How Well Does the IS-LM Model Fit Postwar U.S. Data?

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HOW WELL DOES THE IS-LM MODEL FIT POSTWAR U. S. DATA?*

JORDI GALÍ

Postwar U. S. time series for money, interest rates, prices, and GNP are characterized by a multivariate process driven by four exogenous disturbances. Those disturbances are identified so that they can be interpreted as the four main sources of fluctuations found in the IS-LM-Phillips curve model: money supply, money demand, IS, and aggregate supply shocks. The dynamic properties of the estimated model are analyzed and shown to match most of the stylized predictions of the model. The estimated decomposition is also used to measure the relative importance of each shock, to interpret some macroeconomic episodes, and to study sources of permanent shocks to nominal variables.

I. INTRODUCTION

The IS-LM model, augmented with a Phillips curve, has played a central role in the macroeconomic theory and practice developed in the Keynesian mode. A basic version of that model remains the core of many introductory textbooks (e.g., Dornbusch and Fischer [1987] and Hall and Taylor [1988]), which use it throughout to analyze the effects of changes in some exogenous macroeconomic variables and, in particular, the impact of alternative monetary and fiscal policies.[1]

The augmented IS-LM model is also the backbone of many of the large scale, highly disaggregated macroeconometric models used by governments and commercial firms for the purposes of policy evaluation and economic forecasting. The MPS and the DRI model are two well-known examples of such an application of the Keynesian model.

More generally, the IS-LM model has a substantial influence on policy makers and market participants' views of the economy's workings, as is clearly reflected in the popular business press.

Despite that widespread use, the IS-LM-Phillips curve paradigm has been, since the midseventies, the target of important criticisms. At a theoretical level the model was criticized for its lack

    1. The Phillips curve augmented version of the IS-LM model, which allows for adjustment of prices over time, is often referred to as the Aggregate Demand/ Aggregate Supply model.

of microfoundations (especially on the supply side) and the arbitrariness of its assumptions on the nature of expectations. At the level of econometric practice, the attack focused on the unsuitability of existing macroeconometric models for the purpose of policy evaluation (see Lucas [1976]) as well as on the "incredible restrictions" that were implicitly assumed in those models and that accounted for their econometric identification [Sims, 1980].

Today most macroeconomists accept those criticisms and see them as major contributions to the recent development of the field, at least from a methodological viewpoint. However, and despite that apparent consensus, two different research programs on economic fluctuations have been pursued in recent years. One of them, the "new classical" research program, has altogether rejected the Keynesian paradigm and has begun to reconstruct the whole field of macroeconomics in a way more consistent with neoclassical economic theory, adhering to the principles of market clearing and perfect competition. A second research program, usually labeled "new Keynesian," has been guided by a basic belief in the *empirical relevance* of the macroeconomic models developed in the Keynesian tradition, as exemplified in the IS-LM model. Under that view, the presence of market imperfections (e.g., nominal rigidities) makes room for phenomena that could potentially explain most short-run fluctuations in GNP, and that cannot be captured by equilibrium models. Providing those departures from neoclassical equilibria with the theoretical underpinnings that were missing in their original formulations has thus become the main goal of this research strategy.

Are "new Keynesians" misdirecting their energies in trying to give solid microfoundations to a paradigm that may not even be an acceptable descriptive tool? Was Lucas and Sargent's [1979] indictment of Keynesian economics as "an empirical failure on a grand scale" warranted? Can the IS-LM apparatus still be saved as a framework of reference to analyze events and to understand how the economy works, despite its theoretical shortcomings?[2] These are some of the questions underlying the main goal of the present paper: to reevaluate, with the aid of time series methods, the empirical validity of the IS-LM-Phillips curve model, the central paradigm of Keynesian economics.

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2. Fischer [1987] forcefully argues for the "usefulness" and predictive power of the IS-LM apparatus.

For the purposes of this paper I interpret the essence of that model as lying in two assumptions.

a. The basic structure of the economy can be summarized by means of three equilibrium conditions: two for the goods and asset markets, and one describing the adjustment of prices over time and embodying a long-run neutrality restriction.

b. Movements in the main macro variables are (largely) the result of four types of exogenous disturbances: supply, money supply, money demand, and IS shocks.

The following textbooklike version of the model may help illustrate those basic ingredients:

$$y = \alpha + u_s - \sigma(i - E\Delta p_{+1}) + u_{is} \qquad \text{(IS equation)}$$

$$m - p = \phi y - \lambda i + u_{md} \qquad \text{(LM equation)}$$

$$\Delta m = u_{ms} \qquad \text{(money supply process)}$$

$$\Delta p = \Delta p_{-1} + \beta(y - u_s) \qquad \text{(Phillips curve)},$$

where y denotes the log of GNP, i is the nominal interest rate, and p and m are, respectively, the logs of the price level and the money supply. u_s, u_{ms}, u_{md}, and u_{is} are stochastic processes describing supply, money supply, money demand, and spending (IS) driving forces.[3] Δ and E are the usual first difference and expectational operators, respectively.

The dynamic response of the different variables to a shock in each of the driving processes will depend on the properties of those processes and on a variety of propagation mechanisms built into the economy but usually ignored in illustrative versions of the model like the one above. Nevertheless, most versions of the model generate similar predictions in terms of the response of different macro variables to each of the structural shocks. Some stylized predictions are, among others, the following:

a. Aggregate demand shocks[4] have (at least) short-run effects on GNP and other real variables as a result of slow adjustment of nominal variables.

b. Monetary shocks are transmitted to the real sector through changes in real interest rates.

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3. The steady state of that simple model is characterized by $y = u_s$, so u_s can be naturally interpreted as the process for the natural rate of output.

4. The concept of aggregate demand is used here and in the remainder of the paper in a broad sense, which includes money demand, money supply, and IS shocks.

c. GNP and prices move in the same direction in response to an aggregate demand shock, but in opposite directions in response to an aggregate supply shock.

The strategy pursued here consists of assessing the empirical validity of those predictions by modeling the joint behavior of money, interest rates, prices, and GNP in the postwar United States by means of a vector autoregression (VAR) driven by four exogenous disturbances. Those disturbances are identified so that they can be interpreted as the four structural shocks introduced above: supply, money supply, money demand, and IS. After estimating that model, I look at the response of the economy to each type of structural shock implied by the estimates, and compare it with the stylized response predicted by the IS-LM framework.

The outline of the paper is as follows. Section II presents and discusses the restrictions used to identify the structural model. The more technical issues related to the estimation of the model, the choice and implementation of identifying restrictions, and the robustness of the results to alternative specification and identification strategies are also covered in the same section. Section III shows and discusses the central results of the exercise: the dynamic response of the economy to each type of shock, as well as some measures of its contribution to the variability of each variable at different horizons. Section IV gives an informal interpretation of postwar GNP fluctuations making extensive use of the decomposition estimated in the previous sections. In particular, an attempt is made to identify the sources of GNP decline in each of the six *recessions contained in the sample period and to answer some basic* questions about the nature of such downturns. I also use the previous analysis to shed light on an additional issue: the source of the unit root in some nominal variables. Section V concludes.

II. A Simple Dynamic Macroeconometric Model

The methodology followed here consists of estimating and studying the properties of a VAR model for money, interest rates, prices, and output,[5] which is just-identified by means of a variety of restrictions. The general approach has been used in some recent work (e.g., see Blanchard and Watson [1986], Bernanke [1986],

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5. The choice of variables has a twofold motivation. First, the variables used are central endogenous variables in the textbook model. Second, they are particularly helpful when it comes to identifying the structural disturbances.

Blanchard and Quah [1989], Shapiro and Watson [1988], and Blanchard [1989]), and is often referred to as "structural VAR methodology."

