AN EMPIRICAL ANALYSIS OF OIL PRICE SHOCKS IN THE INTERWAR PERIOD

W. DOUGLAS MCMILLIN and RANDALL E. PARKER*

This paper presents results that indicate that oil price shocks were economically important in explaining movements in industrial production, and, to a lesser degree, movements in wholesale prices in the period between World Wars I and II. The framework for analysis is a vector autoregressive model estimated using monthly data over 1924:2–38:6 that employs a financial intermediation variable, a measure of relative oil prices, and other variables typically found in small macroeconomic models. The impact of oil price shocks is evaluated through computation of variance decompositions and an historical decomposition over the 1929:9–38:6 period.

I. INTRODUCTION

Post-World War II experience demonstrates that disturbances to aggregate supply are important determinants of aggregate economic performance. A casual glance at the post-1970 data strongly suggests a correlation between shocks to the price of oil and recession. Hamilton [1983] formally demonstrates that this correlation arises from what appears to be a causal link that runs from oil price increases to reduced economic activity. The sequence of oil price increases followed by recession characterizes every post-World War II economic downturn in the U.S. with the exception of 1960–61.

Other research confirms the critical role of supply shocks in explaining post-World War II macroeconomic performance. Burbidge and Harrison [1984] employ vector autoregressions (VARs) to examine the impact of oil price shocks over the 1962–82 period for several countries. They conclude that these shocks played a large role in deepening the recessions of the 1970s, with the impact on the 1973–74 recession much greater than that of 1979–80. Tatom [1988] estimates the impact of the 1979–80 increase in the relative price of oil and reports that this shock reduced the amount of output that could be produced with available labor and capital by 5.7 percent. Thoma [1992] re-examines the work of Litterman and Weiss [1985] and finds that the ex ante real interest rate is not exogenous to supply shocks, contrary to what is reported in Litterman and Weiss. Using annual data over the 1948–82 period, Loungani [1986] shows that any correlation between an index of the dispersion of unemployment across industries and the aggregate unemployment rate is due to the dispersion index's collinearity with oil price shocks. Once this collinearity is accounted for, the dispersion index has no explanatory power to account for movements in the aggregate unemployment rate.

While the evidence for the causal link between supply shocks and output appears most dramatic for the post-1970

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data, Hamilton [1983] argues that the entire post-war period be treated as a continuous whole. The enduring regularity of the oil price shock—recession relation in this period leads to a natural question: Is there any evidence that oil price shocks (either positive or negative) played any role in the cyclical fluctuations and secular expansion of the 1920s and the Great Depression? Figure 1 presents a plot of the relative price of oil (defined precisely in section II) for the 1921:1–1938:6 period. We observe a number of sharp movements in the relative price of oil that suggest an assessment of the empirical impact of oil price shocks during the interwar period is warranted. Accordingly, we investigate the effects of oil price shocks during the interwar period within the context of a small macroeconomic model.[1]

The empirical framework is a VAR model that consists of output, the price level, the monetary base, the *M2* money multiplier, the commercial paper rate, government spending, a financial intermediation variable, and a measure of oil price shocks. These are variables frequently found in small macroeconomic models. Monthly data for the period 1924:2–1938:6 are used to specify and estimate the model. We evaluate the impact of oil price shocks on prices and output through computation of variance decompositions; the standard errors reported are generated through Monte Carlo simulations. Historical decompositions for the 1929:9–1938:6 period are also computed so we can specifically examine the effects of oil price shocks over the sample period that includes the Great Depression.

We chose the VAR modeling approach because there is little agreement on the appropriate structural model and VAR estimation places few restrictions on the way in which the system's variables interact. In the specification and estimation of the model, all variables are treated as jointly determined; no a priori assumptions are made about the exogeneity of any of the system's variables at this stage of analysis. However, in the computation of variance decompositions and historical decompositions, some decisions about structure must be made. These decisions are discussed in section III.

Section II discusses the data and the specification of the model, and the empirical results are presented and analyzed in section III. A brief summary and some conclusions are presented in section IV.

