Oil Shocks, Monetary Policy, and Economic Activity

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I. INTRODUCTION

The U.S. economy has experienced nine recessions over the post-World War II period. Whether the causes of these recessions are primarily real or monetary has been widely debated. In this paper we examine two seemingly conflicting results regarding the primary causes of contractions in U.S. economic activity since the end of World War II. One set of results obtained by Hamilton (1983) shows that major downturns in U.S. economic activity are associated with prior exogenous increases in oil prices, while another set of results established by Romer and Romer (1989) indicate that exogenous tightening in monetary policy is the major cause of declines in industrial production and increases in unemployment.

We note that while Hamilton is careful not to rule out the role policy may play in determining economic activity, he does place heavy emphasis on the effects of oil prices. Romer and Romer are more emphatic in their belief that they have uncovered exogenous monetary policy and that this policy is solely responsible for the events they study. We wish to examine their contention by testing whether real disturbances could simultaneously be influencing Federal Reserve policy and downturns in economic activity. Given Hamilton's work and the fact that four of the six episodes that the Romers associate with exogenous monetary policy are very close to oil price shocks, we check to see if these shocks are responsible for their results. We find that including oil prices in their analysis makes monetary policy as specified by the Romers insignificant.

Negating the results of Romer and Romer does not imply that monetary policy plays no role in determining economic activity. Following McCallum's (1983) suggestion, which is also implemented by Sims (1991), we use interest rates as a proxy for monetary policy in Hamilton's model. Specifically, we use the federal funds rate and the spread between the ten-year Treasury bill rate and the funds rate as depicting the relative tightness of monetary policy. In this setting we find that both oil price increases and movements in interest rates are significant in our statistical analysis of real GNP and employment. Further, an analysis of impulse response functions and variance decompositions indicates that innovations in both oil price increases and interest rates are associated with subsequent movements in real economic activity.

II. LITERATURE REVIEW

Here we review the analysis presented in the papers of Romer and Romer (1989) and Hamilton (1983) that are of primary interest to the subject of this paper. More broadly, these two papers represent contributions to the ongoing debate in macroeconomics concerning the primary source of economic fluctuations. Are these sources primarily real or monetary?

Romer and Romer (1989) adopt the perspective of the seminal work of Friedman and Schwartz (1963) that monetary policy explains much of the variation in economic activity. In performing their investigation of the relationship between monetary policy and movements in U.S. economic activity over the post-World War II period, they use Friedman and Schwartz's methodology, which they term the "narrative approach." This approach attempts to isolate historically exogenous monetary policy and then analyze the effects of such policy on economic activity. Whether or not they have accurately identified exogenous monetary shocks is the basis of our critical evaluation of their work.

The Romers' (1989) conclusion is that six of the eight postwar recessions in their data set were caused by contractionary monetary shocks. The identification of these monetary shocks is based on examinations of the "Record of Policy Actions" of the Board of Governors and the Federal Open Market

* We have benefited from the comments of James Hamilton, Thomas Humphrey, Peter Ireland, Jeffrey Lacker, and Bennett McCallum. The views expressed in this paper are those of the authors and do not necessarily reflect those of the Federal Reserve Bank of Richmond or the Federal Reserve System.

Committee (FOMC), as well as the minutes of the FOMC prior to their discontinuance in 1976. The Romers identify as shocks, "only episodes in which the Federal Reserve attempted to exert a contractionary influence on the economy in order to reduce inflation" (p. 134). Consequently, the Romers never investigate whether expansionary policy also has real effects. The Romers argue that the Fed only engages in expansionary policy to alleviate an economic downturn once it has already begun. Thus, it would be difficult to isolate the effect of monetary policy from any "natural recovery mechanism" inherent in the economy. After their examination of the historical record, the Romers identify six times during the postwar period that the Fed caused monetary shocks. The dates of these episodes are given in Table 1.

To investigate whether these monetary shocks do have real effects, the Romers (1989) conduct several experiments. Using monthly data on industrial production and the civilian unemployment rate from January 1948 to December 1987, the Romers estimate a univariate forecast for 36 months following each of the monetary shocks. If the actual values for the industrial production series were lower than the forecasted values based on previous values of each series, this would indicate that monetary policy does have real effects. (The opposite is true for the unemployment rate, since higher rates of unemployment are associated with economic downturns.) For industrial production, they find the average maximum deviation of the actual value from the forecasted value at a three-year horizon was −14 percent, with a range of −8 percent to −21 percent. With the exception of the December 1968 episode, the actual unemployment rate was typically 1.5 to 2.5 percentage points higher than its forecasted value two years after a monetary shock.

Table 1

Dates of Monetary and Oil Price Shocks

Money	Oil Prices
October 1947	December 1947
	June 1953
September 1955	
	February 1957
December 1968	March 1969
	December 1970
April 1974	January 1974 July 1974
August 1978	
October 1979	June 1979
	January 1981
	August 1990

As a second experiment, the Romers regress both series described above on 24 own lags and 36 lags of a dummy variable that assumes a value of one for the six monetary shocks and zero otherwise. From this regression an impulse response function is calculated to examine the effect of a unit shock to the dummy variable. For industrial production, the impact of the monetary shock peaks after 33 months, at which time industrial production is 12 percent lower than it would have been without a monetary shock. Similarly, the civilian unemployment rate peaks after 34 months and is 2.1 percent higher than it would have been otherwise.

Finally, the Romers check to see if other factors could be responsible for their results. They do this in two ways. First, they check whether supply shocks affect their results by excluding the two monetary shocks that could be associated with oil price increases (April 1974 and October 1979) and recalculating the impulse response functions. They find, however, that the new impulse response functions are essentially unchanged.

As a further test, the Romers include a supply shock measure, namely, the relative price of crude petroleum, in their regressions. Again, their results are essentially unchanged.

It is unclear, however, on what basis they reach their conclusion that supply shocks have little impact on the effect of their monetary shock variable. It appears to us that their claim is based solely on the shape and magnitude of the impulse response functions. If so, their conclusion is of limited interest. For instance, in the presence of other explanatory variables, the same impulse response function would be obtained if the estimated coefficients for the money dummy variable remained the same but the standard error of the coefficient increased. Such a situation would imply a less statistically significant effect of the monetary shock. For this reason, we feel that testing the sum of coefficients in a regression would provide a better estimate of the significance of both monetary and supply (i.e., oil) shocks. We perform this test in the next section.

