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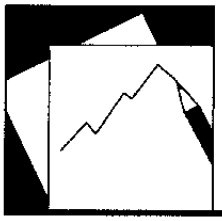

# IMF Working Paper

# Demand-Side Stabilization Policies: What Is the Evidence of Their Potential?

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# Demand-Side Stabilization Policies: What Is the Evidence of Their Potential?

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## Abstract



Using disaggregated data for the United States, this paper explores the effects of the variability of fiscal and monetary policy shocks. Higher variability of government spending shocks around a steady-state growth trend results, on average, in a decline in aggregate demand growth and inflation, with limited effects on output growth. On the other hand, higher variability of monetary shocks results, on average, in an increase in inflation and a decline in output growth. These results indicate the desirability of avoiding large fluctuations over time in either government spending or the money supply.

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## I. INTRODUCTION

Traditional tools of stabilizing aggregate demand have included monetary and fiscal policies. During recessions, measures of stimulating aggregate demand include expansion in government spending or the money supply. Expansionary monetary policy aims at increasing the availability of credit in order to stimulate private spending. Expansionary government spending can stimulate aggregate demand during periods of economic slow down. Economic booms create, in contrast, demand pressure on the limited supply of existing resources. To ease pressure, contractionary fiscal or monetary policies may be necessary to slow down demand growth.

The debate concerning the effectiveness of monetary and fiscal policies in stabilizing the economy has centered on the responsiveness of aggregate demand to policy measures. Arguments against the effectiveness of monetary policy have focused on conditions in financial markets that may interfere with the mechanism determining the response of private spending to changes in the money supply.[2] Arguments against fiscal policy have focused on possible changes in private spending that may counter the effects of government spending on aggregate demand.[3] Potential limitations on demand-side stabilizing efforts have prompted calls to focus macroeconomic policies on growth promoting measures.

This paper explores the relative effectiveness of fiscal and monetary policies in stimulating aggregate demand. To that end, the investigation focuses on two aspects: (i) asymmetry in the response of aggregate demand to expansionary and contractionary policy shocks, and (ii) details of this asymmetry using disaggregated data for components of private spending. Given asymmetry in the size of aggregate demand shifts, conditions on the supply side also determine the allocation of policy shocks between output and price. Asymmetry in the shape of the supply curve may reinforce or offset asymmetry in the size of aggregate demand shifts in the face of policy shocks, providing a new dimension to judge the relative results of fiscal and monetary shocks.

The results indicate asymmetry in the size of aggregate demand shifts in the face of government spending shocks. Asymmetry is attributed to changes in private spending accompanying the expansionary and contractionary shocks to the growth of government spending. The reduction in private spending on consumption and investment more than offsets the expansionary effects of an increase in government spending. This reduction may be explained by two factors. First, is the effect of the increased government spending on the credit market. The rise in the interest rate crowds out private spending. Secondly is the behavior of Ricardian consumers, increasing private savings in anticipation of a higher future tax liability in the face of the increased government spending. There is also evidence of a

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[2] See, for example, Tobin (1947).

[3] See, for example, Barro (1989).

slow down in the growth of aggregate demand in the face of contractionary government spending shocks. Accordingly, higher variability of government spending decreases aggregate demand, on average, over time. The reduction in aggregate demand in the face of government spending shocks is absorbed in price deflation with a moderate effect on output growth.

Demand contraction exceeds expansion in the face of monetary shocks. Demand asymmetry is attributed to a larger reduction in private consumption relative to expansion in the face of monetary shocks. Credit constraints reinforce the reduction in private consumption in the face of contractionary monetary shocks. Asymmetry on the supply side dominates, however, demand asymmetry in the face of monetary shocks. Accordingly, upward price flexibility is in sharp contrast to downward rigidity in the face of monetary shocks. Price inflation insulates real output growth from the expansionary effect of monetary shocks. In contrast, downward price rigidity necessitates that the effects of monetary contraction are absorbed in output reduction. Accordingly, higher variability of the money supply increases price inflation and decreases real output growth, on average, over time.