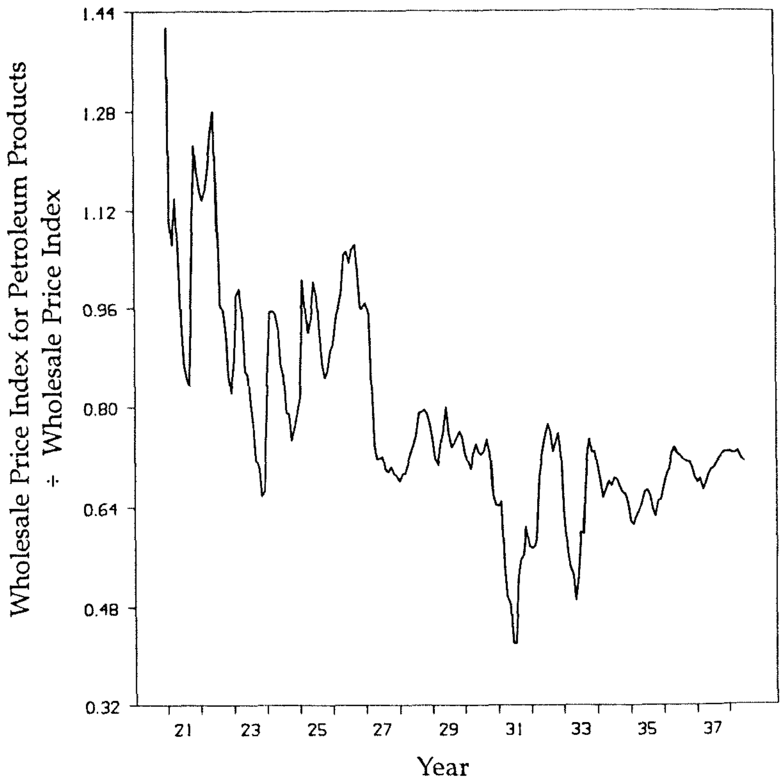
II. MODEL SPECIFICATION

We specified and estimated the model using monthly data over the 1923:2–1938:6 period. Data from 1923:2–1924:1 are used as presample data to generate the lags in the VAR, and the model is estimated over the period 1924:2–1938:6. We do not employ data from earlier years because of changes in the Federal Reserve Board's measure of industrial production. As reported by Romer [1988], in 1940 the Federal Reserve made a major revision to the index of industrial production that did not include the observations before 1923. We start our sample in 1923 to avoid generating results that may be statistical artifacts from the use of historically inconsistent data. The end of the sample coincides with the last peacetime interwar cycle identified by Firestone [1960], and our sample spans three of the four peacetime cycles he identified. The first, which begins in 1921:7, is excluded for the reasons mentioned above. Our sample thus avoids the transition periods from and to wars.

The variables of the model are as follows. The oil price shock variable is measured as the ratio of the wholesale price index for petroleum products to the wholesale price index. The wholesale price index for petroleum products is taken from the Bureau of Labor Statistics

1. Romer [1988] argues that positive supply shocks to farm products moderated the recession of 1921, but no empirical evidence is presented and no consideration is given to oil supply shocks.

FIGURE 1
Relative Price of Oil



Wholesale Prices 1930 and the *Handbook of Labor Statistics*, 1936 and 1941 editions. The wholesale price index comes from the 1933, 1938, and 1943 editions of the *Statistical Abstract of the United States.* Output is measured by the industrial production index with 1977 as the base year. Data for industrial production are taken from the 1985 revision of *Industrial Production* (Board of Governors of the Federal Reserve, 1985). The monetary base is Friedman and Schwartz's [1963] measure and is taken from their Table A-1. The *M2* money multiplier is calculated as the ratio of *M2* (from Friedman and Schwartz, Table A-1) to the monetary base. Real government expenditures include federal government purchases of goods and services and the small amount of transfer payments in our sample. Separate series on purchases and transfer payments were unavailable. Real government expenditures are measured in billions of dollars, and are calculated by deflating nominal government expenditures (taken from Firestone's [1960] Table A-3) by the wholesale price index. The interest rate is the four- to six-month yield on prime commercial paper. The yield differential is calculated as the difference (in percentage points) between the yields on Baa corporate and long-term U.S. government bonds. These variables are from *Banking and Monetary Statistics 1914-1941* (Board of Governors of the Federal Reserve System, 1943).