The present paper builds on Blanchard and Quah [1988], who originally used a long-run constraint to identify aggregate demand and aggregate supply shocks in a bivariate model of GNP and unemployment. More specifically, those researchers achieved identification by constraining aggregate demand shocks not to have a permanent effect on the level of GNP. A similar strategy was used by Shapiro and Watson [1988], but they further decomposed the aggregate supply disturbance—as identified in Blanchard and Quah [1988]—into both productivity and labor supply shocks, which were sorted out by constraining the former not to have a permanent effect on the level of employment.

In this paper I also rely on the Blanchard-Quah identifying restriction to disentangle aggregate supply disturbances from other sources of economic fluctuations. In addition, and in a way complementary to Shapiro and Watson [1988], I dig further into the transitory component of GNP and attempt to disentangle the differential dynamic effects of money supply, money demand, and IS shocks. Identification of those three shocks is achieved by imposing alternative sets of short-run restrictions that are either supported by independent empirical evidence or plausible on other empirical grounds. The simultaneous use of both long-run and short-run identifying constraints can thus be regarded as a methological innovation of the present paper.

A. Identifying Restrictions

First, I impose an orthogonality condition among the four structural shocks. Such a restriction implies that the channels through which each structural disturbance will ultimately affect the economy are left unrestricted; thus, the estimated response of the economy to that disturbance will capture, among other things, the effects of any systematic policy reaction to that type of shock.

A second set of restrictions allows us to sort out the supply shock from the three aggregate demand disturbances by constraining the latter not to have a long-run effect on GNP. In other words, supply shocks are assumed to be the only source of the unit root observed in GNP.[6] That assumption, originally used as an identify-

6. That restriction can also be interpreted as a time series equivalent to a vertical long-run Phillips curve.

ing restriction in Blanchard and Quah [1989], is controversial. Some equilibrium growth models allow for permanent IS shocks (e.g., permanent increases in government spending) that have long-run effects on output, since they may affect the steady state level of capital.[7] Also, in the presence of steady inflation nonneutralities (e.g., a Mundell-Tobin effect), any shock that leads to a permanent change in the rate of money growth and inflation can have a permanent effect on output. Nevertheless, as is argued in Blanchard and Quah [1989], even if such effects exist, their importance relative to the permanent output effect of supply shocks is likely to be small and should hardly affect the model's estimates or their interpretation.

In order to distinguish IS shocks from the two monetary disturbances, I constrain the latter not to have a contemporaneous effect on output. Given that quarterly data are used in the empirical analysis, I am in practice restricting output not to respond to monetary shocks within a quarter. This identifying restriction is meant to capture the presence of so-called "outside lags": in contrast with IS shocks, aggregate demand for goods and services is not directly affected by monetary shocks, but only indirectly by the eventual change in financial conditions they may bring about and, ultimately, by the resulting changes in the real interest rate or the real exchange rate. Thus, the implicit assumption is that aggregate demand takes some time to react to those changes, an assumption that seems to be supported by a variety of empirical evidence, ranging from work on investment (e.g., Shapiro [1986]) and foreign trade flows (e.g., Wilson and Takacs [1979]), to simulations with different large-scale macroeconometric models [Modigliani and Ando, 1976].

Finally, I impose an additional restriction in order to disentangle the two types of monetary shocks: demand and supply. I suggest three alternative assumptions to meet that goal. Two of them constrain the monetary authority not to react systematically to contemporaneous (i.e., within a quarter) innovations in a certain variable, maybe because of informational or decisional lags,[8] or because of large "noise" in the short-run movements in that variable. Under a first assumption, money supply is allowed to respond to contemporaneous changes in the nominal rate and GNP, but not to price changes. Under a second assumption, the

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7. This is a feature, for instance, of many overlapping generations models.
8. This type of restriction is also used in Sims [1986].

TABLE I
IDENTIFYING RESTRICTIONS

Long-run restrictions
R1: no long-run effects of money supply shocks on GNP R2: no long-run effects of money demand shocks on GNP R3: no long-run effects of IS shocks on GNP
Short-run restrictions
R4: no contemporaneous effect of money supply shocks on output R5: no contemporaneous effect of money demand shocks on output R6: contemporaneous prices do not enter the money supply rule R7: contemporaneous GNP does not enter the money supply rule R8: (contemporaneous) homogeneity in money demand

money may react to both contemporaneous changes in price and the nominal rate, but not to GNP. Thus, both assumptions allow money supply to depend on the contemporaneous nominal rate, in a way consistent with an upward sloping money supply schedule (given high-powered money) or a deliberate policy reaction to nominal rate innovations (a change in high-powered money). Under a third assumption the demand for real balances is not affected by contemporaneous changes in prices—given the nominal rate and output—a homogeneity restriction that has some theoretical appeal.[9]

Each of the restrictions above is open to dispute. However, the fact that—in contrast with the early VAR literature—they are explicitly stated and discussed gives the reader a certain feel for the eventual damage done in the process. In any case the restrictions chosen do not touch on "sensitive" issues, like the degree and nature of nominal rigidities.[10]

Table I summarizes the restrictions just introduced and labels them as R1, R2, . . . , R8 for ease of later exposition.

B. Data and Low Frequency Properties

As a preliminary step, and in order to specify the model correctly, we must characterize the long-run properties of the time

9. Absence of short-run homogeneity in the demand for money arises in the presence of costs of adjusting nominal money holdings.
10. Note also that identification of the different disturbances has a simple sequential nature. Thus, even if the restrictions used to sort out (say) the two monetary shocks are not correct, supply and IS shocks will still be correctly identified.

series involved, i.e., their degree of integration and the eventual presence of cointegrating relationships.

Table II reports a variety of test statistics for the null hypothesis of a unit root in y, i, Δp, Δm, $i - \Delta p$, and $\Delta m - \Delta p$. The data used in those tests, and in the remainder of the paper, are the following:

> y: log of GNP, at 1982 prices
> i: yield on three-month Treasury bills
> p: log of the Consumer Price Index
> m: log of M1.

The sample period is 1955:I–1987:III. For all variables I use seasonally adjusted, quarterly data. Data for i, p, and m correspond to the first month in the quarter. All data were obtained from the CITIBASE tape, except for measures of M1 previous to 1959 which were obtained from the *Federal Reserve Bulletin*.

All the test statistics are based on a OLS regression of the form, $x = \hat{\alpha} + \hat{\rho} x(-1) + u$, with time added as a regressor in the y case. $\hat{\tau}$ and $N(\hat{\rho} - 1)$ are the t-statistic and normalized bias statistic

TABLE II
UNIT ROOT TESTS[a]

	$\hat{\theta}$[b]	$\hat{\tau}$	$N(\hat{\rho} - 1)$	$Z[\hat{\tau}]$	$Z[N(\hat{\rho} - 1)]$
y	0.22	−1.37	−4.04	−1.83	−7.00
		(−3.05)	(−15.90)	(−2.62)	(−12.71)
i	−0.07	−2.16	−7.94	−2.08	−7.34
		(−3.13)	(−16.71)	(3.09)	(−16.54)
Δp	−0.58	−4.95	−41.08	−5.04	−37.85
		(−6.99)	(−71.11)	(−7.09)	(−76.88)
Δm	−0.92	−7.13	−74.84	−6.95	−79.34
		(−12.53)	(−143.85)	(−12.44)	(−150.99)
$i - \Delta p$	−0.69	−6.46	−64.04	−6.28	−71.52
		(−8.29)	(−90.89)	(−8.52)	(−102.92)
$\Delta m - \Delta p$	−0.67	−7.08	−73.54	−6.84	−79.07
		(−8.12)	(−88.34)	(−8.24)	(−98.93)

a. See references in the text for a description of the statistics used. The 5 percent critical values are −2.88 for $\hat{\tau}$ and $Z[\hat{\tau}]$ and −14.0 for $N(\hat{\rho} - 1)$ and $Z[N(\hat{\rho} - 1)]$. When a time trend is added, those values are −3.45 and −21.3, respectively.

b. $\hat{\theta}$ is the estimated MA coefficient in a IMA(1,1) specification for each left-hand-side variable. The modified 5 percent critical values shown in brackets are drawn in each case from the empirical distribution of the estimated IMA(1,1) model, obtained from a Montecarlo simulation with 500 replications.

corresponding to the simple Dickey-Fuller [1979] test. $Z[\hat{\tau}]$ and $Z[N(\hat{\rho} - 1)]$ denote the same statistics, as modified in Phillips and Perron [1988] to allow for a more general class of unit root processes. Using 5 percent critical values, the tests do not reject the null of a unit root in y and i, but they reject it for Δp, Δm, $i - \Delta p$, and $\Delta m - \Delta p$. Since the nominal rate cannot have a unit root when both the real rate and inflation are stationary, one should probably interpret the "acceptance" of the unit root in i as the result of a type II error. Thus, one possible characterization of the long-run properties of the data consistent with the previous results can be summarized as follows:

$$y \Rightarrow I(1), \quad i \Rightarrow I(0), \quad \Delta p \Rightarrow I(0), \quad \Delta m \Rightarrow I(0),$$

using the notation and definitions in Engle and Granger [1987].

