THE EFFECTS OF MONETARY POLICY SHOCKS: EVIDENCE FROM THE FLOW OF FUNDS

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Abstract—This paper assesses the impact of a monetary policy shock on the U.S. economy. Our measures of contractionary monetary policy shocks are associated with (i) a fall in various monetary aggregates and a rise in the federal funds rate, (ii) declines in different measures of real activity, (iii) sharp declines in commodity prices and a delayed decline in the GDP price deflator. In addition, net funds raised by the business sector increases for roughly a year, after which it falls. Finally, we find that households do not adjust their financial assets and liabilities for several quarters after a monetary shock.

I. Introduction

In recent years there has been a great deal of work on developing monetary models of business cycles. There has also been substantial progress in constructing empirical measures of exogenous shocks to monetary policy. This paper uses variants of these new measures in conjunction with the Flow of Funds data to assess the impact of a monetary policy shock on the borrowing and lending activities of different sectors of the economy. In so doing, we hope to characterize some of the salient features of the financial data that a successful model of the monetary transmission mechanism ought to account for.

We use two measures of exogenous shocks to monetary policy: orthogonalized shocks to the federal funds rate and orthogonalized shocks to nonborrowed reserves. To build confidence that we have identified shocks to monetary policy we display the dynamic response of two types of variables to these policy shock measures. The first are variables that are directly affected by monetary policy actions. We show that our measures of contractionary policy shocks lead to a fall in the Federal Reserve's holdings of government securities, in total reserves and in M1. In addition, we find evidence of a strong liquidity effect, i.e., a contractionary policy shock is associated with a rise in the federal funds rate and a fall in various measures of money. The second class of variables that we consider is standard macroeconomic aggregates. We show that our measures of contractionary monetary policy shocks are associated with persistent declines in real GDP, employment, retail sales and nonfinancial corporate profits as well as increases in unemployment and manufacturing inventories. In addition, our measures of contractionary monetary policy shocks are associated with sharp, persistent declines in commodity prices. The GDP price deflator does not respond to the policy shock for roughly a year. After that, it declines. This response pattern is qualitatively different from that obtained by other authors who work with policy shock measures that are similar to ours (see, for example, Eichenbaum (1992) and Sims (1992)). They obtain the anomalous result that the price level rises for over two years after a contractionary monetary policy shock. Following Sims and Zhou (1994) we avoid this implication in our analysis by assuming that the monetary authority responds to commodity prices (in addition to other variables) in setting monetary policy. Viewed overall, these results lend credence to the idea that our shocks measure exogenous disturbances to monetary policy, rather than, for example, shocks to the demand for reserves.

Given these results, we turn to the Flow of Funds data, which allow us to examine the impact of a monetary policy shock on the net funds raised by different sectors of the economy. Our first major finding can be summarized as follows. Following a contractionary shock to monetary policy, net funds raised in financial markets by the business sector increases for roughly a year. Thereafter, as the recession induced by the policy shock gains momentum, net funds raised by the business sector begins to fall. This pattern is not captured by existing monetary business cycle models. According to these models, business borrowing falls after a contractionary monetary policy shock. For example, this is the case in the "limited participation" models of Christiano and Eichenbaum (1992, 1995) and Fuerst (1992). It is also true of recent models of the monetary transmission mechanism which stress the importance of imperfect information and the special role of bank credit.[1] Finally, the textbook IS-LM model also predicts that total business loans fall after a monetary contraction.

The fact that net funds raised by the business sector initially rise after a contractionary monetary policy shock does not mean that the frictions embodied in existing monetary business cycle models are not important. But it does imply that these models have abstracted from other important frictions which cause net funds raised by the business sector to rise for a substantial period of time after a contractionary monetary policy shock. In this sense these models provide at best an incomplete explanation of the monetary transmission mechanism. One possible explanation for the observed response pattern of net funds raised by the business sector is that it is difficult for firms to quickly alter their nominal expenditures.[2] Under these circumstances, if a contractionary monetary policy shock leads to a fall in firms' receipts at the beginning of a recession and a fall in net cash flow, say because of a fall in sales and a rise in inventories, then we

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[1] See, for example, Bernanke and Gertler (1989), Bernanke and Blinder (1988), Fisher (1993), Fuerst (1994) and Gertler and Gilchrist (1993,1994).

[2] This conjecture is closely related to conjectures made by Gertler and Gilchrist (1993a) about the factors underlying the movements in short-term borrowing by large and small firms.

would expect their net demand for funds to rise. According to this scenario, the observed eventual decline in net funds raised by firms reflects their ability eventually to reduce their nominal expenditures. Investigating the empirical plausibility of this conjecture in a formal model is an important task that we leave to future research.

The second major finding of this paper is that one cannot reject the view that net funds raised by the household sector remains unchanged for several quarters after a monetary policy shock. A key assumption of "limited participation" monetary business cycle models is that households do not adjust their financial assets and liabilities immediately after a monetary shock. While the Flow of Funds data for the household sector are noisy, they are consistent with this assumption.

The third major finding of this paper is that, according to our federal funds based measure of monetary policy shocks, the increase in net funds raised by firms after a contractionary policy shock coincides with a temporary reduction in net funds raised by the government. We find this result puzzling and attempt to find what aspect of the government's expenditures and receipts can account for it. For the federal funds based measure of policy shocks, this reduction can be traced to a temporary increase in personal tax receipts. After about a year, though, as the recession takes hold and net funds raised by the business and household sectors falls, net funds raised by the government sector increases (i.e., the government budget deficit goes up).

The remainder of this paper is organized as follows. Section II discusses the identifying assumptions underlying our two monetary policy shock measures and presents evidence regarding their plausibility. Section III discusses the Flow of Funds accounts and defines precisely the concept of net funds raised by a sector of the economy. Section IV presents our results for the business sector. The focus of our analysis there contrasts with that of the existing literature which investigates the impact of a contractionary monetary policy shock on specific assets and liabilities of various types of businesses. This literature leaves open the question of what happens to the net amount of funds raised by the business sector as a whole.[3] In addition to using Flow of Funds data, we also use Gertler and Gilchrist's (1994) data set on small and large manufacturing firms to discuss the effects of monetary policy shocks on the borrowing activities of different firms. Section V studies the response to a monetary policy shock of the net funds raised by the other sectors of the economy, particularly the household and government sectors. Concluding remarks are contained in section VI.

II. Our Measures of Shocks to Monetary Policy

Isolating the economic effects of monetary policy actions is not straightforward. This is because, to some extent, policy actions depend on the state of the economy. The response of economic variables to reactive Fed actions reflects the combined effects of the policy action and of the variables to which policy is responding. To isolate the effects of Fed policy actions per se, we need to identify the component of Fed policy that is not reactive to other variables, i.e., that is exogenous. Solving this identification problem requires assumptions. Ours are discussed below.

A. *Identification Assumptions*

We identify a monetary policy shock with the disturbance term in a regression equation of the form:

$$S_t = \psi(\Omega_t) + \sigma\epsilon_{st} \tag{1}$$

Here S_t is the policy instrument, ψ is a linear function, Ω_t is the information set available to the monetary authority when S_t is set, σ is a positive number, and $\epsilon\Theta_{st}$ is a serially uncorrelated shock that is orthogonal to the elements of Ω_t and has variance unity. To rationalize interpreting ϵ_{st} as an exogenous policy shock, (1) must be viewed as the monetary authority's rule for setting S_t. In addition, the orthogonality conditions on ϵ_{st} correspond to the assumption that date t policy shocks do not affect the elements of Ω_t.[4] Our two measures of policy shocks correspond to different specifications of S_t and Ω_t. Conditional on this specification, the dynamic response of a variable to a monetary policy shock can be measured by the coefficients in the regression of the variable on current and lagged values of the fitted residuals in equation (1).

This procedure is asymptotically equivalent to one based on fitting a particular Vector Autoregression (VAR):

$$Z_t = A_0 + A_1 Z_{t-1} + A_2 Z_{t-2} + \dots + A_q Z_{t-q} + u_t \tag{2}$$

The VAR disturbance vector, u_t, is assumed to be serially uncorrelated and to have variance-covariance matrix V. The VAR disturbances are assumed to be related to the underlying economic shocks, ϵ_t, by

$$u_t = C\epsilon_t \tag{3}$$

where C is lower triangular and ϵ_t has covariance matrix equal to the identity matrix. To relate this to (1), suppose that S_t is the k^{th} element in Z_t. Then, ϵ_{st} is the k^{th} element of ϵ_t. In addition, Ω_t includes $Z_{t-1}, \dots, Z_{t-q}$. If $k > 1$ then Ω_t

[3] See, for example, Bernanke and Blinder (1992), Gertler and Gilchrist (1993,1993a), Kashyap, Stein and Wilcox (1993), Oliner and Rudebusch (1992), Ramey (1993,1993a) and Romer and Romer (1991). This literature shows that various firm liabilities increase after a monetary contraction. For example, Gertler and Gilchrist (1993, fig.4) show that short-term bank loans to the manufacturing sector rise. The literature also reports evidence that some firms may be acquiring more assets after a monetary contraction. For example, Bernanke and Blinder (1992) and Gertler and Gilchrist (1993, fig.1) show that banks sell securities and issue large certificates of deposit after a monetary contraction, and leave open the possibility that these are acquired by the business sector (see also Romer and Romer (1991)). Given this evidence, one cannot deduce the sign or the magnitude of the response to a contractionary monetary policy shock of net funds raised by the business sector. This is the issue upon which we focus.

[4] A different class of schemes for identifying monetary policy shocks does not involve the assumption that ϵ_{st} is orthogonal to Ω_t. See, for example, Bernanke (1986), Gali (1992), King and Watson (1992) and Sims (1986).

also includes $Z_{i,t}$ for $i = 1, \ldots, k-1$.[5] We estimate the A_j's and C in (2) and (3) by applying ordinary least squares equation by equation to (2), and then exploiting the fact that C is uniquely determined by the relationship $V = CC'$. Using these estimated parameters, the impulse response of any variable in Z_t to ϵ_{st} may be computed by using (2) and (3) to calculate the response of that variable to a unit impulse in ϵ_{st}.

Our first measure of the policy instrument, S_t, is the log level of nonborrowed reserves. Our decision to work with nonborrowed reserves rather than broad monetary aggregates is motivated by arguments in Christiano and Eichenbaum (1995) that innovations to nonborrowed reserves primarily reflect exogenous shocks to monetary policy, while innovations to broader monetary aggregates primarily reflect shocks to money demand. Our second measure of the policy instrument is the federal funds rate and is motivated by arguments in McCallum (1983), Bernanke and Blinder (1992) and Sims (1986, 1992).

In deciding which variables to include in our empirical analysis (i.e., how to specify Z_t) we must deal with the following trade-off. On the one hand, we would like, in principle, to include all of the variables in our analysis in one large unconstrained VAR and report the implied system of dynamic response functions. However, this strategy is not feasible because of the large number of variables which we wish to analyze. In particular, if we include q lags of n variables in the VAR, then we would have to estimate $(qn+1)n$ free parameters. For even moderate values of n, inference and estimation would be impossible. On the other hand, if we include too few variables in the VAR then we would encounter significant omitted variable bias.

With the above considerations in mind, we chose the following intermediate strategy. The vector Z_t always includes at least the following variables: the log of real GDP (*Y*), the log of the GDP deflator (*P*), the log of an index of sensitive commodity prices (*PCOM*), minus the log of nonborrowed reserves (*NBRD*), the federal funds rate (*FF*), and the log of total reserves (*TR*). When we want to assess the effect of a monetary shock on some other variable, D_t, that variable too is included in Z_t. The reason we work with *NBRD* rather than with the log of nonborrowed reserves is to facilitate comparisons between our two policy shock measures. Positive *FF* and *NBRD* policy shocks both correspond to contractionary monetary policy shocks.

The reason that we include a measure of commodity prices in our analysis is to avoid the well-known "price puzzle" associated with simple federal funds and nonborrowed reserve based policy shock measures. This is the result that positive orthgonalized innovations to *FF* and *NBRD* are associated with a prolonged *rise* in the price level (see Eichenbaum (1992) and Sims (1992)). Sims (1992) conjectured that this response reflects the fact that the Fed has some indicator of inflation in its reaction function that is missing from the VAR underlying the policy shocks measure. Consistent with this conjecture, we find that when *PCOM* is included in the VAR, the response of the price level to measured monetary policy shocks is no longer anomalous. Sims and Zhou (1994) also discuss this resolution of the price puzzle.