Some of our skepticism concerning the Romer and Romer claim that supply shocks—in particular oil price shocks—are unimportant in influencing postwar U.S. economic activity is based on the influential empirical work of Hamilton (1983, 1985) and the theoretical work of Finn (1991). Hamilton's empirical work provides the basis for our investigation in Section IV and will be discussed in detail. Finn's work is also relevant since it provides an interesting model in which oil price shocks act as impulses in a real business cycle model. Her work argues that a significant portion of economic variability attributed to technological innovations is actually accounted for by oil price shocks.

From an empirical perspective, Hamilton (1983) notes that seven of the eight post-World War II recessions in his sample have been preceded by "dramatic" increases in the price of crude oil. He then hypothesizes three different explanations for this observation. First, the correlation between oil price increases and recessions is simply coincidence. Second, there is some other variable or set of variables that not only cause the oil price increases, but also cause the recessions. Finally, the oil price increases are at least partly responsible for the recessions. Although Hamilton does not explicitly refute the first hypothesis in his (1983) paper, in a later paper (1985) he rejects this hypothesis at the 0.0335 significance level.

Hamilton (1983) provides a detailed analysis of the second hypothesis. As a starting point, he considers the impact of oil prices in Sims's (1980) six-variable VAR model of the economy. This model includes real GNP, unemployment, U.S. prices, wages, money (M1), and import prices. Collectively, these variables do not Granger-cause oil prices. Using bivariate Granger-causality tests, Hamilton also finds that individually none of the six variables in Sims's model Granger-cause oil prices when four lags are used. However, oil prices do Granger-cause real GNP. Oil prices also Granger-cause unemployment. The only variable in Sims's system which does Granger-cause oil prices is the change in import prices when eight lags are included. Hamilton concludes, however, that import prices do not explain fluctuations in economic activity sufficiently to merit consideration as a variable that is jointly causing oil prices and economic fluctuations.

To further insure that no other third explanatory variable is responsible for both the increases in oil prices and the declines in real GNP, Hamilton (1983) tests several other series to see if they Granger-cause oil prices. Various output measures, including nominal GNP, the ratio of inventories to sales, the index of leading economic indicators, the index of industrial production, and the ratio of man-days idle due to strikes to total employment are used. Of these various measures, only the ratio of man-days idle due to strikes to total employment Granger-causes oil prices. As with import prices, variations in this series still do not account for the cyclical variation of output. Several different price series are also checked. Only one of the seven prices series considered, the price of coal, Granger-causes oil prices when both four and eight lags are included. Again, however, this series cannot explain future output. Finally, two financial variables are considered—the yields on BAA bonds and the Dow-Jones Industrial Average. Neither of these variables are found to Granger-cause oil prices. Thus, Hamilton concludes there is little evidence that some third variable explains both the increases in oil prices and the recession that normally follows. Since both the first and second hypotheses have been rejected, his finding bolsters the argument for the last alternative. Specifically, "the timing, magnitude, and/or duration of at least some of the recessions prior to 1973 would have been different had the oil price increase or attendant energy shortages not occurred" (1983, p. 247).

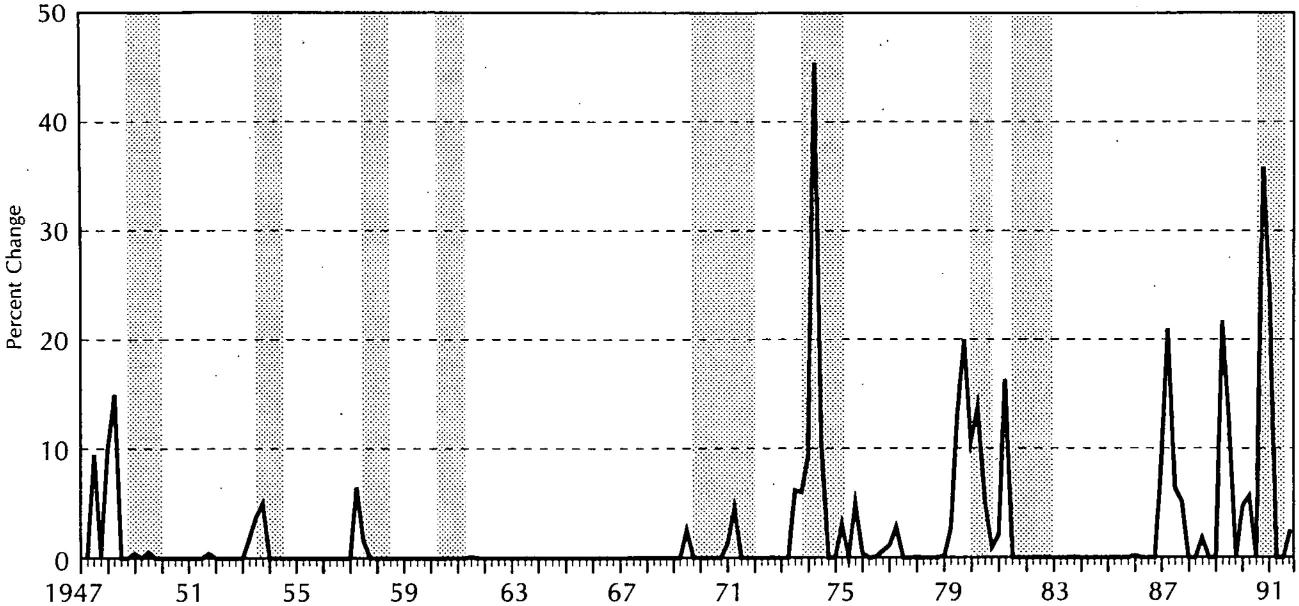
III. A Reexamination of the Romer and Romer Hypothesis

Romer and Romer (1989) attempt to uncover the effects of monetary policy by examining the response of the economy to unexpected exogenous tightening in policy. By focusing on monetary tightness in response to excessive inflation, they claim an ability to isolate shocks that are purely monetary in nature. For this procedure to capture solely monetary events it is important that the inflationary pressures that the Fed is reacting to are not caused by real disturbances. As one can see from Table 1 and Chart 1, four of their dates are very near positive shocks to oil prices (POIL). Indeed, in both the 1974 and 1979 episodes the effects of oil price increases on inflation were discussed at FOMC meetings.

In order to sort out the effects of oil prices and the six contractionary episodes selected by Romer and Romer, we include the percent change in oil prices (OIL) in a reexamination of their statistical results. We first replicate their results in Table 2, and then check them for sensitivity to slight changes in lag structure and the sample period. We perform this check because our oil price data does not

Chart 1

POSITIVE OIL PRICE SHOCKS



Note: Shading denotes recessions.

Table 2

The Romer and Romer Results*

$$IP_t = \alpha_0 + \sum_{i=1}^{11} B_{1i}M_{it} + \sum_{j=1}^{24} B_{2j}IP_{t-j} + \sum_{k=0}^{n} B_{3k}MD_{t-k},$$

where IP = the log change of industrial production,
M = a set of monthly seasonal dummy variables,
and MD = the Romers' dummy variable for contractionary monetary shocks.