Overall, asymmetry highlights the adverse effects of demand-side stabilization policies in several directions. The variability of government spending is not desirable. Crowding out of private spending dominates efforts to stimulate demand through the increased government spending. The variability of the money supply is also undesirable, decreasing output growth and increasing price inflation. Given the adverse effects of demand-side stabilization, macroeconomic policies should focus on long-term growth promoting measures.

## II. The Asymmetric Effects of Policy Shocks

This section illustrates determinants of asymmetry in the face of demand-stabilizing policies. Traditionally, these policies have included the management of the money supply and/or government spending. The former aims at varying the money supply to determine the level of liquidity and, therefore, private spending. The latter aims at determining aggregate demand by varying the level of public spending.

Asymmetry in the face of monetary and fiscal policies can be generally differentiated into demand- and supply-side channels (see, e.g., Kandil (1995), (1996), (1998), (1999) and (forthcoming) and Karras (1996a) and (1996b)). Consider the following relationship:

$$Dv_t = \sum_{j=0}^{x} \beta^{m}_{pvj} posm_{t-j} + \sum_{j=0}^{x} \beta^{m}_{nvj} negm_{t-j} + \sum_{j=0}^{x} \beta^{g}_{pvj} posg_{t-j} + \sum_{j=0}^{x} \beta^{g}_{nvj} negg_{t-j}, \qquad v = y, p \tag{1}$$

$D(.)$ is the first-difference operator. The log of real output is denoted by $y$ where $p$ denotes the log value of the price level. Monetary shocks are differentiated into distributed lags of positive and negative shocks, $posm_{t-j}$ and $negm_{t-j}$. The difference between $\beta^{m}_{pvj}$ and $\beta^{m}_{nvj}$ measures asymmetry in the variables' response to monetary shocks. Government spending shocks are differentiated into distributed lags of positive and negative shocks, $posg_{t-j}$ and

$negg_{t-j}$. The difference between $\beta^{g}_{pvj}$ and $\beta^{g}_{nvj}$ measures asymmetry in the variables' response to government spending shocks. The $\beta$ parameters are likely to be determined by two factors: (i) the size of aggregate demand shifts in the face of the policy shock, and (ii) conditions on the supply side that determine capacity constraints and price flexibility in the face of aggregate demand shifts.

## A. Demand-Side Asymmetry

Conditions on the demand and/or the supply side of the economy may differentiate the expansionary and contractionary effects of shocks to government spending and the money supply.

### Demand-Side Asymmetry in the Face of Government Spending Shocks

The traditional view is that an increase in government spending stimulates aggregate demand. The effects of government spending are likely, however, to be complicated by two factors. First, is the effect of government spending on financial markets. An increase in government spending is likely to increase the budget deficit.[4] To finance the increased spending, the government increases borrowing. Given the limited supply of available loanable funds above capacity level, an increase in government borrowing raises the interest rate, crowding out private spending. This channel moderates the expansionary effects of an increase in government spending on aggregate demand. As government debt builds up with fiscal expansion(s), Miller, Skidelsky, and Weller (1990) argue that the mounting risk of default or increasing inflation risk will reinforce crowding out effects through interest rates. Hence, policy credibility is crucial. That is, if the government lacks a track record of fiscal prudence, the interest rates will most likely reflect risk premia. Sizable risk premia represent perhaps the clearest reason that fiscal multipliers could turn negative. That is, private spending decreases in the face of a rise in the interest rate induced by a sizable risk premia following a fiscal expansion.[5]

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[4] Given the limits on tax revenues and the political unpopularity of raising taxes, traditional methods to finance the increased government spending are either borrowing or monetizing the budget deficit. In light of the inflationary consequences of the latter option, many governments have been heavily borrowing to finance the increased spending. The time-series data under investigation end in 1996. Since 1953, the annual government budget in the United States has been in deficit except for the years 1956, 1957 and 1969.

[5] This explanation was advocated in view of the evidence of expansionary fiscal contractions, see, e.g., Giavazzi and Pagano (1990), and Alesina and Perotti (1995). For evidence of asymmetry in interest-rate adjustment to government spending shocks, see Kandil (forthcoming).

