Interest rate shocks and the dollar

Charles L. Evans

From February through June 1994, the dollar depreciated 9.9 percent against the German mark and 10.2 percent against the Japanese yen. This depreciation has occurred during a period when (1) the Federal Open Market Committee (FOMC) announced a tightening of reserve positions on four occasions, which resulted in an increase in the federal funds rate of 125 basis points; (2) the Bundesbank lowered its discount and Lombard rates by 50 basis points in May; and (3) the prime minister of Japan resigned. Instead of the yen weakening, the dollar hit a then postwar low against the yen at the end of June.

Episodes like this are harsh reminders that exchange rate movements are virtually impossible to forecast over short horizons. Since the mid-1980s, international economists have often reminded us that sophisticated models for forecasting exchange rate fluctuations cannot outguess a simple forecast of *no change*. Meese and Rogoff (1983), for example, argued this point exhaustively for forecasting horizons under two years.

However, there is increasing evidence that exchange rate movements are in fact predictable at longer horizons. Eichenbaum and Evans (1992) find evidence that unexpected increases in the federal funds rate lead to an eventual appreciation of the dollar against the German mark, French franc, Italian lira, Japanese yen, and British pound, but it often takes over two years for this effect to take noticeable hold.[1] Indeed, Evans (1994) finds that a large part of the dollar's recent depreciation against the mark and the yen may be due to the unusually low federal funds rate during the period following the recent U.S. recession—over two years ago. Similarly, Mark (1993) finds that changes in exchange rates over a four-year period have a predictable component, but not for time periods shorter than this. Specifically, taking account of relative monetary policies and the state of real income in Germany and the United States helps predict four-year movements in the German mark against the dollar.

This article examines the relationship between shocks to short-term interest rates in the United States, Germany, and Japan and movements in the yen/dollar and mark/dollar exchange rates since 1979. The evidence indicates that much of the dollar's recent depreciation against the yen is consistent with the behavior of the U.S. federal funds rate and short-term interest rates in Japan since 1991.

A random walk through the currency markets?

Since the Bretton Woods era ended in 1973, most major currencies have floated against the U.S. dollar. One rationale behind this change was that it would allow countries to pursue alternative monetary policies independent of U.S. policies. Countries that pursue higher inflation rate policies will simply allow their currencies to depreciate against the currencies of countries with lower inflation. Con-

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sequently, knowing a country's monetary policy, the state of its real economy, relative inflation, and interest rate differential should help one forecast future movements in the exchange rate between its currency and the dollar.

An influential study by economists Richard Meese and Kenneth Rogoff (1983) concluded that sophisticated models of exchange rate determination make poor forecasts. In fact, the forecasts produced by these models were not consistently better than the simple random walk forecast of *no change*. Meese and Rogoff's findings are especially sobering today. Imagine trying to forecast the future path of the dollar following Chairman Greenspan's February 4 announcement that the FOMC had decided to increase slightly the degree of pressure on reserve positions. From that date through June, the federal funds rate has increased by 125 basis points, so it would have been tempting to forecast a dollar appreciation—and even more tempting with the additional knowledge that the Bundesbank would lower its discount and Lombard rates in May. Yet over this period, the dollar has depreciated from 1.752 to 1.58 German marks and from 109.0 to 98.6 yen.

In this period, forecasting *no change* would have been more accurate than forecasting an appreciation of the dollar. Apparently, over relatively short forecasting horizons such as these, exchange rate fluctuations are largely composed of random movements that can push the dollar up or down, in spite of the current state of monetary policies or the real conditions of the relevant countries' economies.

Recent evidence on U.S. monetary policy shocks and the dollar

In contrast to the above literature focusing on short-run exchange rate forecasts, recent studies have found a stronger, more predictable relationship between monetary policy actions and movements in exchange rates at longer horizons. Eichenbaum and Evans (1992) investigated monthly movements in bilateral exchange rates between the U.S. and Japan, Germany, France, Italy, and the United Kingdom. The analysis focused on the post-Bretton Woods era (1974 to 1990), when these countries' currencies floated against the dollar. A controversial aspect of this research is the necessity of characterizing U.S. and foreign monetary policy actions. We addressed this concern by considering several measures of U.S. monetary policy variables: exogenous shocks either to the federal funds rate or to the ratio of nonborrowed reserves to total reserves, and movements in the Romer and Romer index of monetary policy contractions.[2] A robust finding across these monetary policy measures was that an expansionary U.S. monetary policy shock leads to a reduction in short-term U.S. interest rates and a statistically significant depreciation of the dollar against these five major currencies. This depreciation, however, occurs slowly over the course of two to three years, and the maximum impact is estimated to take effect after two years. An implication of these estimates is that predictions of movements in the dollar based upon perceived shifts in U.S. monetary policy are likely to be reliable only at long forecast horizons.

Clarida and Gali (1994) identified monetary policy shocks in an alternative way. Using a structural vector autoregression (VAR) modeling strategy and quarterly data, these economists econometrically identified monetary policy shocks by assuming that they have no long-run effects on real variables. This is an appealing assumption to most economists who believe that the long-run Phillips curve is vertical and that the natural rate of unemployment is unaffected by monetary policy.[3] Like Eichenbaum and Evans, Clarida and Gali found that expansionary U.S. monetary policy actions led to a depreciation of the dollar against most major currencies. Because the latter's model considered only a small number of variables, their measures of monetary policy could be capturing additional nonmonetary shocks that have only transitory effects on real variables.[4] Nevertheless, using two alternative identification strategies, the Clarida-Gali and Eichenbaum-Evans results produced a similar picture of the effects of monetary policy shocks on the dollar.

Analyzing monthly data, Eichenbaum and Evans were able to control for a variety of nonmonetary variables that are likely to affect monetary policy and exchange rates. These control variables are not generally available in weekly data. Nevertheless, in weekly data covering 1985-90, Lewis (1993) found complementary evidence that the dollar depreciates against the mark following reductions in the federal funds rate, increases in M1, or increases in nonborrowed reserves. This indicates that the effects of monetary policy on exchange rates are robust across different time periods.

