favorable to the position held by proponents of indexed bonds.

[20] See Arturo Estrella and Gikas Hardouvelis, "Possible Roles of the Yield Curve in Monetary Policy," *Intermediate Targets and Indicators for Monetary Policy*, Federal Reserve Bank of New York, New York, 1990; and James H. Stock and Mark W. Watson, "The Business Cycle Properties of Selected U.S. Economic Time Series, 1959-1988," National Bureau of Economic Research, Working Paper no. 3376.

Table 7

Predictive Value for Future Real GNP Growth: Comparison of Indexed Gilt and Other Variables

Four lags of	Regression Number			
	(1)	(2)	(3)	(4)
Real GNP growth	X	X	X	X
Long-term government bond yield		X	X	X
Three-month interbank rate		X	X	X
IG measure of expected inflation			X	
Twelve-month change in RPI				X
$\bar{R}^2$	0.16	0.17	0.14	0.55
Standard error	2.69	2.67	2.72	1.97

Note: Sample period is 1983-II to 1990-IV.

Conclusion

This article has used data from the U.K. market for index-linked gilts to assess the alleged policy benefits of indexed bonds. It has been suggested that a real-time market measure of expected inflation (and the corresponding ex ante real interest rate) derived from indexed bond prices could provide the Federal Reserve System with valuable information about market perceptions of, and reaction to, its policies, and convey information about future inflation and real economic developments. The evidence presented in this article, however, suggests that the prices of index-linked gilts may not convey much information about future inflation and real economic activity. For this reason, authorities

may question whether a real-time market measure of expected inflation can shed light on private sector reactions to monetary policy.

The ability of the IG measure of expected inflation to anticipate future inflation developments appears to be, at best, mixed. It is a biased predictor of future inflation, fares no better than simple inflation expectations measures based on past inflation, and does not add appreciably to the predictive power of a more sophisticated backward-looking model of inflation expectations.

U.K. indexed bond prices also do not seem to convey policy-relevant information about future real economic activity. This finding is consistent with the IG measure's being an imperfect gauge of private sector inflation expectations and with the failure of the corresponding real interest rate to reflect accurately ex ante real interest rates faced by the private sector. The behavior of the IG measures of expected inflation and the real long-term interest rate during the period of restrictive monetary policy from mid-1988 to late 1990 further supports this judgment. In sum, these results suggest that the U.K. IG measure of inflation expectations seems to offer only limited, if any, information for the conduct of monetary policy.

Tracking the Economy with the Purchasing Managers' Index

by Ethan S. Harris

In the last several years the purchasing managers' index has emerged as a key indicator of manufacturing activity. This "index" consists of five separate indexes measuring monthly changes in manufacturing output, employment, new orders, inventories, and vendor deliveries, together with a composite index that gives a weighted average of the other five. Financial markets are now quite sensitive to the index, and news reports on the economy regularly feature it. The index receives such close attention for several reasons: it is the first broad indicator released each month, it covers the cyclically sensitive manufacturing sector (Chart 1), and the data are easy to interpret and are virtually never revised.

Despite the index's popular appeal and market-moving power, some skepticism about the utility of this indicator is warranted. It is not constructed with the scientific sampling and statistical methods that underlie most official macroeconomic series (see appendix). A qualitative measure of activity, it reports whether business has increased or decreased but makes no assessment of the strength of the change. Most important, the index has not been rigorously tested: although there is ample evidence that the index tracks the general ups and downs of the economy, analysts have not demonstrated that the purchasing managers' data yield information on the economy beyond that already provided by other indicators.

This article analyzes the strengths and weaknesses of the index as a forecasting tool. It begins by explaining how the index is constructed. The next section presents the basic correlations between the five component indexes and the economic aggregates they are supposed to track. The remainder of the article investigates the predictive power of the purchasing managers' data: Do the indexes lag or lead economic activity? Do they foreshadow turning points in the business cycle? Can the indexes improve on the forecasts of simple economic models or on consensus forecasts?

Our results give mixed support for the purchasing managers' index. One shortcoming is the index's tendency to pick up activity in the weeks preceding the month it is supposed to measure. Another limitation is that none of the components explains more than half of the monthly variation in the corresponding official statistics. Furthermore, the index is not a reliable leading indicator: it sends too many false signals and its lead time is too erratic to be of use in anticipating cyclical swings. Nevertheless, the index does add significantly to the explanatory power of simple econometric models and consensus forecasts. And it could be even more useful to forecasters if the sampling and statistical methodology were improved. Thus, although the index has some important limitations, with careful application it can be useful in forecasting economic activity.

Description

About the middle of each month the National Association of Purchasing Managers (NAPM) surveys roughly 300 association members representing twenty-one manufacturing industries in all fifty states. The survey asks each purchasing manager how the current level of five key economic indicators—production, new orders, employment, inventories, and vendor delivery time—

compares with the previous month's level.[1] The responses are simply "higher," "lower," or "the same." The unweighted percentage of firms in each category is then tabulated and a diffusion index is constructed by summing the percentage of positive responses and one-half of those responding "the same."[2] A reading above 50 percent in a diffusion index means that more firms are expanding activity than contracting activity. Finally, these data are seasonally adjusted and combined into a single weighted composite index.

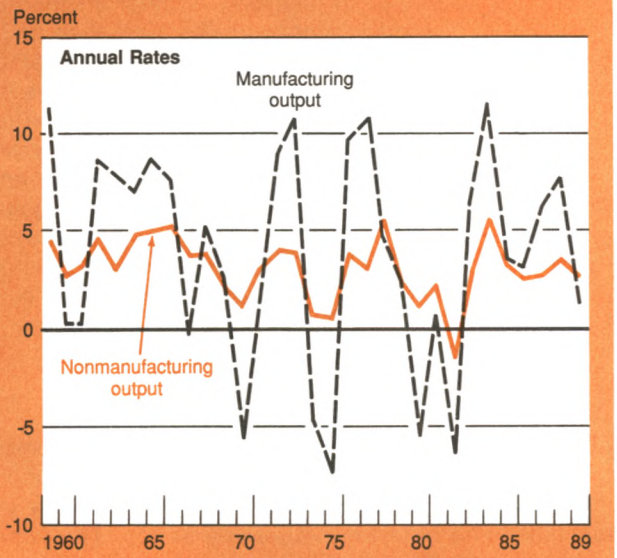
Although the survey has been published since 1931 (with an interruption for World War II), several of its more sophisticated features were only introduced in recent years. The data were originally published in raw, seasonally unadjusted form; in the early 1980s, with help from the Commerce Department, the association began publishing seasonally adjusted diffusion indexes. The sample size has also been increased to almost 300 from about 225. Since the summer of 1989, when financial markets became increasingly interested in the index, the survey has been released earlier and at the same time each month. It now usually "beats" the employment report by several days and thus captures maximum attention in the market.[3]

[1]The survey also includes questions on commodity prices and buying policy. In the last several years new export orders and imports have been added.