As argued in Schwert [1988], the previous tests are likely to be considerably biased if the true process is an IMA(1,1) with a nonnegligible MA coefficient. In particular, if the latter coefficient is negative and close to one in absolute value, the tests above will tend to reject the unit root null too often in small samples. Following the procedure in Schwert, I derive the "adjusted" critical values for the previous test statistics, based on the IMA(1,1) model previously estimated for each variable. Such critical values are the figures in brackets in Table II. The picture that emerges when the new critical values are used is considerably different: the unit root null is not rejected for any of the variables considered. That result could be interpreted as evidence of a unit root in y, i, Δp, Δm, $i - \Delta p$, and $\Delta m - \Delta p$, and carried over to the empirical analysis. There are two reasons, however, for maintaining the assumption of stationarity in $i - \Delta p$ and $\Delta m - \Delta p$ in what follows. First, the test p-values for those variables are much smaller than for the other variables, making the nonrejection a likely consequence of the low power of the modified tests. Second, the assumption of a unit root in the real rate seems rather implausible on a priori grounds, given its inconsistency with standard equilibrium growth models (e.g., see Shapiro and Watson [1988]).[11] On the other hand, a unit root in the growth rate of real balances—which implies nonstationary velocity growth—is difficult to reconcile with reasonable specifications of money demand. Taking those factors into account, an alternative plausible characterization of

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11. In Galí [1989] I argue that stationarity of the real rate can be interpreted as a sufficient condition for a "full" long-run Fisher effect.

the long-run properties of the data would be

$$y \Rightarrow I(1), \quad i \Rightarrow I(1), \quad \Delta p \Rightarrow I(1), \quad \Delta m \Rightarrow I(1)$$
$$(i,\Delta p) \Rightarrow CI(1,1) \text{ with cointegrating vector } (1,-1)$$
$$(\Delta m,\Delta p) \Rightarrow CI(1,1) \text{ with cointegrating vector } (1,-1).$$

The discussion above suggests that either $\mathbf{x} \equiv [\Delta y, \Delta i, i - \Delta p, \Delta m - \Delta p]'$ or $\mathbf{x}^* \equiv [\Delta y, i, \Delta p, \Delta m]'$ can be assumed to be a covariance stationary process, though the evidence is far from being clear-cut as to what the right specification is. Given that ambiguity, I carried out the empirical analysis under the two alternative specifications. All the qualitative results discussed in Sections II and III were identical under both specifications.[12] Quantitatively, the results were also very similar. Given that robustness, I shall restrict the discussion to the $\mathbf{x} \equiv [\Delta y, \Delta i, i - \Delta p, \Delta m - \Delta p]'$ specification.

C. Specification and Implementation of Identifying Restrictions

I assume that $\mathbf{x} \equiv [\Delta y, \Delta i, i - \Delta p, \Delta m - \Delta p]'$ is a covariance stationary vector process. Each element of $\mathbf{x}$ has a zero mean; i.e., it has been previously demeaned. I further assume that each element of $\mathbf{x}$ can be expressed as a linear combination of current and past structural shocks. Formally, $\mathbf{x}$ has a vector moving average representation of the form,

$$(1) \qquad\qquad \mathbf{x} = C(L)\,\boldsymbol{\epsilon},$$

where $\boldsymbol{\epsilon} = [\epsilon_s, \epsilon_{ms}, \epsilon_{md}, \epsilon_{is}]'$ is the vector of serially uncorrelated structural disturbances (supply, money supply, money demand, and IS, respectively). The 4×4 matrix of polynomial lags $C(L) \equiv [C_{ij}(L)]$, for $i,j = 1, \ldots, 4$, is the object to be estimated. Once we have $C(L)$, a straightforward transformation will allow us to recover expressions for the levels of the different variables in terms of the current and lagged values of the structural disturbances.

The reduced-form, Wold moving average representation of $\mathbf{x}$ is given by

$$(2) \qquad\qquad \mathbf{x} = E(L)\mathbf{v},$$

where $E(L) \equiv [E_{ij}(L)]$ for $i,j = 1, \ldots, 4$, $E(0) = I$, and $E(L)$ is invertible.[13] Thus, $\mathbf{v}$ is the vector of *innovations* in the elements of

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12. An exception to that statement is the results and discussion in subsection IV.C., which are meaningful only under a unit root in i, Δp, and Δm.
13. It is not difficult to show that the alternative vector process $[\Delta y, \Delta i, \Delta^2 m, \Delta^2 p]$ would not have an invertible moving average representation, under the maintained hypothesis of pairwise cointegration between i, Δm, and Δp.

vector $\mathbf{x}$. Formally, $\boldsymbol{\nu}$ is defined by $\boldsymbol{\nu} \equiv \mathbf{x} - P[\mathbf{x}|\mathbf{x}(-1), \mathbf{x}(-2), \ldots]$, where P is the orthogonal projection operator. Furthermore, let Σ denote the variance-covariance matrix of the vector of innovations $\boldsymbol{\nu}$; i.e., $\Sigma \equiv E \boldsymbol{\nu}\boldsymbol{\nu}'$.

The (reduced-form) autoregressive representation is given by

(3) $$B(L)\mathbf{x} = \boldsymbol{\nu},$$

where $B(L) \equiv [B_{ij}(L)]$ for $i, j = 1, \ldots, 4$, $B(0) = I$, and $B(L) = E(L)^{-1}$.

The innovations in $\boldsymbol{\nu}$ are assumed to be linear combinations of the structural disturbances in $\boldsymbol{\epsilon}$, i.e.,

(4) $$\boldsymbol{\nu} = S\boldsymbol{\epsilon},$$

for some 4×4 full rank matrix S. Note that (4) implies that $P[\boldsymbol{\epsilon}|\mathbf{x}(-1), \mathbf{x}(-2), \ldots] = 0, j \geq 1$, and

(5) $$C(L) = E(L)S.$$

Premultiplying both sides of (3) by S^{-1}, we obtain the vector autoregressive representation of $\mathbf{x}$ in terms of the structural disturbance vector $\boldsymbol{\epsilon}$:

(6) $$A(L)\mathbf{x} = \boldsymbol{\epsilon},$$

where $A(L) \equiv [A_{ij}(L)]$, for $i, j = 1, \ldots, 4$ and $A(0) \equiv S^{-1}$.

OLS can be used to obtain consistent estimates of the coefficients in $B(L)$.[14] By inversion of $B(L)$ we get an estimate of $E(L)$. A consistent estimate of Σ can be computed in a trivial way, using the residuals of the OLS regressions. The structural model, i.e., the coefficients of $A(L)$ and $C(L)$, will be identified to the extent that we introduce enough restrictions to determine the sixteen elements of matrix S uniquely. Given S, we can easily recover $C(L)$ by postmultiplying our $E(L)$ estimate by S (see (5)).