Germany and Japan, 1979-94

To investigate these relationships further for Germany and Japan, I considered a three-variable VAR for each country. For Japan the data are the yen/dollar exchange rate (expressed in yen per dollar), the federal funds rate, and a two-day call money rate in Japan. I used analogous data for Germany. The data are weekly, covering the period March 2, 1979, through June 24, 1994. All observations are from Friday of the given week unless one market was closed on that day, in which case the observations are from Thursday. I transformed the data so that the three variables in the VAR are:

1) the federal funds rate (FF);

2) the difference between the foreign interest rate and the federal funds rate (RGER-FF and RJAP-FF, respectively, at annualized percentage rates); and

3) 100 times the logarithm of the exchange rate (mark/dollar and yen/dollar, respectively).

Each equation in the VAR contains 26 weekly lags of the three variables plus a constant.

Three shocks are identified as transformations of the three error terms in the VAR, one from each autoregression. A positive shock to the federal funds rate (FF shock) is defined as an unforecast increase in the federal funds rate that induces contemporaneous movements in the foreign interest rate and the exchange rate. Under certain sets of assumptions, a shock such as this can be interpreted as contractionary U.S. monetary policy. Specifically, suppose that the federal funds rate were the instrument of monetary policy. The Federal Reserve considers myriad types of data before deciding on the final setting of this policy instrument. To the extent that the Fed's policy setting deviates from the value dictated by this information set and the reaction function, a positive deviation of the federal funds rate can be interpreted as a contractionary U.S. monetary policy shock. The weekly data in the three-variable VARs do not contain as much information as the data employed in the Fed's reaction function. However, to the extent that much of the important variation in the economy's fundamentals is captured by variation in these three variables, the measured FF shock may have many of the same attributes as a U.S. monetary policy shock.[5]

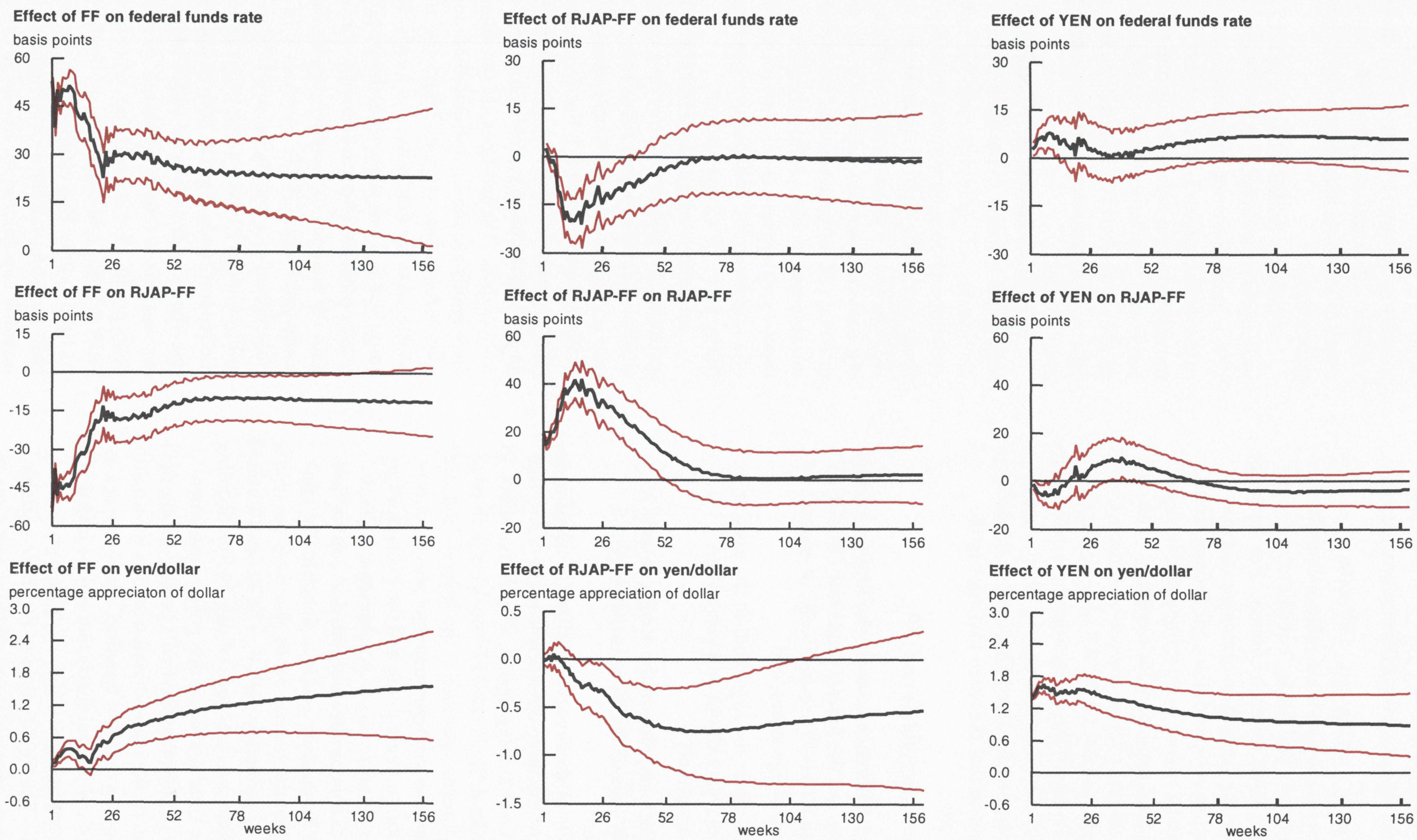
A positive RGER-FF (or RJAP-FF) shock is an unforecast increase in RGER-FF (RJAP-FF); it induces a contemporaneous movement in the exchange rate but no contemporaneous movement in the federal funds rate (by assumption). Under a similar set of assumptions as above, the RGER-FF shock can be interpreted as a contractionary German monetary policy shock.

A positive MARK (or YEN) shock is an unforecast increase in the mark/dollar exchange rate (or yen/dollar rate) that induces no contemporaneous movement in the federal funds rate or the German interest rate spread (RGER-FF).[6] This is a catch-all shock, capturing contemporaneous variation in the exchange rate that cannot be accounted for by the two interest rate shocks. A few possible causes of these exchange rate shocks are increasing fears of a trade war, the collapse of a government's ruling party, or a coup attempt.