When the federal funds rate was specified as the policy instrument, we estimated ϵ_{st} using the following ordering of the variables in Z_t: $(Y_t, P_t, PCOM_t, FF_t, NBRD_t, TR_t, D_t)$. We refer to this measure of a monetary policy shock as an *FF* policy shock.[6] When *NBRD* was specified as the policy instrument, we estimated ϵ_{st} using the following ordering of the variables in Z_t: $(Y_t, P_t, PCOM_t, NBRD_t, FF_t, TR_t, D_t)$. We refer to this measure of a monetary policy shock as an *NBRD* policy shock. On two occasions in our analysis below, the variable D_t is an indicator of aggregate production activity: the unemployment rate and the log of employment. In those cases, we place D_t just before the policy variable in the VAR. This is consistent with our basic identifying assumption that policy shocks have no contemporaneous impact on aggregate output. Put differently, any contemporaneous correlation between the VAR disturbance to the policy variable and the indicator of aggregate production is assumed to reflect causation from production to the policy variable, and not the other way around.

B. *Assessing Our Monetary Policy Shock Measures*

To help assess the properties of our monetary policy shocks, it is useful to consider the benchmark *FF* and *NBRD* policy shocks that emerge from six variable VARs that include only the price level, commodity prices, output, nonborrowed reserves, the federal funds rate and total reserves in the vector Z_t. In both cases, the VAR was estimated using quarterly data over the period 1960:Q1–1992:Q4, using 4 lags of the variables in the system (i.e., $q = 4$).

The solid lines in figure 1 depict the estimated time series of our benchmark *FF* and *NBRD* policy shocks. The dotted lines are the analog estimates obtained when *PCOM* is not included in the analysis. Since all of the policy shock measures are by construction serially uncorrelated, they tend to be somewhat noisy. For ease of interpretation we report the centered, three quarter moving average of the shocks, i.e., we report $\sigma(\epsilon_{s,t+1} + \epsilon_{s,t} + \epsilon_{s,t-1})/3$. Also, for convenience we include shaded regions, which begin at a National Bureau of Economic Research (NBER) business cycle peak, and end at a trough. The estimated standard deviation, σ, of the *FF* policy shocks is 0.79%, at an annual rate, while the standard deviation of the *NBRD* policy shock is 1.61%. The two monetary policy shock measures have a correlation of 0.49. As figure 1 suggests, the estimated standard deviation of the *FF* policy shocks is influenced by the high variance of those shocks in the early 1980s. For example, excluding the period

[5] Equation (1) is proportional to the k^{th} equation of C^{-1} times (2).

[6] While our procedure deals with the problem of parameter profligacy, it has one drawback: the implied *FF* and *NBRD* policy shocks can depend on the variable D_t that is included in the VAR. This means that the shock measures can be slightly different across VARs. This is because the measured innovations to FF_t and NBR_t depend, in principle, on lagged values of D_t.

FIGURE 1. — THREE QUARTER, CENTERED AVERAGE OF FF POLICY SHOCKS WITH AND WITHOUT COMMODITY PRICES

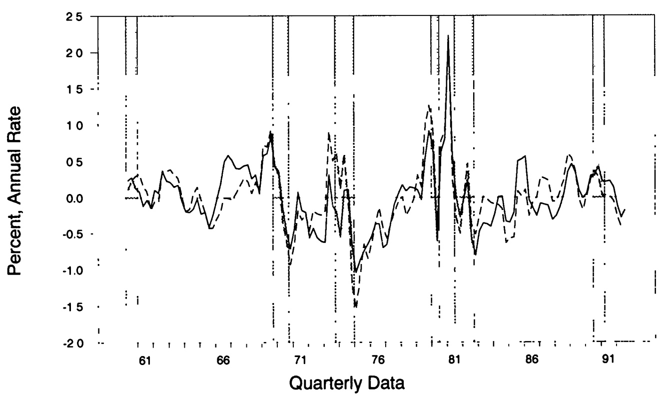
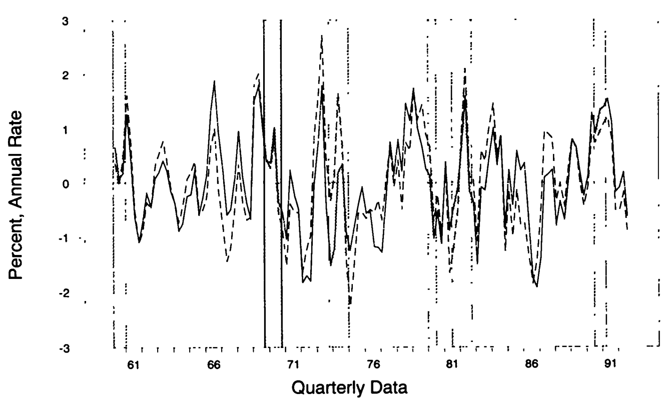


FIGURE 1A.—THREE QUARTER, CENTERED AVERAGE OF NBRD POLICY SHOCKS WITH AND WITHOUT COMMODITY PRICES



Note: For the solid lines, the policy shocks are estimated as the orthogonalized innovations from the 6-variable VARs which include *Y, P, PCOM, FF, NBRD*, and *TR*; for the dashed lines, the policy variables are estimated as the orthogonalized innovations from the 5-variable VARs which include *Y, P, FF, NBRD*, and *TR*. In each case, the three-quarter, centered averages are computed with equal weights applied to the time $t-1$, t, and $t+1$ orthogonalized innovations.

1979Q4–1982Q4, the standard deviation of the *FF* and *NBRD* shocks is 0.58 and 1.56, respectively.

In describing our results, we find it useful to characterize monetary policy as "tight" or "contractionary," when the smoothed policy shock is positive, and "loose" or "expansionary" when it is negative. According to the *FF* policy shock measure, policy was relatively tight before each recession, and became easier around the time of the trough.[7] A similar pattern is observed for *NBRD* shocks, except that in the 1981-1982 period, policy was loose at the start, very tight in the middle, and loose at the end of the recession.

Notice that including *PCOM* in the analysis leads to some substantial differences in the estimated policy shocks. For concreteness, we concentrate on the federal funds based measures. First, absent *PCOM*, it appears that monetary policy was very tight at the outset and during the middle of the 1973-74 recession, and then eased at the end of that episode. With *PCOM*, policy appears less tight at the onset of the recession. Since inflation was quite high (and rising) during and after this recession, omitting *PCOM* from the analysis could contribute to the inference that tight monetary policy leads to a high price level (i.e., the price puzzle). Second, with *PCOM*, we find that policy was relatively tight towards the end of 1966. This corresponds to the episode commonly referred to as the "credit crunch." Without *PCOM*, we do not find that policy was tight during this period. Third, with *PCOM*, we find that policy was relatively tight around the end of 1985. This is not the case when *PCOM* is excluded from the analysis. Since this was a period in which inflation was dropping, this result too helps explain why the presence of *PCOM* in the VAR used to measure policy shocks helps resolve the price puzzle.

We now consider the effects of monetary policy shocks on various economic aggregates. Figure 2 displays the dynamic response of several variables (such as Total Reserves, M1 and the Fed's holdings of government securities) which are closely related to monetary policy actions. The two rows pertain to the effects of *FF* and *NBRD* policy shocks, respectively. Solid lines represent our point estimates, while dashed lines denote plus and minus one standard deviation bands.[8] Table 1 reports point estimates and standard errors of time averages of the impulse responses in figure 2. Results are reported for averages over the first and second half of the first year following a shock, and for the second and third years after a shock. These tables also report, for each variable, the percentage of the 24-quarter ahead forecast error variance attributable to our policy shock measures. As in Eichenbaum and Evans (1995), standard errors were computed using a suitably modified version of the method described in footnote 8.

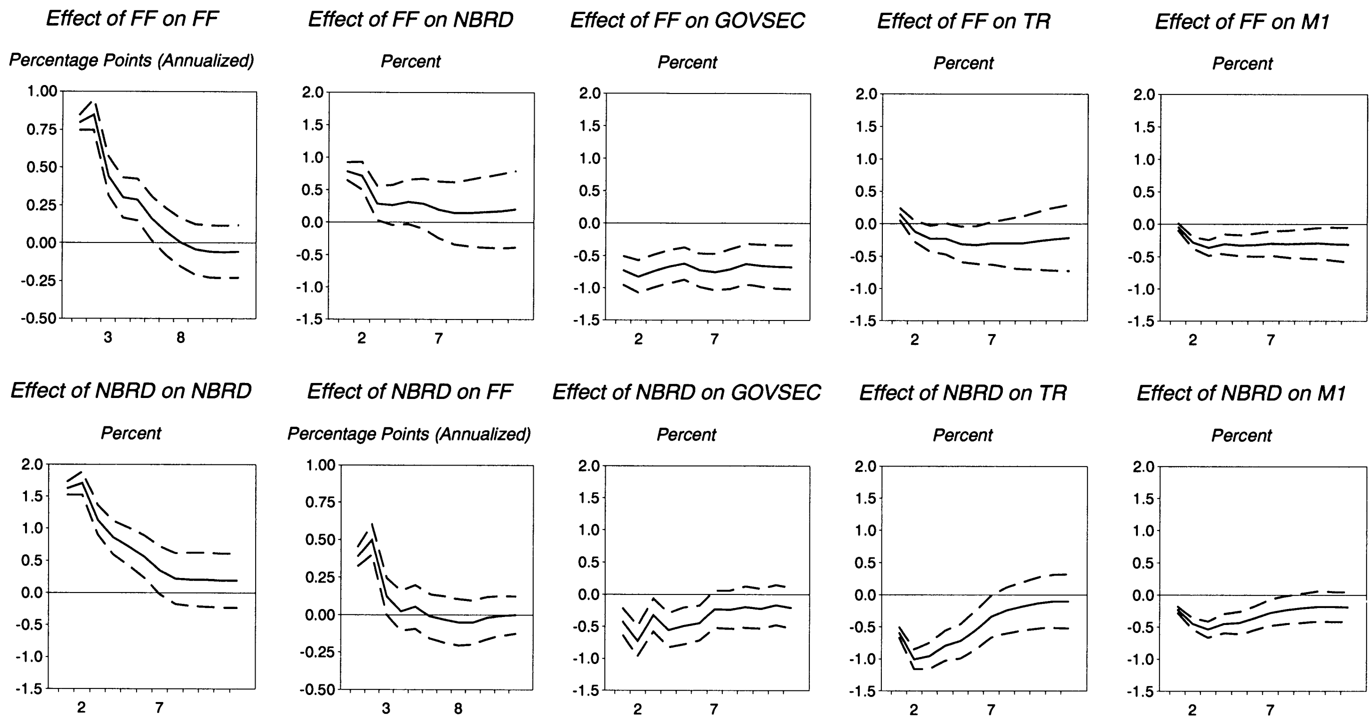
To begin with, consider our results for *FF* policy shocks. Several observations are worth emphasizing. First, the effect of an *FF* policy shock on the federal funds rate is persistent, with the funds rate staying up about 6 quarters after a shock. Second, a positive *FF* policy shock generates statistically significant declines in the Fed's holdings of U.S. government securities, as well as in nonborrowed reserves (i.e., *NBRD* goes *up*). These findings are consistent with the presence of a strong liquidity effect and with the view that the Fed raises interest rates by selling U.S. government securities. Third, the fall in total reserves is negligible initially (actually, our point estimates show a small, statistically insignificant *rise*). Eventually they fall by around 0.4%. So, according to this policy shock measure, the Fed insulates total reserves in the short run from the full impact of a contraction in nonborrowed reserves by increasing borrowed reserves.[9] (See Strongin

[7] In figure 1, the beginning of the 1973–74 recession appears to be an exception to the general pattern. To some extent this reflects the effects of averaging since there was a 210 basis point FF policy shock in 1973Q3.

[8] These were computed using the Monte Carlo method described in Doan (1990), example 10.1, using 500 draws from the estimated asymptotic distribution of the VAR coefficients and the covariance matrix of the innovations, u_t, in (2). The point estimates and standard errors of our coefficients are the average and standard deviation across draws of the simulated impulse responses.

[9] A given percentage change in total reserves and in nonborrowed reserves corresponds roughly to an equal dollar change in these variables. Historically, nonborrowed reserves are roughly 95% of total reserves. Since 1986, that ratio has moved up, being above 98% most of the time.