Next I show the form taken by the restrictions above, in the context of the model that has just been specified.

The assumption of mutually orthogonal shocks, together with a convenient normalization condition, implies that $E \, \boldsymbol{\epsilon}\boldsymbol{\epsilon}' = I$. Using (4), we thus get

(7) $$SS' = \Sigma,$$

which provides ten nonlinear restrictions on the elements of S, given Σ. Just-identification of the structural model requires six

14. Of course, in practice it is necessary to work with a "truncated" version of what would otherwise generally be an infinite-order VAR.

additional restrictions, which will be given by R1 to R5 plus another restriction chosen among R6, R7, and R8.

R1, R2, and R3, the aggregate demand long-run neutrality restrictions, are given by $C_{12}(1) = C_{13}(1) = C_{14}(1) = 0$. Thus, given (5), they imply the following linear restrictions on S, respectively,

$$(8) \qquad E_{11}(1)S_{12} + E_{12}(1)S_{22} + E_{13}(1)S_{32} + E_{14}(1)S_{42} = 0$$

$$(9) \qquad E_{11}(1)S_{13} + E_{12}(1)S_{23} + E_{13}(1)S_{33} + E_{14}(1)S_{43} = 0$$

$$(10) \qquad E_{11}(1)S_{14} + E_{12}(1)S_{24} + E_{13}(1)S_{34} + E_{14}(1)S_{44} = 0.$$

Restrictions R4 and R5—absence of a contemporaneous effect of monetary shocks on output—imply the following two direct constraints on S:

$$(11) \qquad S_{12} = 0$$

$$(12) \qquad S_{13} = 0,$$

since, by construction, S_{ij} measures the contribution of the jth structural shock to the contemporaneous innovation in the ith element of vector $\mathbf{x}$.

Finally, R6, R7, and R8 can be implemented as linear restrictions involving some of the elements of $A(0)$, the matrix of contemporaneous relations. From (4) and (6) we know that $A(0)\nu = \epsilon$. Thus, the second and third rows in $A(0)$—respectively associated with the money supply and money demand disturbance—can be interpreted as the *contemporaneous* component of a money supply and a money demand equation.[15] Given the specification of vector $\mathbf{x}$, R6, R7, and R8 take the following form, respectively:

$$(13) \qquad A_{23}(0) + A_{24}(0) = 0$$

$$(14) \qquad A_{21}(0) = 0$$

$$(15) \qquad A_{33}(0) = 0.$$

Given $S \equiv A(0)^{-1}$, restrictions (13) to (15) map into three nonlinear restrictions on the elements of S.

D. Choice of Identifying Restrictions

An additional restriction is needed to just-identify the model. I shall choose that restriction from R6, R7, and R8.

15. This kind of interpretation is possible whenever the money supply equation and the money demand equation include no structural disturbances other than their own (e.g., see the "illustrative" model in Section I). These types of short-run identifying restrictions were used in Blanchard and Watson [1986], among others.

As a side exercise I test each possible pair among R6, R7, and R8, using the remaining restriction (together with restrictions R1 to R5) to just-identify the model. In each case the test performed is either a t-test or an F-test on the coefficients of the second and third rows of $A(L)$. The test is performed after estimating those coefficients by 2SLS, using the estimates of the structural disturbances corresponding to the three remaining equations as instruments for the contemporaneous regressors.[16]

Unfortunately, those tests involve some rejections (at the usual 5 percent significance level). When using R6 to identify the model, I cannot reject R7 ($t = 1.41$), but I do reject R8 ($t = -2.40$). If instead R7 is used as an identifying restriction, R8 is not rejected ($t = -0.72$), but R6 is ($F_{1,112} = 9.58$, p-value = 0.0024). Finally, when R8 is used to identify the model, the test rejects R6 ($F_{1,112} = 4.83$, p-value = 0.029) but not R7 ($t = -0.60$). How to interpret the previous results? Taken literally they are consistent with two mutually exclusive hypotheses: (a) both R7 and R8 are correct, but R6 is not; or (b) only R6 is accurate, but the test does not have enough power to reject R7.

Given the possibility of choice and the lack of strong priors, I estimated the model using the three alternative sets of just-identifying restrictions. The estimates of $C(L)$ were very similar in the three cases. In the remainder of the paper I report and discuss the estimates obtained using R1 to R6 as just-identifying restrictions, pointing out along the way any significant differences in the results obtained using R7 or R8.

III. EMPIRICAL EVIDENCE: IMPULSE RESPONSES AND VARIANCE DECOMPOSITION

This section presents and discusses the benchmark estimates of $C(L)$, based on identifying restrictions R1 to R6. The reduced-form VAR (see (3)) estimated on a first stage was "truncated" at four lags, which was enough to induce white noiselike residuals.

Suitably transformed, the estimates of $C(L)$ allow us to express GNP, money growth, inflation, real balances, and both the nominal and real interest rate—all the variables of interest—as the sum of four distributed lags of the structural disturbances.

16. That 2SLS procedure using "generated instruments" can be shown to yield consistent estimates of the coefficients in $A(0)$. Furthermore, those estimates have the same asymptotic distribution as the 2SLS estimates obtained with the "true" structural disturbances as instruments.

Formally,

$$(13) \qquad\qquad \mathbf{z} = F(L)\boldsymbol{\epsilon},$$

where $z \equiv [y, i, \Delta p, \Delta m, m - p, i - \Delta p(+1)]'$ and $F(L) \equiv [F_{ij}(L)]$ for $i = 1, \ldots, 6$ and $j = 1, \ldots, 4$. Thus, the coefficients of the polynomial lag $F_{ij}(L)$ give the estimated dynamic response of vector $\mathbf{z}$'s ith variable to a one-standard deviation realization in the jth structural disturbance.[17]

Table III reports, for each structural shock, the impulse response of the six variables in $\mathbf{z}$ at selected horizons, together with the associated standard errors.[18] Those responses are plotted in Figures I to IV. With few exceptions, that response matches the predictions of standard versions of the IS-LM model with slow price adjustment and strong and persistent real effects of each AD shock. Both the timing and the size of the responses conform to conventional wisdom and are largely consistent with the predictions of much more structured macroeconometric models.

Table IV shows the contribution of each structural disturbance to the variance of k-quarters ahead forecast errors for each variable in $\mathbf{z}$, i.e., the so-called "variance decomposition." The results here seem less akin to a traditional Keynesian view of economic fluctuations. Such a view would tend to perceive monetary or real changes in aggregate demand as the most important source of short-run economic fluctuations, while constraining supply factors, such as technical progress and population growth, to explain the long-run upward trend in output. In contrast with that view, the estimates here suggest that aggregate supply shocks, defined as those having a permanent effect on GNP, are also the most important source of GNP variability at business cycle frequencies.

Next I discuss in more detail the estimated effects of each structural shock, as well the variance decompositions.

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17. Under the assumption that agents observe in each period the realization of each structural disturbance and that they know $C(L)$—and thus perfectly foresee the impact the current shock will have on future inflation—the dynamic response of $r \equiv i - \Delta p(+1)$ can actually be interpreted as the response of the expected real rate.

18. Standard errors were obtained by means of a Montecarlo procedure based on normal random drawings from the distribution of the reduced-form VAR. The standard errors corresponding to $C(L)$ were then based on transformations of each reduced-form draw using the initial estimate of S, and are thus conditional on the latter. That explains the lack of uncertainty associated with the estimates of the contemporaneous responses, given (4).