An interesting question that these VAR estimates can address is, how do average-size shocks affect the federal funds rate, the German and Japanese interest rate spreads, and the exchange rate over time? For Japan, figure 1 plots the estimated effects of the three shocks on each of the three variables for three years of weekly data. The red lines are one-standard-error bands around the estimated impulse response functions.[7] Figure 2 plots the analogous effects for Germany. As Lewis' (1993) empirical analysis suggested, the weekly data results presented here are broadly consistent with the analysis of monthly data by Eichenbaum and Evans (1992). A positive FF shock (interpreted as a contractionary U.S. monetary policy shock) leads to a persistent increase in the federal funds rate. In both cases, the initial one-standard-deviation FF shock induces an increase in the federal funds rate of about 50 basis points. Since many movements in the federal funds rate over time are on the order of 25 basis points, this estimate may be somewhat high for a one-standard-deviation shock. A possible explanation for this large estimate is that the sample period is dominated by the

FIGURE 1

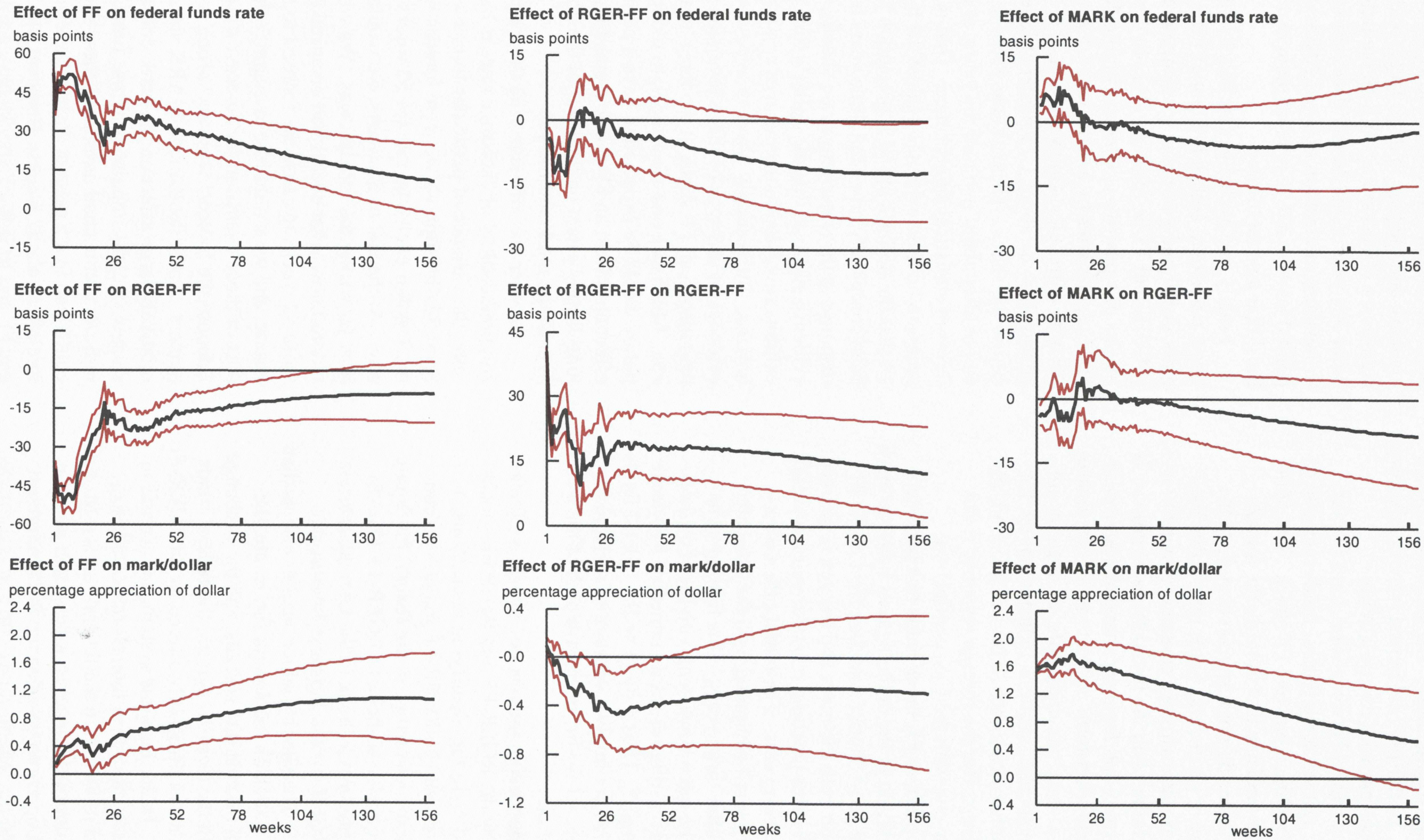
Effects of FF, RJAP-FF, and YEN shocks



Note: Impulse response functions estimated from three-variable vector autoregression of federal funds rate, Japanese call money rate, and yen/dollar exchange rate. Data cover March 1979 through June 1994. The red lines represent one-standard-error bands.

FIGURE 2

Effects of FF, RGER-FF, and MARK shocks



Note: Impulse response functions estimated from three-variable vector autoregression of federal funds rate, German call money rate, and mark/dollar exchange rate. Data cover March 1979 through June 1994. The red lines represent one-standard-error bands.

years 1979 to 1984, when interest rate movements were quite large. The smaller estimated effects for the 1987-94 period (reported below) are consistent with this possibility.

The spread between short-term foreign interest rates and the federal funds rate is negative following a positive FF shock. The point estimates indicate that initially the foreign interest rates do not respond strongly to the increase in the federal funds rate. After about one year, the estimated spread is about 15 basis points rather than the initial 50 basis points. If the German and Japanese monetary authorities use these short-term interest rates as the instruments of their monetary policies, then the impulse response functions indicate that the foreign authorities tighten a bit following a U.S. tightening. But the foreign response is not one-for-one with the U.S. contraction.