[2]The NAPM survey treats vendor delivery time somewhat differently. The responses for this indicator are "slower," "faster," and "no change." The diffusion index for vendor deliveries is the sum of the percentage reporting slower delivery time and half the percentage reporting no change.

Chart 1

Manufacturing and Nonmanufacturing Output Growth



Source: National Income and Product Accounts, Table 6.2.

The index as a measure of economic activity

The NAPM component indexes have counterparts in official data published by the federal government. Since the indexes are measures of the diffusion of the economic activity, they should have roughly a linear relationship to the *growth* in corresponding government data.[4] In other words, if a higher proportion of firms are reporting expanded activity, then we would expect higher growth in aggregate activity.

Table 1 presents evidence of how closely the NAPM data track the economy. The table shows the results of regressing the percent change in the official data on the corresponding component of the index. The first three columns present estimates using monthly data for the 1959-91 period. As the t-statistics (in parentheses) show, the NAPM coefficient is significant in all of the equations. The overall fit (R-square), however, is generally modest: the indexes explain less than half of the monthly variation in growth for all variables. The weakest results are for new orders and prices, two highly volatile series; the best results are for employment.

The fourth and fifth columns of Table 1 show the overall fit when quarterly and annual data are used. Although this time aggregation generally improves the fit, the NAPM data still leave a good portion of the variation in growth unexplained. The last two columns of Table 1 show the implied break-even point for the indexes. Theoretically, when aggregate growth is zero, a diffusion index should average out to about 50 percent, with equal numbers of firms reporting higher and lower activity. The regression estimates suggest that using 50 percent as the break-even point can be misleading. For example, in the regression of industrial production on the composite index, estimates for the 1980-91 period show a break-even rate of just 46.9 percent.[5]

[3]Interest in the index has also drawn attention to some of the regional purchasing managers' surveys. The Chicago index is closely watched, in part because it is released before the national index.

[4]Specifically, if (1) firms have identical but nonsynchronous cycles and (2) growth is evenly distributed among large and small firms along a rectangular distribution, then there will be an exact linear relationship between the proportion of firms expanding and the rate of growth of aggregate activity. Regression tests found no evidence of significant nonlinearities.

[5]Recent experience illustrates the danger of using 50 percent as the break-even point. From May 1989 to April 1990 the composite NAPM index dipped below 50 percent, averaging 47.6 percent. If

The index as a leading indicator

Tracing the general movements in economic activity is not a very rigorous test of an indicator. Much of the interest in the purchasing managers' index among business economists stems from its alleged ability to signal changes in economic trends. The tremendous attention the index now receives started in the summer of 1989 when the index, falling below 50 percent, appeared to presage a recession. Clearly the index's early release makes it a "timely indicator"; the more difficult question is whether it in fact anticipates activity in the months ahead. Does it lead activity or measure contemporaneous activity? And are business economists correct in assuming that it gives a reliable warning of recession?

The purchasing managers' index, like all diffusion indexes, has leading indicator qualities. Chart 2 shows the relationship between the composite index and the growth in manufacturing output over the business cycle. The index peaks when growth is highest, declines to 50 percent as growth levels off, and then falls below 50 percent as the economy slips into recession. Empirical work by Cox and Torda shows that the composite index "reached its cyclical peak about 11½ months before the onset of the seven postwar recessions" and that "the lead time of the composite index of leading economic indicators is similar, about 12 months."[6] Cox and Torda also find that the composite index generally leads cyclical recoveries.

Unfortunately, average lead time is a poor criterion for judging a leading indicator. To be useful, a leading indicator must predict turning points with a relatively regular lead of at least a few months. It must also give a relatively small number of false signals. Here we test the predictive power of two types of movement in the composite index: turning points in the index and periods when the index crosses various "break-even" or "threshold" points.

Neither NAPM signal reliably predicts business cycle turning points. As Chart 2 shows, the index often turns down long before a business cycle peak, reflecting the slowing of growth following the initial cyclical recovery. Even if we ignore this initial peak, the index has multiple peaks in the course of each expansion, and the peak

Footnote 5 (continued)
50 percent is the break-even point, this drop in the index implies about a 2 percent decline in manufacturing output. In fact, as the regression estimates predict, output showed no change over this period.

[6] William A. Cox and Theodore S. Torda, "Survey By Purchasing Managers Can Provide Signal On End Of Recession," *Business America*, July 14, 1980, p. 21.

Table 1

"Break-even" Regressions for Manufacturing Growth

Series Explained	Constant	Slope	Predictive Power (R^2) Monthly	Quarterly	Annual	Break-even Point 1959-91	1980-91
Industrial production	−3.62 (11.7)	0.070 (12.9)	.300	.666	.582	51.5	49.3
Payroll employment	−2.44 (17.9)	0.050 (18.4)	.465	.772	.681	49.1	47.4
New orders†	−3.22 (4.5)	0.063 (4.8)	.074	.558	.588	51.4	49.3
Materials inventories	−2.20 (10.2)	0.049 (11.2)	.246	.512	.239	44.7	47.0
Capacity utilization‡	69.24 (89.2)	0.236 (16.9)	.426	.439	.435	—	—
Crude producer prices	−1.89 (3.4)	0.034 (4.1)	.041	.169	.506	56.3	56.1
With the Composite Index							
Industrial production	−3.30 (10.3)	0.067 (11.4)	.250	.556	.669	49.0	46.9
Real GNP	−3.60 (7.4)	0.081 (9.1)	—	.393	.713	44.4	44.5

Notes: Regression coefficients are based on the January 1959–May 1991 sample. Except in the capacity utilization equation, the dependent variable enters as a simple percentage change. Absolute t-values are in parentheses.

†Sample starts in 1967 and the dependent variable is deflated using the implicit deflator for shipments.