Real government expenditures are included as a fiscal policy measure.[2] Monetary policy is represented primarily by

2. Ideally, tax rates would also be included, but reliable monthly series for tax rates are not available. Real government expenditures include only federal spending since we are unaware of a monthly series for state and local spending.

inclusion of the monetary base. Although it is common for studies of the interwar period to include $M2$ as the monetary policy variable, this was not done because fluctuations in $M2$ reflect, in part, the behavior of banks and the public which alters the multiplier linking the monetary base and $M2$.[3] Since there is feedback from the state of the economy to the behavior of the public and banks and hence to the $M2$ multiplier and $M2$, the use of $M2$ as the monetary policy variable does not seem appropriate. The $M2$ multiplier is added following the evidence provided in Rush [1985], Fackler and Parker [1990], and Raynold, Beard, and McMillin [1993] regarding its importance in explaining output over the interwar period.[4] Bernanke [1983] argued that disruptions to financial intermediation had important nonmonetary effects on output and prices in addition to their monetary effects. One of Bernanke's measures of shocks to financial intermediation is the yield differential. This variable is also the focus of Mishkin's [1991] study of financial crises. Bernanke [1983, 266] argued that this variable is "an indicator of the strength of lender preferences for safe, liquid assets (and hence of the difficulty of risky borrowers in obtaining funds)." Thus a disruption to intermediation should lead to an increase in the yield differential. Evidence that shocks to financial intermediation matter is provided in Bernanke [1983], Fackler and Parker [1990], Flacco and Parker [1992], and Raynold, Beard, and McMillin [1993].[5]

It is now common to employ unit root and cointegration tests prior to specification and estimation of VAR models. However, these tests are not uncontroversial. Because of concerns about these tests, we follow Hamilton's [1994] suggestion and estimate the models in both first differences and levels.[6]

The AIC criterion was used to determine the lag length of the VAR model, and

3. Over most of our sample, the Fed did not have discretionary authority to vary the reserve requirement ratios; this was granted in 1935. The reserve/deposit ratio component of the $M2$ multiplier was affected by bank decisions on excess reserves, deposit flows between member and nonmember banks, and changes in state reserve requirements.

4. A referee pointed out that the monetary base is not a perfect monetary policy measure. Consequently, we examined the sensitivity of the results reported in Table I to alternative monetary measures. We first substituted total reserves for the monetary base and the total reserves multiplier ($M2$/total reserves) for the base multiplier. We then substituted $M2$ for the monetary base and the $M2$ multiplier. For the first-differences model, the point estimates of the variance decompositions for these two alternative models were within one standard deviation of those in Table I. For the levels model, most of the point estimates were also within one standard deviation of those in Table I; the remainder were within two standard deviations. Thus, the choice of monetary variables does not have any significant effects on the results for oil price shocks reported in Table I.

5. Bernanke [1983] and Raynold, Beard, and McMillin [1993] also consider the real value of deposits of failed banks and the real liabilities of failed commercial businesses as alternative proxies for disruptions to financial intermediation. These variables were not included here in order to keep the size of the system manageable.

6. In particular, the ability of these tests to distinguish between trend and difference stationarity has been challenged by Sims [1988] and DeJong and Whiteman [1991], among others. Furthermore, DeJong [1992] has recently questioned the ability of cointegration tests to correctly identify cointegration among series. However, Phillips [1991] has strongly criticized the methodology and conclusions of these studies.

Despite concerns about the unit root and cointegration tests, we performed the usual battery of tests. Augmented Dickey-Fuller tests with the lag length determined using the criterion of Schwert [1987] indicated a unit root could not be rejected for any of the model variables. Cointegration tests of the type recommended by Engle and Yoo [1987] indicated the absence of cointegration. But, Johansen's [1988] test indicated the presence of cointegration. However, since Hansen [1990] pointed out that the power of both the Engle-Yoo and Johansen tests falls substantially as the size of the system increases, Hansen's two-stage test was also employed. The power of this test is unaffected by the size of the system. This test requires normalization on each variable in the system; in only one normalization was any cointegration indicated. The augmented Dickey-Fuller tests in conjunction with the Engle-Yoo and Hansen results indicate first differences are preferred to a trend stationary representation. However, the augmented Dickey-Fuller tests in conjunction with the Johansen results are consistent with estimation in levels since, as Lutkepohl [1991] notes, estimation of a cointegrated system using levels and least squares generates the same asymptotic properties of the coefficient estimates as does a maximum likelihood estimator which incorporates the cointegration restrictions. Furthermore, he points out that the covariance matrix estimator from least squares is a consistent estimator of the asymptotic covariance matrix.

this criterion suggested a lag of twelve months for both the first-differences and levels specifications. No evidence of serial correlation in the residuals of the models was found.