FIGURE 2. — EFFECT OF POLICY SHOCKS ON MONETARY VARIABLES



Note: The estimated impulse response functions were computed from the following VARs: in row (1) the effects of *FF*, *NBRD*, and *TR* were estimated from a single 6-variable VAR which includes *Y*, *P*, *PCOM*, *FF*, *NBRD*, and *TR*; the other impulse response functions were estimated from two 7-variable VARs which include *Y*, *P*, *PCOM*, *FF*, *NBRD*, *TR*, and *D*, where *D* is *GOVSEC* and M1 (respectively); row (2) is the same as row 1 except that the policy shock is *NBRD*. The dashed lines are one-standard error bands.

TABLE 1. — PROPERTIES OF IMPULSE RESPONSE FUNCTIONS WITH COMMODITY PRICES INCLUDED

	Effects of Federal Funds Policy Shocks on:				
	FF	*NBRD*	*GOVSEC*	*TR*	M1
1–2 Quarters	0.821	0.751	–0.779	0.014	–0.166
Significance	0.000	0.000	0.000	0.911	0.015
3–4 Quarters	0.371	0.276	–0.711	–0.232	–0.336
Significance	0.002	0.317	0.001	0.277	0.011
Variance Decomposition	23.070	6.375	15.128	5.738	14.566
Significance	0.004	0.279	0.064	0.360	0.120

	Effects of Negative Nonborrowed Reserve Policy Shocks on:				
	NBRD	*FF*	*GOVSEC*	*TR*	M1
1–2 Quarters	1.665	0.443	–0.576	–0.795	–0.338
Significance	0.000	0.000	0.002	0.000	0.000
3–4 Quarters	0.992	0.075	–0.442	–0.872	–0.493
Significance	0.000	0.530	0.045	0.000	0.000
Variance Decomposition	10.655	7.344	5.790	7.505	10.106
Significance	0.042	0.025	0.238	0.112	0.114

Note: For each panel in tables 1 and 2, rows (1) and (2) report the average response of the column variable over the first half year and second half year following a policy shock. Row (3) reports the percentage of the variance of the column variable's 24-quarter-ahead forcast error attributable to the policy shock. The underlying estimated impulse response functions and variance decompositions were computed as described in the note to figures 2 and 3.

TABLE 2. — PROPERTIES OF IMPULSE RESPONSE FUNCTIONS WITH COMMODITY PRICES INCLUDED

	Effects of Federal Funds Policy Shocks on:							
	Y	*EMPL*	*UNEMP*	*PCOM*	*RSALES*	*TRADE P*	*NF PROF*	*MFG INV*
1–2 Quarters	–0.022	–0.010	0.009	–0.024	–0.215	–0.840	–1.645	0.604
Significance	0.476	0.434	0.359	0.100	0.027	0.001	0.032	0.000
3–4 Quarters	–0.437	–0.149	0.087	–0.144	–0.844	–1.293	–6.361	0.684
Significance	0.000	0.009	0.004	0.003	0.000	0.000	0.000	0.034
Variance Decomposition	29.744	16.819	5.324	14.974	35.565	18.382	19.075	27.482
Significance	0.024	0.032	0.082	0.019	0.001	0.017	0.012	0.011

	Effects of Negative Nonborrowed Reserve Policy Shocks on:							
	Y	*EMPL*	*UNEMP*	*PCOM*	*RSALES*	*TRADE P*	*NF PROF*	*MFG INV*
1–2 Quarters	–0.031	–0.008	0.011	–0.019	–0.137	–0.751	–1.646	0.399
Significance	0.277	0.552	0.272	0.215	0.173	0.011	0.047	0.009
3–4 Quarters	–0.297	–0.088	0.050	–0.095	–0.568	–0.504	–5.372	0.524
Significance	0.002	0.125	0.176	0.064	0.001	0.173	0.000	0.078
Variance Decomposition	11.340	4.247	4.100	6.084	13.051	7.192	12.341	9.960
Significance	0.149	0.193	0.193	0.148	0.101	0.128	0.054	0.127

Note: For each panel in tables 1 and 2, rows (1) and (2) report the average response of the column variable over the first half year and second half year following a policy shock. Row (3) reports the percentage of the variance of the column variable's 24-quarter-ahead forcast error attributable to the policy shock. The underlying estimated impulse response functions and variance decompositions were computed as described in the note to figures 2 and 3.

(1995) for a discussion of this point.) Fourth, consistent with the interpretation of a positive *FF* shock as reflecting a contractionary monetary policy shock, M1 declines in a statistically significant way. Consider next the effect of an *NBRD* policy shock. As can be seen, with one exception, inference is qualitatively robust to which of the two policy measures is used. The exception has to do with the degree to which total reserves are initially insulated from policy shocks. The *FF* measure implies that total reserves are insulated, contemporaneously, from monetary policy shocks. The *NBRD* measure implies that roughly one-third of the policy shock is contemporaneously transmitted to total reserves.

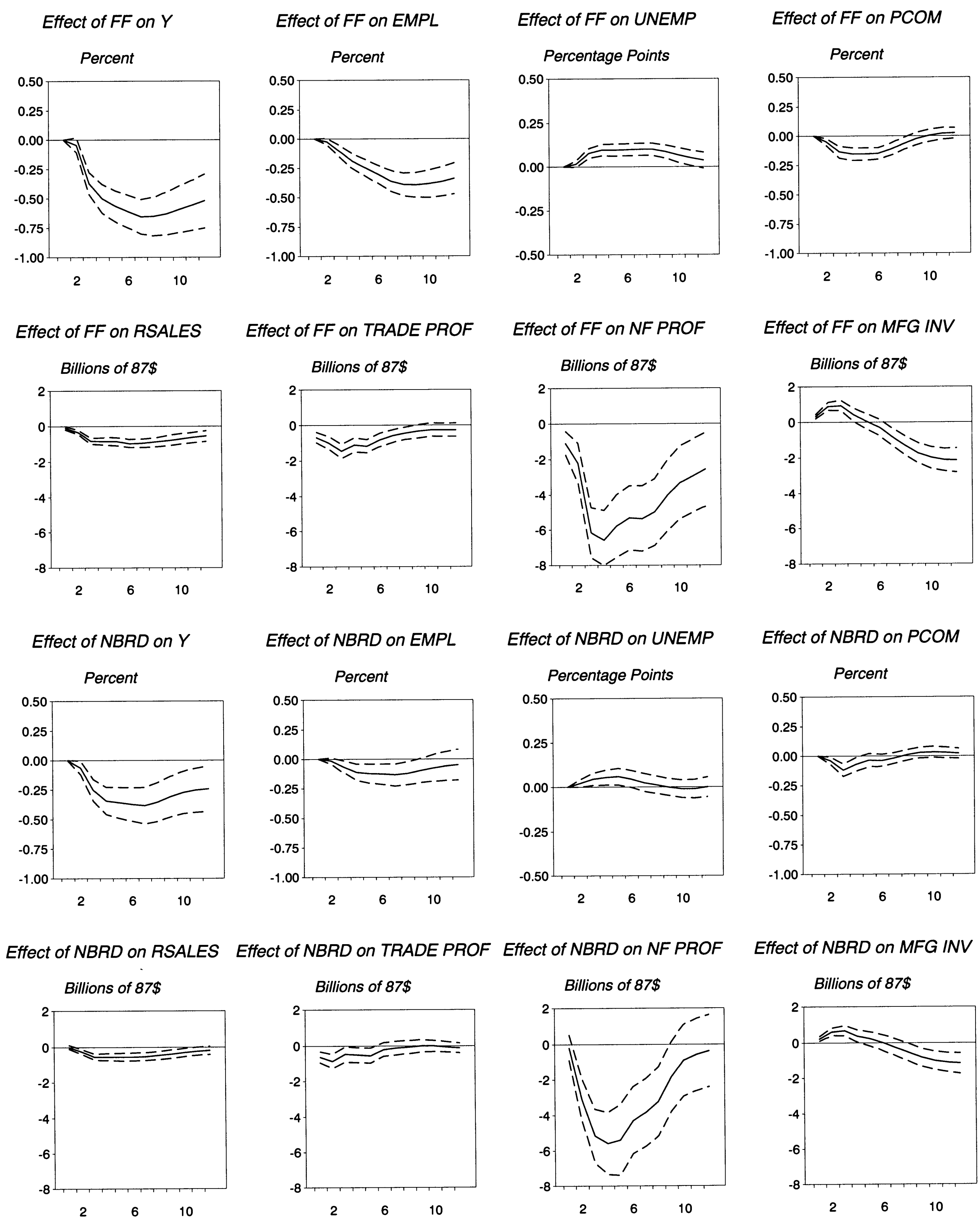
We now discuss the effect of our monetary policy shock measures on broader economic aggregates. The first two rows of figure 3 display the response of aggregate output, employment, unemployment, the commodity price index, retail sales, corporate profits in retail trade, nonfinancial corporate profits, and manufacturing inventories to an *FF* policy shock. The corresponding dynamic response functions for an *NBRD* policy shock are displayed in rows three and four. To begin with, consider our results for an *FF* policy shock. First, after a delay of about two quarters, a contractionary monetary policy shock leads to a sustained, statistically significant drop in GDP. These findings are consistent with results in Bernanke and Blinder (1992), Eichenbaum (1992) and Sims (1992). Second, with a similar delay, an *FF* policy shock leads to a significant, persistent decline in employment, and a significant increase in the unemployment rate. Third, in contrast to the delayed response of aggregate output, employment and unemployment, there is some evidence of an immediate reduction in economic activity. Specifically, retail sales, corporate profits in retail trade and nonfinancial corporate profits immediately fall while manufacturing inventories immediately rise in response to an *FF* policy shock.[10] From rows 3 and 4 of this figure, we see that the dynamic response functions are qualitatively similar whether we work with *FF* or *NBRD* policy shocks. However, table 2 indicates that the response functions are less precisely estimated when we work with *NBRD* policy shocks.

We now consider the implications of our policy measures for two price indices: the index of commodity prices and the GDP price deflator. According to figure 3, both of our policy shock measures lead to sharp, persistent declines in the commodity price index. Figure 4 shows that the GDP deflator is roughly flat for a year after a monetary policy shock, after which it declines (see the left column of figure 4). Notice that when *PCOM* is excluded from the VAR, the GDP deflator rises for over two years in response to either an *FF* or an *NBRD* policy shock (see the right column of figure 4). This last result is consistent with the findings on the "price puzzle" reported by Eichenbaum (1992) and Sims (1992). Evidently, including *PCOM* in the analysis is important for resolving the price puzzle (see Sims and Zhou (1994) for corroborating evidence on this point).[11]

[10] In results not reported here, we also found that contractionary monetary policy shocks drive down stock prices (measured as the ratio of the S&P 500 stock price index relative to the GNP deflator).

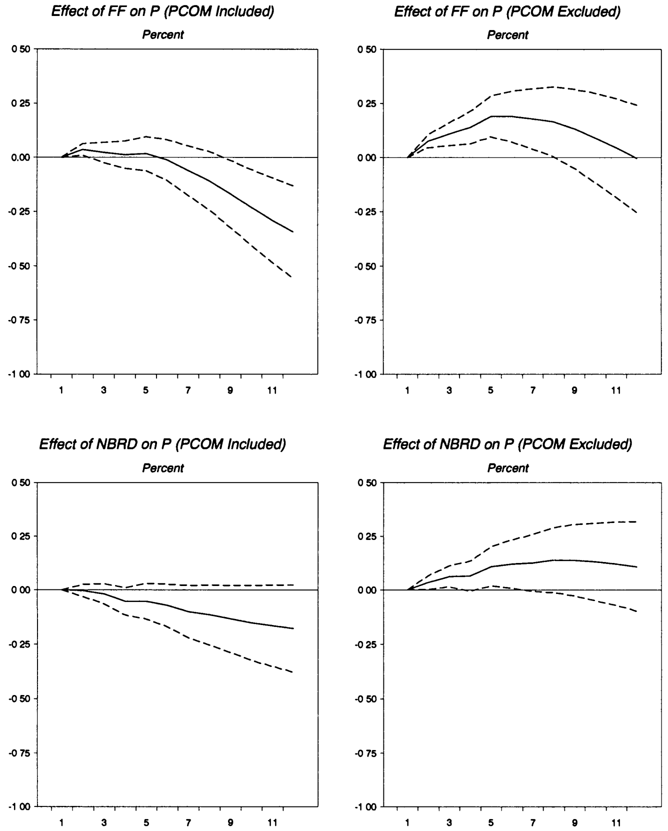
[11] Similar results were obtained using the *Journal of Commerce* Commodity Index and the Producer Price Index of Crude Materials. We have not done an exhaustive search for other variables that could solve the price puzzle. However, we did find that using the price of oil (rather than *PCOM*) did not do so.