In another direction, some economists have questioned the importance of changes in the interest rate in response to government spending. They appeal to the Ricardian Equivalence argument to emphasize the importance of government spending on private savings.[6] Given concerns about the budget deficit, agents foresee future tax liabilities associated with the increased government spending. Accordingly, private consumption is likely to decrease in response to the increased government spending. The reduction in private consumption moderates demand expansion. Risk averse households are likely to assign higher probability to future tax liability.[7]

**Demand-Side Asymmetry in the Face of Monetary Shocks**

Theoretical channels may differentiate demand shifts in response to expansionary and contractionary monetary shocks as follows:

1) Money supply contraction decreases credit availability and raises the interest rate. Higher interest rates increase the cost of borrowing, decreasing private spending. Higher interest rates increase the risk of borrowers' bankruptcy, prompting banks to change their lending behavior, and begin to ration credit. This credit constraint further suppresses private spending and augments the central bank's tight policy.[8]

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[6] See, for example, Barro (1989): "The substitution of a budget deficit for current taxes has no impact on the aggregate demand for goods. In this sense, budget deficits and taxation have equivalent effects on the economy-hence, the term, "Ricardian Equivalence Theorem." For a coherent theoretical illustration of the Equivalence Theorem, see Barro (1974).

[7] For more details, see, for example, Feldstein (1976). Taxpayers may face binding liquidity constraints if consumption absorbs disposable income entirely. With these constraints, households are likely to increase savings in anticipation of future tax liability. In contrast, households are constrained from increasing consumption (decreasing savings) in anticipation of future tax reduction. At the empirical level, see, e.g., Hubbard and Judd (1986), results indicate that 20% of US households are liquidity constrained.

[8] Examples are models advocating the asymmetric effects of credit rationing policies, as in Bernanke (1983). Jackman and Sutton (1982) set a similar argument by focusing on the effect of interest rate changes on spending. They report that as interest rates rise (in response, e.g., a tight monetary policy), consumption spending falls the full amount as a result of the increase in debt payments. In contrast, a decrease in interest rates (in response, e.g., an expansionary monetary policy) induce higher levels of spending, but by an amount less than the change in liabilities. Similarly, Bernacke and Gertler (1989) analyze the relation between changes in the interest rate and investment demand. They find that large drops in investment are more likely to occur than large increases.

2) Expansionary monetary policy, in contrast, is negatively influenced by credit constraints. Money supply expansion increases the availability of credit and decreases the interest rate. A reduction in interest rates will not lead, however, to higher levels of borrowing and spending. This is because banks' willingness to lend may not stimulate an increase in spending without an increase in the demand for credit.[9]

### B. Supply-Side Asymmetry

Conditions on the supply side in the labor and/or product markets may differentiate the slope of the aggregate supply curve in the face of expansionary and contractionary aggregate demand shifts. New Keynesian explanations have focused on market imperfections towards an explanation of asymmetric fluctuations. The source of rigidity has varied between sticky-wage and sticky-price explanations.

Sticky-wage models have traced sources of cyclical fluctuations to conditions in the labor market.[10] Implicit or explicit labor contracts may offer an explanation. Given nominal wage rigidity, an unanticipated increase in price, in response, e.g., to a positive shock to government spending or the money supply, decreases the real wage and increases the output supplied in the short-run. Conditions in the labor market may differentiate, however, upward and downward nominal wage flexibility in the face of expansionary and contractionary demand shocks.[11] In a scenario that assumes more flexibility of the nominal wage in the

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[9] For example, if consumers do not believe in the Federal Reserve's ability to stimulate demand through expansionary monetary policy, they continue to make pessimistic forecasts during a recession. Consequently, lower interest rates may not provide a very strong incentive for consumers to increase spending during a recession. Likewise, firms may not be inclined to increase borrowing for investment in response to lower interest rate if they do not believe the economy will rebound from a recession. For some empirical evidence along this line, see Gertler and Gilchrist (1992).

[10] See, for example, Gray (1978).