Sample Period	1948:2–1987:12	1948:2–1987:12	1950:1–1990:12	1950:1–1990:12
IP	–.219(.327)	–.134(.506)	–.162(.460)	–.059(.77)
MD (n=36)	–.100(.0167)		–.089(.028)	
MD (n=24)		–.085(.0066)		–.071(.023)
$\bar{R}^2$	.790	.788	.796	.794
S.E.E.	.0132	.0132	.0127	.0128

$$U = \alpha_0 + \alpha_1 \text{TREND} + \sum_{i=1}^{11} B_{1i}M_{it} = \sum_{j=1}^{24} B_{2j}U_{t-j} + \sum_{k=0}^{n} B_{3k}MD_{t-k},$$

where U = the civilian unemployment rate, and the remaining variables are as described above.

Sample Period	1948:1–1987:12	1948:1–1987:12	1950:1–1990:12	1950:1–1990:12
U	.972(.000)	.971(.000)	.973(.000)	.973(.000)
MD (n=36)	2.106(.016)		2.06 (.014)	
MD (n=24)		1.25 (.054)		1.06 (.097)
$\bar{R}^2$	.977	.977	.977	.977
S.E.E.	.267	.268	.259	.261

* The reported results are the estimated sum of coefficients for each variable, with the p-value for the t-test testing the null hypothesis that this sum equals zero included in parenthesis. The estimates for the constant and monthly dummies, as well as the trend term in the employment regression, are not reported.

exactly overlap with their sample period and we want to make sure that we do not confuse oil price effects with a slight change of specification. As one can see from the results in the table, the sum of coefficients on the money dummy is significant at the 10 percent level in all regressions and at the 5 percent level in most regressions. Therefore, our results concerning the addition of oil prices reflect the effect of oil prices. (See Tables 3a and 3b.)

The real price of oil series is derived using Mork's (1989) procedure that corrects for the effect of price controls in the early 1970s. As mentioned, the regressions are run on monthly data over a slightly different sample period than the one used by Romer and Romer (1989). We analyze the period 1950:1-1990:12. As in their analysis, we include seasonal dummies and a trend in the regressions for unemployment. Our specification includes only 24 lags of the dependent variable rather than the 36 lags employed in their study.[1] The dependent variables examined are the percent change in industrial production (IP) and the unemployment rate (U). The independent variables are the Romer and Romer money dummy (MD) and oil (OIL). We also examine regressions in which we separate the effects of positive oil price shocks (POIL) from negative oil price shocks (NOIL).

Tables 3a and 3b present results that are consistent with the methodology of Romer and Romer. Implicit in this specification is the assumption that the money dummy and oil prices are exogenous. We also ran regressions omitting contemporaneous values of oil prices and the money dummy with little change in results.

In the regressions on industrial production, changes in oil prices have asymmetric effects. This finding is consistent with the result of Mork (1989) and the discussion in Shapiro and Watson (1988). There are numerous reasons why the effect of oil prices on economic activity may be asymmetric. One model that formally treats this asymmetry is Hamilton (1988), which relies on specialized labor inputs and on movements of labor across sectors.

In Hamilton's (1988) model any exogenous change in the supply of oil and hence its price can induce unemployment. Individuals choose to relocate from an industry that is adversely affected by oil price shocks if the effect of the shock is prolonged enough to warrant the costs associated with relocation. Since there exist some industries that can suffer when oil prices rise as well as industries that suffer when prices fall, any change in oil prices can potentially induce declines in output and employment. For example, a fall in the price of oil could cause a contraction in the oil industry. Analogously, a rise in the price could cause unemployment and a decline in output in industries that use oil as an input or that produce goods such as automobiles that rely on the use of oil. Depending on the relative strength of income and substitution effects and the relative importance of various sectors in the economy, the effects of oil price changes could be either symmetric or asymmetric. It is also possible that a rise in the price of oil could lead to a decline in economic activity while a fall in the price of oil could have little or no effect.

Another class of models that can produce asymmetric results are models that involve differential financing costs when firms finance their activities using either retained earnings or external finance [see Gertler (1988), Fazzari, Hubbard and Peterson (1988), and Gilchrist (1989)]. In the absence of complete hedging arrangements, firms relying on oil as an essential input are more likely to bump up against a financing constraint when oil prices rise and thus could face an increase in their effective cost of capital. The rise in the effective cost of capital would lower investment and output.

The regression results in Tables 3a and 3b indicate that positive changes in oil prices are associated with declines in industrial production while monetary policy is insignificant, where significance is measured using t-statistics for the sum of the coefficients. The significance levels are depicted inside the parentheses next to the sums of coefficients. With regard to unemployment, changes in oil prices have a significant positive effect while monetary policy is again insignificant. Also, if we use only money dummies for the two periods—September 1955 and August 1978—that are not contaminated by large oil price movements, the sum of the coefficients on the dummy variable is insignificant.

We conclude from this exercise that monetary policy as isolated by Romer and Romer is not statistically associated with subsequent real economic activity. Rather it is the presence of oil price shocks that occurred at nearly the same time as their contractionary monetary episodes that is responsible for their results.

[1] Using 36 lags did not appreciably alter our results and the slight change in sample period needed to accomodate our oil price data is innocuous.

Table 3a

Monthly Regression Results*

$$IP_t = \alpha_1 + \sum_{i=1}^{11} B_{1i}M_{it} + \sum_{j=1}^{24} B_{2j}IP_{t-j} + \sum_{k=0}^{24} B_{3k}MD_{t-k} + \sum_{l=0}^{24} B_{4l}POIL_{t-l} + \sum_{m=0}^{24} B_{5m}NOIL_{t-m},$$

where IP = log change of industrial production
M = a set of monthy seasonal dummy variables
MD = the Romers' dummy variable for contractionary monetary policy
POIL = positive log changes of the price of oil constructed according to Mork's (1989) methodology
NOIL = negative log changes of the price of oil constructed according to Mork's (1989) methodology.

Sample Period	1950:1–1990:12	1950:1–1990:12
IP	−.234(.300)	−.206(.351)
POIL	−.149(.089)	−.144(.047)[1]
NOIL	−.009(.923)	
MD	−.044(.232)	−.048(.147)
$\bar{R}^2$	.792	.796
S.E.E.	.0128	.0127

* The reported results are the estimated sum of coefficients for each variable, with the p-value for the t-test testing the null hypothesis that this sum equals zero included in parentheses. The estimates for the constant and monthly dummies are not reported.