FIGURE 3. — EFFECT OF POLICY SHOCKS ON MACROECONOMIC VARIABLES



Note: The estimated impulse response functions were computed from the following VARs: in rows (1) and (2) the effects of *Y* and *PCOM* were estimated from a single 6-variable VAR which includes *Y, P, PCOM, FF, NBRD*, and *TR*; the other impulse response functions were estimated from six 7-variable VARs which include *Y, P, PCOM, FF, NBRD, TR* and *D*, where *D* is *EMPL, UNEMP, RSALES, TRADE PROF, NF PROF*, and *MFG INV*, respectively; rows (3) and (4) are the same as rows (1) and (2) except that the policy shock is *NBRD*. The dashed lines are one-standard error bands.

FIGURE 4. — EFFECT OF POLICY SHOCKS ON PRICE LEVEL



Note: The estimated impulse response functions were computed from the following VARs: in column (1) the effects on *P* were estimated from a single 6-variable VAR which includes *Y, P, PCOM, FF, NBRD,* and *TR*; in column (2), the effects on *P* were estimated from a single 5-variable VAR which includes *Y, P, FF, NBRD,* and *TR*. The dashed lines are one-standard error bands.

We conclude this section by briefly discussing the contribution of monetary policy shocks to the variability of the different economic aggregates under consideration. From table 2 we see that *FF* policy shocks account for 30%, 17%, 5% and 35% of the 24 quarter ahead forecast error variance of real GDP, employment, unemployment and retail sales, respectively. The corresponding numbers for *NBRD* policy shocks are 11%, 4%, 4%, and 13%, respectively.[12] So, monetary policy shocks seem to be an important contributor to aggregate fluctuations. The effects associated with *FF* shocks are larger than those associated with *NBRD* shocks.

In summary, the results in this section support the view that *FF* and *NBRD* shocks are reasonable measures of exogenous money supply shocks. The alternative interpretations that we can think of seem implausible. For example, the view that a positive *FF* policy shock really reflects a positive shock to money demand (rather than supply) seems hard to square with our finding that total reserves and M1 fall after an *FF* policy shock. The view that a positive *NBRD* shock reflects a negative money demand shock is difficult to reconcile with the fact that it is followed by a rise in the interest rate and the unemployment rate, as well as a fall in output, employment, and retail sales. The view that a positive *FF* policy shock reflects an increase in household and/or business optimism (due, say, to an increase in the marginal product of capital) seems hard to reconcile with the fall in aggregate economic activity that follows an *FF* shock. Finally, a rise in interest rates due to a shock generating a sectoral reallocation of resources could, in principle, lead to an initial fall in aggregate economic activity. The obvious candidate is a shock to the price of oil. However, this scenario seems implausible given the persistence of the fall in aggregate economic activity that occurs after *FF* and *NBRD* policy shocks.

III. The Flow of Funds Data

In our analysis we make extensive use of data from the Flow of Funds accounts (FOFA). We pay particular attention to *net funds raised* by different sectors in the economy. To describe this concept, it is useful to display its link to the National Income and Product Accounts (NIPA). For any given sector, this link is characterized by the identity:

$$\textit{Tangible Investment} - \textit{Saving} = \textit{Net Funds Raised in Financial Markets}. \quad (4)$$

Here, tangible investment corresponds to expenditures on nonfinancial assets, while saving corresponds to income net of expenses. For example, in the case of the business sector, tangible investment includes fixed and inventory investment, while saving corresponds roughly to after-tax profits net of dividends (dividends are treated as a cost, symmetrically with debt service expenses). In the case of households, tangible investment includes residential construction and purchases of consumer durables, while saving corresponds roughly to after-tax income net of consumption of nondurables and services. If there is an imbalance between tangible investment and saving, this automatically results in an accumulation of financial assets and/or financial liabilities to ensure that (4) holds. Since one sector's assets represent some other sector's liabilities, it follows that the sum of net funds raised in financial markets must be zero across all sectors. Another way of saying this is that aggregate saving must equal aggregate investment.

For our analysis, we divided the economy into six sectors: (nonfinancial) business, household, (federal, state and local) government, financial business, foreign and the monetary authority. This seems like the natural division given our desire to shed light on the empirical plausibility of models like the "limited participation" models of Christiano and Eichenbaum (1992, 1995) and Fuerst (1992).[13] Data for the year 1991 on the variables in equation (4) are reported in table 3. In addition, that table breaks down net funds raised into funds raised by issuing liabilities ("financial sources of

[12] Point estimates and standard errors were computed using a suitably modified version of the procedure underlying our point estimates and standard errors for the impulse response coefficients. See footnote 8.

[13] This is also why we cannot work solely with more disaggregated data sets such as the *Quarterly Financial Reports,* although we do report some results obtained using Gertler and Gilchrist's (1994) data set which is based on the *Quarterly Financial Reports.*

TABLE 3. — SAVINGS, INVESTMENT AND NET FUNDS RAISED
BILLIONS OF DOLLARS, 1991

	Business	Household	Government	Financial	Foreign	Monetary	Total
Investment (*I*)	452.2	655.6	−2.8	62.0	0	0.2	1167.20
Saving (*S*)	541.3	849.6	−275.6	40.8	−8.9	−1.8	1145.40
I–S	−89.1	−194.0	272.8	21.2	8.9	2.0	21.80
Net Funds Raised	−73.0	−209.6	304.7	8.5	−4.8	0	25.80
Financial Sources of Funds	3.0	178.5	353.1	751.3	45.7	22.3	1353.90
Financial Uses of Funds	76.0	388.1	48.4	742.8	50.5	22.3	1328.10

Source: Table 1, pp 10–11, "Guide to the Flow of Funds Accounts," Board of Governors of the Federal Reserve System, 1993. Investment: line 4; saving: line 1; *I–S*: investment minus saving; net funds raised: negative of line 11.
Notes: Housholds: includes personal trusts and nonprofit organizations; business: farm, nonfarm noncorporate, and nonfarm financial corporate; Government: state and local government; Financial: sponsored agencies and mortgage pools plus commercial banking plus private nonbank finance; Monetary: monetary authority.

funds") and funds raised by acquiring assets ("financial uses of funds"). The data are in billions of current dollars. We use the numbers in this table to make concrete the concepts just discussed, and to illustrate some of the measurement error issues that arise with the data.

According to table 3, in 1991 the business sector generated $541.3 billion internally. Of this, $452.2 billion was allocated to tangible investment.[14] So, the NIPA data imply that net funds raised in financial markets was –$89.1 billion. According to the FOFA accounts, in 1991 the business sector used $76 billion to purchase financial assets, and acquired $3 billion by issuing financial liabilities. So, according to this measure, net funds raised in financial markets equaled –$73 billion. The difference between FOFA and NIPA measures, $16.1 billion, is a statistical discrepancy that indicates the presence of measurement error in one or both data sources. Another indication of measurement error is that, for both the FOFA and NIPA measures, the sum of net funds raised across all sectors is not equal to zero. It is difficult to know, a priori, which is the better measure of net funds raised for any sector. Because of this, all calculations concerning net funds raised were done using both measures. In practice, we found that this made no difference for the business and government sector, but made a marginal difference for the household, foreign and financial intermediary sectors. We will return to this point later.

Our baseline data source is the FOFA. In addition to looking at net funds raised, we use the FOFA data to decompose net funds raised into gross funds raised by issuing liabilities and funds used by acquiring assets. We further subdivided liabilities into its long- and short-term components.[15]

IV. The Response of Firms' Financial Assets and Liabilities to a Monetary Policy Shock

This section investigates the response of firms' financial assets and liabilities to a monetary policy shock. Our primary findings can be summarized as follows: after a contractionary monetary policy shock, net funds raised by the business sector rises for two to four quarters. By the end of the first year, net funds raised by this sector begin to decline. These movements primarily reflect changes in the short-term liabilities of the business sector. Moreover, the increase in short-term liabilities is concentrated in large firms and corporations. This last result is based on an analysis of FOFA data on corporate and non-corporate business, as well as Gertler and Gilchrist's (1994) data on large and small manufacturing firms that are based on the *Quarterly Financial Reports*.

Let *BNET* denote real, net funds raised in the business sector as measured by the FOFA data. As noted in the previous section, *BNET* equals the amount of funds raised by issuing financial liabilities (*BLIAB*), net of funds spent acquiring financial assets (*BASSETS*),

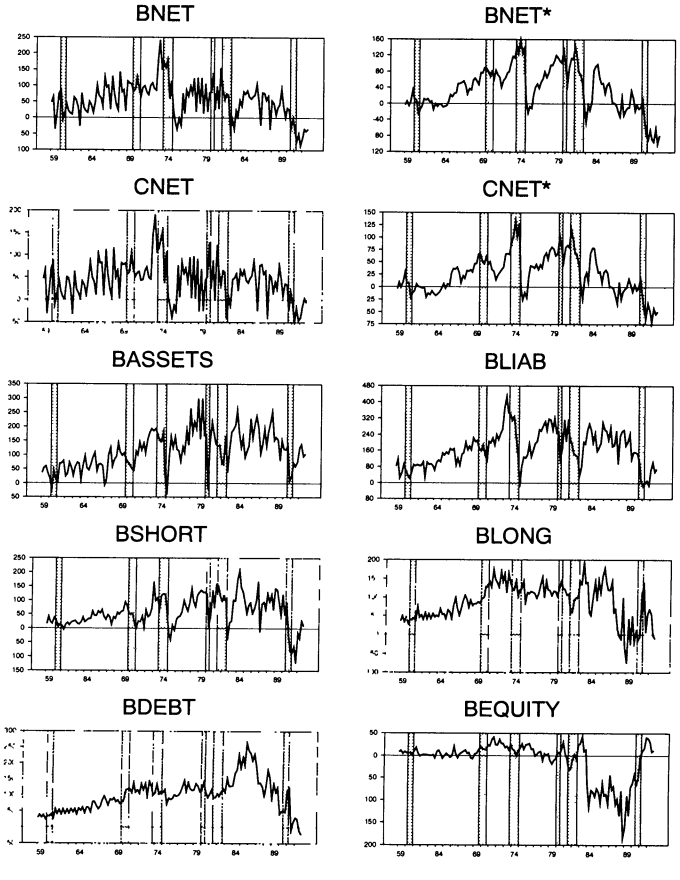
$$BNET = BLIAB - BASSETS. \tag{5}$$

The liabilities issued to raise funds can be divided into two categories, long and short term. Long-term liabilities, *BLONG*, equal funds raised by issuing equity (*BEQUITY*) plus funds raised by issuing long-term debt (*BDEBT*). The latter is composed of tax-exempt debt, corporate bonds, and mortgages. Short-term debt, *BSHORT*, is composed of funds raised by issuing commercial paper, bank and other loans. We denote net funds raised by the corporate sector, *CNET*. The NIPA measures of net funds raised by the business and corporate sectors are denoted by *BNET** and *CNET**. The data, which are expressed in annual rates, are displayed in figure 5. A notable feature of the data is the differences between the NIPA and FOFA measures of net borrowing by the business and corporate sectors. In particular, the FOFA measures contain an important high frequency component that is not present in the NIPA data. This is consistent with the notion that there is measurement error in one or both of these series.