TABLE III
DYNAMIC RESPONSES TO ONE-STANDARD DEVIATION SHOCKS

Type of shock:	Supply	Money supply	Money demand	IS
GNP				
1 quarter	0.71	0.00	0.00	0.47
5 quarters	1.07	0.57	−0.27	0.35
	(0.17)	(0.18)	(0.21)	(0.16)
10 quarters	0.92	0.32	−0.19	0.03
	(0.20)	(0.28)	(0.25)	(0.22)
20 quarters	1.10	0.08	−0.03	0.00
	(0.28)	(0.34)	(0.28)	(0.25)
Nominal rate				
1 quarter	−0.17	−0.57	0.37	0.27
5 quarters	0.18	0.07	0.22	0.62
	(0.09)	(0.10)	(0.12)	(0.09)
10 quarters	−0.01	0.32	−0.02	0.61
	(0.13)	(0.13)	(0.11)	(0.15)
20 quarters	−0.10	0.47	−0.02	0.62
	(0.17)	(0.20)	(0.16)	(0.20)
Money growth				
1 quarter	−0.12	2.77	1.30	1.46
5 quarters	−0.04	−0.08	−0.10	−0.05
	(0.31)	(0.32)	(0.32)	(0.24)
10 quarters	0.09	0.11	0.26	0.44
	(0.11)	(0.19)	(0.11)	(0.15)
20 quarters	−0.02	0.32	0.04	0.60
	(0.14)	(0.16)	(0.13)	(0.16)
Inflation				
1 quarter	−1.03	−0.09	−1.14	1.18
5 quarters	−0.01	0.45	−0.16	0.97
	(0.20)	(0.19)	(0.19)	(0.17)
10 quarters	−0.23	0.69	−0.17	0.68
	(0.22)	(0.22)	(0.20)	(0.23)
20 quarters	−0.15	0.56	−0.07	0.61
	(0.24)	(0.29)	(0.22)	(0.28)
Real balances				
1 quarter	0.22	0.71	0.61	0.06
5 quarters	0.73	0.94	0.37	−0.83
	(0.19)	(0.21)	(0.20)	(0.16)
10 quarters	1.00	0.21	0.85	−1.50
	(0.30)	(0.36)	(0.28)	(0.31)
20 quarters	1.63	−0.82	1.41	−1.68
	(0.60)	(0.65)	(0.50)	(0.60)

TABLE III
(CONTINUED)

Type of shock:	Supply	Money supply	Money demand	IS
Real rate				
1 quarter	0.07	−0.78	−0.15	−0.23
5 quarters	0.31	−0.63	0.24	−0.20
	(0.17)	(0.19)	(0.15)	(0.15)
10 quarters	0.19	−0.31	0.18	−0.03
	(0.13)	(0.18)	(0.13)	(0.14)
20 quarters	0.04	−0.09	0.03	0.00
	(0.11)	(0.16)	(0.10)	(0.10)

A. Supply Shocks

Figure I summarizes the response of the economy to a "favorable," one-standard deviation shock to the aggregate supply disturbance. The initial impact on GNP, which increases by 0.7 percentage points in the period of the shock, is larger than for any other shock. The same variable reaches a peak four quarters after the shock, after having increased by 1.1 percentage points, stabilizing later at roughly the same level. As the textbook model predicts, a favorable supply shock has a negative effect on prices: the initial deflationary impact is substantial (a 1 percent decrease in prices), but it soon vanishes. In fact, the observed increase in money supply may be interpreted as an attempt by the Fed to stabilize prices, possibly at the expense of higher output volatility.

The nominal rate hardly moves. This is largely consistent with a standard LM equation: the increase in money demand caused by the increased activity is satisfied at an almost unchanged nominal rate by the increase in real balances resulting from both the monetary expansion and the lower price level. This lack of variability in the nominal rate explains why the response of real balances shows a shape similar (up to scale) to the output response. That still hides substantial lags in the adjustment of real balances: the implied short-run income elasticity is about 0.3, whereas its long-run value is close to 1.5 (given the almost unchanged nominal rate).[19]

19. Traditional empirical money demand equations typically imply lower values for those elasticities, though they are likely to be affected by simultaneity considerations. The corresponding estimates in Goldfeld [1973] are 0.19 and 0.68, for instance.

TABLE IV
DECOMPOSITION OF FORECAST ERROR VARIANCE

Component:	Supply	Money supply	Money demand	IS
GNP				
1 quarter	0.69	0.00	0.00	0.31
5 quarters	0.67	0.12	0.02	0.19
10 quarters	0.72	0.14	0.04	0.10
20 quarters	0.83	0.09	0.02	0.06
Nominal rate				
1 quarter	0.06	0.60	0.20	0.14
5 quarters	0.03	0.15	0.21	0.61
10 quarters	0.02	0.15	0.11	0.72
20 quarters	0.02	0.24	0.05	0.69
Money growth				
1 quarter	0.00	0.67	0.15	0.18
5 quarters	0.03	0.68	0.14	0.15
10 quarters	0.03	0.66	0.15	0.16
20 quarters	0.03	0.55	0.13	0.29
Inflation				
1 quarter	0.28	0.01	0.34	0.37
5 quarters	0.18	0.09	0.20	0.52
10 quarters	0.12	0.24	0.12	0.52
20 quarters	0.09	0.32	0.08	0.51
Real balances				
1 quarter	0.05	0.54	0.40	0.01
5 quarters	0.20	0.55	0.10	0.14
10 quarters	0.22	0.25	0.12	0.40
20 quarters	0.29	0.10	0.20	0.41
Real rate				
1 quarter	0.01	0.88	0.03	0.08
5 quarters	0.17	0.56	0.14	0.13
10 quarters	0.18	0.57	0.15	0.10
20 quarters	0.18	0.58	0.15	0.09

Supply shocks account for about 70 percent of output variabil-
ity at business cycle frequencies (one to ten quarters, say);[20] this is
one of the most striking results of the paper. As mentioned above,
even though such a result can be accommodated by the IS-LM-

20. This is largely consistent with the evidence in Shapiro and Watson [1988]
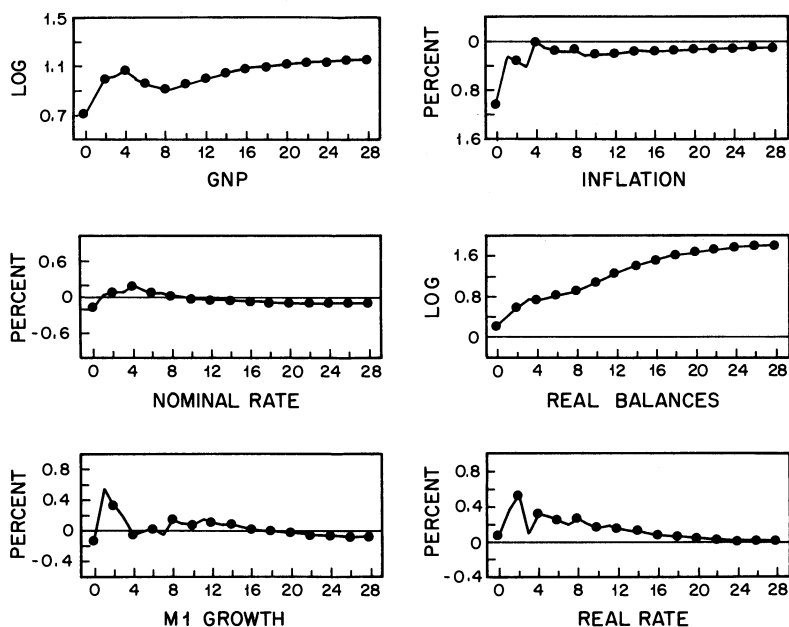and some specifications in Blanchard and Quah [1989].

FIGURE I
Dynamic Response to a Supply Shock

Phillips curve framework, it is clearly at odds with a traditional Keynesian view of business cycles. The results here provide an additional insight, however: part of the supply-induced variability in GNP may arise from the typical monetary response to such shocks.

B. Money Supply Shocks

Figure II shows the response of the different variables to a one-standard deviation shock in money supply. The typical path of money after that shock takes the form of an initial 0.7 percent increase in the level of M1, followed by a somewhat erratic behavior in that variable and, eventually, by a permanent rise in its growth rate.