A positive FF shock leads to a persistent appreciation of the dollar against both the mark and the yen.[8] Notice that the effect of the FF shock on both the mark and the yen is delayed, in both cases reaching its maximal effect after at least two years. The initial effect is extremely small compared with the estimated effect after three years. This finding turns out to be quite consistent with the short-horizon forecasting results documented by Meese and Rogoff. Thus a shock to the federal funds rate does not imply a substantial revision to the forecast for the near-term path of the exchange rate.

The foreign interest rate shocks are measured by the RGER-FF and RJAP-FF shocks. According to the identifying restrictions, a positive shock to RGER-FF induces no contemporaneous change in the federal funds rate. Consequently, a shock to RGER-FF (RJAP-FF) represents a shock to the German interest rate, RGER (or the Japanese interest rate, RJAP). The shocks induce smaller effects than the FF shock on the federal funds rate, the foreign interest rate spreads, and the exchange rate. In the German system, the federal funds rate is not significantly altered by an RGER-FF shock. In the Japanese system, an increase in Japanese short-term interest rates leads to a modest reduction in the federal funds rate. For both countries, however, a persistent positive spread opens up between the foreign interest rate and the federal funds rate that is estimated to be about twice as large for Japan as for Germany after six months. Interestingly, the dollar is estimated to depreciate against both the mark and the yen, but the larger and more significant effects are again with the latter. After one year, a one-standard-deviation shock to Japanese interest rates (about 20 basis points) leads to a 0.75 percent depreciation of the dollar against the yen.

Finally, the exchange rate shocks have a large, persistent, and significant effect on the mark/dollar and yen/dollar exchange rates (MARK and YEN, respectively). In the early phases of a positive exchange rate shock, the dollar appreciates by a little over 1.5 percent for both currencies. One year later, the dollar continues to be about 1.25 percent higher than before the shock. These shocks seem to dampen out after about two to three years, at least in terms of statistical significance. That is, there seems to be little evidence against the hypothesis that the dollar's initial appreciation has been completely unwound three years later. In response to these exchange rate shocks, the evidence suggests that the dollar's time path exhibits reversion to the mean over a long horizon. Interestingly, there is somewhat less evidence of this type of mean reversion in response to an FF shock at the three-year horizon. Much as a one-time shock to monetary policy would be expected to have a permanent effect on prices, an FF shock seems to have a long-lasting effect on the level of the dollar against the mark and the yen.

Another way of measuring the long-horizon predicability of exchange rates is by examining the variance of particular forecast errors. Specifically, suppose we were forecasting the mark/dollar exchange rate for 52 weeks from now. At the end of 52 weeks, we would know how far wrong the forecast was. We would like to know what events had occurred during those 52 weeks to cause the forecast to be wrong, and we would like to quantify the impact of those events on the forecast's error. Suppose the forecast was very wrong, say by 5 percent. Since the average MARK shock has a relatively large effect on the mark/dollar exchange rate, the impulse response functions indicate that a small number of these shocks could lead to a 5 percent shift in the exchange rate after only 52 weeks. However, the average FF and RGER-FF shocks have a smaller impact effect on the mark/dollar; so a larger (and less probable) number of these shocks would be required for this to happen. Consequently, at short horizons, we would expect most of the forecast error variance to be explained by exchange rate shocks. At longer horizons, however, the FF shocks are likely to have more explanatory power. The effect of the FF shocks is delayed and builds over time, while the exchange rate shocks dampen.

Table 1 reports this decomposition of forecast error variances for Germany and Japan. Two observations are in order. First, at extremely short forecast horizons, virtually all of the forecast errors are due to the realization of exchange rate shocks. Since these shocks are not easily or readily identified with real-world events, this large percentage demonstrates our inability to explain exchange rate movements. This finding is consistent with Meese and Rogoff's finding that sophisticated models of exchange rate determination cannot outperform a random walk forecast at short horizons. Second, at longer horizons the explanatory power of these exchange rate shocks is smaller. This seems to be due to the mean reversion in these unknown shocks. This is an indication as to why long-horizon movements in exchange rates have a forecastable component.

TABLE 1

Percentage of yen/dollar forecast error variance explained by:

Forecast horizon	FF shocks	RJAP-FF shocks	YEN shocks
1 week	0.8	0.0	99.2
6 weeks	2.5	0.0	97.5
13 weeks	3.3	0.3	96.4
26 weeks	4.9	1.8	93.3
1 year	16.2	7.2	76.6
2 years	33.1	11.7	55.2
3 years	45.4	10.6	44.0

Percentage of mark/dollar forecast error variance explained by:

Forecast horizon	FF shocks	RGER-FF shocks	MARK shocks
1 week	1.0	0.4	98.6
6 weeks	2.8	0.1	97.1
13 weeks	5.0	1.0	94.0
26 weeks	5.1	2.4	92.5
1 year	9.7	4.3	86.0
2 years	21.0	4.2	74.8
3 years	33.2	4.0	62.8

Note: FF shocks represent an unforecasted movement in the federal funds rate. RJAP-FF shocks (RGER-FF shocks) represent an unforecasted movement in the foreign interest rate spread. YEN shocks (MARK shocks) represent an unforecasted movement in the exchange rate.

Historical decomposition of exchange rates, 1979-94

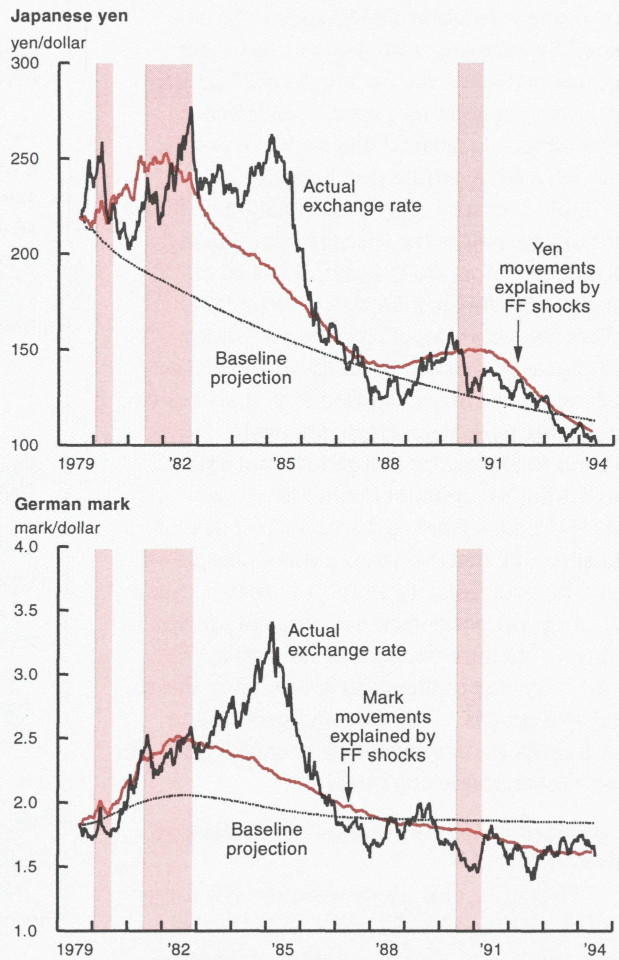
The statistical analysis assumes that variations in YEN and MARK are due to the three shocks discussed above. An interesting question that this statistical model can address is, how much of the dollar's depreciation against the yen since 1991 is due to shocks to the federal funds rate? A historical decomposition can provide an answer.