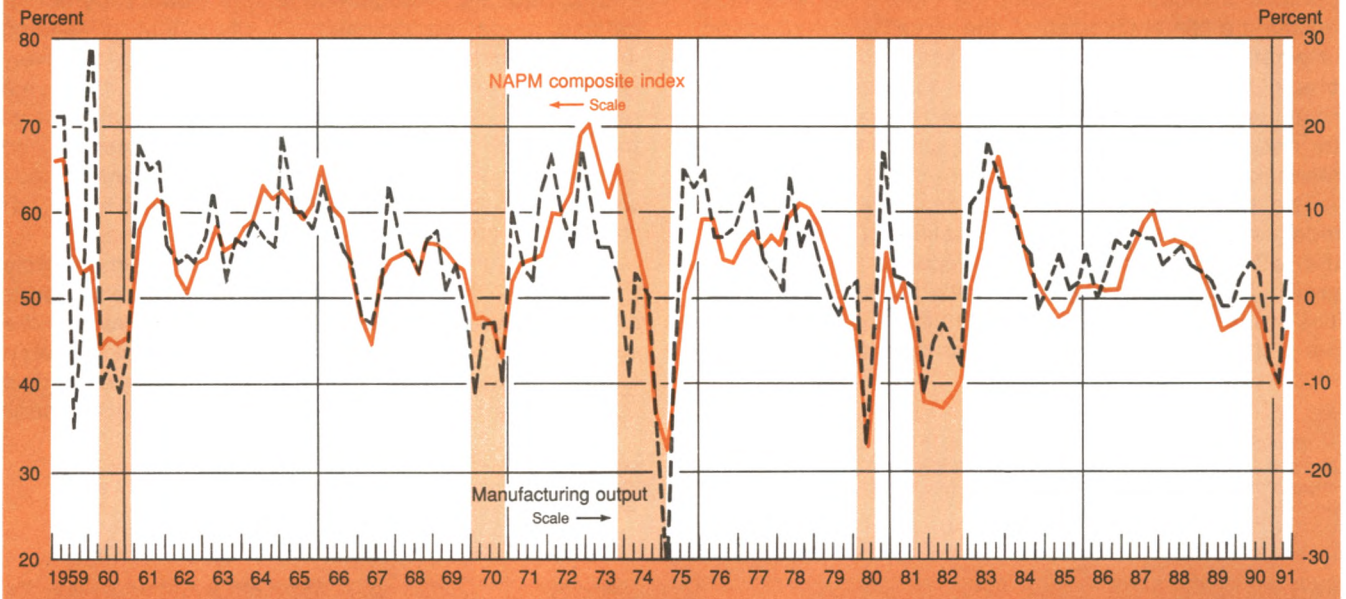
‡The independent variable is vendor deliveries, lagged three months.

that finally "correctly" signals recession can occur anywhere from zero to twenty months before the onset of recessions. The index is just as erratic in predicting cyclical troughs, bottoming out anywhere from zero to twelve months before the economy-wide trough.

If the 50 percent threshold is used rather than the index's peak, equally vexing problems emerge (Table 2). The index usually drops below 50 before cyclical peaks,

Chart 2

The Purchasing Managers' Index and the Growth in Manufacturing Output



Notes: Chart shows quarterly averages of monthly data. Manufacturing output is from the industrial production index. Shaded areas denote recessions.

Table 2

Does the Composite Index Signal Business Cycle Turning Points?

Lead (+) or Lag (−) Time in Months

	NAPM Threshold				NAPM Threshold		
Peak	50.0	49.0	44.5	Through	50.0	49.0	44.5
November 1948	+8	+8	0	October 1949	+1	+1	+2
July 1953	+2	+2	−1	May 1954	0	0	+2
August 1957	+5	+5	−2	April 1958	−2	−2	−1
April 1960	+1	+1	−1	February 1961	−2	−1	−1
December 1969	−1	−1	−9	November 1970	−3	−3	−1
November 1973	−10	−10	−11	March 1975	−5	−5	−3
January 1980	+5	+2	−2	July 1980	−2	−2	−1
July 1981	0	0	−2	November 1982	−3	−3	−2
July 1990	+14	0	−3				
Average	+2.7	+0.8	−3.4	Average	−2.0	−1.9	−0.5
False alarms	4	4	1	False alarms	0	0	1

Notes: In keeping with the leading indicator literature, the composite index is assumed to signal a turning point when it crosses the threshold value for three or more consecutive months. The signal is dated from the first month the threshold is crossed. Signals reversed for at least three months before a cyclical turning point occurs are considered "false alarms."

but the lead time is quite variable. In the 1973-75 recession, the index did not signal recession until almost a year after the onset of the downturn; by contrast, in the most recent recession, the index stumbled along at just below 50 percent for more than a year before the economy turned down. Even worse, it falsely predicted four business cycle peaks, with several signals lasting as much as a year. Its record for cyclical troughs is equally dismal: the index usually surpassed the 50 percent break-even point two to five months after the economy had moved out of recession.

Similar problems arise when threshold values below 50 percent are used. The findings in Table 1 suggest a 49 percent break-even value for industrial production and a 44.5 value for real GNP. Using 49 percent rather than 50 percent as the break-even value has virtually no impact on the timing of the signal. Using 44.5 percent changes the results, but not for the better. At cyclical peaks, the index falls below 44.5 percent after the turning point in all but one downturn, with an average lag of three months. At cyclical troughs, the signal is a little more timely, but again it usually fails to anticipate the recovery. The only advantage of the 44.5 percent threshold is that it produces only two false signals in the postwar period.

Thus the composite index has two problems as a leading indicator. First, because business cycles do not follow a smooth growth pattern, the index often peaks during the initial recovery and then reaches several mini-peaks in the course of an expansion. Second, because growth usually does not flatten out gradually at the peak of the business cycle, the composite index may not dip below 50 percent until after the recession starts. Furthermore, as noted in the appendix, the NAPM data may lag economic activity by about half a month because respondents have incomplete data on the current month when they fill out the survey. Therefore, as a cyclical indicator, the index is better used to *confirm* recent turning points than to anticipate them.

Three horse races

Clearly the composite index and its components have important limitations as stand-alone indicators of the strength of the economy. This section tests how the indexes perform in comparison with alternative forecasting tools. In particular, the analysis explores how the indexes stack up against economic models and consensus forecasts in explaining the growth in nonfarm payroll employment, industrial production, and real GNP. The results confirm that the indexes are poor stand-alone predictors, but they also demonstrate that the indexes provide helpful incremental information to forecasters. In other words, the indexes represent an imperfect but useful addition to our knowledge of current economic conditions.

Forecasting nonfarm employment growth

In the last several years the employment report has become the most important economic indicator for data-watchers.[7] Recognizing this, the purchasing managers' survey committee has pushed up the release date for the index so that it now usually precedes the employment report. Not surprisingly, the composite index and its employment component are viewed as vital information in the payroll employment guessing game.

The explanatory power of the index is tested against two standards. First, the predictions of a simple economic model of employment growth are compared with those of the NAPM data. Second, the performance of the NAPM data is measured against that of the consensus forecast reported by Money Market News Service.

The informal economic model used here is constructed from variables available to forecasters before the purchasing managers' data are released. These include several interest rate spread variables identified in work by Bernanke, Estrella and Hardouvelis, and others as reliable predictors of economic activity.[8] Specifically, the model includes the six-month commercial paper rate, the spread between the commercial paper and Treasury bill rates, the spread between corporate BAA bonds and ten-year Treasuries, and the difference between ten-year and three-month Treasury rates. Also included are several "real" variables watched by payroll forecasters: domestic auto sales, initial claims for unemployment insurance, and the index of leading economic indicators. All told, this ad hoc economic model has eight explanatory variables. The four interest rate variables are entered contemporaneously and with six lags, autos and claims enter currently and with a lag, and both the index of leading indicators and the dependent variable enter with six lags. Adding the NAPM employment index to this model yields a rigorous test of its incremental explanatory power.[9]

Table 3 compares the explanatory power of the economic model, the NAPM employment index, and the full

[7]The markets appear to have a "flavor of the month" approach to economic indicators, with merchandise trade, consumer prices, producer prices, money growth, and the employment report each getting top billing at various times. Overall, however, employment seems to be the most consistent leader.