[1] The F-test testing the null hypothesis that the sum of coefficients for POIL equals the sum of coefficients for NOIL was F(1,381) = 2.723 with a p-value of .100.

Table 3b

Monthly Regression Results*

$$U_t = \alpha_0 + \alpha_1 TREND + \sum_{i=1}^{11} B_{1i}M_{it} + \sum_{j=1}^{24} B_{2j}U_{t-j} + \sum_{k=0}^{24} B_{3k}MD_{t-k} + \sum_{l=0}^{24} B_{4l}OIL_{t-l},$$

where U = the civilian unemployment rate
M = a set of monthly seasonal dummies
MD = the Romers' dummy variable for contractionary monetary shocks
and OIL = log changes in the price of oil constructed according to Mork's (1989) methodology.

Sample Period	1950:1–1990:12
U	.974(.000)
OIL	3.65 (.0248)[1]
MD	.225(.760)
$\bar{R}^2$	.977
S.E.E.	.261

* The reported results are the estimated sum of coefficients for each variable, with the p-value for the t-test testing the null hypothesis that this sum equals zero included in parentheses. The estimates for the constant and monthly dummies are not reported.

[1] The F-test testing the null hypothesis that the sum of coefficients for POIL equals the sum of coefficients for NOIL was F(1,380) = .0169 with a p-value of .897.

IV. Monetary Policy Reconsidered

In this section we reinvestigate the potential effects of monetary policy in the statistical model used by Hamilton (1983). In his study monetary policy is represented by M1. McCallum (1983) makes the forceful argument that policy is better represented by short-term interest rates since over most of the postwar period the operating instrument of the Federal Reserve has been the federal funds rate. Sims (1991) also supports this viewpoint. We use two different interest rate measures to represent monetary policy. They are the average federal funds rate and the spread between the ten-year Treasury bill rate and the funds rate. These series are displayed in Chart 2 and Chart 3. One can see most recessions are preceded by a run-up in the funds rate or a flattening or inversion of the yield curve.

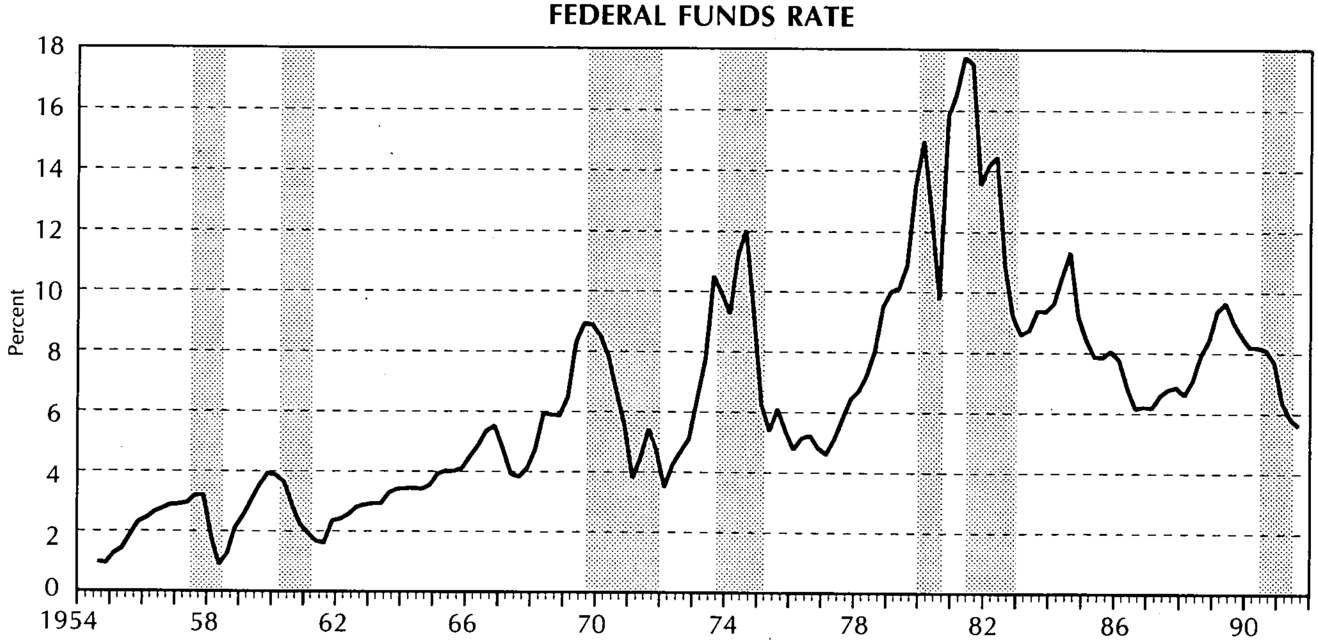
The empirical results are displayed in Table 4 for the sample period 1955:3-1991:3, where we include four lags of each variable. Again we test for an asymmetric effect of oil prices on output, which is measured by real GNP. The other variables in the regression are the funds rate (RFF), the spread (RS), the unemployment rate (U), import prices (IM), the wage rate (W), and the inflation rate (π) as measured by the GNP deflator. Following Hamilton we use first differences of the logs of GNP, import prices, the wage rate, inflation, and oil prices.

The results indicate that both positive percent changes in oil prices and our interest rate measures have significant explanatory power in explaining percentage changes in GNP. The signs on the coefficients for both our interest rate measures are consistent with a monetary policy interpretation. A rise in the funds rate or a rise in the funds rate relative to long-term interest rates (a fall in the spread) is associated with restrictive monetary policy and, hence, with declines in output.

To further examine our results we look at variance decompositions and impulse response functions. Our preferred specification is to order positive changes in oil prices first and our interest rate measures last. We prefer this because (1) oil price rises appear to be exogenous events [see Hamilton (1983, 1985)] and (2) putting interest rates last in the orthogonalization implies that the effects of interest rates are due to innovations that are orthogonal to other variables in the system. Thus the interest rate innovation is orthogonal to any taste or technology shocks that affect economic activity or inflation. These effects may reasonably be thought of as policy. McCallum (1983) shows that when the monetary authority uses an interest rate instrument, innovations in monetary policy are best captured by innovations in the nominal interest rate. By ordering interest rates last in our orthogonalization, we hope to exclude the effects of other endogenous variables

Chart 2

FEDERAL FUNDS RATE



Note: Shading denotes recessions.

Table 4

Quarterly Regression Results for the Log Change of Real GNP*

$$GNP_t = \alpha_0 + \sum_{i=1}^{4} \alpha_{1i} X_{t-i},$$

where X is a vector of explanatory variables.

(Note: Each column below corresponds to a distinct X-vector.)