The VAR estimates imply that the exchange rate can be expressed as a moving average of current and past FF shocks, foreign interest rate shocks, and exchange rate shocks, plus a constant term. How much of the exchange rate's fluctuations over a particular time period are accounted for by the FF shock? One way to answer this question is simply to assume that the historical values of the foreign interest rate and exchange rate shocks are identical to zero for each time period, and then to plot the fitted exchange rate autoregression using the FF shocks as the only nonzero explanatory variables. If all of the variation in exchange rates were accounted for by the FF shocks, the fitted values would be identical to the actual exchange rate series. If the FF shocks were statistically independent of the exchange rate, and consequently explained none of its fluctuations, then the fitted values would be a smooth path relative to the volatile exchange rate path. Obviously, this analysis can be done for each of the shocks. The three resulting paths for the exchange rate represent a historical decomposition of the exchange rate fluctuations that are explained by the FF, foreign interest rate, and exchange rate shocks.

Initial conditions at the beginning of the data present an additional difficulty to any interpretation. For example, imagine that for some unexplained reason, the dollar were overvalued at the beginning of the sample period, say March 1979. If no other shocks were to hit these economies, then the dollar would be expected eventually to depreciate to eliminate the overvaluation. Depending on the reasons for the overvalued dollar and the structures of the U.S. and foreign economies, this transition might take two weeks, two years, or two decades. In the historical decompositions, no matter which path the FF shocks take over the period 1979-94, the effects of this depreciation will be superimposed on the path explained by the FF shocks. To continue with a hypothetical example, suppose that the initial realizations of the FF shocks implied that U.S. monetary policy shocks were extremely contractionary. Monetary theories of exchange rate determination predict that the dollar should appreciate relative to currencies with more expansionary monetary policies. Since the underlying tendency for the dollar in this example was to depreciate prior to the FF shock realizations, the actual path of the exchange rate will depend on the relative strengths of these two competing effects.

FIGURE 3

Exchange rate movements explained by FF shocks



Notes: Calculations based on three-variable vector autoregression.
Shaded areas indicate recessions.

Figure 3 displays the weekly time paths of YEN and MARK from March 1979 through June 1994. The line labeled baseline projection in each panel displays the effects of the initial conditions on the projected exchange rate path. For the mark, initial conditions in 1979 projected the dollar would appreciate from around 1.80 marks to above 2 marks in 1982, then settle down to an average level of about 1.85 marks by the end of the sample period in 1994. Essentially, the VAR is estimating MARK to be a stationary process with a well-defined mean value of about 1.85 marks.

For the yen, on the other hand, initial conditions project a continual depreciation of the dollar from 1979 through 1994. This phenomenon seems to be due less to the initial conditions in 1979 and more to the nonstationary behavior of YEN over this sample period. From 1979 through 1985, the dollar traded between 200 and 280 yen; from 1988 through June 1994, the dollar was between 100 and 160 yen. The VAR estimates indicate that YEN has no well-defined mean over the longer sample period. Apparently, the estimates are fitting a unit root with negative drift; this means that the fitted values for YEN will trend downward in the absence of any shocks. It also implies that the end points of the projected path will fit the data's end points very closely, irrespective of the paths of monetary policy.

Figures 3, 4, and 5 display the projected path of the exchange rate that is due to realizations of the FF shock, the foreign interest rate shock (RJAP-FF and RGER-FF), and the exchange rate shock (YEN and MARK shocks), respectively. Recall from the impulse response functions in figures 1 and 2 that the FF shocks accounted for mainly long-horizon movements in the dollar, specifically, the one to three-year horizons. Figure 3 indicates that for both the yen and mark, FF shocks account for long, slow movements in the exchange rate. Relative to the projected path from the initial conditions, the FF shocks account for higher levels of the dollar over the period 1980-85. One interpretation of this path is that contractionary monetary policy shocks led the dollar to appreciate through 1982, and the subsequent depreciation represents either a reversion to the mean for the mark or a resumption of the negative drift for the yen.

In figure 4, the foreign interest rate shocks account for relatively small deviations of the exchange rate from the initial projected path. For the yen, RJAP-FF shocks do account for part of the dollar's depreciation from the peak of the last business cycle in 1990 through 1992, but their total explanatory power remains small over the full sample period. The RGER-FF shock has virtually no explanatory power for the mark.