[8]Ben S. Bernanke, "On the Predictive Power of Interest Rates and Interest Rate Spreads," Federal Reserve Bank of Boston *New England Economic Review*, November-December 1990, pp. 51-68; Arturo Estrella and Gikas A. Hardouvelis, "The Term Structure as a Predictor of Real Economic Activity," Federal Reserve Bank of New York, Research Paper no. 8907, May 1989.

[9]Each model was also tested using the NAPM composite index and using manufacturing employment as the dependent variable, and the results were very similar.

model (that is, the economic model combined with the NAPM index) over two sample periods, one of extended duration (1959-91) and the other limited to recent years (1980-91). For each model the table shows the coefficient on the employment index with its t-statistic and the overall fit of the model as measured by the adjusted R-square. Several results are noteworthy. First, although both the economic model and the purchasing managers' index are highly significant, the economic model explains somewhat more of the variation in employment growth. This finding should not be surprising, however, because the NAPM data measure only growth in the manufacturing sector, while the economic model has a rich array of explanatory variables. Second, and more important, when the NAPM variable is added to the economic model, this variable continues to be highly significant. In fact, the adjusted R-squares suggest that the best model combines the NAPM data and the economic model.[10]

Even stronger support for the NAPM index comes from comparing it with the consensus forecast for payroll employment growth issued by Money Market News Service. This informal survey of data watchers is taken just before the NAPM and employment data are released. The sample is limited to the period since 1985 because of the difficulty in obtaining earlier data. Table 4 shows the results of this comparison. Again, both the NAPM index and the consensus explain a large portion of the variation in employment, but the best results are obtained when the consensus and NAPM are combined in the same equation. This finding suggests that payroll forecasters should modify their forecast in light of the NAPM release. For example, all else equal, a 1 percentage point increase in the NAPM index should induce a 10,000 upward revision in expected payroll employment growth.

So far we have focused on the in-sample fit of the various employment models. The ultimate test of these equations, however, is how they perform out of sample. For each model a series of one-month-ahead forecasts is calculated by using data from 1959 to 1984 and then extending the sample forward one month at a time. Table 5 shows the relative size of the prediction errors for each of the models. As with the in-sample tests, adding either the composite or employment index to the other models reduces the average prediction errors. The best result combines a simple autoregressive

[10] Ideally, it would make sense to modify the estimation in two ways: (1) simplify the model by dropping the less significant lags on each variable and (2) use unrevised data for the independent variables (to duplicate what is available to forecasters). Our purpose here, however, is to stack the odds against the NAPM index as much as possible rather than to devise an optimal model. Furthermore, preliminary tests show that the results are not sensitive to either of these changes.

Table 3
Explaining the Percent Change in Nonfarm Payroll Employment

Model	Sample: 1959-91 NAPM†	$\bar{R}^2$	Sample: 1980-91 NAPM†	$\bar{R}^2$
NAPM index	0.022 (16.9)	.423	0.024 (12.2)	.522
Economic model‡	—	.429	—	.600
Full model§	0.021 (7.3)	.506	0.019 (3.6)	.646

†Values are coefficients on the NAPM index, with absolute t-values in parentheses.

‡Includes the commercial paper rate, three interest rate spread variables, auto sales, initial claims, the index of leading indicators, and lags of the dependent variable.

§Includes both the NAPM employment index and all of the economic variables.

Table 4
Explaining Employment Growth with the NAPM Employment Index and the Consensus Model

Model	Constant	NAPM	Consensus	$\bar{R}^2$
NAPM index	−0.775 (6.0)	0.020 (7.3)	—	.408
Consensus model	−0.035 (1.6)	—	1.173 (10.7)	.600
NAPM combined with consensus model	−0.429 (4.0)	0.009 (3.7)	0.917 (7.5)	.658

Notes: Sample period is January 1985 to May 1991. The dependent variable is the percentage change in total nonfarm employment. Consensus data are converted from change to percentage change. Absolute t-values are in parentheses.

Table 5
Out-of-Sample Prediction Errors for Payroll Employment Growth

Model	Without NAPM	With NAPM: Employment	With NAPM: Composite
NAPM index only	—	.157	.145
Autoregressive model	.143	.141	.136
Economic model	.181	.158	.146

Notes: Table shows the root mean square error for the January 1985–May 1991 period. The "autoregressive model" simply uses six lags on the dependent variable.

model with the composite index.[11]

[11]Note that the economic model alone does the worst job of predicting out of sample for this period. This result is consistent with Bernanke's argument that a structural shift in the relationship between the spread variables and economic activity occurred in the 1980s.

Table 6
Explaining Industrial Production Growth

Model	Constant	NAPM	Consensus	Hours	$\bar{R}^2$
NAPM index	−2.726 (8.4)	0.055 (9.0)	—	—	.371
Consensus model	0.059 (1.3)	—	0.926 (12.8)	—	.544
Hours	0.027 (4.6)	—	—	0.507 (11.4)	.488
Economic model	1.478 (1.6)	—	—	—	.618
NAPM index plus consensus model	−0.401 (0.9)	0.009 (1.1)	0.829 (7.2)	—	.544
NAPM index plus hours	0.178 (4.4)	0.004 (5.1)	—	0.401 (8.8)	.568
NAPM index plus economic model	−0.073 (0.1)	0.030 (2.1)	—	—	.631

Notes: Sample period is January 1980 to May 1991. The dependent variable is the percentage change in the industrial production index. The consensus is from Money Market News Service. Absolute t-values are in parentheses.

Table 7
The NAPM Composite Index and Real GNP Growth

Model	Constant	NAPM	Consensus	$\bar{R}^2$
NAPM index	−14.460 (5.5)	0.326 (6.6)	—	.361
Consensus model	0.546 (0.8)	—	0.832 (4.6)	.217
Economic model	11.346 (4.6)	—	—	.658
NAPM index plus consensus model	−12.000 (4.2)	0.261 (4.5)	0.363 (1.9)	.378
NAPM index plus economic model	0.506 (0.1)	0.152 (1.7)	—	.669

Notes: Sample period is 1970-I to 1989-II. The dependent variable is annualized one-quarter growth in real GNP. Absolute t-values are in parentheses.

Forecasting industrial production and real GNP

The NAPM data are also useful in forecasting industrial production and real GNP. Table 6 compares the explanatory power of four models of industrial production: the NAPM production index, the growth in employee hours, the Money Market consensus forecast, and an economic model using the same variables discussed in the previous section. The t-statistics on the NAPM coefficients suggest that the index adds significantly to the economic model and the simple employee hours model, but that it is not a useful addition to the consensus forecast. This finding should not be a surprise, however, since the NAPM data are available to forecasters before the consensus survey is taken and therefore should already be incorporated into the consensus forecast.