	(1)	(2)	(3)	(4)
GNP	.0841(.784)	.045 (.88)	−.067 (.833)	−.068 (.83)
POIL	−.0723(.0136)[1]	−.077 (.0068)	−.079 (.007)[2]	−.083 (.0041)
NOIL	.0213(.398)		.029 (.255)	
RFF	−.001 (.007)	−.0012(.0019)		
RS			.003 (.004)	.0026(.005)
U	.002 (.001)	.0021(.0015)	.0005(.457)	.0003(.66)
IM	.096 (.197)	.11 (.14)	.173 (.026)	.188 (.013)
W	−.718 (.077)	−.69 (.078)	−.528 (.175)	−.40 (.28)
π	.523 (.271)	.56 (.23)	.176 (.682)	−.088 (.83)
$\bar{R}^2$	.32	.31	.31	.30
S.E.E.	.0082	.0082	.0082	.0083

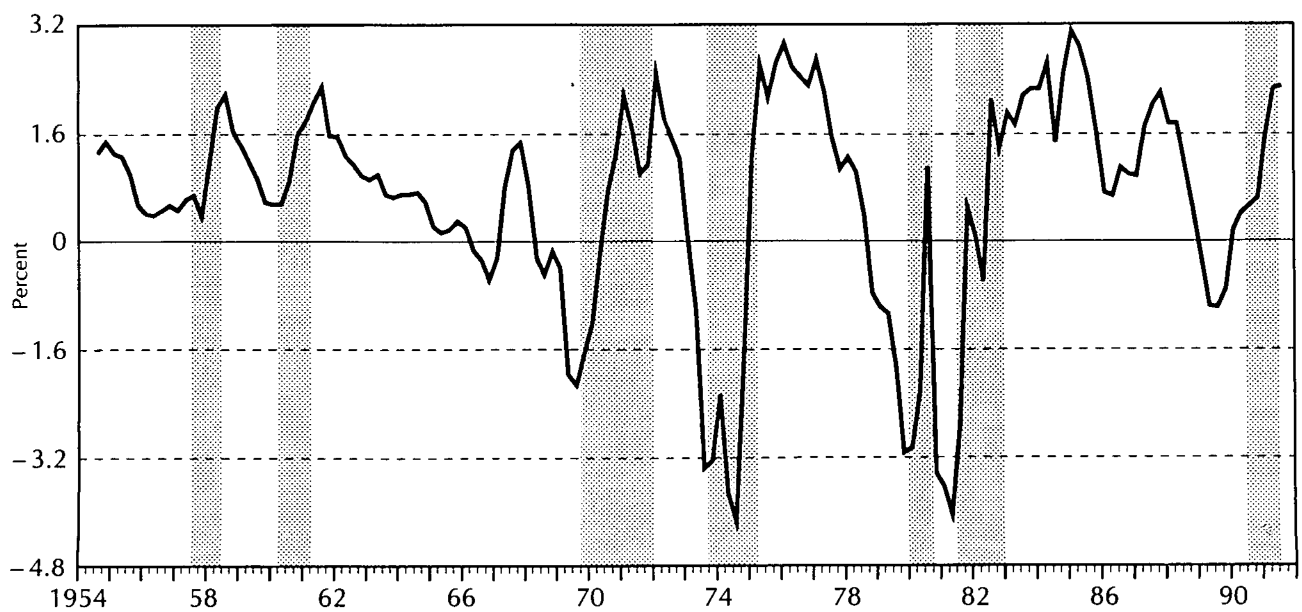
* The reported results are the estimated sum of coefficients for each variable in the X-vector, with the p-value for the t-test testing the null hypothesis that this sum equals zero included in parentheses. Estimates for the constant term are not reported. The sample period is 1955:3-1991:3.

[1] The F-test testing the null hypothesis that the sum of coefficients for POIL equals the sum of coefficients for NOIL was F(1,112) = 6.866 with a p-value of .01.

[2] The F-test testing the null hypothesis that the sum of coefficients for POIL equals the sum of coefficients for NOIL was F(1,112) = 8.97 with a p-value of .003.

Chart 3

INTEREST RATE SPREAD



Note: Shading denotes recessions.

that may influence Fed behavior. As a specification check we include results from an alternative ordering in which interest rates are ordered first and positive oil price changes are ordered last.

The variance decomposition results are given in Table 5. In our preferred specification oil prices explain between roughly 5 and 6 percent of the variation in GNP. These results are not very sensitive to the ordering of the variables, nor do they seem to vary with respect to the interest rate measure. This evidence is consistent with the hypothesis that oil prices are exogenous. The federal funds rate explains about 5 percent of the variation in output in our preferred specification, while the spread explains roughly 8 percent of the variation in GNP. Not surprisingly, the contribution of these two variables for changes in GNP is influenced by their ordering in the orthogonalization.

Charts 4a and 4b depict the summed impulse response functions for our preferred specification. The cumulative response of GNP to a 1 percent increase in oil prices peaks in seven quarters at a value