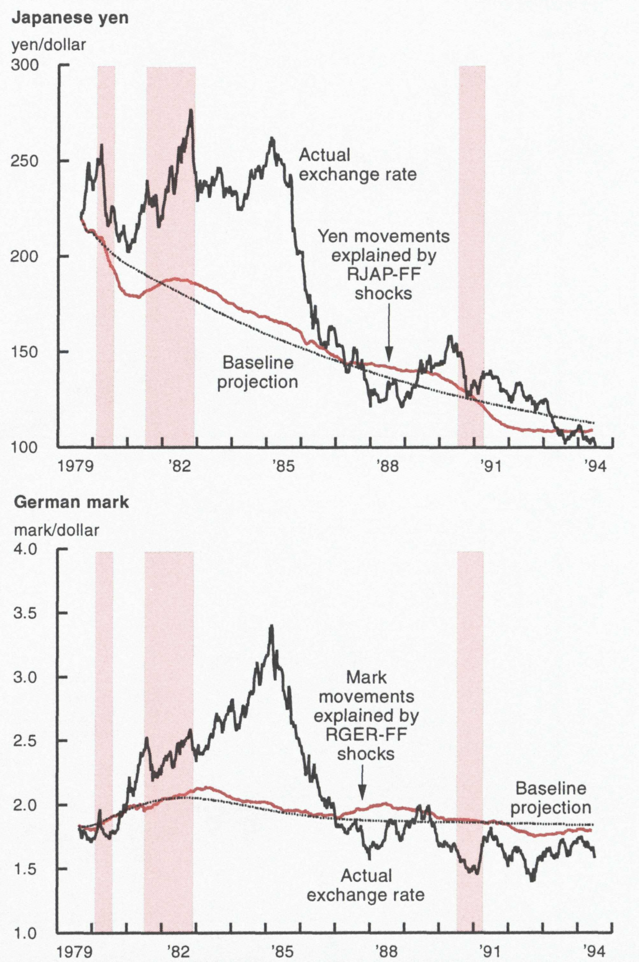
As the impulse response functions indicated, most of the short-term variation in these two exchange rates is due to the unexplained YEN and MARK shocks, and this is evident in figure 5. Specifically, the projected path from these shocks reflects the jaggedness of the actual exchange rates. This occurs even though the overall level of the exchange rate is not well captured by the shocks, especially for the yen. For example, from 1980 through 1985, the average value of the dollar was around 240 yen, but the YEN shocks projected it to be around 180 yen.

Two conclusions seem to follow. First, accurately forecasting exchange rate movements over short time horizons (under one year) requires knowledge and an understanding of unexplained YEN and MARK shocks. Considering the persistence of these shocks, as displayed in the impulse response functions, it is not surprising that a random walk forecast of exchange rate movements does reasonably well by comparison. That is, after a YEN shock, YEN does not change much for 12 months, so forecasting *no change* will not be far wrong. Second, FF shocks seem to explain longer-run movements in exchange rates. The information content in short-term interest rates is more likely to improve exchange rate forecasts at the two-year horizon and beyond.

One caveat in the analysis of Japan is the estimated negative drift in YEN over the entire 1979-94 period. This drift term implies that the out-of-sample forecasts will be for the dollar to continue depreciating indefinitely, but that seems implausible despite the recent depreciation. The likely source of this nonstationarity is the behavior of YEN in 1985 and 1986. From 1987 to the present, this exchange

FIGURE 4

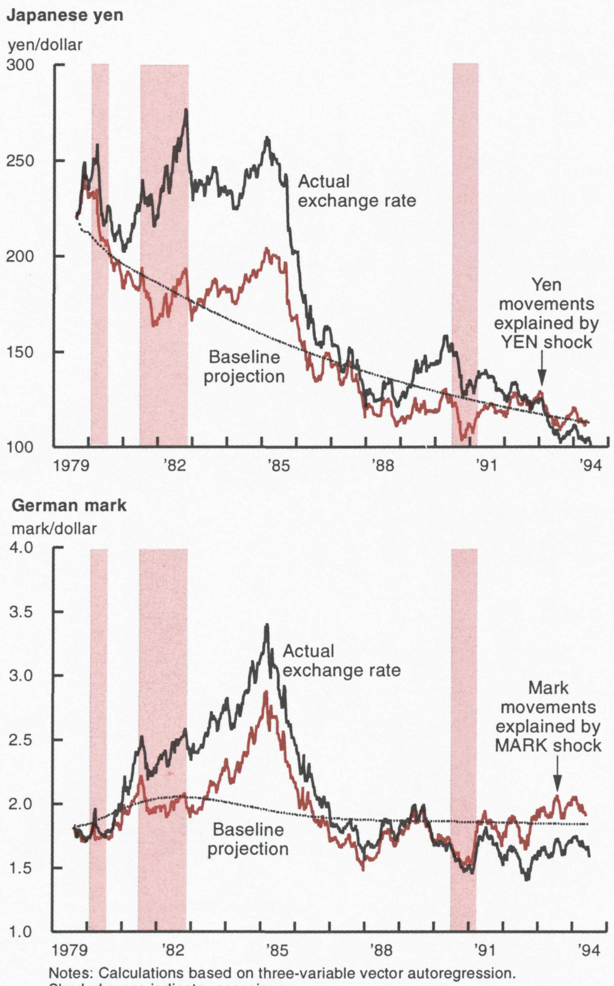
Exchange rate movements explained by RJAP-FF and RGER-FF shocks



Notes: Calculations based on three-variable vector autoregression. Shaded areas indicate recessions.

FIGURE 5

Exchange rate movements explained by YEN and MARK shocks



Notes: Calculations based on three-variable vector autoregression.
Shaded areas indicate recessions.

rate has traded in a narrower band. So it is an interesting robustness check to see how the exchange rate analysis changes for this period.