Table 7 shows the results of the final horse race. It compares the power of the composite NAPM index, the economic model, and a consensus forecast to predict growth in real GNP. For the economic model the variables used are the same as those in the employment and industrial production equations, but each variable enters contemporaneously and with two lags. The consensus data, compiled by the American Statistical Association and the National Bureau of Economic Research, are one-quarter-ahead forecasts, taken in the middle of the preceding quarter. Again, the results of the comparison are generally supportive of the NAPM data. The NAPM index predicts real GNP growth better than the consensus forecast, although worse than the economic model. The relatively weak performance of the consensus is easy to explain: the NAPM and economic models use up-to-date information, while the consensus is based only on information available before each quarter. A more important result is that the NAPM index continues to be significant when added to the other models (although it is only marginally significant when combined with the economic model).

Conclusion

Despite its growing popularity, the NAPM index has undergone very little critical scrutiny. Our results suggest that the index is a flawed but still useful indicator. It is a poor leading indicator and, on its own, can be a misleading measure of short-run movements in the economy. In combination with other data, however, it is very helpful in predicting contemporaneous manufacturing activity. In sum, the index deserves at least part of its reputation as a key economic indicator.

Appendix: The Design of the NAPM Data Set

With one notable exception, the NAPM data have received high praise in the literature.[†] Hoagland and Taylor, for example, argue that the survey data "are available sooner, are more reliable, and are much more cost effective than government information."[‡] Klein and Moore cite the early release of the data as an important advantage; they recommend that the inventory index be substituted for the official inventory data to improve the timing of the index of leading indicators.[§]

Despite this strong support, the NAPM data need improvement in at least three important areas.

Sampling bias

Unlike the surveys underlying official statistics, the purchasing managers' survey does not use a scientific sample. The NAPM data are drawn from hand-picked members of larger, older firms rather than from a probability sample. No attempt is made to account for industry growth through the increase in the number of firms. Furthermore, newer, fast-growing firms are added to the sample only after they have become established in the business, while declining firms remain in the sample until they go out of business. In official statistics, both of these downward biases are eliminated through adjustments and rebenchmarking.

The sampling design has additional problems. The sample is small, comprising less than 1 percent of the association's membership. Because of nonresponses and the entry and exit of members, firms answering the survey questionnaire can vary from sample to sample. No attempt is made to correct for this variation by linking companies that respond in both the current and previous month—a procedure followed in the official statistics. Finally, the data are never revised, implying that errors are never corrected and late responses are never incorporated into the data.

These sampling problems may explain the apparent downward bias in the indexes. Theoretically, when aggregate activity is unchanged, the indexes should read about 50 percent, with equal numbers of firms reporting higher and lower activity. In fact, as Table 1 in the text shows, the break-even values tend to be well below 50 percent. The results for the inventory index are particularly troubling. Not only is the break-even point well below 50 percent, but the index also *averages* only 47.8 percent over the entire postwar period. This finding implies that the level of inventories held by manufacturing firms has had a downward trend. Government statistics, on the other hand, show inflation-adjusted materials and supplies for manufacturers roughly doubling over this period.[‖]

Backward-looking data

An important attribute of the NAPM data—its timeliness—is also one of its biggest shortcomings. Since the results are released just after the end of each month, the questionnaire must be answered in the middle of the month. As a result, when respondents try to compare the "current" month with the "previous" month, they may in fact be comparing their impression of the last few weeks (including part of the previous month) with their recollections of the weeks before that interval. As the table below shows, the timing of the responses means that in some cases the NAPM data are more closely correlated with lagged activity than with current activity.

Subjective responses

Survey respondents may not accurately assess whether conditions are "better" or "worse." Their answers may reflect what should be or what is projected rather than what is. The low average reading for inventories, for

[†]The exception is Feliks Tamm, "An Agenda for Inventories Input to the Leading Composite Index," in Kajal Lahiri and Geoffrey H. Moore, eds., *Leading Economic Indicators*, (Cambridge: Cambridge University Press, 1991), pp. 429-60. Tamm points out a variety of flaws in the NAPM inventory data. Some of his concerns are discussed here.

[‡]John H. Hoagland and Barbara E. Taylor, "Purchasing Business Surveys: Uses and Improvements," *Freedom of Choice: Presentations from the 72nd Annual International Purchasing Conference* (Oradell, N.J.: National Association of Purchasing Management, 1987), p. 1.

[§]Philip A. Klein and Geoffrey H. Moore, "N.A.P.M. Business Survey Data: Their Value as Leading Indicators," *Journal of Purchasing and Materials Management*, Winter 1988, pp. 32-40.

[‖]Comparing the NAPM indexes for employment and output with the official diffusion indexes for manufacturing employment and industrial production confirms this bias. Regression estimates for the 1980-91 period show that the break-even values for both official diffusion series are closer to 50 percent.

Correlation of NAPM Indexes and Manufacturing Data

Official Series	Lead	Contemporary	Lag
Industrial production	.410	.547	.614*
Employment	.569	.682	.720*
New orders	.211	.272	.426*
Materials inventories	.481	.496*	.476

Notes: The sample period is January 1959 to May 1991. The asterisk indicates peak correlation.

Appendix: The Design of the NAPM Data Set *(continued)*

example, may reflect the constant concern about excessive stocks rather than actual inventory management. Wishful responses are particularly likely since the sample is taken before the full results for the month are known, and many of the questions refer to areas of the firm not under the direct purview of the purchasing manager.

The response that economic activity is "the same" is equally problematic. Over time an average of more than half the responses is "the same." For example, from January 1990 to June 1991 the percentage of "same" responses was: new orders (46.5), production (53.9), inventories (53.1), vendor deliveries (82.3), and employment (64.4). Such stability at the firm level seems quite unlikely in an unstable period for the economy as a whole. Apparently, "the same" is a catch-all assessment meaning "don't know" and "no response" as well as "no change."

Improving the data

In a real sense the NAPM data set is an uncut gem. By using modern sampling and statistical techniques, the association could greatly improve the accuracy of the data. A probability sample should replace the hand-picked sample; respondents should be linked from one sample to the next; efforts should be made to reduce the number of "same" responses and to ensure that responses reflect actual activity; and respondents should be encouraged to report on the current month's activity only. In addition, correctly accounting for inventories and adjusting for lags and leads in the components would improve the composite index.[††] Of course, the NAPM data neither could nor should mimic the official statistics: this would require delays in its release and would put an impossible burden on the respondents. The purchasing managers' association has made some efforts to refine the data. Nevertheless, with the index increasingly in the spotlight, further modernization is warranted.

††The inventory index should enter the composite index as a first difference rather than a level since it measures a stock rather than a flow. In a forthcoming paper, Mark Flaherty and the author present an alternative composite index that has an improved track record in predicting industrial production, real GNP, and the index of coincident indicators.