III. EMPIRICAL RESULTS

We evaluate the effects of shocks to oil prices through computation of variance decompositions and historical decompositions, which are based on the moving average representation of the model. Variance decompositions indicate the proportion of the forecast error variance of a variable explained by shocks to itself and the other variables in the system. For example, the variance decomposition for industrial production indicates the percentage of the forecast error variance of industrial production explained by shocks to oil prices and the other variables in the system. If oil price shocks are an important determinant of movements in industrial production or the wholesale price index, one would expect oil price shocks to explain a significant fraction of the forecast error variance of these variables. Since Runkle [1987] has noted the importance of reporting variance decompositions with their standard errors, a Monte Carlo procedure is used to generate standard errors for the variance decompositions. One thousand draws are employed in the Monte Carlo simulation. The estimates are judged to be "significant" if they are at least twice the standard error.

Historical decompositions are used to determine the effects of oil price shocks on industrial production and the wholesale price index in a particular subperiod of our sample. Historical decompositions assign credit to the shocks to the variables in the system for the difference between what can be labeled the base projection for a series and the actual series. The extent to which a series that adds the shock(s) to a particular variable(s) to the base projection is closer to the actual series than is the base projection alone is a measure of the importance of that variable or that set of variables.[7]

Since the equations of the VAR contain only lagged values of the system's variables, any contemporaneous relations among the variables are reflected in the correlation of residuals across equations. In this paper, the Choleski decomposition is used to orthogonalize the variance-covariance matrix. In this approach, the system's variables are ordered in a particular way, and, in this way, some structure is imposed in the computation of the variance decompositions and historical decompositions. In this technique, when a variable higher in the ordering changes, variables lower in the ordering are assumed to change. The extent of the change depends upon the covariance of the variables higher in the ordering with those lower in the ordering.

Based upon the arguments of Bernanke and Blinder [1992], we consider two different orderings. The first ordering is based upon the assumption that shocks to oil prices are free of contemporaneous feedback from the other model variables. This is consistent with the view that shocks to the relative price of oil arise from developments in oil markets and are not importantly influenced by contemporaneous movements in macro variables. This assumption implies that oil price shocks are structural and that oil price shocks should be placed first in the ordering. Ordering 1 is oil price shocks, real government expenditures, the monetary base, industrial production, the wholesale price index, the commercial paper rate, the *M*2 multiplier, and the yield differential. As long as oil price shocks are placed first in the ordering, rearrangement of the other variables will not affect the estimates of oil price shocks on these variables. We note that this ordering is based

7. For a technical description of historical decompositions, see Fackler and Parker [1994] or Raynold, Beard, and McMillin [1993].

on the assumption that the relative price of oil doesn't respond within the same month to shocks to the other model variables. We emphasize this assumption is made only for contemporaneous relations. Feedback from the other variables to the relative price of oil occurs with a lag.

The justification for ordering 1 is based upon a consideration of the oil market over our sample. During this time, the "rule of capture" that was legally operative in the development of oil fields considered underground oil to be like a wild animal whose capture conferred ownership. Whatever came out of the well belonged to the well owner regardless of where the oil originated. The discovery of a field led to a proliferation of drilling rigs, a surge in the oil supply, and frequently to a sharp decline in the relative price of oil.