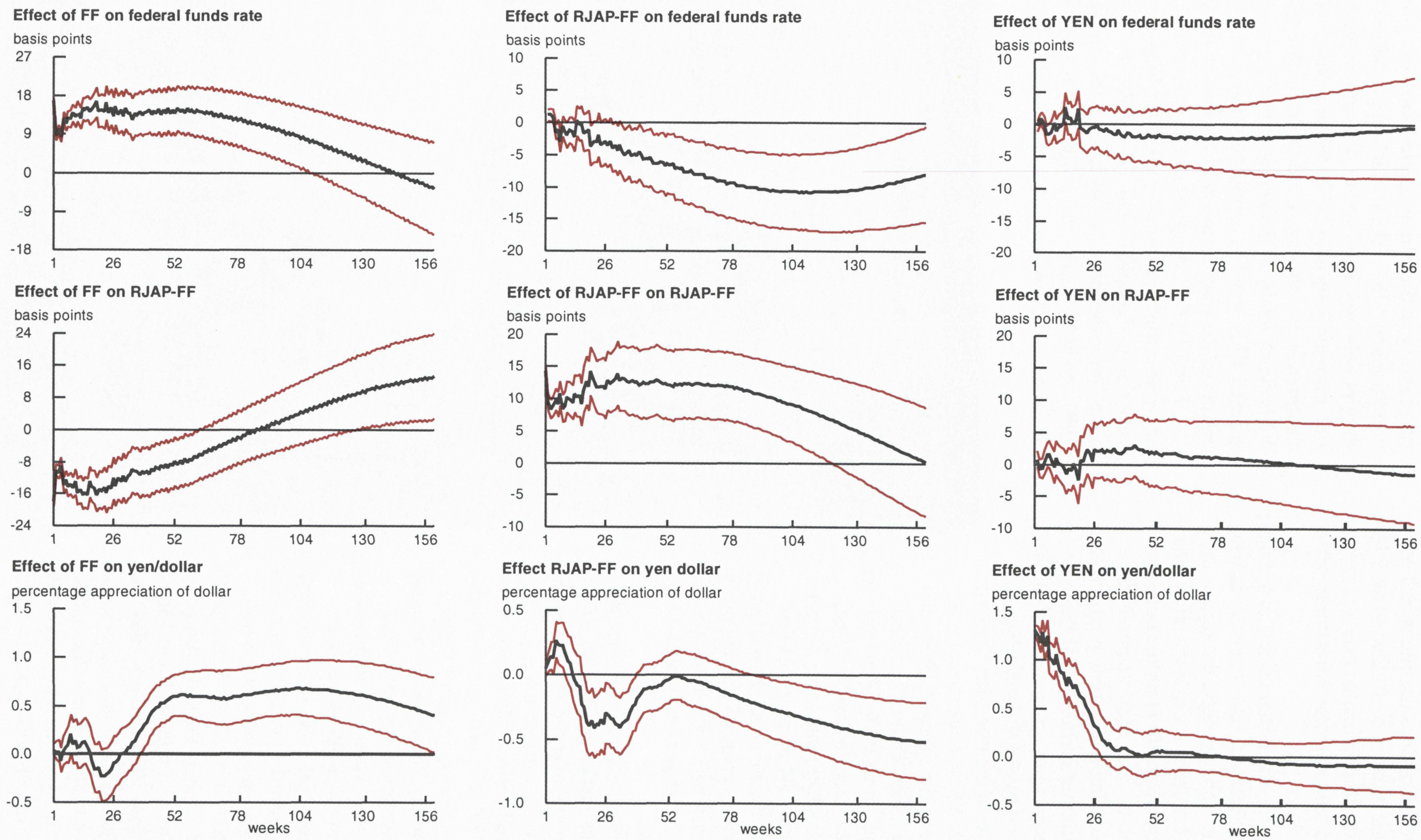
Japan, 1987-94

Figure 6 displays estimated impulse response functions for Japan from a VAR based on weekly data from July 1987 through June 1994. While the qualitative effects are similar, there are some interesting differences between these responses and their full-sample counterparts in figure 1. First, because the period 1979 to 1984 was excluded, average changes in the federal funds rate were smaller. Consequently, the estimated one-standard-deviation FF shock is smaller, about 18 basis points versus 50 basis points for the 1979-94 period. This means that a 25-basis-point FF scale was less likely in the 1987-94 period than in the 1979-94 period. However, the effect of this shock on the federal funds rate is more persistent over the first year. Second, the initial effect of the 18-basis-point FF shock on the dollar is small and uncertain for the first nine months; that is, the standard errors are large relative to the estimated effect. Over the second year, however, the dollar has appreciated on the order of 0.5 percent. Taking into account the smaller size of the FF shock over the 1987-94 period, a 50-basis-point shock is estimated to translate into an approximately 1.5 percent appreciation of the dollar in the second year; this is comparable to the estimates reported in figure 1 for the 1979-94 period.

Third, the RJAP-FF shock is estimated to have a more delayed effect on the federal funds rate and the dollar. At the end of the second year, an initial 15-basis-point increase in the short-term Japanese interest rate is estimated to reduce the federal funds rate by about 10 basis points. Since the spread RJAP-FF is estimated to be less than 10 basis points at this time, the Japanese interest rate has declined on net from its initial increase. The statistical analysis here is too simple to allow an evaluation of the underlying causes of these interest rate changes, but the results are suggestive. For instance, the response pattern could be consistent with a monetary contraction in Japan that reduces economic activity in both Japan and the United States; the U.S. monetary response might be to reduce U.S. short-term interest rates somewhat to accommodate the reduction in activity. To assess that possibility would require a statistical analysis that examines economic activity simultaneously with interest rate shocks. Another possibility is that the RJAP-FF shock represents an attempt by Japanese monetary authorities to

FIGURE 6

Effects of FF, RJAP-FF, and YEN shocks



Note: Impulse response functions estimated from three-variable vector autoregression of federal funds rate, Japanese call money rate, and yen/dollar exchange rate. Data cover June 1987 through June 1994. Red lines represent one-standard-error bands.

reduce the value of the dollar, and these efforts are accommodated by the U.S. In fact, the dollar does decline by 0.5 percent after three years following an RJAP-FF shock; this estimated effect is more delayed than over the full-sample period (figure 1).

Fourth, the initial effects of the unexplained exchange rate shock continue to be large. Interestingly, the shocks only persist for about six months, after which their estimated effect on the dollar is about zero. This reduced persistence relative to the full-sample period means that a smaller percentage of the long-horizon forecast error variance can be explained by YEN shock. For example, at the two-year forecast horizon, YEN shock explains 42 percent of the forecast error variance in YEN versus 55 percent over the entire 1979-94 period. At the three-year forecast horizon, YEN shock explains only 27 percent versus 44 percent. At this horizon, the FF shock now explains 54 percent versus 45 percent previously, and RJAP-FF shock accounts for 19 percent versus 11 percent.