The Keynesian money-real rate-output transmission mechanism is captured strikingly well by the estimates. As a result of the observed slow adjustment of prices, the increase in M1 initially increases real balances. Given output, which is restricted not to respond immediately, the higher level of liquidity drives both the
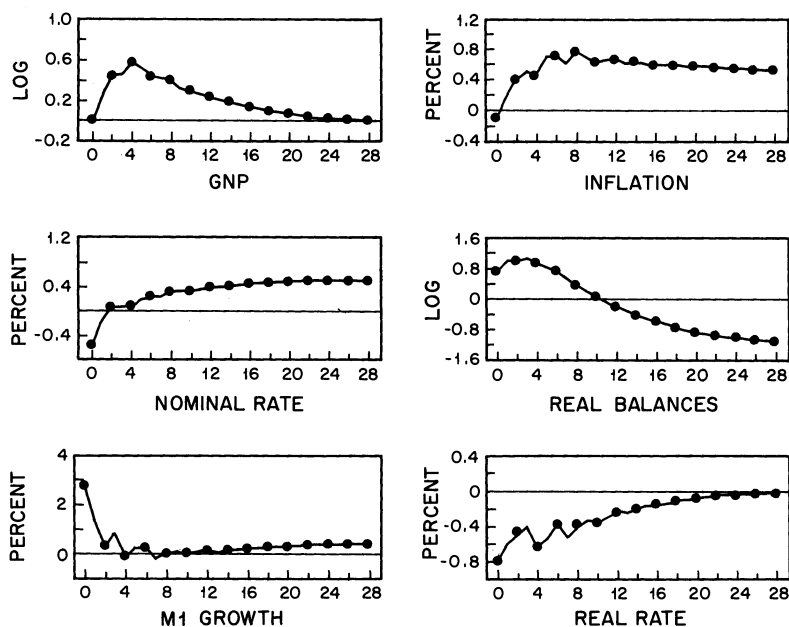
FIGURE II
Dynamic Response to a Money Supply Shock

nominal and the real rate down by about 60 and 80 basis points, respectively. Output, presumably following aggregate demand, gradually responds to the lower real rate, reaching a peak four quarters after the shock, when its level is 0.6 percentage points higher. As output goes up, so does inflation and the nominal rate, in a way consistent with a Phillips curve and an LM equation. Their dynamic response is such that the real rate remains low for a long period, leading to long-lived effects of money on output.

In the long run, output and the real rate return to their initial values. In contrast, the nominal rate, inflation, and money growth are affected permanently and reach a higher new steady state level. The long-run level of real balances goes down, as a standard money demand equation would predict, with an implied interest-semielasticity close to 2.[21]

The downward response of the nominal rate to an increase in money suggests that the "liquidity effect" dominates. This is worth

21. The corresponding estimate in Goldfeld [1973] is 1.69.

stressing, since it coexists with a positive correlation between innovations in money and nominal interest rates. The latter "statistical" fact has often been interpreted as evidence against the standard transmission mechanism.[22]

However, as Figure II makes clear, the estimates here imply that shocks to the *exogenous component* of money supply are negatively correlated with nominal rate innovations. The results discussed in the following sections suggest that the positive comovement between money and nominal rate innovations results from the way the monetary authority has typically responded to the changes in nominal rates triggered by money demand and IS shocks.

The contribution of money supply shocks to output variability at a five- to ten-quarter horizon is around 13 percent.[23] The same types of shocks are, in any event, largely responsible for the short-run variability of the nominal and the real rate (60 percent and 88 percent of one quarter ahead forecast error variance, respectively), as well as for the variance of money growth and inflation at longer horizons.

C. Money Demand Shocks

Figure III shows the impulse responses corresponding to a positive money demand shock, i.e., an increase in the level of real balances demanded, given output and interest rates. As we could expect, the response of the different variables is qualitatively the mirror image of the response to its supply counterpart. A basic difference arises from the partial monetary accommodation to the increased demand for real balances, which leads to a negative correlation between money and output and a positive correlation between money and nominal interest rate.[24] A second difference is found in the relatively fast adjustment of prices, in contrast with the sluggishness observed in the case of a money supply shock. Indeed, equilibrium models would predict a downward jump in prices as a way to prevent money demand shocks from affecting

22. See Mishkin [1983] for a discussion of the reduced-form evidence on money and interest rate surprises.
23. That value turned out to be considerably smaller when R8, instead of R6, was used as an identifying restriction.
24. The response of M1 to the money demand shock is sensitive to the identifying restrictions used. When R7 is used, money supply appears to "overaccommodate" the increase in money demand, leading to a small decrease in the real rate and a small increase in output. In contrast, when R8 is used, the money supply is reduced after the increase in shock to money demand leading to a large upward jump in nominal and real rates and a large reduction in output.
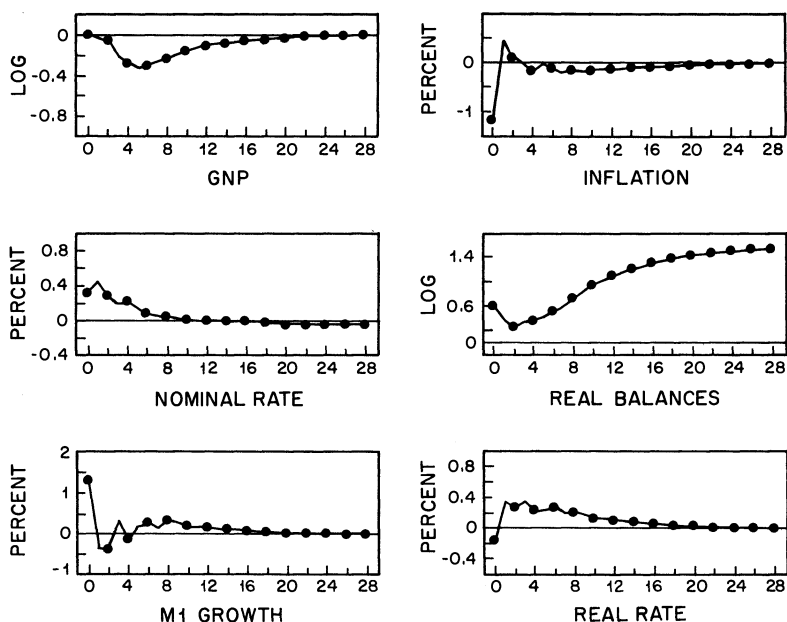
FIGURE III
Dynamic Response to a Money Demand Shock

real variables. The estimated price response does not quite do that job here: both nominal and real interest rates, together with output, are affected by the money demand shock.

Of all the variables considered in Figure III, only real balances are permanently changed by the shock to money demand: their long-run level is 1.5 percent higher. The contribution of those shocks to the variability of output is quite small (3.8 percent at a ten-quarter horizon), which may be explainable in part by the partially accommodating response in the money supply.[25] The contribution to other variables' fluctuations is relatively small, with the exception of real balances.