Subsection IVA analyzes the impact of monetary policy shocks on *BNET*, *BNET**, *CNET*, and *CNET**. Subsection IVB studies the impact on the components of *BNET*. Finally, subsection IVC considers the impact of monetary policy

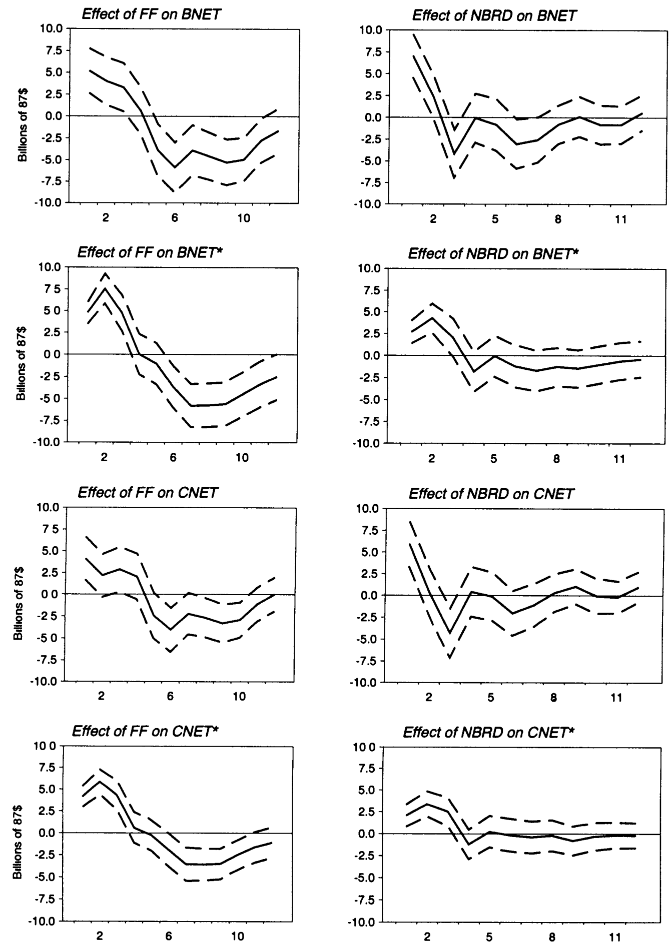
[14] In this respect, 1991 was an unusual year, since the business sector typically invests more than it saves.
[15] For further details on the FOFA, see Board of Governors (1993).

FIGURE 5. — FLOW OF FUNDS TIME SERIES: BUSINESS SECTOR



Note: Billions of 1987 dollars. See the text for data definitions

FIGURE 6. — EFFECT OF POLICY SHOCKS ON NET FUNDS RAISED BY THE BUSINESS AND CORPORATE SECTORS



Note: Column (1) pertains to an *FF* policy shock and is generated from four 7-variable VARs which include *Y, P, PCOM, FF, NBRD, TR* and *D*, where *D* is *BNET, BNET*, CNET,* and *CNET**, respectively. Column (2) pertains to an *NBRD* policy shock and the underlying *VARs* are the same as those underlying row (1). The dashed lines are one-standard error bands.

shocks on the short-term financial liabilities of different subsectors of the business sector.

A. *Net Funds Raised by the Business Sector*

Figure 6 presents the dynamic response of *BNET, BNET*, CNET,* and *CNET** to a contractionary monetary policy shock. Table 4 presents results pertaining to time averages of impulse responses, as well as variance decompositions.

A number of key results emerge here. First, according to our point estimates, the net amount of funds raised by the business sector *rises* for between two and four quarters after a contractionary shock to monetary policy. These responses are more persistent for *FF* policy shocks and NIPA measures of net funds raised. The rise in *BNET** averages roughly 6.1 billion 1987 dollars in the first two quarters after an *FF* policy shock. This is equal to about 16.6% of the quarterly average of *BNET** (36.8 billion 1987 dollars) over our sample period (1960Q1–1992Q4). The response of *BNET** to an *NBRD* policy shock averages about 3.5 billion 1987 dollars per quarter over the first two quarters after a shock. Second, for both policy shock measures, the rise in *BNET, BNET**, and *CNET** is statistically significant for about one-half year. Third, for both policy shocks, the different measures of net borrowing eventually fall after initially rising. Fourth, in these baseline VARs which include a commodity price index (*PCOM*), *FF* policy shocks account for only about 10%–13% of the 24-quarter-ahead variance in net funds raised by the business sector; *NBRD* policy shocks account for less of this variance. In light of our discussion in section II, it is interesting to contrast these results with those that emerge when commodity prices are not included in the analysis. In that case, *FF* policy shocks account for about 18%–22% of the forecast error variance in *BNET* and *BNET**. Furthermore, the initial effects of contractionary monetary policy shocks on *BNET, BNET**, *CNET,* and *CNET** are larger, more persistent, and more precisely estimated.

The 1969–70 recession illustrates the VAR results summarized in the previous paragraph. According to the NBER, this recession started in 1969Q4 and ended in 1970Q4.[16] Both

[16] Romer and Romer (1989) identify 1968Q4 as the beginning of a monetary contraction.

TABLE 4. — PROPERTIES OF INCOME RESPONSE FUNCTIONS WITH COMMODITY PRICES

	Effects of Federal Funds Policy Shocks on:							
	BNET	*BNET**	*CNET*	*CNET**	*BASSET*	*BLIABIL*	*BSHORT*	*BLONG*
1–2 Quarters	4.612	6.150	3.141	4.971	2.078	5.235	6.617	−2.866
Significance	0.011	0.000	0.043	0.000	0.424	0.072	0.002	0.115
3–4 Quarters	1.940	2.382	2.449	2.456	−11.430	−9.873	−0.730	−2.958
Significance	0.338	0.227	0.176	0.098	0.001	0.015	0.802	0.114
Variance Decomposition	10.138	14.491	7.385	12.205	16.101	17.067	12.085	5.935
Significance	0.018	0.049	0.017	0.033	0.004	0.015	0.030	0.092
	Effects of Negative Nonborrowed Reserve Policy Shocks on:							
	BNET	*BNET**	*CNET*	*CNET**	*BASSET*	*BLIABIL*	*BSHORT*	*BLONG*
1–2 Quarters	4.678	3.473	3.083	2.722	−1.050	4.537	4.198	−1.415
Significance	0.005	0.005	0.057	0.016	0.685	0.123	0.056	0.426
3–4 Quarters	−2.132	0.105	−1.950	0.643	−6.746	−8.108	−5.043	2.046
Significance	0.288	0.958	0.300	0.645	0.044	0.052	0.065	0.284
Variance Decomposition	6.011	4.809	6.204	4.828	7.415	7.234	8.729	5.261
Significance	0.017	0.115	0.026	0.098	0.037	0.062	0.034	0.029

Note: See notes to Table 1. The underlying estimated impulse response functions and variance decompositions were computed as described in the note to figures 6, 7, and 8.

policy shock measures indicate that the start of the recession was associated with very tight monetary policy (see figure 1). The end of the recession was associated with a sharp reversal of policy, which became expansionary. Coincident with this reversal, *BNET** and *CNET** went from being high when monetary policy was tight, to low when policy became loose (see figure 5).

The initial rise of net funds raised by the business sector in response to a contractionary monetary policy shock is one of the key results of the paper. Christiano, Eichenbaum and Evans (1994) explores the robustness of this finding along several dimensions. First, we redo the analysis for different sample periods and for alternative measures of net funds raised. Second, we report results for the case in which a quadratic time trend is included in the VAR. Finally, we redo our analysis using alternative schemes for identifying monetary policy shocks that have been used in the literature. For example, we consider the identification schemes of Bernanke and Blinder (1992), Gertler and Gilchrist (1993, 1993a, 1994), Romer and Romer (1989), Sims (1992), and Strongin (1995). With one exception, we find that our results are robust. The exception is that there is little information in the data about the response of *BNET*, *BNET**, *CNET* or *CNET** to a Romer and Romer policy shock.[17]

[17] The Romer and Romer measure of policy is a dummy variable that equals one in quarters when, in the view of the Romers, the Fed initiated a period of tight monetary policy, and zero otherwise. Since there are only five such periods in our sample, it is not surprising that standard errors are large.

B. *Factors Underlying the Response of Net Funds Raised to a Policy Shock*

We now analyze the response of the components of *BNET* to a contractionary monetary policy shock. Figure 7 displays the response of total assets (*BASSETS*), total liabilities (*BLIAB*), short-term liabilities (*BSHORT*), and long-term liabilities (*BLONG*) to a monetary policy shock. Table 4 presents results pertaining to time averages of impulse responses, as well as variance decompositions.

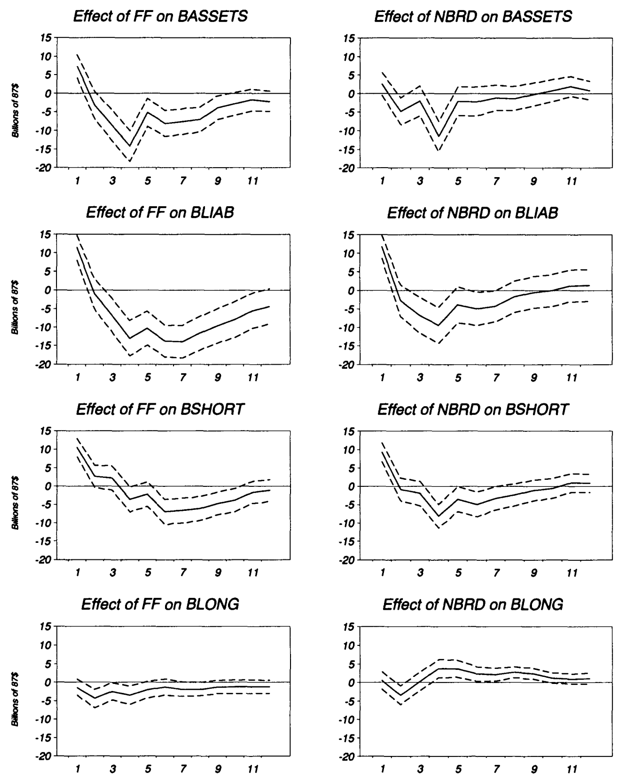
Our results indicate that the initial rise in *BNET* primarily reflects an increase in liabilities. In particular, *BLIAB* rises by about 4.5 billion 1982 dollars per quarter in the first two quarters after a contractionary monetary policy shock. As the recession deepens, *BLIAB* falls substantially. Both the initial rise and the eventual decline in *BLIAB* are statistically significant. In contrast, the initial rise in *BASSETS* is small and not statistically significant.

Figure 7 and table 4 reveal that virtually all of the response in liabilities reflects movements in short-term liabilities. Total short-term liabilities rise for between one and three quarters after a contractionary monetary policy shock, and then fall. These movements are quite substantial. To see this, note that the first quarter response of short-term liabilities to a contractionary monetary policy shock is about 10 billion 1987 dollars. This represents roughly a 17% increase relative to the postwar average of *BSHORT* (58.9 billion 1987 dollars).

C. *Short-term Borrowing by Subsets of the Business Sector*

We now investigate the extent to which the rise in short-term financial liabilities is experienced by different subsets of

FIGURE 7. — EFFECT OF POLICY SHOCKS ON COMPONENTS OF NET FUNDS RAISED BY THE BUSINESS SECTOR



Note: See figure 6 for analogous explanation of impulse response functions.

the aggregate business sector. Let *Corp* and *NCorp* denote the log of the stock of corporate and noncorporate short-term liabilities. Let *Small* and *Large* denote the log of the stock of short-term liabilities of small and large manufacturing firms.[18] These data are expressed in current dollars.[19] Impulse response functions are graphed in figure 8, while time averages of impulse responses, as well as variance decompositions are reported in table 5.

A number of key results emerge here. First, consistent with our previous findings, total short-term business and manufacturing liabilities rise for roughly one year after a monetary contraction. In the case of an *FF* policy shock, both liabilities increase significantly for the first year. An *NBRD* shock generates a significant increase in total manufacturing liabilities for two quarters. However, the rise in total business loans is not significant. Second, the response of corporate business and large manufacturing firms is stronger than the corresponding sector aggregate. This reflects in part the weaker rise in the short-term financial liabilities of noncorporate firms and small manufacturing firms. Consistent with this, the difference between corporate and noncorporate, and large and small manufacturing firms, rises. Fourth, inference about the difference between the corporate and noncorporate responses is sensitive to which measure of monetary policy we use. Specifically, with *NBRD* policy shocks there is little evidence of any significant difference. However, with *FF* policy shocks, the difference appears to be quite significant.

The results in this subsection are complementary to those of Gertler and Gilchrist (1994) and Fisher (1993), who also analyze the response of the short-term financial liabilities of large and small manufacturing firms to an innovation in the federal funds rate and nonborrowed reserves, respectively. Their policy shock measures are related to, but not identical with, what we call *FF* and *NBRD* policy shocks. Even though they use different identifying assumptions, their results are quite similar to ours.

In sum, we find that, regardless of whether we work with the FOFA data, or Gertler and Gilchrist's manufacturing data, short-term business borrowing rises for a substantial period of time after a contractionary monetary shock, and then declines. This pattern is particularly pronounced for corporations and for large manufacturing firms.