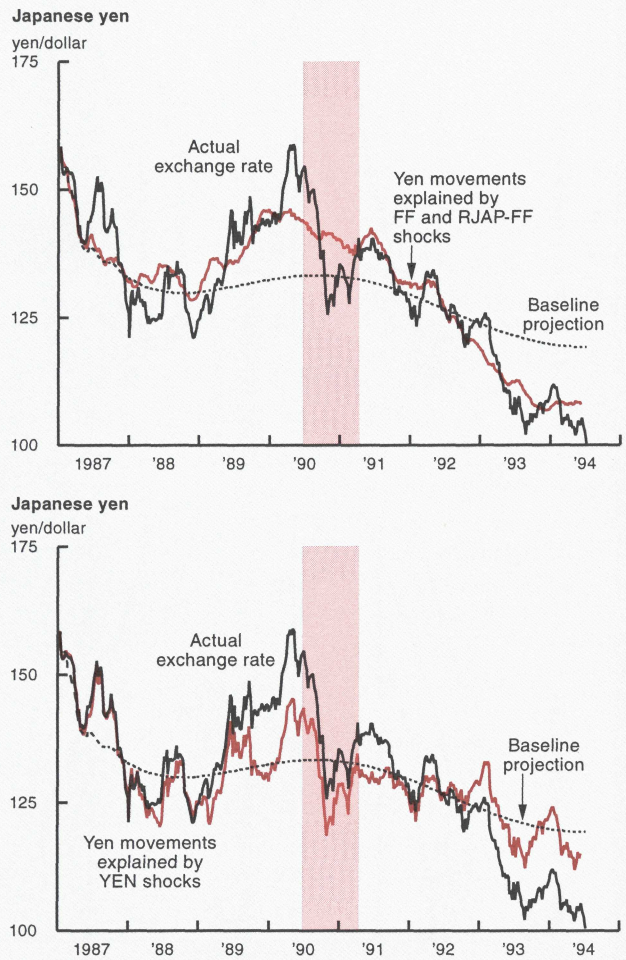
Finally, figure 7 displays the historical decomposition of YEN movements over the 1987-94 period from the estimated VAR. The projected paths explained by the FF and RJAP shocks have been combined in the top panel of figure 7. Individually, these shocks account for a substantial portion of the YEN movements; combining these explanations leads to a clearer depiction of the role of interest rate shocks over the period. Notice that the projected path from the initial conditions in 1987 oscillates gently around a better-defined average value in the range of 120 to 130 yen. From 1987 through 1988, the unexplained YEN shock accounts for most of the dollar's fluctuations against the yen; in other words, the interest rate shocks explain virtually none of these movements.

Beginning in 1989, the FF and RJAP-FF shocks account for a substantial part of the dollar's appreciation relative to the path projected from the initial conditions in 1987. The dollar's appreciation beginning in February 1990 and its subsequent depreciation through September 1990 are not explained by the interest rate shocks. Credit this volatile period to YEN shock again, and note again that the unexplained YEN shock is capturing some portion of the effects of the Iraqi invasion of Kuwait on the dollar.

From 1991 to the present, the interest rate shocks account for virtually all of the long-horizon variation in the dollar. The FF and RJAP-FF shocks account for the initial dollar level in the spring of 1991. In March 1991, the dollar was at 134.55 yen and the interest rate shocks accounted for a level of

FIGURE 7

Exchange rate movements explained by interest rate and YEN shocks



Notes: Calculations based on three-variable vector autoregression.
Data cover January 1987 through June 1994. Shaded area indicates recession.

138.34. By the end of May 1994, the dollar was at 104.3 yen and the interest rate shocks projected a level of 108.0. This implies that the dollar's 25 percent decline during this period is consistent with the interest rate shocks that occurred in the United States and Japan during the most recent recesssion and the subsequent recovery. Of course, there have been many large short-term swings in the exchange rate that are not explained by the interest rate shocks; these are accounted for by the YEN shock.

Conclusion

The dollar's recent depreciation against both the mark and the yen has been dramatic. Accurately forecasting short-term changes in exchange rates is a nearly impossible task. However, at longer forecast horizons, the evidence indicates that the stance of monetary policy, as measured by unexpected movements in short-term interest rates, affects the dollar significantly. The vector autoregression analysis indicates that interest rate shocks account for a substantial part of the dollar's depreciation against the yen from 1991 through June 1994. Apparently, the relatively low federal funds rate over this period has contributed to the dollar's decline. The statistical analysis implies that the recent 125-basis-point increase in the federal funds rate should ultimately lead to a stronger dollar, but those effects will likely go unnoticed for some time.

NOTES

[1]Meese and Rogoff (1984) also documented evidence that long-horizon exchange rate movements are substantially easier to forecast than short-horizon changes.

[2]In the vector autoregression analysis, monetary policy actions are identified with orthogonalized innovations in either the funds rate or the ratio of nonborrowed reserves to total reserves. Bernanke and Blinder (1992) and Sims (1992) identify monetary policy shocks with orthogonalized innovations in short-term interest rates; Christiano and Eichenbaum (1992) and Strongin (1992) identify these shocks with orthogonalized innovations in nonborrowed reserves and the ratio of nonborrowed reserves to total reserves, respectively. The Romer index is taken to be exogenous, as assumed by Romer and Romer (1989).

[3]See Campbell and Rissman (1994) for a recent discussion of the Phillips curve.

[4]The statistical analysis in this article is also unable to control for a variety of nonmonetary phenomena, such as the condition of labor markets or changes in relative prices that may be reflected in commodity price movements.

[5] Eichenbaum and Evans (1992) considered a much larger set of conditioning variables for the federal funds rate equation. In one case, we allowed the policy instrument to respond systematically to U.S. industrial production, foreign industrial production, the U.S. price level, the ratio of nonborrowed reserves to total reserves, the federal funds rate, the foreign interest rate, and the exchange rate. Clearly, this set of variables can capture a greater amount of variation in the economy's underlying nonmonetary fundamentals than simply interest rates and the exchange rate. Still, many of the results are comparable to the weekly estimates here. For an elaboration, see Eichenbaum and Evans (1992) and Christiano, Eichenbaum, and Evans (1994).

[6]In technical terms, the shocks are identified as orthogonalized innovations from the VAR, where the order of the Wold causal chain is the federal funds rate, the foreign interest rate spread, and the exchange rate.

[7]The standard errors were computed using Monte Carlo methods described in Eichenbaum and Evans (1992). The number of Monte Carlo draws in this study was 200.

[8]See Eichenbaum and Evans (1992) for a more detailed analysis of the statistical significance of these types of impulse response functions.

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