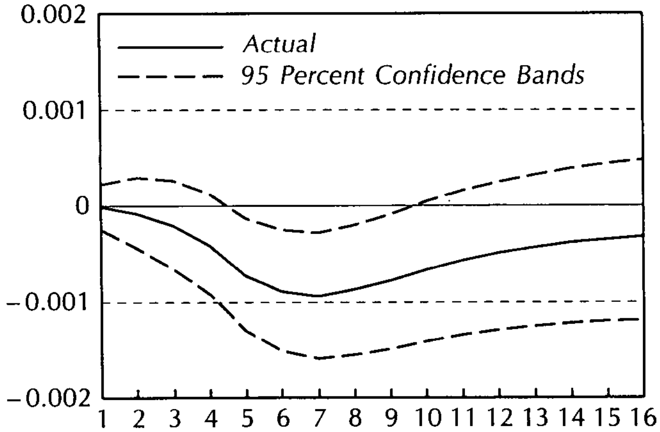
Table 5

Variance Decompositions for Percent Change in GNP

	(POIL)		(RFF)	
Step	Percent of Variance Explained	95% Confidence Interval	Percent of Variance Explained	95% Confidence Interval
(POIL first, RFF last)				
1	.01	(.00, 2.29)	.00	(.00, .00)
4	2.03	(.00, 8.53)	5.29	(.13, 11.49)
8	5.09	(.61, 13.50)	5.15	(1.36, 10.51)
12	5.71	(.71, 14.62)	5.00	(1.46, 10.36)
16	5.83	(.61, 15.21)	4.94	(1.46, 10.36)
(POIL last, RFF first)				
	(POIL)		(RFF)	
1	.00	(.00, .00)	3.58	(.00, 10.36)
4	1.51	(.00, 6.94)	11.84	(3.79, 21.18)
8	4.92	(.52, 12.69)	14.17	(5.97, 22.58)
12	5.77	(.69, 14.12)	13.79	(5.88, 22.21)
16	6.35	(.55, 15.36)	13.65	(5.84, 22.09)
(POIL first, RS last)				
	(POIL)		(RS)	
1	.01	(.00, 2.51)	.00	(.00, .00)
4	1.88	(.00, 8.79)	7.43	(.69, 15.15)
8	5.29	(.26, 14.87)	7.93	(1.80, 15.59)
12	5.65	(.50, 15.44)	7.95	(2.00, 15.99)
16	5.58	(.49, 15.48)	8.38	(1.83, 17.07)
(POIL last, RS first)				
	(POIL)		(RS)	
1	.00	(.00, .00)	.01	(.00, 2.80)
4	1.98	(.00, 7.50)	8.71	(1.09, 18.61)
8	5.89	(.78, 13.29)	10.94	(3.16, 21.24)
12	6.85	(1.25, 14.58)	10.85	(3.27, 21.52)
16	7.18	(1.20, 15.28)	11.25	(3.22, 22.50)

Chart 4a

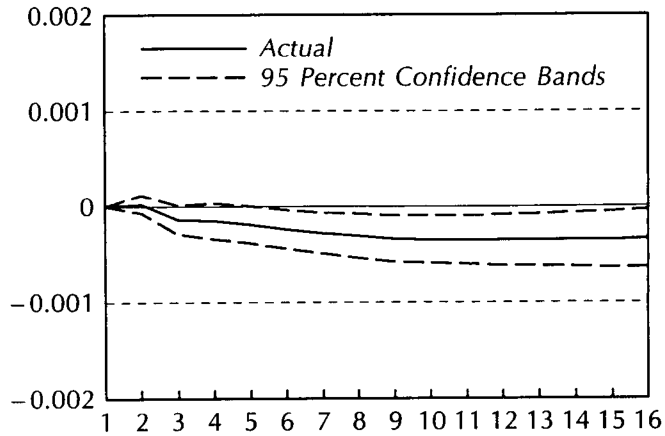
CUMULATIVE RESPONSE OF DLN(GNP) TO A 1 PERCENT SHOCK IN SERIES POIL



Order: POIL, first; RFF, last

Chart 4b

CUMULATIVE RESPONSE OF DLN(GNP) TO A 1 PERCENT SHOCK IN SERIES RFF



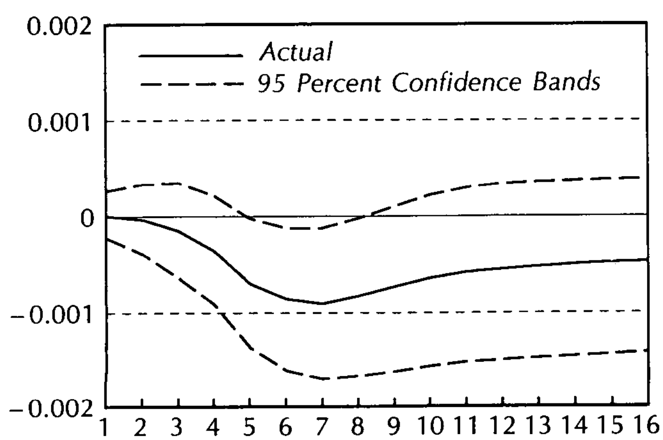
Order: POIL, first; RFF, last

of −.094 percent. This result is very close to the one reported in Shapiro and Watson (1988) in a somewhat different empirical setting. Our result corresponds to a 4.23 percent loss in output due to a 45 percent increase in oil prices attributable to the 1973 oil embargo. The response of GNP to a 1 percent increase in the average funds rate for the period, which equals an increase of 6.39 basis points, peaks at 13 quarters with a decline in GNP of −.036 percent. This change would correspond to a loss in output of 3.39 percent in response to a funds rate increase from 9.83 to 15.85. These last numbers depict the run-up in interest rates during the autumn of 1980 resulting from the restrictive monetary policy conducted by the Fed. The alternative ordering of the variables results in similar impulse response functions for a positive oil price shock, while the effect of the funds is increased by about 50 percent.

The results using the spread are depicted in Charts 5a and 5b. In our preferred specification, the response of GNP to a 1 percent increase in oil prices again peaks in the seventh quarter at a value of −.091 percent while GNP's response to the spread peaks in quarter nine at a value of −.0057 percent. This result implies a 4.1 percent loss in output due to the 1973 oil embargo and a 4.25 percent loss in output due to the 1980 tightening in monetary policy. Changing the ordering of the variables increases the effects of both variables by about 20 percent.

Chart 5a

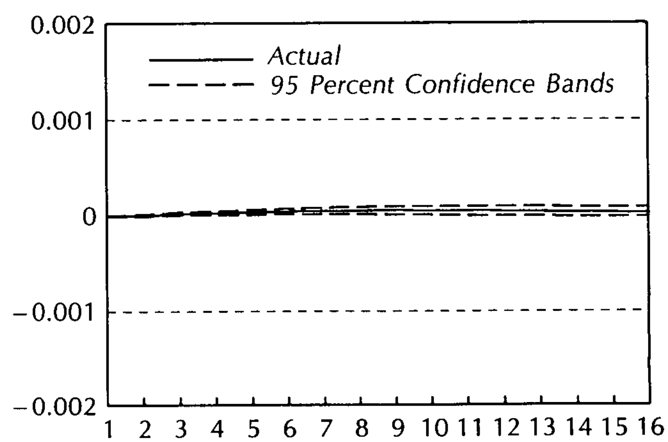
CUMULATIVE RESPONSE OF DLN(GNP) TO A 1 PERCENT SHOCK IN SERIES POIL



Order: POIL, first; RS, last

Chart 5b

CUMULATIVE RESPONSE OF DLN(GNP) TO A 1 PERCENT SHOCK IN SERIES RS



Order: POIL, first; RS, last

To further examine the effects of oil prices and monetary policy on real economic activity, we also look at the response of the percentage change of employment in nonfarm and nongovernment activities to changes in oil prices and interest rates. These regressions are given in Table 6 and are identical to those reported in Table 4, with employment replacing GNP. The results using the spread as a measure of monetary policy are consistent with our results for GNP, but the funds rate does not appear to affect employment significantly. Increases in oil prices reduce employment and enter asymmetrically in the empirical specification that uses the spread, a result consistent with Mork's (1989) conclusions. By contrast, we reject an asymmetric effect in regressions with the funds rate. Taking the results on GNP and employment together, our results are broadly consistent with Mork's (1989) finding of asymmetry.