Figure 1 plots the relative price of oil over the period 1921:1–1938:6. Prior to the beginning of our sample, the discovery of vast new supplies of oil in Texas and Oklahoma, increased competition from the break-up of the Standard Oil trust, and World War I set up the framework necessary for producers to develop production capacities far beyond what had previously been known and generated a secular decline in the relative price of oil through most of the 1920s. The sharpest declines that are evident in the downward trend (1921–23, 1926–28, and 1930–31) all revolve around major new oil strikes that led to extremely rapid production. Specifically, the Santa Fe Springs, California strike occurred in 1919 and production peaked in 1923. The Long Beach, California field was discovered in 1921 with peak production in 1923. The strikes in Powell, Texas and Smackover, Arkansas also contributed to the sharp price decline in 1921-23. Similar circumstances prevailed for the declines of 1926–28 (strikes in Seminole, Oklahoma and Hendricks, Texas with peak production in late 1927 and mid-1928, respectively) and 1930–31 (strikes in Oklahoma City and East Texas with peak production in 1931 for both which led to "a virtual flood of oil" (Williamson et al. [1963, 338]).

The sharp spike in relative oil prices beginning in late 1931 is consistent with the production limits in Texas and Oklahoma that were enforced by martial law and with the imposition of an excise tax on crude oil imports. The brief downward turn in late 1932 to early 1933 is consistent with prevention of enforcement of production limits by the State Supreme Court in Oklahoma and the Federal court prevention of enforcement of East Texas production limits in October 1932. The rebound in relative oil prices beginning in early 1933 is coincident with the passage of new production limitation laws in Texas and Oklahoma. The stability of relative prices after this reflects in large part the new "conservation" and prorationing laws.[8]

Although ordering 1 is our preferred ordering, we also consider a second ordering that assumes that shocks to the relative price of oil have no contemporaneous effects on the other variables and that shocks to the other variables have effects on the relative price of oil within the same month. This assumption implies that oil price shocks should be placed last in the ordering and provides a very conservative test of the effects of oil price shocks. Ordering 2 merely moves oil price shocks from first to last with no change in the ordering of the other variables. Again,

8. For a more complete description of the historical events, see Clark [1968], Nash [1968], Osborn [1932], and Williamson et al. [1963].

A referee mentioned the possibility that expected future output may affect oil prices so that oil prices may merely proxy for expected future output. Although this cannot be ruled out on strictly logical grounds, we feel that our discussion of the oil market over our sample provides substantial support for the notion that most of the fluctuations in the relative price of oil were driven by supply factors in this market, not demand or supply factors common to the overall economy. On this basis, we believe our placement of oil price shocks first is appropriate. Furthermore, since our measure of oil prices is a relative price, it is not entirely clear to us the direction of any effect of expected future output on oil prices.

since oil price shocks are placed last, rearrangement of the other variables will not affect the impact of oil price shocks on the variables that precede it.[9]

The variance decompositions for the period 1924:2–1938:6 are presented in Table I. The estimated standard errors are shown in parentheses next to the point estimates of the variance decompositions. An asterisk indicates the point estimate is at least twice the standard error. Variance decompositions at horizons of six, twelve, twenty-four, thirty-six and forty-eight months are presented in order to convey a sense of the dynamics of the system. The first two columns contain the effects of oil price shocks on industrial production and the wholesale price index for the first-differences model for orderings (1) and (2), respectively. Columns three and four contain the effects of oil price shocks on industrial production and the wholesale price index when the model is estimated in levels with a second-degree polynomial in time included for orderings (1) and (2), respectively.

We see that oil price shocks have economically substantial and significant effects on industrial production. This is true for both the first-differences and levels models for both orderings, although the effects are somewhat larger when oil price shocks are ordered first. Of the variation in industrial production not explained by its own shocks (not shown in the table in order to conserve space), oil price shocks explain 33 percent at a horizon of forty-eight months for ordering 1 (25 percent for ordering 2) for the first-differences model and 25 percent (ordering 1 and 17 percent for ordering 2) for the levels model. The effects of oil price shocks on the wholesale price index are, however, weaker, and significance is contingent upon whether the system is estimated in first-differences or levels form. We do note, however, that the results for the levels model are, in all cases, within two standard deviations of those for the first-differences model. After forty-eight months, oil price shocks explain about 22 percent of the variation in the wholesale price index not explained by shocks to the wholesale price index (again not shown in the table) for ordering 1 (16 percent for ordering 2) for the first-differences model. For the levels model, the percentages for orderings 1 and 2 are 10 percent and 6 percent, respectively. In general, we see that the effects of oil price shocks are estimated less precisely in the levels models.[10]

9. An alternative to the Choleski decomposition is Bernanke's [1986] structural VAR approach in which the researcher uses the contemporaneous values of the residuals from the VAR model in the estimation of a structural model. The residuals of the structural model can then be interpreted as fundamental shocks to the model variables since all contemporaneous correlation is purged. But, as noted by Bernanke and Blinder [1992], the results of this approach are sensitive to the specification of the model. This is a critical problem since there is no general agreement on the "best" structural model. For this reason, we use the approach described in the text.