V. The Rest of the Economy

In section IV we analyzed the response of net funds raised by the business sector to a contractionary monetary policy shock. In this section we study the corresponding responses of the other sectors of the economy. We find that, consistent with "limited participation" theories, the data show little evidence that net funds raised by households responds significantly in the first few quarters after a monetary policy shock.[20]

A. *The Household Sector*

In this subsection we study the real, net amount of funds raised by the household sector, *HNET*. This variable equals the amount of funds that households raise by issuing financial liabilities (*HLIAB*), net of funds spent acquiring financial assets (*HASSETS*). We also consider the NIPA-based measure of net funds raised by the household sector, *HNET**. The data are displayed in figure 9. Note the difference at high frequencies between *HNET* and *HNET**. These differences, which are analogous to what we found for the business sector data, are an indication of measurement error in one or both of the FOFA and NIPA data.

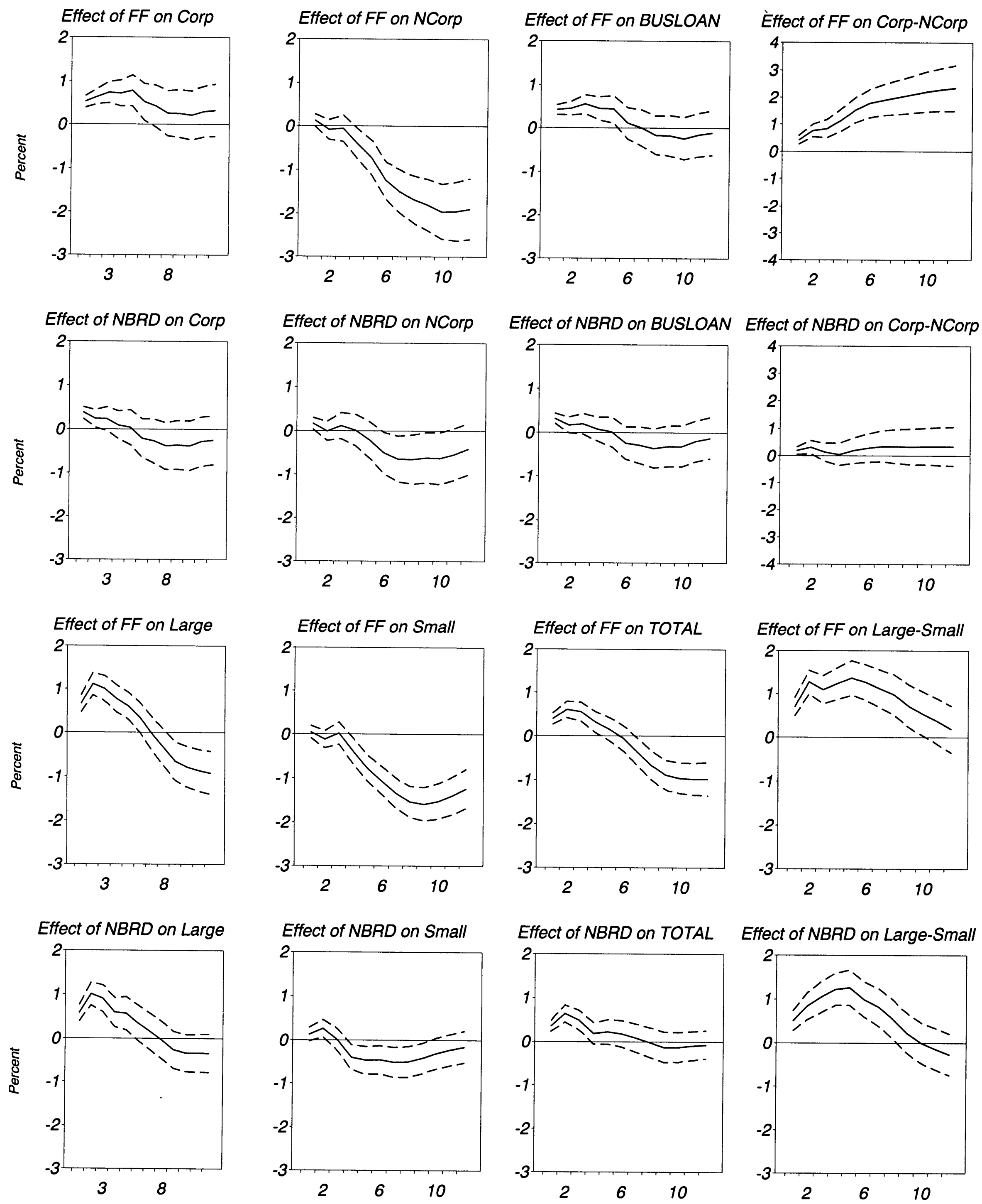
The impulse response functions of these variables to a contractionary monetary policy shock are displayed in figure 10. Table 6 reports results pertaining to time averages of impulse responses, as well as variance decompositions. According to our results, there is little evidence against the view that net funds raised by the household sector initially remains unchanged after a monetary policy shock. In the case of an *FF* policy shock, *HNET* and *HNET** do not respond in a sta-

[18] We are grateful to Simon Gilchrist for providing us with these data.

[19] The results do not depend on whether the stock of short-term liabilities is expressed in real or nominal terms, since the price level does not respond strongly to a monetary policy shock (see section II).

[20] See, for example, Christiano and Eichenbaum (1992, 1995) who assume that the amount of funds that the household sector sends to the financial sector does not change immediately after a shock to monetary policy. See also Kashyap and Stein (1994) for a discussion of the relationship between "limited participation" models and the "lending channel" of the monetary transmission mechanism.

FIGURE 8. — EFFECT OF POLICY SHOCKS ON BUSINESS SECTOR SHORT-TERM LIABILITIES



Note: Row (1) pertains to an *FF* policy shock and is generated from four 7-variable VARs which include *Y, P, PCOM, FF, NBRD, TR*, and *D*, where *D* is *Corp, NCorp, BUSLOAN*, and *Corp–NCorp*, respectively. Row (2) pertains to an *NBRD* policy shock and the underlying VARs are the same as those underlying row (1). Rows (3) and (4) are the same as rows (1) and (2) except that the corporate data are replaced by large manufacturing firm data, and the noncorporate data are replaced by the small manufacturing firm data. All data are in current dollars. The dashed lines are one-standard error bands.

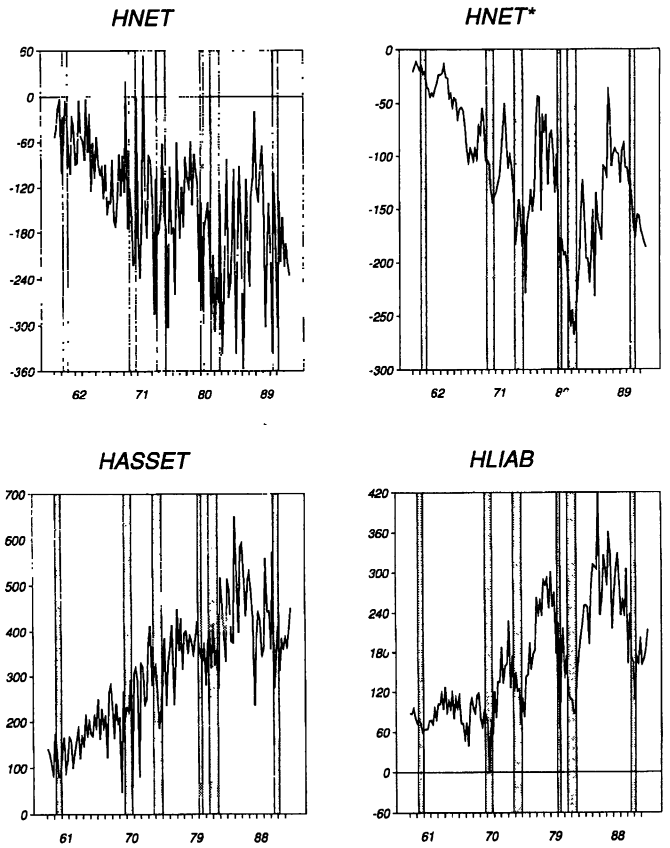
TABLE 5. — PROPERTIES OF INCOME RESPONSE FUNCTIONS WITH COMMODITY PRICES

	Effects of Federal Funds Policy Shocks on:							
	Corp	*NCorp*	*Busln*	*Co–NC*	*Large*	*Small*	*Total*	*Lg–Sm*
1–2 Quarters	0.583	0.028	0.438	0.593	0.884	–0.037	0.495	0.984
Significance	0.000	0.874	0.000	0.001	0.000	0.801	0.001	0.000
3–4 Quarters	0.731	–0.227	0.501	0.998	0.890	–0.191	0.436	1.168
Significance	0.005	0.472	0.033	0.006	0.002	0.462	0.043	0.000
Variance Decomposition	6.148	27.535	4.864	27.792	14.262	30.951	16.124	17.737
Significance	0.208	0.042	0.222	0.021	0.043	0.002	0.035	0.016
	Effects of Negative Nonborrowed Reserve Policy Shocks on:							
	Corp	*NCorp*	*Busln*	*Co–NC*	*Large*	*Small*	*Total*	*Lg–Sm*
1–2 Quarters	0.309	0.083	0.244	0.248	0.794	0.189	0.495	0.670
Significance	0.037	0.605	0.064	0.158	0.000	0.230	0.001	0.005
3–4 Quarters	0.161	0.062	0.138	0.089	0.749	–0.198	0.337	1.137
Significance	0.576	0.845	0.576	0.805	0.014	0.434	0.133	0.001
Variance Decomposition	3.677	4.167	3.735	3.106	5.974	5.943	3.788	11.460
Significance	0.293	0.321	0.325	0.397	0.097	0.154	0.117	0.044

Note: See notes to table 1. The underlying estimated impulse response functions and variance decompositions were computed as described in the note to figures 6, 7, and 8.

tistically significant way for the first four and two quarters, respectively. In the case of an *NBRD* policy shock, *HNET** does not display a statistically significant response in the first two quarters, while the entire *HNET* response is insignificantly different from zero.

FIGURE 9. — FLOW OF FUNDS TIME SERIES: HOUSEHOLD SECTOR



Note: Billions of 1987 dollars.

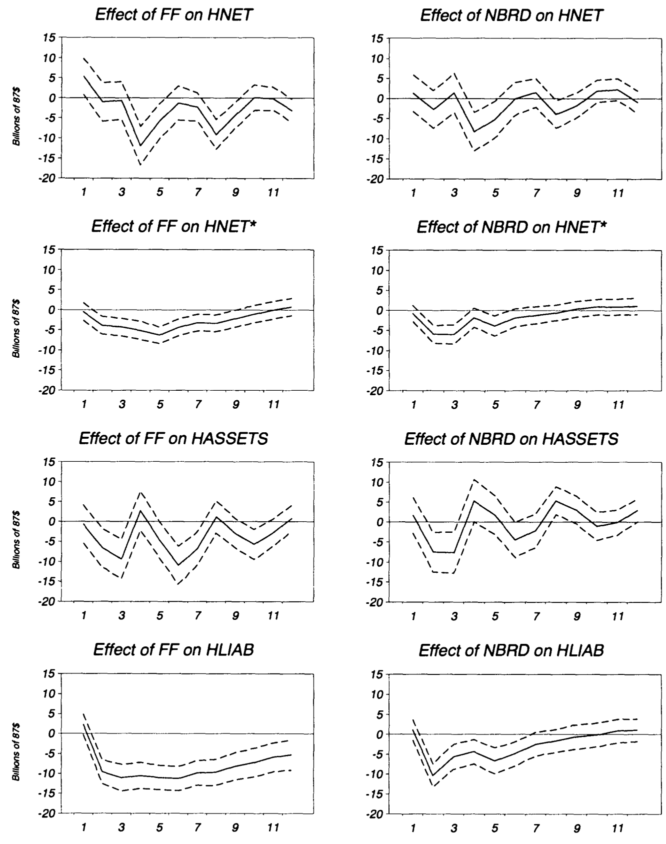
We now consider the dynamic response of the components of *HNET* to a contractionary monetary policy shock. According to our point estimates, a contractionary *FF* policy shock generates a fall both in funds used to acquire assets (*HASSET*) and in funds raised by issuing liabilities (*HLIAB*). The

TABLE 6. — PROPERTIES OF IMPULSE RESPONSE FUNCTIONS WITH COMMODITY PRICES

	Effects of Federal Funds Policy Shocks on:			
	HNET	*HNET**	*HASSET*	*HLIAB*
1–2 Quarters	2.191	–2.162	–3.644	–3.594
Significance	0.480	0.249	0.282	0.089
3–4 Quarters	–6.261	–4.707	–3.340	–10.794
Significance	0.049	0.014	0.328	0.000
Variance Decomposition	8.894	10.283	8.677	24.068
Significance	0.013	0.057	0.043	0.003
	Effects of Negative Nonborrowed Reserve Policy Shocks on:			
	HNET	*HNET**	*HASSET*	*HLIAB*
1–2 Quarters	–0.688	–3.311	–2.879	–4.573
Significance	0.836	0.060	0.342	0.025
3–4 Quarters	–3.437	–3.951	–1.182	–4.988
Significance	0.297	0.051	0.748	0.046
Variance Decomposition	5.512	6.893	6.036	8.075
Significance	0.044	0.097	0.049	0.053

Note: See notes to table 2. The underlying estimated impulse response functions and variance decompositions were computed as described in the note to figures 10 and 11.