Treasury and Federal Reserve Foreign Exchange Operations

May-July 1991

The dollar rose significantly in June and early July, only to ease back during the next few weeks and end the May-July reporting period with little net change. Over the three months as a whole, the dollar rose about 2 percent against the mark, about 1 percent against the yen, and just under 1 percent on a trade-weighted basis.[1]

Shifting assessments of the strength of economic recovery in the United States were important in stimulating movements of the dollar exchange rate during the period. In addition, political turbulence in Eastern Europe helped support the dollar against the mark through most of the period, while intervention and evidence of international cooperation around the time of the Group of Seven (G-7) summit meeting in July was seen in the market as limiting the prospect of a continuing dollar rise.

The U.S. monetary authorities intervened on two occasions to signal an interest in resisting the rise of the dollar, selling a total of $150 million against marks as part of their cooperation with other central banks. The U.S. monetary authorities also engaged in off-market transactions with foreign monetary authorities, selling $8,548.5 million equivalent of their foreign currency reserves for dollars.

A report presented by Sam Y. Cross, Executive Vice President in charge of the Foreign Group at the Federal Reserve Bank of New York and Manager of Foreign Operations for the System Open Market Account. Vivek Moorthy was primarily responsible for preparation of the report.

[1]The trade-weighted basis is as measured by the Federal Reserve Board index.

The dollar fluctuates without clear direction in May

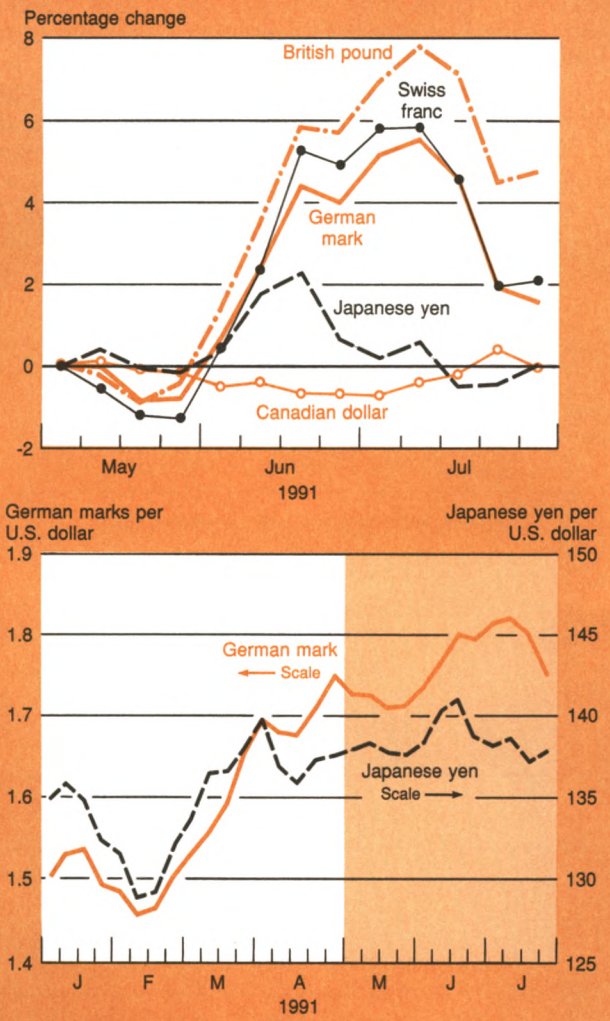
As the period opened, sentiment toward the dollar was favorable but market participants appeared uncertain whether the dollar could extend the sharp rise that it had experienced during the preceding two months. The U.S. discount rate cut of 50 basis points to 5.5 percent on April 30 had been unexpected, and that move generated some downward pressure on dollar rates on May 1. The U.S. employment data for April, released on May 3, were stronger than expected, but on inspection, other details of the report revealed areas of continuing weakness. In that environment, the dollar traded in a narrow range for the first half of May.

Then, late in European trading on Friday, May 17, Sweden's Riksbank announced that it would link the Swedish krona to the ECU, replacing its trade-weighted basket of currencies, in which the dollar carried the largest weight, with a basket composed entirely of European Community currencies. Within a few hours of the announcement the dollar moved up by about four pfennigs against the mark as Swedish and other Scandinavian entities rushed to adjust the currency composition of their liabilities to that of the ECU by purchasing dollars to repay dollar-denominated liabilities. With Swedish interest rates relatively high, Swedish entities had borrowed extensively abroad, partly to finance domestic operations, confident that they were largely shielded from exchange rate risk because the Swedish authorities would limit the movement of the krona's exchange rate relative to the trade-weighted basket to only a couple of percentage points. With the change in the krona's peg, the exchange risk these companies would henceforth face on their dollar liabilities was

perceived to be much higher than before, and they had an incentive to replace dollar-denominated liabilities with those of European currencies more heavily represented in the ECU. With U.S. markets still open after the Swedish announcement, and with the mark relatively widely traded in the U.S. market, the pressures resulting from the May 17 exchange-market operations were concentrated in dollar/mark transactions, resulting in the sharp rise of the dollar against the mark. Under these circumstances, there was some intervention; the U.S. authorities sold $50 million on that Friday. After the weekend, with pressures continuing, there was intervention by a number of foreign central banks. Soon thereafter the markets settled down and the dollar traded in a narrow range for the rest of the month.

Chart 1

After generally rising through June and early July, the dollar eased towards the end of the period.



Notes: The top chart shows the percentage change of the weekly average of daily closing rates from May 1991 through July 1991. The bottom chart shows the weekly average closing rates for the German mark and the Japanese yen from January 1991 through July 1991.

The dollar advances during June and early July

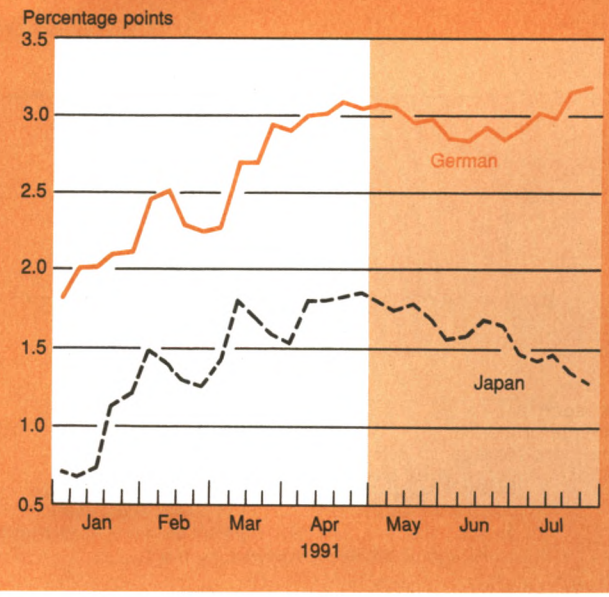
During early June, a slew of U.S. economic indicators were released that were generally much more favorable than expected, and market observers began to talk about the possibility that the U.S. recovery might be more vigorous than previously anticipated. In response, expectations of a further decline in U.S. interest rates faded and the dollar started to rise. In particular, on June 7, when it was reported that May employment rose well above expectations, the dollar rose almost two pfennigs on the day to close at DM 1.7720.