A second alternative, not employed in this paper, is suggested by Blanchard and Quah [1989]. This procedure involves the imposition of long-run constraints which are, in principal, consistent with a variety of structural models. Moreover, this estimation technique involves the assumption that aggregate demand shocks have transitory effects on output while aggregate supply shocks have permanent effects. However, Calomiris [1993] raises an important question as to whether there is a consensus on the appropriate long-run constraints for the interwar period. He points out that recent research on the interwar period has emphasized that aggregate demand shocks might have long-lived effects on output through, for example, changes in the cost of credit intermediation. This suggests that using an identification scheme that assumes only transitory effects of aggregate demand would be inappropriate. Thus, as in the case of the specification of the "best" structural model, there is not unanimity on the appropriate long-run constraints for the interwar period, and, for this reason, we use the approach described in the text. Similar considerations arise for the technique used by Gali [1992] which blends long-run and short-run restrictions in the identification of fundamental shocks.

10. Impulse response functions for industrial production and the wholesale price index for a one-standard deviation shock to the relative price of oil were computed for the first-differences model. The impulse response functions indicate an initial sharp significant increase in the wholesale price index and the results thereafter bounce around zero. Industrial production declines slightly over the first several months following an increase in oil prices, but this decline doesn't appear to be significantly different from zero. Significant negative effects appear at horizons of eighteen and twenty-seven months.

TABLE I
Variance Decompositions for the Effects of Oil Price Shocks on Industrial Production and Wholesale Prices[a]

	Horizon	First Differences Ordering (1)		First Differences Ordering (2)		Levels Ordering (1)		Levels Ordering (2)	
Industrial Production									
	6	1.7	(2.2)	0.9	(1.4)	3.7	(3.7)	1.4	(1.5)
	12	7.7	(4.8)	7.1	(3.6)	6.3	(5.3)	6.0	(4.0)
	24	19.4	(5.5)*	15.3	(4.2)*	13.7	(6.9)	9.2	(4.5)*
	36	24.7	(5.9)*	19.4	(4.5)*	22.0	(8.1)*	15.0	(5.6)*
	48	25.6	(6.2)*	20.1	(4.7)*	21.6	(9.3)*	15.2	(6.3)*
Wholesale Prices									
	6	8.1	(3.2)*	4.6	(2.1)*	10.9	(6.0)	1.9	(2.1)
	12	9.6	(3.9)*	6.9	(2.9)*	5.0	(4.5)	2.2	(2.9)
	24	13.9	(5.1)*	10.0	(3.7)*	4.1	(5.3)	1.9	(3.2)
	36	14.5	(4.9)*	10.4	(3.6)*	6.5	(6.3)	3.7	(4.0)
	48	14.3	(5.1)*	10.3	(3.6)*	8.3	(7.5)	5.0	(4.8)

[a]The sample period is 1924:2-1938:6. Ordering (1) is the relative price of oil, real government expenditures, monetary base, industrial production, wholesale price index, commercial paper rate, M2 multiplier, and yield differential. Ordering (2) is real government expenditures, monetary base, industrial production, wholesale price index, commercial paper rate, M2 multiplier, yield differential, and relative price of oil. The numbers in parentheses are the standard errors generated from a Monte Carlo simulation with 1000 draws. * indicates the point estimate is at least twice the standard error.