Regarding variance decompositions (Table 7), positive oil price shocks account for roughly 8-10 percent of the variation in employment when oil prices enter first in the orthogonalization. Their contribution is reduced to about 6 percent when oil enters last. The contribution of the monetary policy variables is greatly enhanced when they are the first element in the orthogonalization. This result indicates that disturbances other than those depicting policy are included in the interest rate innovations. In our preferred specification the funds rate contributes roughly 6 percent to the variation in employment while the spread contributes about 15 percent.

The impulse response functions also look very similar to those depicted for GNP. These are displayed in Charts 6a, 6b, 7a, and 7b. In our preferred specification, the effect of a 1 percent positive

Table 6

Quarterly Regression Results for the Log Change of Employment*

$$E_t = \alpha_0 + \sum_{i=1}^{4} \alpha_{1i} X_{t-i},$$

where X is a vector of explanatory variables.

(Note: Each column below corresponds to a distinct X-vector.)

	(1)	(2)	(3)	(4)
E	.31 (.115)	.34 (.070)	.30 (.122)	.31 (.093)
POIL	−.031 (.084)[1]	−.028 (.108)	−.039 (.030)[2]	−.036 (.036)
NOIL	−.010 (.52)		−.0038(.81)	
RFF	−.0003(.19)	−.0003(.15)		
RS			.0013(.011)	.0013(.0062)
GNP	.50 (.015)	.47 (.017)	.35 (.096)	.34 (.097)
IM	.014 (.78)	.0016(.97)	.059 (.23)	.051 (.27)
W	−.41 (.106)	−.47 (.052)	−.40 (.095)	−.43 (.052)
π	.63 (.039)	.68 (.020)	.53 (.044)	.56 (.024)
$\bar{R}^2$	.54	.56	.55	.56
S.E.E.	.0051	.0051	.0051	.0050

* The reported results are the estimated sum of coefficients for each variable in the X-vector, with the p-value for the t-test testing the null hypothesis that this sum equals zero included in parentheses. Estimates for the constant term are not reported. The sample period is 1955:3-1991:3.

[1] The F-test testing the null hypothesis that the sum of coefficients for POIL equals the sum of coefficients for NOIL was $F(1,112) = .95$ with a p-value of .332.

[2] The F-test testing the null hypothesis that the sum of coefficients for POIL equals the sum of coefficients for NOIL was $F(1,112) = 2.56$ with a p-value of .113.

Table 7

Variance Decompositions for Employment

(POIL first, RFF last)

Step	(POIL) Percent of Variance Explained	(POIL) 95% Confidence Interval	(RFF) Percent of Variance Explained	(RFF) 95% Confidence Interval
1	.03	(.00, 2.66)	.00	(.00, .00)
4	1.61	(.00, 8.89)	4.86	(1.80, 12.75)
8	10.25	(.26, 22.16)	5.94	(.00, 14.67)
12	10.27	(.50, 22.19)	5.80	(.00, 14.51)
16	10.35	(.55, 22.28)	5.80	(.00, 14.56)

(POIL last, RFF first)

Step	(POIL) Percent of Variance Explained	(POIL) 95% Confidence Interval	(RFF) Percent of Variance Explained	(RFF) 95% Confidence Interval
1	.00	(.00, .00)	9.45	(1.20, 19.48)
4	1.17	(.00, 6.76)	8.89	(2.34, 17.89)
8	5.84	(.00, 16.96)	11.44	(2.95, 21.83)
12	5.86	(.00, 17.43)	11.29	(3.11, 21.63)
16	6.06	(.00, 17.96)	11.27	(3.29, 22.64)

(POIL first, RS last)

Step	(POIL) Percent of Variance Explained	(POIL) 95% Confidence Interval	(RS) Percent of Variance Explained	(RS) 95% Confidence Interval
1	.02	(.00, 2.67)	.00	(.00, .00)
4	1.14	(.00, 8.18)	6.84	(.00, 15.50)
8	7.26	(.00, 18.45)	15.67	(3.25, 26.55)
12	8.14	(.00, 19.53)	15.74	(3.49, 26.53)
16	8.42	(.02, 20.06)	15.58	(3.63, 26.15)

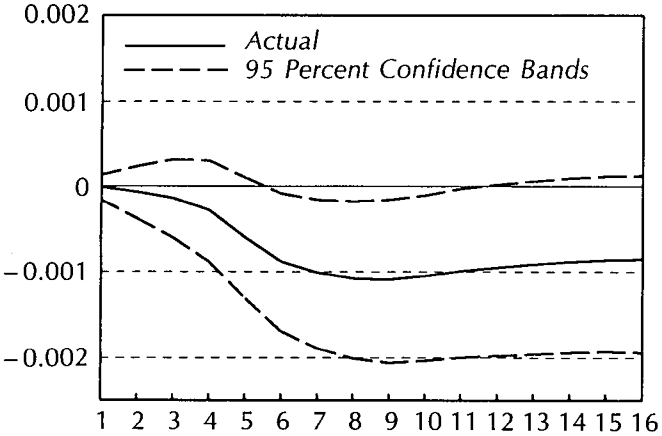
(POIL last, RS first)

Step	(POIL) Percent of Variance Explained	(POIL) 95% Confidence Interval	(RS) Percent of Variance Explained	(RS) 95% Confidence Interval
1	.00	(.00, .00)	3.22	(.00, 9.48)
4	2.00	(.00, 8.93)	8.16	(.45, 17.58)
8	5.96	(.00, 15.85)	21.55	(6.20, 35.57)
12	6.86	(.00, 17.05)	21.75	(6.55, 35.67)
16	7.40	(.00, 18.13)	21.59	(6.62, 35.22)

oil price shock peaks in quarter nine and causes employment to fall by .11 percent, while a 1 percent increase in the funds rate causes employment to fall by roughly .036 percent. These impulse responses correspond to a 5 percent fall in employment due to the 1973 oil embargo and a 3.4 percent fall in employment resulting from the 1980 monetary policy pursued by the Fed. When the spread is used to depict monetary policy, the effects of an oil price increase peak in the eighth quarter at −.085 percent and the effects of the spread peak in quarter eleven at .0077 percent (Charts 7a and 7b). Again these results correspond to a decline in employment of 3.8 percent and 5.7 percent over the 1973 and 1980 episodes, respectively. Thus both monetary policy and oil price disturbances appear to significantly associate with subsequent movements in employment.