Developments in Germany during June also tended to strengthen the dollar. News of Germany's first trade deficit since 1981, evidence that inflation was higher than previously anticipated—even before the imposition of a consumption tax that would raise all major price indexes for the upcoming months—and what some saw as the reluctance of the Bundesbank to raise official interest rates all weighed on the mark. By late June, the

Chart 2

Three-Month Eurorate Differentials

Foreign Rate minus U.S. Rate



dollar had risen well above DM 1.80 in intraday trading.

With respect to the yen, the dollar showed its greatest strength of the reporting period during the first half of June, breaking above the ¥142 level three times. The dollar-yen exchange rate reflected not only the more buoyant outlook for the U.S. economy but also concerns in Japanese financial markets about possible problems with banking and stock market practices.

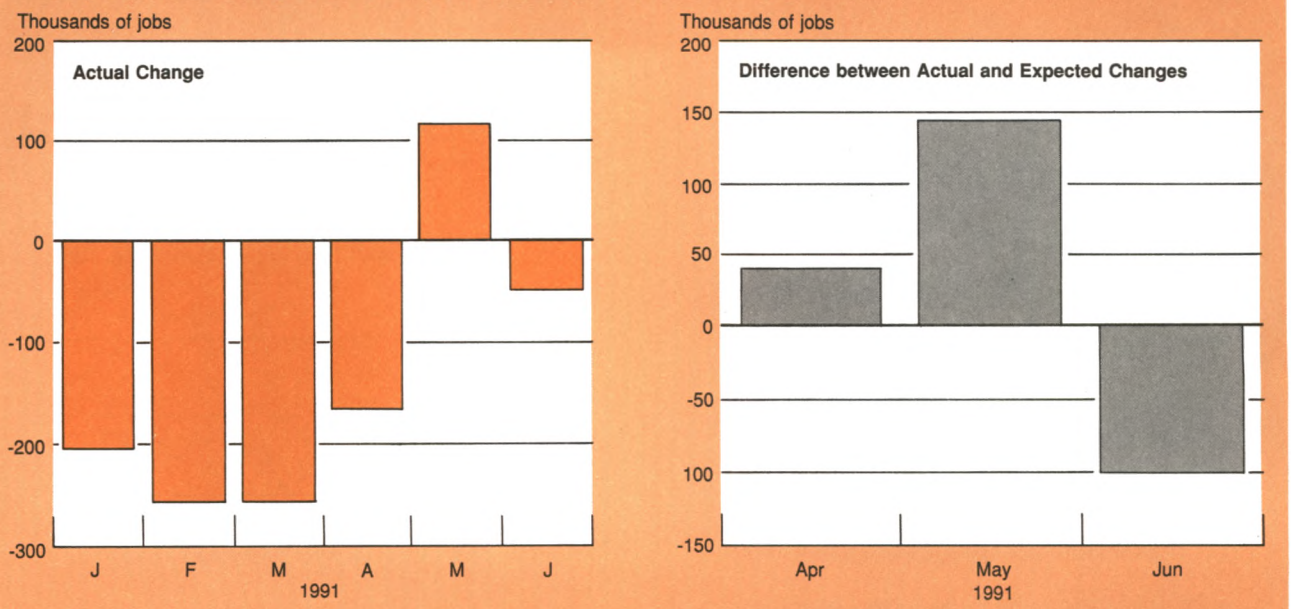
As the dollar moved up to levels not seen for more than a year, market participants became wary of the possibility that some action to curb the dollar's rise might be decided upon at the G-7 meeting of finance ministers and central bankers, scheduled to be held in London on June 23. As a result, the market became less concerned about the upside risk for the dollar, and the currency traded in a narrow range as the meeting approached.

In the event, the G-7 ministers and governors issued a communiqué that "reaffirmed their commitment to cooperate closely, taking account of the need for orderly markets, if necessary through appropriately concerted action in foreign exchange markets." Market participants did not initially construe the G-7 statement as a firm commitment to intervene to resist the dollar's rise. But comments following the meeting by several officials, including Japanese Finance Minister Hashimoto, French Finance Minister Beregevoy and U.S. Treasury Under Secretary Mulford, reinforced the feeling that the possibility of intervention was being actively considered. Rumors about off-market transactions between the Bundesbank and the Federal Reserve, which were later confirmed by the authorities (see below), were also taken as indications that preparations to contain the dollar's rise were underway.

Thereafter, the dollar remained well below its earlier highs against the yen. The release on June 25 of data indicating a larger than expected rise in U.S. durable goods orders for May temporarily supported the dollar against all currencies. But the spreading talk of new financial scandals in Japan was by this time having offsetting effects on the yen. On the one hand, market participants came to expect that the authorities might move more quickly than otherwise to lower interest rates as Japanese share prices continued to decline. In fact, the Bank of Japan announced a one-half percentage point cut in its discount rate, to 5.5 percent, on

Chart 3

Data released during the period first supported the dollar and later led it to ease. The employment report for May was much stronger than anticipated while that for June was much weaker.



Notes: The left panel shows the reported monthly changes in nonfarm payroll employment as of end-July. The right panel shows the actual minus expected monthly changes in payroll employment: the actual changes used in computing these differences are the preliminary numbers for April, May, and June 1991 reported on May 3, June 7, and July 5, 1991, respectively, while the corresponding expected changes are based on surveys of market expectations.

July 1. On the other hand, market participants viewed the adverse impact of the stock market's decline on Japanese banks' capital ratios as increasing the likelihood that major Japanese investors would be repatriating overseas funds to invest in new subordinated debt instruments that these banks would be issuing to shore up their capital positions. These offsetting developments helped to keep the dollar-yen exchange rate relatively steady, trading around ¥138 for the remainder of the three-month reporting period.

The mark, however, came under further selling pressure at the end of June and early July. The dollar initially strengthened against the mark in response to the better than expected U.S. data for May durable goods orders released on June 25. Two days later, when, in response to a controversial German court ruling, German officials reportedly suggested that a withholding tax on investment income might be reinstated, the dollar broke decisively through the DM 1.80 level. The idea that such a tax—very unpopular when it was imposed in 1989 and quickly withdrawn—might again be under consideration had an immediate depressing impact both on the mark and mark-denominated assets. The DAX index of share prices slumped 2.5 percent the following day, and the dollar continued to rise in the following days to reach its high against the mark for the period and the year of DM 1.8427 in European trading on July 5.