It is interesting to note the time pattern of significant effects for industrial production and the wholesale price index. For example, in the first-differences model, significant effects are found at all horizons reported for the wholesale price index whereas for industrial production the first significant effect reported is for a horizon of twenty-four months, although the effects at the twelve-month horizon can be considered marginally significant (especially for ordering 2). (As noted above, the effects are estimated less precisely in the levels model. None of the reported effects on the wholesale price index are significant while significant effects are found at the twenty-four-month horizon for industrial production.) Consider a textbook aggregate demand—aggregate supply model in which the short-run aggregate supply curve is relatively flat. An increase in the relative price of oil shifts the short-run and long-run aggregate supply curves left. In the short run, the price level should rise and output should fall. For a given short-run aggregate supply curve, the relative impact on price and output depends on the slope of the aggregate demand curve. The pattern of results we obtain suggests a relatively steep aggregate demand curve since we observe significant effects on price and initially insignificant effects on output. However, we expect the output effects to become larger over time as adjustment to long-run equilibrium occurs, and indeed we observe this. We would also expect bigger effects on price as this adjustment proceeds, and we also observe this in Table I. The impact on price will be mitigated (and the effect on output enhanced) to some degree if aggregate demand also depends on wealth. Since an increase in the relative price of oil can be viewed as a negative productivity shock which lowers the natural level of output, private sector wealth falls and aggregate demand shifts left. The time pattern of significant effects in Table I can be explained within the context of a standard textbook model, although other explanations might be found.

The variance decomposition results demonstrate that the interwar period can be viewed as an historical antecedent to the post-World War II experience in the sense that shocks to relative oil prices had important macro effects, especially for output. One major difference with the post-World War II period is that many of the major interwar oil price shocks were negative. An interpretation of our results is that the negative oil price shocks of 1921–23 and 1926–28 contributed to the prosperity of this time by raising the natural level of output and that the negative oil price shocks of 1930 to mid-1931 and mid-1932 to early 1933 somewhat lessened the downturn of this period. No doubt the generally declining relative price of oil contributed importantly to the substitution of oil for coal in production and to the development of the automobile industry. The importance of the automobile industry to the prosperity of the 1920s is discussed by Soule [1947].

It is also useful to examine a particular part of our sample in which the relative price of oil fluctuated substantially but evinced no secular trend. Table II provides historical decompositions for industrial production and the wholesale price index over the period 1929:9–1938:6. These computations are additional evidence of the importance of oil price shocks during the Great Depression. Table II presents the root-mean-squared errors (RMSE) for the contributions of oil price shocks and the other variables in the system. The base projection for industrial production, for example, is the dynamic forecast of industrial production based solely on information prior to 1929:9. The RMSE for oil price shocks represents the contribution of movements in oil price shocks since 1929:9 to lowering the RMSE of the base projection. As such, this may be interpreted as a method for segregating the responsibility for movements in industrial production after 1929:9 among the system variables. The results show that oil price shocks lower the base projection for industrial production by a minimum of 13 percent and as much as 24 percent, depending on the specification. Moreover, they consistently provide as much or more explanatory power for lowering the RMSE of the base projection than many variables thought to be of greatest importance in explaining the Great Depression.

For example, consider the results for ordering 1 for the first-differences and levels models. Shocks to the monetary base reduce the base projection RMSE for industrial production by 2 percent in the first-differences model and by 6 percent in the levels model while shocks to the *M*2 multiplier reduce the RMSE by 5 percent in the first-differences model and by 10 percent in the levels model. Shocks to the monetary base and the *M*2 multiplier jointly reduce the base projection RMSE by 7 percent in the first-differences model and 16 percent in the levels model. (These results are not reported in Table II in order to save space.[11]) Thus shocks to oil prices have stronger effects on industrial production than do shocks to the monetary base

11. The results for the joint effects of the monetary base and the *M*2 multiplier cannot be determined simply by adding their separate effects since this would not account for the interaction between these shocks.

TABLE II
Historical Decompositions for Industrial Production and Wholesale Prices