FIGURE 10. — EFFECT OF POLICY SHOCK ON THE HOUSEHOLD SECTOR



Note: See notes to figure 6 for an analogous explanation of impulse response functions.

fall in assets is not statistically significant for the first year, while the fall in liabilities is insignificant for the first two quarters. In the case of a contractionary *NBRD* policy shock, our point estimates also indicate an overall decline in both *HASSET* and *HLIAB*. The change in *HASSET* is not statistically significant at any of the reported horizons. However, the change in *HLIAB* is significant in the first two half years after an *NBRD* policy shock.

It is difficult to draw strong conclusions from the household data because of possible problems with measurement error. Still, viewed overall, our results are consistent with the class of "limited participation" models considered by Christiano and Eichenbaum (1992, 1995), Fuerst (1992), Fisher (1993), Lucas (1990), Grilli and Roubini (1991), and Schlagenhauf and Wrase (1995). This is because a key assumption in those models is that households do not adjust their financial assets, liabilities, or net funds raised in financial markets immediately after a monetary policy shock.

B. *The Other Sectors of the Economy*

In the previous subsection we showed that the initial increase in net funds raised by the business sector does not coincide with a decrease in net funds raised by the household sector. In this subsection we briefly analyze the remaining sectors of the economy to assess whose funds decline in the initial wake of a contractionary monetary policy shock.

Let *FINET*, *FONET*, and *GNET* denote the FOFA measures of net funds raised by the financial, foreign and government sectors, respectively. We denote the corresponding NIPA measures by *FINET**, *FONET**, and *GNET**. The impulse response functions of these variables to a contractionary monetary policy shock are displayed in figure 11. Table 7 reports results pertaining to time averages of impulse responses, as well as variance decompositions.

According to our results, the rise in net funds raised by firms does not coincide with a decline in net funds raised by either the financial or foreign sector during the first two to four quarters of a monetary contraction. The financial sector does not display robust initial responses across the four cases considered in figure 11: in the first two quarters, *FINET* falls insignificantly while *FINET** rises (insignificantly for an *NBRD* shock). The foreign sector response is also not statistically significant in the first two quarters. Interestingly, both *FONET* and *FONET** rise in a statistically significant manner in the second half year after either an *FF* or an *NBRD* policy shock. The size of this response ranges from 2.5 to 6.8 billion 1987 dollars. This evidence indicates that the foreign sector is raising net funds three to four quarters after a policy shock just as the domestic business and household sectors seem to be reducing their net funds raised. This may reflect the dynamic response of foreign central banks to a contractionary U.S. monetary policy shock. For example, if foreign central banks react with a delay, so that foreign economies begin their recession later than the United States, then the demand for funds by the foreign business sector could be rising just as the domestic demand for funds falls (see Eichenbaum and Evans (1995) and Grilli and Roubini (1993)).

The dynamic response pattern of net funds raised by the government is also interesting. Both *GNET* and *GNET** fall in a statistically significant manner in the first two quarters after an *FF* policy shock. After that, as the economy begins to move into a recession (see section II), net funds raised by the government rises. For the *NBRD* policy shocks, the initial responses of *GNET* and *GNET** are smaller and not statistically significant from zero. So there is some disagreement between the two policy shock measures on this dimension. Interestingly, for the *FF* policy shock, the initial decline in net funds raised by the government is of the same order of magnitude as the initial rise in net funds raised by firms. In this case, according to table 4, net funds raised by firms jumps around 4.5 to 6 billion 1987 dollars per quarter in the first two quarters after a policy shock, while net funds raised by the government falls by between 6 and 8 billion 1987 dollars over the same period (see table 7). To put the initial response of the government sector into perspective, it is useful to make two observations. First, our results do not imply that the government deficit goes down in a recession. In section II we showed that the decline in real GDP precipitated by a contractionary monetary policy shock begins in earnest only a year or so after the shock. According to figure 11, it is at that

TABLE 7. — PROPERTIES OF IMPULSE RESPONSE FUNCTIONS WITH COMMODITY PRICES

	Effects of Federal Funds Policy Shocks on:					
	GNET	*FINET*	*FONET*	*GNET**	*FINET**	*FONET**
1–2 Quarters	–7.896	–1.586	2.248	–5.974	0.806	–0.527
Significance	0.000	0.154	0.192	0.000	0.001	0.635
3–4 Quarters	1.767	2.141	4.564	–0.183	1.346	2.405
Significance	0.498	0.081	0.036	0.930	0.000	0.102
Variance Decomposition	11.990	8.385	8.765	13.338	15.255	8.766
Significance	0.012	0.037	0.074	0.019	0.070	0.118
	Effects of Negative Nonborrowed Reserve Policy Shocks on:					
	GNET	*FINET*	*FONET*	*GNET**	*FINET**	*FONET**
1–2 Quarters	–3.100	–0.971	2.341	–1.526	0.249	1.085
Significance	0.172	0.397	0.163	0.379	0.303	0.307
3–4 Quarters	1.215	–0.802	6.861	1.592	0.055	3.801
Significance	0.628	0.553	0.001	0.409	0.888	0.007
Variance Decomposition	5.928	5.198	8.379	6.467	6.796	7.384
Significance	0.061	0.034	0.026	0.078	0.177	0.082

Note: See notes to table 2. The underlying estimated impulse response functions and variance decompositions were computed as described in the note to figures 10 and 11.

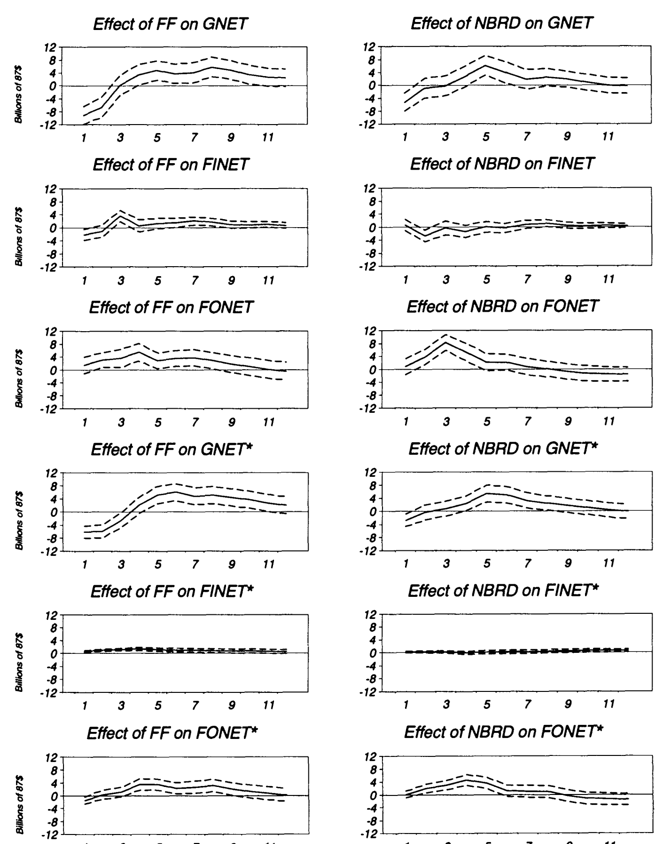
time that net funds raised by the government goes up. Second, the magnitude of the initial fall in net funds raised is not large relative to either total government receipts, or to the average value of net funds raised by the government. For example, total government receipts in 1982 is 960.5 billion dollars (see 1993 Economic Report of the President, p. 440.) Also, net funds raised by the government averages 106.7 billion 1987 dollars in our data sample.

C. *A Closer Look at Government*

While the initial decline in government borrowing after a contractionary *FF* policy shock is small, we find it puzzling. To shed light on this result, we now investigate the source of the decline. We begin by looking at NIPA data on the government deficit, as well as data on government expenditures and receipts. We measure expenditures and receipts net of government transfer payments and net of net interest paid by government. Figure 12 displays the dynamic response functions of the government deficit, government expenditures and government receipts to contractionary *FF* and *NBRD* policy shocks. Even though the effect of *NBRD* shocks on *GNET* and *GNET** was insignificant, we continue to investigate their impacts here for symmetry. Table 8 reports results pertaining to the time average of impulse responses, as well as variance decompositions.

Consider first the case of *FF* policy shocks. Consistent with the results in the previous subsection, in the two quarters after a contractionary monetary policy shock, the NIPA government deficit falls by about 5 billion 1987 dollars per quarter.[21] The fall in the deficit is primarily due to a significant

FIGURE 11. — EFFECTS OF POLICY SHOCKS ON GOVERNMENT, FINANCIAL, AND FOREIGN SECTORS



Note: See notes to figure 6 for an analogous explanation of impulse response functions.

[21] The NIPA measure of net government borrowing corresponding to *GNET** that is used in figure 11 and table 7 differs slightly from the NIPA measure used in figure 12 and table 8 for two reasons. First, differences reflect data revisions, since they come from different sources. Second, the concepts are slightly different. For example, the NIPA-based measure of the federal government surplus provided in Board of Governors (various issues) is the official NIPA measure minus insurance credits to households (11.9), plus mineral rights sales (7.8). The numbers in parentheses are values of these variables in 1982, in current dollars.

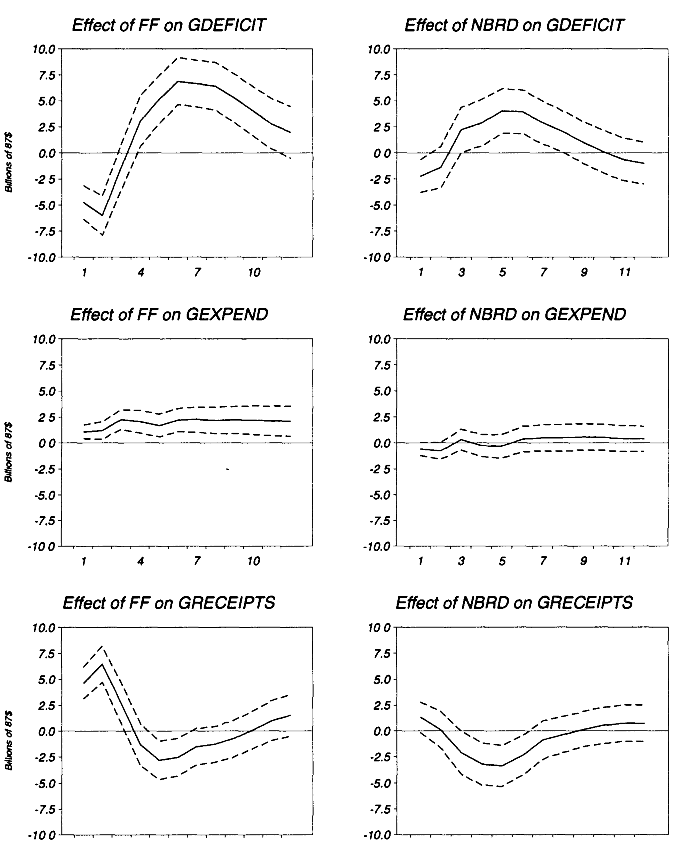
TABLE 8. — PROPERTIES OF IMPULSE RESPONSE FUNCTIONS WITH COMMODITY PRICES

	Effects of Federal Funds Policy Shocks on:							
	GDEFICI	*GEXPEN*	*GRECEI*	*PERTAX*	*CORPTA*	*INDBTA*	*SSTAX*	*TRANSF*
1–2 Quarters	−5.367	1.129	5.554	4.634	−0.181	0.181	0.304	−1.115
Significance	0.000	0.087	0.000	0.000	0.617	0.493	0.332	0.046
3–4 Quarters	0.850	2.156	0.718	3.502	−2.893	−0.950	−0.317	−0.031
Significance	0.683	0.025	0.686	0.028	0.000	0.046	0.411	0.967
Variance Decomposition	17.218	15.929	8.088	11.533	20.606	6.943	28.294	9.204
Significance	0.006	0.112	0.021	0.022	0.001	0.308	0.011	0.071