D. IS Shocks

The dynamic effects of a one-standard deviation IS shock are summarized in Figure IV. Several features deserve attention. The first feature is the strength of its initial impact on GNP, which rises

25. Again, that contribution is larger when R8 is used, as can be expected from the discussion in the previous footnote.
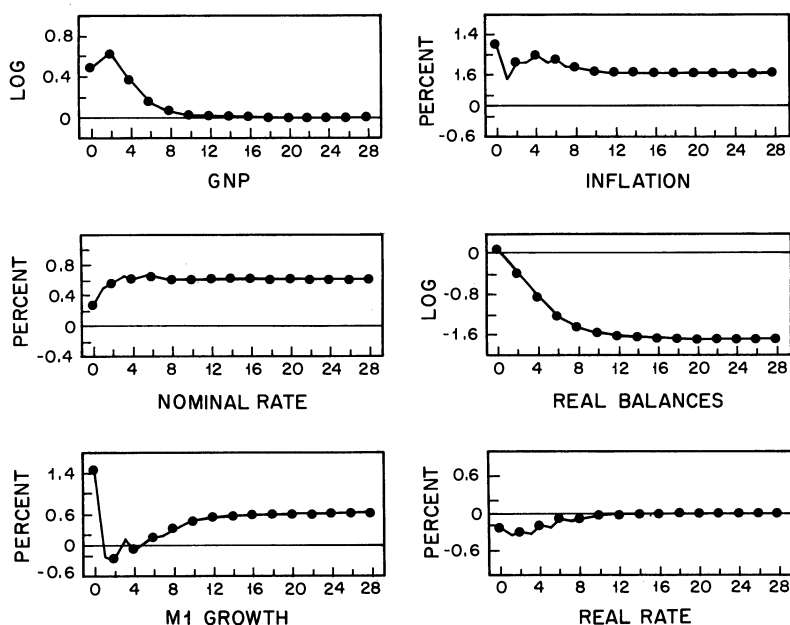
FIGURE IV
Dynamic Response to an IS shock

by almost 0.5 percent in the quarter of the shock. The second is the relatively low persistence in the response of the same variable, at least compared with both monetary shocks: GNP reaches a peak two quarters after the shock; and the effects of the latter almost vanish after four quarters.

As the IS-LM model predicts, a positive IS shock—a shift to the right in the IS curve—increases the nominal interest rate. That increase is, however, more than offset by the upward adjustment in inflation, thus driving the real rate down. About two years after the shock, the real rate returns to its initial level.

IS shocks have a substantial permanent effect on money growth, inflation, and the nominal interest rate, as well as real balances. An interpretation of the kind of mechanisms underlying that permanent impact is given in the next section. The implicit point estimate for the long-run interest semielasticity of money demand is close to 2.5, not far from the value obtained in the case of a money supply shock.

A look at the variance decomposition in Table IV suggests that

IS shocks play a substantial role in short-run GNP fluctuations, accounting for 19 percent of the five quarters ahead forecast error variance. The same types of shocks are also the most important source of long-run variability in nominal rates and inflation.

IV. EVENTS, RECESSIONS, AND SOURCES OF UNIT ROOTS

A. An Informal Interpretation of U. S. GNP Fluctuations (1955–1987)

In the previous section I showed the estimated response of the economy to four disturbances that were interpreted as supply, money demand, money supply, and IS shocks. I argued that such responses are largely consistent with the predictions of mainstream versions of the IS-LM-Phillips curve model. This section presents the decomposition of GNP time series implied by the estimated model (1). Figures Va and Vb display the movements in GNP associated with the supply component, with and without the deterministic drift term, respectively. Figures VI, VII, and VIII
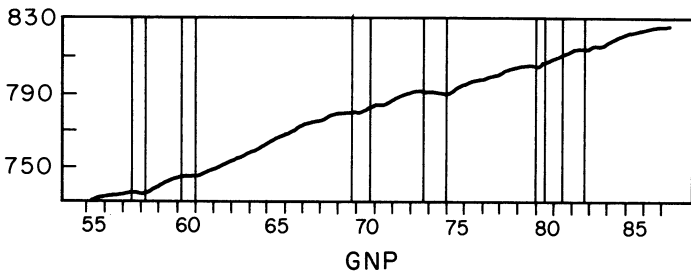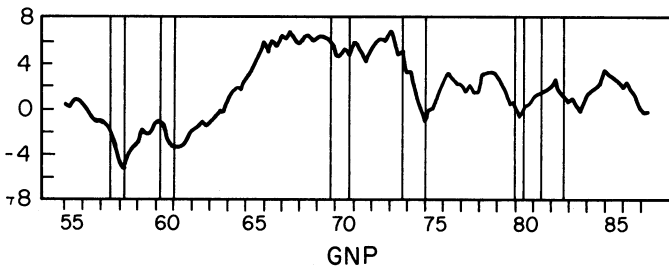
FIGURE Va
Supply Component of GNP (drift added)

FIGURE Vb
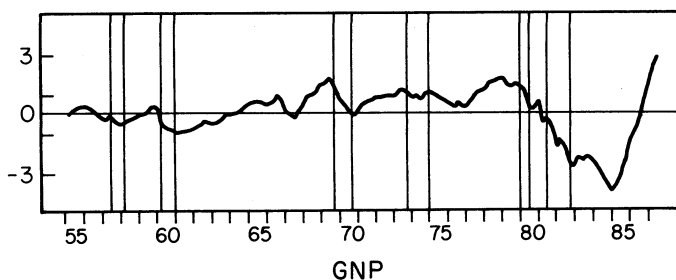Supply Component of GNP (no drift)

GNP

FIGURE VI
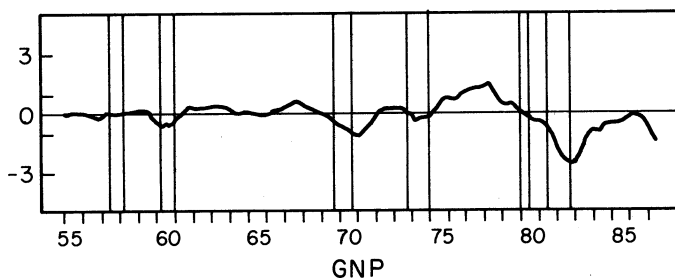Money Supply Component of GNP

GNP
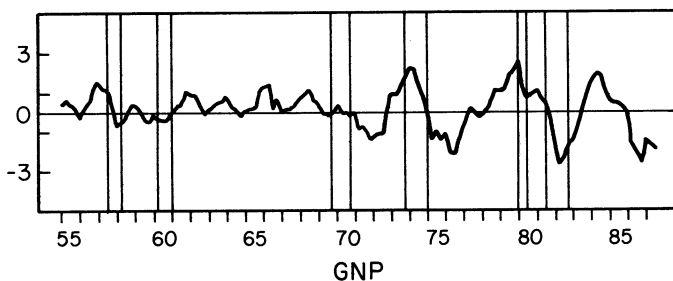
FIGURE VII
Money Demand Component of GNP

GNP

FIGURE VIII
IS component of GNP

show the money supply, money demand, and IS components of GNP fluctuations. Recessions, as dated by the NBER, are represented in those figures by means of vertical bands.

For expository convenience, the sample period is divided into three subperiods. Some of the "events" stressed by traditional accounts of U. S. postwar cycles are hinted at in brackets.

(a) 1955:I–1961:I.

In contrast with the sixties, supply shocks have an essentially negative contribution to the economic performance of this period. In particular, they play a crucial role in the two recessions included in the subperiod (increase in raw materials' prices 1956–1957, steel strike 1959).

The boom preceding the 1957–1958 recession is largely driven by positive IS shocks. Those shocks also seem to have a significant role in both recessions (increase in the full employment budget surplus, balanced budget FY60).

(b) 1961:II–1970:IV.

One of the features highlighted by the estimated GNP decomposition for this period is the extraordinary impulse to the economy stemming from supply factors. That source of rapid growth seems to weaken substantially from 1966 onward, roughly coinciding with the starting point of the "productivity slowdown" detected in the growth literature.

Keynesian interpretations of the rapid growth in the sixties have usually relied on the role of IS shocks induced by expansionary fiscal policies (1962 investment subsidy, 1964 tax cut, Vietnam war). The estimates here indeed suggest a positive contribution of IS shocks during this period. That contribution, however, is small relative to that of supply shocks.

The decomposition assigns a large role to both money supply and money demand disturbances in the 1969–1970 recession. Supply shocks are also shown to have had a substantial role (General Motors strike 1970).

(c) 1971:I–1987:III.

This period showed much wider fluctuations in GNP. The decomposition of that variable suggests that the four types of disturbances are to be held responsible for the increased volatility, though their relative importance varies over time.

The main event early in the period is the deep 1973–1975 recession. The decomposition shows the economy as being in the middle of a strong IS-led expansion at the onset of the recession (dollar devaluation). A milder positive contribution of money supply and supply elements is also detected. Supply factors clearly trigger the 1974–1975 downturn and account for three fourths of the decrease in GNP (OPEC part I). The subsequent expansion relies on the positive contributions of the three demand shocks, together with a well-behaved supply side.