Table 1

Federal Reserve Reciprocal Currency Arrangements

In Millions of Dollars

Institution	Amount of Facility July 31, 1991
Austrian National Bank	250
National Bank of Belgium	1,000
Bank of Canada	2,000
National Bank of Denmark	250
Bank of England	3,000
Bank of France	2,000
Deutsche Bundesbank	6,000
Bank of Italy	3,000
Bank of Japan	5,000
Bank of Mexico	700
Netherlands Bank	500
Bank of Norway	250
Bank of Sweden	300
Swiss National Bank	4,000
Bank for International Settlements:	
Dollars against Swiss francs	600
Dollars against other authorized European currencies	1,250
Total	30,100

The dollar gives back most of its gains during the rest of July

Just as the dollar was reaching its highs of the period against the mark, market confidence in the U.S. recovery began to weaken. U.S. economic data released during the month no longer provided unambiguous evidence of economic recovery. The release on July 5 of the employment report for June, in particular, showed an unexpected drop in employment.

Simultaneously, expectations began to grow that the Bundesbank would tighten monetary policy and pursue a more aggressive monetary stance than previously supposed. By then, the release of price figures for several German states that suggested a sharp acceleration in prices for "core" items was seen as giving the Bundesbank more reason for an early policy tightening move. Market participants appeared to be uncertain only about the extent and timing of such a move—whether it would come before or after the succession of Dr. Schlesinger to the Presidency of the Bundesbank at the end of July.

Against this background, the dollar's rise against the mark stalled, and the exchange rate fluctuated without direction just above DM 1.80. However, on July 11, when the Bundesbank did not raise official interest rates at its biweekly meeting and when a sharp drop in U.S. weekly unemployment insurance claims was reported, the dollar jumped back up to almost DM 1.84. Early the next morning, as the dollar continued to move higher, foreign central banks conducted several rounds of intervention, selling dollars against both marks and other currencies. After the New York market opened, the U.S. monetary authorities also participated, selling $100 million against marks. The widespread participation of central banks in the concerted intervention, ahead of the G-7 summit meeting the next week, and the fact that the central banks continued to operate throughout the day suggested to market participants that the central banks were united in their intention to curb the dollar's rise. As a result, the dollar declined by about five pfennigs during the day to close in New York at DM 1.7893. This episode of intervention, together with an increasingly uncertain U.S. economic scenario, set the tone for trading for the rest of the month. The dollar again reached the DM 1.80 level on two occasions the next week in response to strong industrial production data and Chairman Greenspan's statement in his semiannual Humphrey-Hawkins testimony that a recovery was under way, but it failed to move higher.

The communiqué released on July 17 after the G-7 summit meeting reiterated support for close cooperation in foreign exchange markets, monetary and fiscal

policies to foster low real interest rates, and Soviet economic and political transformation. While the communiqué had little immediate impact on exchange rates, it contributed to an atmosphere in which the fear of concerted intervention remained. In that environment, the dollar did not strengthen even when unexpectedly favorable housing starts data were released later that day.

During the rest of July, new U.S data releases brought into question the vigor and even the sustainability of economic recovery. Sentiment also spread among U.S. financial market analysts that a significant decline in U.S. inflation, both actual and prospective, would be reflected in a decline in long bond yields. Moreover, statements by a variety of U.S. officials, including some FOMC members, about the need to respond if M2 growth remained weak revived market expectations that U.S. short rates might still decline. As a result, the dollar fell below DM 1.80 during the third week of July and to levels around DM 1.75 for the rest of the period.

The dollar closed the May-July reporting period about 2 percent higher against the mark and 1 percent higher against the yen. The dollar rose about 5.5 percent against the Swiss franc as expectations grew that the monetary authorities in Switzerland would not follow those in Germany by tightening monetary policy. The dollar eased very slightly against the Canadian dollar as the market came to believe that the Canadian authorities would be more restrained about easing monetary policy than would the U.S. monetary authorities.

* * *

During the reporting period, the U.S. monetary authorities conducted off-market operations directly with foreign monetary authorities to adjust the foreign currency reserve assets of both the Exchange Stabilization Fund (ESF) and the Federal Reserve. The U.S. authorities exchanged $8,548.5 million equivalent of foreign currencies for dollars:

- On June 25, the U.S. authorities purchased a total of $5,548.5 million against German marks from the Deutsche Bundesbank in spot and forward transactions. The U.S. and German authorities agreed that their respective holdings of German marks and dollars were in excess of current needs and that it was to their mutual advantage to reduce those holdings. For each of these transactions, 60 percent of the purchase was to be executed for the account of the Federal Reserve and 40 percent for the account of the ESF. A spot transaction of $2,230.5 million settled on June 27. A forward transaction of $556.2 million settled on July 29. The remaining forward transactions are to be settled during the remainder of the calendar year.
- On July 16, the U.S. authorities purchased a total of $3,000 million against another foreign currency in spot and forward transactions with a foreign monetary authority. The dollars purchased were split equally between the ESF and the Federal Reserve. A spot transaction of $1,000 million settled on July 18. Forward transactions totaling $2,000 million are to be settled during the next quarterly reporting period.

In addition, in July, the ESF sold a total of $130.2 million equivalent of marks against SDRs. The ESF also purchased a total of $230.4 million against sales of SDRs in transactions with foreign monetary authorities in need of SDRs either for payment of IMF charges or for repurchases. Both the sales and purchases of SDRs were arranged by the IMF.

Primarily because of its acquisition of dollars in the foreign currency exchanges and SDR transactions described above, the ESF was able, after the end of the reporting period, to repurchase $2,500 million equivalent of foreign currency warehoused with the Federal Reserve. These repurchases reduced the amount of ESF foreign currency balances warehoused with the Federal Reserve from $4,500 million equivalent to $2,000 million equivalent as of the end of August.

During the May-July period, the Federal Reserve realized profits of $147.5 million from the off-market foreign currency exchanges described above. The Treasury realized profits of $60.3 million, of which $18.8 million was from the off-market foreign currency and SDR exchanges and $41.5 million was from the renewal of certain warehousing operations.

The Federal Reserve and the ESF regularly invest

Table 2

Net Profits (+) or Losses (−) on United States Treasury and Federal Reserve Foreign Exchange Operations

In Millions of Dollars

	Federal Reserve	U.S. Treasury Exchange Stabilization Fund
Valuation profits and losses on outstanding assets and liabilities as of April 30, 1991	+2,316.3	+570.6
Realized April 30, 1991 to July 31, 1991	+147.5	+ 60.3
Valuation profits and losses on outstanding assets and liabilities as of July 31, 1991	+1,919.9	+321.4

Note: Data are on a value-date basis.

their foreign currency balances in a variety of instruments that yield market-related rates of return and that have a high degree of quality and liquidity. A portion of the balances are invested in securities issued by foreign governments. As of the end of July, holdings of such securities by the Federal Reserve amounted to $7,807.7 million equivalent, and holdings by the Treasury amounted to the equivalent of $7,540.2 million valued at end-of-period exchange rates.

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