	First Differences Ordering		Levels Ordering	
	(1)	(2)	(1)	(2)
Industrial Production				
Base Projection	.04090	.04090	.09961	.09961
Base Projection + Relative Oil Price	.03097 (.76)	.03337 (.82)	.08123 (.82)	.08644 (.87)
Base Projection + Real Government Expenditures	.03496 (.85)	.03321 (.81)	.09021 (.91)	.08476 (.85)
Base Projection + Monetary Base	.04016 (.98)	.04010 (.98)	.09328 (.94)	.09306 (.93)
Base Projection + *M2* Multiplier	.03898 (.95)	.03887 (.95)	.08951 (.90)	.08948 (.90)
Base Projection + Yield Differential	.03707 (.91)	.03687 (.90)	.08972 (.90)	.08938 (.90)
Wholesale Prices				
Base Projection	.01290	.01290	.03696	.03696
Base Projection + Relative Oil Price	.01156 (.90)	.01195 (.93)	.03204 (.87)	.03366 (.91)
Base Projection + Real Government Expenditures	.01253 (.97)	.01243 (.96)	.03541 (.96)	.03464 (.94)
Base Projection + Monetary Base	.01211 (.94)	.01210 (.94)	.03374 (.91)	.03386 (.92)
Base Projection + *M2* Multiplier	.01199 (.93)	.01195 (.93)	.03227 (.87)	.03223 (.87)
Base Projection + Yield Differential	.01148 (.89)	.01147 (.89)	.02869 (.78)	.02837 (.77)

[a]The period is 1929:9–1938:6. Ordering (1) is the relative price of oil, real government expenditures, monetary base, industrial production, wholesale price index, commercial paper rate, M2 multiplier, and yield differential. Ordering (2) is real government expenditures, monetary base, industrial production, wholesale price index, commercial paper rate, M2 multiplier, yield differential, and relative price of oil.

and the *M2* multiplier jointly. Shocks to the yield differential reduce the RMSE by 9 percent in the first-differences model and by 10 percent in the levels model. Clearly the effects of oil price shocks are stronger than are those for the yield differential alone. Shocks to the monetary base, the *M2* multiplier, and the yield differential jointly reduce the base projection RMSE by 16 percent and 24 percent in the first-differences and levels models, respectively. For the first-differences model, shocks to oil prices have larger effects on industrial production than do the joint effects of the monetary base, the *M2* multiplier, and the yield differential. However, in the levels model, the joint effects of these three variables are moderately larger than are the effects of shocks to oil prices. The results for shocks to oil prices on the wholesale price index are not as strong, as was the case with the variance decompositions.

Finally, a broader look at supply shocks was also taken. Variance decompositions were also calculated for a system in which the relative price of fuel replaced the relative price of oil. The relative price of fuel was measured by the wholesale price index for fuel and lighting relative to the wholesale price index. The variance decompositions for industrial production revealed a similar pattern to that for the oil shock measure, but the magnitude of the estimates was less. This is not surprising since the fuel index includes oil prices as well as the prices of coal, coke, and gas. The coal industry was in a period of decline in our sample period (Soule [1947]), and the other materials were less important than oil. It seems that it is shocks to oil prices rather than fuel prices in general that matter most over our sample. Based on the arguments of Romer [1988], we also looked at the impact of relative farm prices measured by the wholesale price index for all farm products relative to the wholesale price index. In this case, the most sensible ordering for the variance decompositions is to place relative farm prices last since contemporaneous movements in macro variables can importantly affect farm prices. The variance decompositions indicated shocks to relative farm prices had essentially no effect on industrial production or the wholesale price index.[12]

12. Details are available on request.

IV. CONCLUSIONS

This paper has examined whether there is any evidence that supply shocks played a role in explaining the behavior of industrial production and wholesale prices during the interwar period. The results confirm that oil price shocks were economically important and significant in explaining movements in industrial production during the interwar period. This result is robust to both specification and ordering changes in the computation of variance decompositions and historical decompositions. Hamilton [1983] made the point that the entire 1947–72 period should be considered when evaluating the economic effects of oil price shocks on the macroeconomy. In his view, the post-1970 events should really be treated as an extension of the entire post-World War II era.[13] The evidence presented in this paper indicates that it is appropriate to also add the interwar period to the discussion when referring to the economic effects of oil price shocks.

13. Hamilton [1983] focuses much of his discussion on bivariate and multivariate Granger-causality tests. The multivariate tests are done within a VAR system that includes real GNP, the unemployment rate, and other relevant macro variables. Although the estimation procedures of this paper are not an exact replication of the techniques used by Hamilton [1983], Sims [1982] points out that the variance decompositions may be interpreted as providing evidence on the strength of Granger-causal relations. Interpreted in this fashion, our results indicate Granger-causality from oil price shocks to industrial production and the wholesale price index.

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