Chart 6a

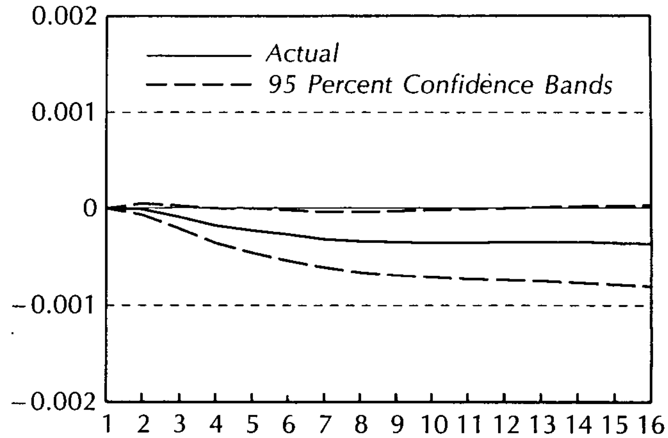
CUMULATIVE RESPONSE OF DLN(EMP) TO A 1 PERCENT SHOCK IN SERIES POIL



Order: POIL, first; RFF, last

Chart 6b

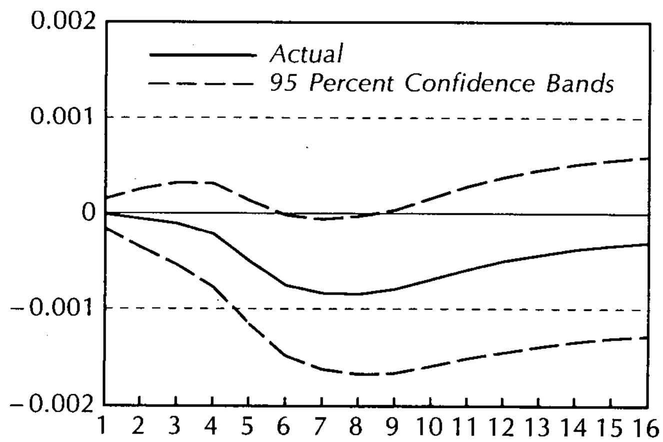
CUMULATIVE RESPONSE OF DLN(EMP) TO A 1 PERCENT SHOCK IN SERIES RFF



Order: POIL, first; RFF, last

Chart 7a

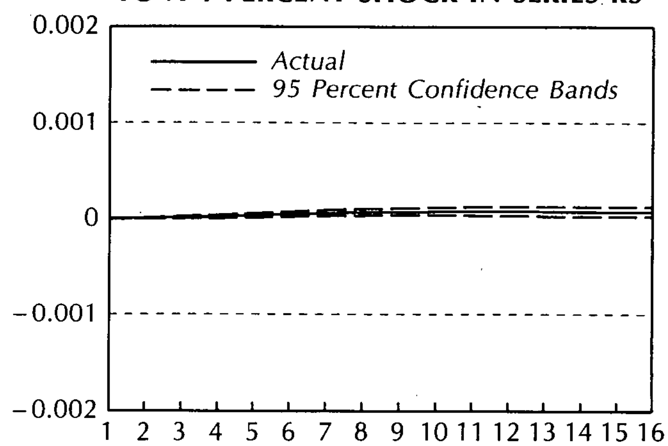
CUMULATIVE RESPONSE OF DLN(EMP) TO A 1 PERCENT SHOCK IN SERIES POIL



Order: POIL, first; RS, last

Chart 7b

CUMULATIVE RESPONSE OF DLN(EMP) TO A 1 PERCENT SHOCK IN SERIES RS



Order: POIL, first; RS, last

V. Conclusion

In this paper we take a somewhat more inclusive look than that taken by the Romers at the causes for economic downturns in the post-World War II U.S. economy. We find that their identification of monetary policy does not produce any convincing results. Nevertheless we do find that both tight monetary policy and oil price increases are statistically associated with declines in economic activity.

References

Fazzari, Steven M., R. Glenn Hubbard, and Bruce C. Peterson. "Financing Constraints and Corporate Investment," *Brookings Papers on Economic Activity*, vol. 1 (1988), pp. 141-95.

Finn, Mary G. "Energy Price Shocks, Capacity Utilization and Business Cycle Fluctuations." Institute for Empirical Macroeconomics, Federal Reserve Bank of Minneapolis, Discussion Paper No. 50, September 1991.

Friedman, Milton, and Anna Jacobsen Schwartz. *A Monetary History of the United States, 1867-1960*. Princeton University Press: Princeton, 1963.

Gertler, Mark. "Financial Structure and Aggregate Economic Activity: An Overview," *Journal of Money, Credit and Banking*, vol. 20 (August 1988, part 2), pp. 559-88.

Gilchrist, Simon. "An Empirical Analysis of Corporate Investment and Financing Hierarchies Using Firm Level Panel Data." Unpublished manuscript, 1989.

Hamilton, James D. "Oil and the Macroeconomy Since World War II," *Journal of Political Economy*, vol. 91 (April 1983), pp. 228-48.

__________. "Historical Causes of Postwar Oil Shocks and Recessions," *Energy Journal*, vol. 6 (January 1985), pp. 97-116.

__________. "A Neoclassical Model of Unemployment and the Business Cycle," *Journal of Political Economy*, vol. 96 (June 1988), pp. 593-617.

Hoover, Kevin D., and Stephen J. Perez. "Post Hoc Ergo Propter Hoc Once More: An Evaluation of 'Does Monetary Policy Matter?' In the Spirit of James Tobin." Institute of Government Affairs, University of California at Davis, Working Paper No. 74, 1991.

McCallum, Bennett T. "A Reconsideration of Sims' Evidence Concerning Monetarism," *Economics Letters*, vol. 13 (1983), pp. 167-71.

Mork, Knut Anton. "Oil and the Macroeconomy When Prices Go Up and Down: An Extension of Hamilton's Results," *Journal of Political Economy*, vol. 97 (June 1989), pp. 740-44.

Romer, Christina D., and David H. Romer. "Does Monetary Policy Matter? A New Test in the Spirit of Friedman and Schwartz," *NBER Macroeconomics Annual*, vol. 4 (1989), pp. 122-70.

Shapiro, Mathew D., and Mark W. Watson. "Source of Business Cycle Fluctuations," *NBER Macroeconomic Annual*, vol. 3 (1988), pp. 111-48.

Sims, Christopher A. "Macroeconomics and Reality," *Econometrica*, vol. 48 (1980), pp. 1-48.

__________. "Interpreting the Macroeconomic Times Series Facts: The Effects of Monetary Policy." Unpublished manuscript, August 1991.

Tatom, John A. "Are the Macroeconomic Effects of Oil Price Changes Symmetric?" *Carnegie Rochester Conference Series on Public Policy*, vol. 28 (1988), pp. 325-68.