[11] See, for example, Kandil (forthcoming b). Implicit or explicit contractual wage negotiations may establish that nominal wage flexibility is asymmetric. Asymmetric nominal wage flexibility may be the result of institutional settings that differentiate wage and salary negotiations in the upward and downward directions. During boom periods, cost of living adjustments may be specified to guarantee workers an upward adjustment of wages to keep up with inflation. In contrast, firms may be reluctant to take aggressive measures towards adjusting nominal wages in the downward direction during recessionary periods. This is because the search and training cost of hiring new workers to accommodate a future rise in demand may actually exceed the perceived loss of retaining workers at wages that exceed the marginal physical product of labor during recessionary periods. Alternatively, the asymmetric flexibility of nominal wages may be an endogenous response to aggregate uncertainty. Models of the variety of Gray (1978) have emphasized the dependency of the

(continued...)

upward direction, positive demand shocks will prompt instantaneous rise of wages. The upward flexibility of the nominal wage moderates the reduction of the real wage and the increase in output growth in the face of expansionary demand shocks. Consequently, the increased demand will be reflected in a higher cost of the output produced and, in turn, higher prices. In contrast, if nominal wages are more downwardly rigid, the counter cyclical response (increase) of the real wage exacerbates the contractionary effect of negative demand shocks on output and moderates the deflationary effect on prices. Accordingly, asymmetric nominal wage adjustment implies a steeper supply curve in the face of expansionary demand shifts compared to contractionary shifts.

Sticky-price explanations have isolated output fluctuations in the short-run from conditions in the labor market.[12] Menu costs limit the frequency of adjusting prices over time. These are the costs involved in implementing and announcing a price change. Given price rigidity, firms resort to adjusting output in the short-run in response to unanticipated demand shifts, e.g., a positive shock to government spending or the money supply. Conditions in the product market may establish, however, that prices adjust asymmetrically in the face of demand shocks.[13] Asymmetric price adjustment implies that shifts in aggregate demand have asymmetric effects on output. Since prices are sticky downward, a fall in aggregate demand reduces output. Higher upward flexibility of prices moderates the rise in output in response to expansionary demand shocks. Accordingly, asymmetric price adjustment implies a steeper supply curve in the face of expansionary demand shifts compared to contractionary shifts.

## III. Empirical Investigation

The approach of the empirical investigation will first provide time-series evidence of the asymmetric effects of monetary and government spending shocks on unanticipated changes in: private consumption, private investment, and aggregate demand. Mindful of the potential

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degree of indexation on the variability of stochastic disturbances. In a situation where positive and negative shocks are not equally variable, agents' incentives for the optimal degree of indexation would be asymmetric.

[12] See, for example, Ball, Mankiw, and Romer (1988).

[13] See, for example, Ball and Mankiw (1994). Positive trend inflation plays a key role in introducing asymmetries. Inflation causes firms' relative prices to decline automatically between adjustments. This requires greater adjustment of firms' desired prices in the face of positive shocks compared to negative shocks. When a firm wants a lower relative price in the face of negative demand shocks, inflation does much of the work, decreasing the need to pay the menu costs to adjust prices. By contrast, a positive shock means that the firms' relative price rises while its actual price is falling, creating a large gap between desired and actual prices. As a result, positive shocks are more likely to induce a larger price adjustment compared to negative shocks.

importance of conditions on the supply side, the investigation will look for evidence of asymmetry in the shape of the supply curve, reinforcing or offsetting asymmetry in the size of aggregate demand shifts induced by (policy) shocks.

### A. Asymmetry on the Demand Side

What are the impacts of higher variability of government spending and/or monetary shocks on the growth of private consumption, private investment, and aggregate demand? In the first step of the empirical investigation, the analysis aims at verifying asymmetry in the effects of the shocks to government spending and the money supply.[14] The empirical models for the investigation of demand-side asymmetry are specified as follows:[15]

$$Dcs_t = a_0 + \sum_{j=0}^{x} a_{1j} posg_{t-j} + \sum_{j=0}^{x} a_{2j} negg_{t-j} + \sum_{j=0}^{x} a_{3j} posm_{t-j} + \sum_{j=0}^{x} a_{4j} negm_{t-j} + \eta_{ct} \qquad (2)$$

$$Dis_t = b_0 + \sum_{j=0}^{x} b_{1j} posg_{t-j} + \sum_{j=0}^{x} b_{2j} negg_{t-j} + \sum_{j=0}^{x} b_{3j} posm_{t-j} + \sum_{j=0}^{x} b_{4j} negm_{t-j} + \eta_{it} \qquad (3)$$

$$Dds_t = c_0 + \sum_{j=0}^{x} c_{1j} posg_{t-j} + \sum_{j=0}^{x} c_{2j} negg_{t-j} + \sum_{j=0}^{x} c_{3j} posm_{t-j} + \sum_{j=0}^{x} c_{4j} negm_{t-j} + \eta_{dt} \qquad (4)$$