	Effects of Negative Nonborrowed Reserve Policy Shocks on:							
	GDEFICI	*GEXPEN*	*GRECEI*	*PERTAX*	*CORPTA*	*INDBTA*	*SSTAX*	*TRANSF*
1–2 Quarters	−1.799	−0.692	0.744	0.042	−0.024	−0.031	0.118	−0.368
Significance	0.247	0.287	0.595	0.972	0.948	0.908	0.714	0.517
3–4 Quarters	2.557	0.020	−2.610	−0.864	−2.092	−0.737	0.188	−0.463
Significance	0.193	0.984	0.159	0.567	0.000	0.137	0.604	0.520
Variance Decomposition	6.194	4.237	4.564	5.087	7.649	4.956	12.751	6.617
Significance	0.067	0.320	0.085	0.127	0.040	0.322	0.117	0.175

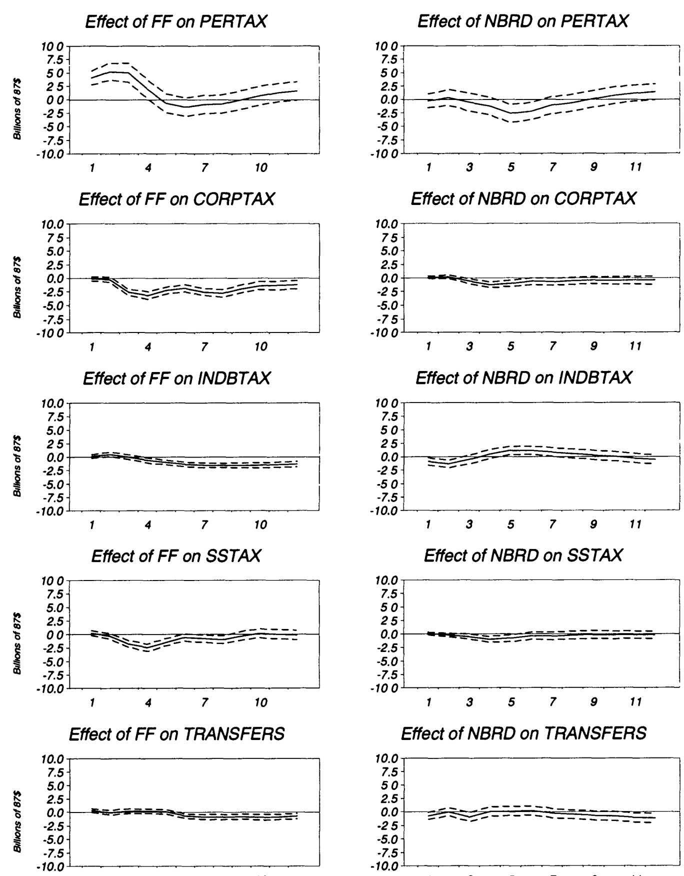
Note: See notes to table 1. The underlying estimated impulse response functions and variance decompositions were computed as described in the note to figures 11 and 12.

FIGURE 12. — EFFECT OF POLICY SHOCKS ON COMPONENTS OF THE GOVERNMENT BUDGET



Note: See notes to figure 6 for an analogous explanation of impulse response functions.

FIGURE 13. — EFFECT OF POLICY SHOCKS ON GOVERNMENT TAX RECEIPTS



Note: See notes to figure 6 for an analogous explanation of impulse response functions.

increase in government tax receipts, which rise by about 5 billion 1987 dollars per quarter in the first year after a policy shock. Second, although *GDEFICIT* falls after an *NBRD* policy shock, the decline is statistically insignificant, as are the responses of the other variables.

To see which component of government receipts is responsible for the rise in *GDEFICIT* following an *FF* policy shock, we computed the dynamic response functions of federal personal income taxes (net of transfer plus interest payments), corporate income taxes, indirect business taxes, social security taxes, and transfer plus net interest payments. These are reported in figure 13. Time averages of impulse response functions, as well as variance decompositions appear in table 8. Our results indicate that the rise in government receipts primarily reflects a rise in government personal income taxes *net* of transfers. These rise by an average of about 4.7 billion 1987 dollars in the first year after an *FF* policy shock. This rise primarily reflects an increase in personal income taxes *gross* of transfers. This suggests the possibility that some aspect of the tax system is responsible for the temporary decrease in government borrowing after an *FF* contractionary monetary policy shock.

VI. Conclusion

This paper characterized the response of the flow of funds between different sectors of the economy to a monetary shock. To do this, we constructed empirical measures of shocks to monetary policy and displayed the response of various non-FOFA economic aggregates to these measures. With one exception, these responses accord to a striking degree with conventional views about how monetary policy shocks affect the economy. The exception is that prices hardly change for three years after our measure of a contractionary monetary policy shock. An important task for future research is understanding this response pattern.

In our analysis of the FOFA data, we found that net funds raised by the business sector rises for roughly a year after a contractionary monetary policy shock. Thereafter, as the recession induced by the policy shock takes hold, net funds raised by the business sector declines. We conjecture that the initial rise in net funds raised reflects a deterioration in firms' cash flow due to a fall in sales, an initially unchanged level in production and a rise in inventories (see section II for some evidence on this point). While beyond the scope of this paper, it would be interesting to investigate the empirical plausibility of this conjecture. To the extent that this conjecture is true, an important task facing modelers of the monetary transmission mechanism is to identify the frictions which inhibit firms from quickly adjusting their nominal expenses after a contractionary monetary policy shock and the associated need to better understand the interaction between production and inventory dynamics.

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APPENDIX

In this appendix we describe our data sources. The data are described in the same order that they appear in the text. Unless indicated otherwise, all line and table numbers refer to the Board of Governors' *Guide to the Flow of Funds Accounts* (1993). The Flow of Funds data used in this paper are from the initial release of the third quarter of 1993 (December 8, 1993).[22] The data were seasonally adjusted by the reporting agency. Flow data from this source were converted to 1987 dollars using the seasonally adjusted GDP price deflator.

1. Data on the Fed's holdings of government securities were taken from line 7 plus line 9, table L.110.
2. Data on nonborrowed reserves plus extended credit are from the Federal Reserve's macroeconomic data base.
3. The data for the federal funds rate, total reserves, M1, real GDP, the GDP price deflator, manufacturing inventories, corporate profits in the trade sector and corporate profits in the nonfinancial sector were taken from the Federal Reserve's macroeconomic data base. Employment, unemployment and retail sales were taken from CITIBASE. Employment has mnemonic LP, and is total employees on nonagricultural payrolls. The mnemonic for unemployment is LHUR, and is the unemployment rate for all workers 16 years of age and older. The mnemonic for total retail sales is *RTRR*. These data are seasonally adjusted.
4. Nominal net funds raised by nonfinancial business is the negative of line 10, table F.101. The real analog is denoted by *BNET.*
5. Funds spent by nonfinancial business acquiring financial assets is given by line 11, table F.101. The real analog is denoted by *BASSETS*.
6. Funds raised by nonfinancial business issuing financial liabilities is given by line 12, table F.101. The real analog is denoted by *BLIAB*.
7. Funds raised by nonfinancial business issuing long-term financial liabilities, *BLONG*, is the sum of lines 13, 15, 16 and 17 in table F.101. The real analog is denoted by *BLONG*.
8. Funds raised by nonfinancial business issuing equity *BEQUITY* is line 13 in table F.101. The real analog is denoted by *BEQUITY.*
9. Funds raised by nonfinancial business issuing long-term debt, *BDEBT,* is the sum of lines 15, 16 and 17 in table F.101. The real analog is denoted by *BDEBT.*
10. Funds raised by nonfinancial business issuing short-term debt, *BSHORT,* is the sum of lines 18, 19 and 20 in table F.101. The real analog is denoted by *BSHORT.*
11. Net funds raised by corporations, *CNET,* is given by the minus of line 18, table F.104. The real analog is denoted by *CNET.*
12. The stock of corporate short-term liabilities is measured by the sum of lines 27 (bank loans, n.e.c.), 28 (commercial paper), and 29 (other loans) in table L.104. The log of this variable is denoted by *Corp.*
13. The stock of noncorporate short-term liabilities is measured by the sum of lines 18 (bank loans, n.e.c) and 19 (other loans) in table L.103. The log of this variable is denoted by *NCorp.*
14. The data on large and small manufacturing firms were kindly provided to us by Simon Gilchrist. The data are in flow form. We converted them to stocks by summing the flows and arbitrarily fixing the initial stock in 1959Q1.
15. The FOFA data on net funds raised by the household sector *HNET* corresponds to the Net Funds Raised row in the Household column of table 3.1 in the text. The corresponding NIPA data *HNET** correspond to the I-S row in that table.
16. FOFA data on net funds raised by the financial sector equal net funds raised by Sponsored Agencies and Mortgage Pools plus Commercial Banking plus Private Nonbank Finance. These correspond to minus {line 3, table F.107 plus line 1,table F.108 minus line 19, table F.107 plus line 5, table F.108} minus {line 3, table F.111 minus line 23, table F.111} minus {line 4, table F116 minus line 23, table F116}. The real analog to this series is denoted by *FINET.* The NIPA data on net funds raised by the financial sector equals *FINET* minus Discrepancy The latter equals line 24, table F.107 plus line 41, table F.111 plus line 41, table F116. The real analog to this time series is denoted by *FINET**
17. FOFA data on net funds raised by the foreign sector equal minus line 10, table 109. The real analog to this series is denoted by *FONET.* The NIPA data on net funds raised by the foreign sector equal *FONET* minus Statistical Discrepancy. The latter equals line 56, table F.109 after converting to 1987 dollars.
18. The FOFA measure of net funds raised by the government (local, state and federal) is minus line 11, table F.105 minus line 14, table F.106. The real analog to this time series is denoted by *GNET.* The NIPA measure of net funds raised by the government sector equals *GNET*– Statistical Discrepancy. The latter equals line 30, table F.105 plus line 35, table F.106 after converting to 1987 dollars.
19. The government deficit is –*(GGFNET+GGSNET*). These are the CITIBASE data mnemonics for the seasonally adjusted federal surplus, and state and local government surpluses. For our purposes, federal government expenditures (net of transfers) are defined as *GGFEX– GGFT – GGFINT– GGAID*. These are, respectively, the NIPA definition of federal expenditures, transfer payments (to persons and net payments to the rest of the world), net interest paid, and grants-in-aid to state and local governments. The result is total federal purchases plus subsidies less current surplus of government enterprises. Our definition of state and local government (net of transfers) expenditures is the same as the above, except *F* in the mnemonics is replaced by *S*, and *GGAID* does not appear. Total government expenditures is federal expenditures plus state and local government expenditures, as defined above. Our definition of federal government receipts (net of transfers) is *GGFR – GGFT – GGFINT –GGAID*, where *GGFR* denotes total federal government receipts. State and local government receipts net of transfers is as above, except *F* is replaced by *S* in the mnemonics, and *GGAID* does not appear. Total government receipts is the sum of the federal and state and local government receipts. The data were converted into billions of 1987 dollars using the GDP deflator.
20. The CITIBASE mnemonics for federal personal income taxes, corporate income taxes, indirect business taxes and social security taxes are, respectively, *GGFPT, GGFCA, GGFTX, and GGFSIN*. The measure of federal personal income taxes we work with is net of transfers and interest, i.e., *GGFPT – GGFT – GGFINT.* The corresponding mnemonics for state and local government replace the *F* by an *S*. For personal interest income, the mnemonic is *GPINT.* The data were converted to billions of 1987 dollars using the GDP deflator.

[22] As more data are included in the Z.1 Statistical Release, the line numbers of the tables will not correspond exactly to the line numbers referred to in *Guide to the Flow of Funds Accounts* (1993). Since the *Guide* also contains the original data sources for the Flow of Funds Accounts, we selected its line numbering convention.