The 1980 minirecession and the 1981–1982 depression can be better described as a single episode involving all shocks. In a first stage, around 1979, both demand and supply shocks, together with

TABLE V
DECOMPOSITION OF GNP CHANGE IN SIX RECESSIONS

Component:	Supply	Money supply	Money demand	IS
57:III–58:II	0.62	0.06	−0.01	0.33
60:II–61:I	1.16	0.16	−0.18	−0.14
69:IV–70:IV	0.38	0.45	0.14	0.03
73:IV–75:I	0.78	−0.02	0.00	0.24
80:I–80:III	0.11	0.29	0.08	0.52
81:III–82:IV	0.06	0.38	0.26	0.30

supply factors, trigger the downturn in economic activity (OPEC part II, Fed October 1979, velocity fall in the early eighties). The recovery has its origin in 1982, when IS shocks start pushing output up (effective tax reductions, investment tax credit, defense buildup). A few months later, the negative money demand-driven cycle, started in the late seventies, reaches a turning point. Almost contemporaneously, money supply changes the sign of its effects on activity, but only transitorily (Fed Fall 1982): the negative contribution of money supply will not be over until early 1985. Perhaps surprisingly, the estimates point to money supply forces as the basic source of GNP growth in the 1986–1987 period.

B. Are All Recessions Alike?

Next I focus on the behavior of GNP during the recessions contained in the sample period, as dated by the NBER. I pose a basic question: are recessions mainly the result of the coincidence in time of different structural shocks that happen to move output in the same direction, or has each historical recession been mostly the consequence of large negative realizations in one of the structural disturbances? Table V reports estimates of the relative contribution of each structural shock to the change in GNP during the six recessions included in the sample period.[26] Using a 10 percent share as a benchmark to assign a given type of shock a "significant" role in a given recession, we see that in no case has a *single* driving force accounted for the observed GNP decline. In three of the six recessions three or more shocks have played a significant role. That result suggests that the hypothesis of recessions caused by the "concentration of a variety of negative shocks"

26. The exercise is performed after removing the deterministic trend from *y*.

may provide a good characterization of the typical postwar U. S. recession.

That previous conclusion should not be interpreted, however, as implying that "all recessions are alike": as can be seen in Table V, the relative contribution of each shock varies considerably across recessions. Indeed, it is difficult to pick two recessions with a similar "profile," perhaps with the exception of the 1957–1958 and 1973–1975 recessions. Such results thus seem to confirm some of the more general conclusions found in Blanchard and Watson [1986].

The largest relative contribution observed corresponds to supply shocks in the 1973–1975 recession. Only in the 1960–1961 recession do we find some components (specifically, money demand and IS) that make a "significant" positive contribution to GNP (figures with negative sign). In all other cases that positive contribution is very small.

C. What Is the Source of the Unit Root in Nominal Variables?

As noted above, time series evidence for the U. S. postwar period suggests the possibility of the presence of a unit root component in inflation, the nominal rate, and the growth rate of money. Under that maintained hypothesis a natural question may be posed: what are the mechanisms underlying the nonstationarity in those nominal variables? Focusing on the estimated response of nominal variables to each type of shock may give a clue about the ultimate source(s) of nonstationarity.

Figure IX shows the joint response of nominal variables to the four shocks considered in this paper. The estimates point to money supply and IS shocks as the basic sources of nonstationarity in i, Δp, and Δm.

Both the pattern of response of those variables and the long-run effects of a one-standard deviation shock are very similar in the two cases. More interestingly, that pattern suggests an interpretation of the mechanisms at work along the lines of the monetarist critique of stabilization policies. For instance, take the IS shock response. The initial impact on output pushes the nominal rate upward, though this is dampened by a contemporaneous one-shot money expansion consistent with a monetary policy aimed at stabilizing the nominal rate. That initial monetary reaction does not prevent the nominal rate from following an upward path, as a result of increasing prices and output pressure, in a way consistent with a simple LM equation. About a year after
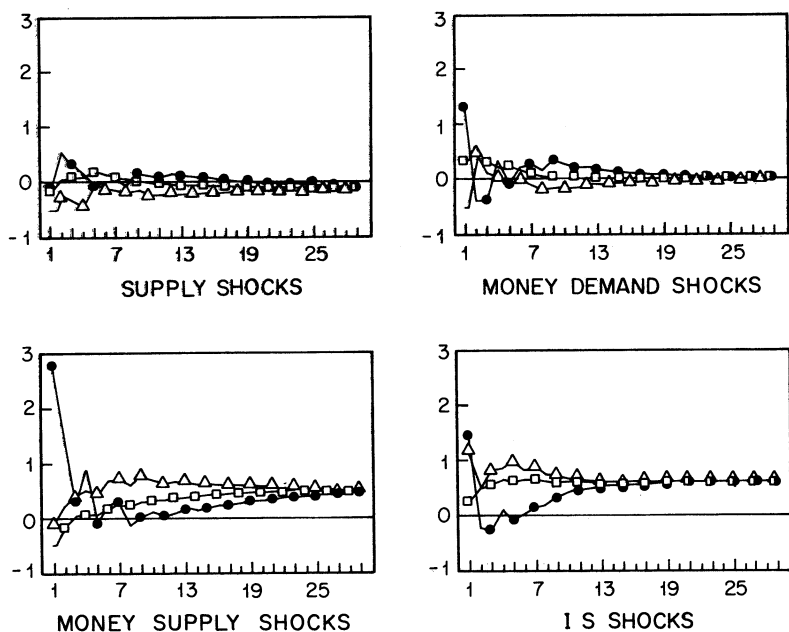
FIGURE IX
The Unit Root in Inflation (△), Money Growth (●), and the Nominal Rate (□)

the shock, money supply starts growing at a sustained higher rate, accommodating the higher inflation. In the context of the IS-LM-Phillips curve framework, the absence of such monetary accommodation would require a deflation—and thus a recession—to bring real balances and the real interest rate to its initial level. A similar pattern of response can be observed in the money supply shock case.

The interpretation above thus suggests that the Fed's desire to avoid output fluctuations may have resulted in "nominal instability," in the sense of having led to permanent changes—and thus a unit root—in nominal rates and inflation.

V. SUMMARY AND CONCLUSIONS

The present paper has attempted to assess how well an extended IS-LM framework fits postwar U. S. data. In the spirit of stylized versions of that model, I assume that fluctuations in money, interest rates, prices, and GNP are largely the result of four

types of economic forces: supply, money supply, money demand, and IS shocks. Accordingly, I develop and estimate a simple macroeconometric model driven by four exogenous disturbances, which are identified so that they can be interpreted as the basic forces introduced above.

Several conclusions arise from the study of the estimated model.

a. The dynamic response of the economy to different types of disturbances matches closely most of the qualitative predictions of a Phillips curve-augmented IS-LM framework.

b. The decomposition of the time series for GNP in terms of the four structural components leads to an interpretation of postwar U. S. fluctuations that largely matches traditional accounts. An important departure from a traditional view of fluctuations is given by the large estimate of the contribution of supply factors to short-run GNP fluctuations.

c. A closer look at recessions suggests that they are caused by the coincidence in time of several adverse shocks of a different nature, with the corresponding mix varying substantially across recessions.

d. The results also point to the typical dynamic response of the Fed to IS and money supply shocks as the basic source of the unit root component detected in the nominal interest rate and inflation.

To conclude, I think few of the results above are surprising *in themselves;* they largely match those of much more structured and detailed models. The fact that they have been obtained with a highly stylized macroeconometric model—involving only four equations and a *minimum* of assumptions—allows us to see them as providing some independent evidence which, overall, seems to support the *empirical relevance* of the IS-LM-Phillips curve paradigm.

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