Unanticipated growth in private consumption, private investment, and aggregate demand are denoted by $Dcs_t$, $Dis_t$, and $Dds_t$, respectively. Expansionary and contractionary shocks to the growth of government spending around its steady-state (full-equilibrium) value are denoted by $posg_t$ and $negg_t$, respectively.[16] Expansionary and contractionary shocks to the growth of

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[14] By construction, shocks in the empirical model represent random i.i.d. components of the series in response to exogenous shocks impinging on the economic system. Given the random nature of the dependent variables, the empirical models seek to identify asymmetry in the response of demand shocks to policy shocks.

[15] The $a_j$, $b_j$, and $c_j$ coefficients approximate the size of unanticipated demand shifts in the face of policy shocks. Coefficients are determined by random contemporaneous correlations on the demand side and persistent effects (due to the multiplier effect) beyond agents' expectation. Given that the shocks are randomly distributed (see Appendix A for details), the introduction of other shocks (e.g., energy price shocks) does not affect the coefficients under consideration.

[16] The approach of this investigation is to approximate shocks in response to discretionary fiscal spending around an anticipated steady-state trend. This is in contrast to readily available measures of the deficit that may vary endogenously, as suggested by Barro (1989), with variation in the government's tax collection in response to economic conditions (e.g., recessions).

the money supply around its steady-state value are denoted by $posm_t$ and $negm_t$, respectively. $x$ is the length of the distributed-lag effect over time.[17] Asymmetry will be measured by the difference between the cumulative effects of expansionary and contractionary shocks.

### B. Asymmetry on the Supply Side

In addition to demand-side asymmetry, conditions on the supply side may determine the asymmetric effects of monetary and government spending shocks. What is the impact of higher variability of aggregate demand on price inflation and output growth? To investigate supply-side asymmetry, empirical models are specified to measure the response of output and price to aggregate demand shocks. The models replicate the reduced-form solutions of output and price in standard macro models.[18] Underlying these solutions is the assumption that the output supplied fluctuates in response to unanticipated changes in the price level in the short-run. Assuming rationality, price surprises are a function of demand and supply shocks impinging on the economy.

Nominal variables adjust fully, eliminating output fluctuations in response to anticipated demand shifts. In contrast, anticipated supply shifts enter the production function, determining both nominal and real variables. Accordingly, output growth and price inflation fluctuate in response to demand and supply shifts as follows:

$$Dp_t = d_0 + d_1 E_{t-1} Dq_t + d_2 E_{t-1} Dd_t + \sum_{j=0}^{x} d_{3j} posd_{t-j} + \sum_{j=0}^{x} d_{4j} negd_{t-j} + \sum_{j=0}^{x} d_{5j} Dqs_{t-j} + \eta_{pt} \qquad (5)$$

$$Dy_t = e_0 + e_1 E_{t-1} Dq_t + e_2 Dy_{t-1} + \sum_{j=0}^{x} e_{3j} posd_{t-j} + \sum_{j=0}^{x} e_{4j} negd_{t-j} + \sum_{j=0}^{x} e_{5j} Dqs_{t-j} + \eta_{yt} \qquad (6)$$

Stationarity is tested following the suggestions of Nelson and Plosser (1982). Test results (see, e.g., Dickey and Fuller (1981)) reject the stationarity of variables under investigation. Given these results, the empirical models are specified in first-difference form where $D(.)$ is the first-difference operator. The log values of the price level and real output at time t are denoted by $p_t$ and $y_t$, respectively. Supply-side shifts are approximated by anticipated and unanticipated changes in the energy price. The log value of the energy price is denoted by $q_t$. Anticipated growth in the energy price given information at time t-1 is denoted by $E_{t-1}Dq_t$.

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[17] The data under investigation are quarterly. Due to the multiplier effect, shocks may persist in the economic system beyond agents' expectations. To capture persistence in demand fluctuations in response to policy changes, the empirical models are estimated in a distributed-lag form.

[18] Underlying the model specification is a production function in which labor and energy are complements. Accordingly, variables in product markets fluctuate in response to aggregate demand and energy price shifts.

The distributed-lag variable, $Dqs_{t-j}$, denotes energy price shocks. Let $d_t$ be the log value of aggregate demand. Anticipated growth in aggregate demand given information at time *t-1* is denoted by $E_{t-1}d_t$. The distributed lag variables $posd_{t-j}$ and $negd_{t-j}$ measure expansionary and contractionary shocks to the growth of aggregate demand around an anticipated steady-state trend.

Energy price shifts, both anticipated and unanticipated, are inflationary, increasing the output price. That is, $d_1>0$, $\sum_{j=0}^{x} d_{5j} > 0$. The effects of energy price shifts in reducing real output growth are consistent with $e_1<0$, $\sum_{j=0}^{x} e_{5j} < 0$.

Producers adjust prices in response to anticipated growth in aggregate demand. Consequently, $d_2>0$ and real output does not vary in response to anticipated growth in aggregate demand.[19] The lagged dependent variable in (6) captures persistence in the output adjustment over time. Accordingly, $e_2>0$.[20]

Asymmetric nominal wage and/or price may establish a kinked-slope supply curve in the face of aggregate demand shifts. If prices are more flexible upward, the aggregate supply curve is steeper in the face of expansionary demand shifts. Accordingly, $\sum_{j=0}^{x}(d_{3j} - d_{4j}) > 0$ and $\sum_{j=0}^{x}(e_{3j} - e_{4j}) < 0$.

### C. The Combined Effects of Demand and Supply Asymmetries

Aggregate demand shifts in (5) and (6) are likely to vary with changes in policy variables. Substituting changes in the money supply and government spending for aggregate demand shifts, the empirical models in (5) and (6) combine the effects of demand and supply asymmetries in the face of monetary and government spending shocks:

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[19] Anticipated demand shifts are orthogonal, by construction, to unanticipated shifts. The asymmetric effects of aggregate demand shocks remain robust upon accounting for anticipated demand shifts in the empirical model.

[20] Anticipated aggregate demand shifts (see Appendix A) are, by construction, function of the lagged price. This eliminates the need to include the lagged dependent variable in equation (5).

$$Dp_t = f_0 + f_1 E_{t-1} Dq_t + f_2 E_{t-1} Dg_t + f_3 E_{t-1} Dm_t + \sum_{j=0}^{x} f_{4j} posg_{t-j} + \sum_{j=0}^{x} f_{5j} negg_{t-j} + \sum_{j=0}^{x} f_{6j} posm_{t-j} + \sum_{j=0}^{x} f_{7j} negm_{t-j} + \sum_{j=0}^{x} f_{8j} Dqs_{t-j} + \eta_{pt} \quad (7)$$

$$Dy_t = g_0 + g_1 E_{t-1} Dq_t + g_2 Dy_{t-1} + \sum_{j=0}^{x} g_{3j} posg_{t-j} + \sum_{j=0}^{x} g_{4j} negg_{t-j} + \sum_{j=0}^{x} g_{5j} posm_{t-j} + \sum_{j=0}^{x} g_{6j} negm_{t-j} + \sum_{j=0}^{x} g_{7j} Dqs_{t-j} + \eta_{pt} \quad (8)$$

Let $g_t$ be the log value of government spending. Anticipated growth in government spending given information at time t-1 is denoted by $E_{t-1}Dg_t$. This component measures average (steady-state) growth of government spending over time. Positive and negative shocks to the growth of government spending are denoted by *posg*, and *negg*. Let $m_t$ be the log value of the money supply. Anticipated growth in the money supply given information at time *t-1* is denoted by $E_{t-1}Dm_t$. Positive and negative shocks to monetary growth are denoted by *posm* and *negm*. The cumulative response of variables to the shocks to government spending and the money supply is likely to vary with two factors: (i) the size of aggregate demand shifts, and (ii) conditions on the supply-side.

## IV. Empirical Results

The empirical models are estimated using quarterly data over the sample period 1970.I–1996.III. The estimation of the empirical models (2) through (8) follows the methodology described in Appendix A. Description and sources of the data are described in Appendix B.

Assume monetary and government-spending shocks are distributed symmetrically around a steady-state trend. This trend varies with agents' rational expectations of anticipated government spending and the money supply. Anticipated policy variables correspond to agents' observations of macro-economic fundamentals over time.

The models are estimated with varying lag lengths, $x$=4,6,8, for three specifications: (i) the model specification with monetary and government spending shocks,[21] (ii) the model specification with government spending shocks only, and (iii) the model specification with monetary shocks only. To conserve space, results are reported for specification (i) with $x$=6.[22]

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[21] This specification accounts for the possibility that the Fed may be accommodating the change in government spending in order to stabilize the interest rate. As suggested by Evans (1987), "Central banks are often alleged to stabilize their domestic nominal interest rates."

[22] The qualitative results of the paper are robust for varying lag lengths. The results are available upon request.

## A. Evidence of Demand-Side Asymmetry

The first set of estimation combines models (2) through (4) to determine asymmetry in the effects of government spending shocks and monetary shocks on unanticipated growth in private consumption, private investment and aggregate demand. To establish robustness of the evidence, disaggregate data for each demand variable are under investigation. Tables 1 through 3 summarize the sum of the distributed-lag coefficients for the positive and negative components of monetary and government spending shocks in models (2) through (4).[23]

### Asymmetry in the Response of Private Consumption to Policy Shocks

The data under investigation decompose personal consumption expenditures into three components: (i) Durable Goods, (ii) Nondurable Goods, and (iii) Services. Table 1 summarizes the results of estimating the empirical model in (2). The behavior of Ricardian consumers is evident to be asymmetric in the face of government spending shocks. Specifically, expansionary government spending shocks have a cumulative negative effect on personal consumption expenditures, which is statistically significant on several underlying components of Durables and Nondurable Goods. The reduction of private consumption is not statistically significant for Services or underlying components. In contrast, the effect of contractionary government spending shocks is positive, in general, decreasing private consumption of Durable Goods and other Nondurable Goods.

Asymmetry is evident by the difference in the cumulative response of private consumption to expansionary and contractionary government spending shocks. Private consumption appears to be decreasing in the face of expansionary and contractionary government spending shocks. This is evident by the cumulative negative and statistically significant *difference* for personal Consumption Expenditure and several underlying components. Given the time-series evidence, higher variability of government spending shocks (higher probability of realizing positive and negative shocks) decreases the growth of private consumption, on average, over time.[24]

The results of estimating the empirical model in (2) also indicate asymmetry in the response of private consumption to monetary shocks. There is no evidence of a significant increase in private consumption or underlying components in the face of expansionary monetary shocks.[25] The effects of contractionary monetary shocks are evident in decreasing private

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[23] Statistical significance will be established at the five or ten percent levels. Detailed estimates are available upon request.

[24] Higher variability determines the dispersion of the positive and negative shocks around the zero average for the shock. Higher variability is attributed to more frequent realization of positive and negative shocks and/or larger shocks.

[25] Further, expansionary monetary shocks have a cumulative negative and statistically significant effect on private consumption of Other Household Operation. That is, the

(continued...)

consumption. Credit constraints appear, therefore, to reinforce the contractionary effect of tight monetary policy in decreasing private consumption. Asymmetry is evident by the *difference* in the cumulative response of private consumption to expansionary and contractionary monetary shocks. Where the evidence is significant, higher variability of monetary shocks decreases private consumption, on average, over time.

Given the above evidence, the *difference* between the cumulative effects of expansionary government spending and monetary shocks is negative and statistically significant for several components of Personal Consumption Expenditures. The reduction in private consumption attributed to monetary shocks generally exceeds that attributed to government spending shocks.

**Asymmetry in the Response of Private Investment to Policy Shocks**

The data under investigation decompose Gross Private Domestic Investment into Fixed Investment and the Change in Business Inventories.[26] Private Fixed Investment is made of two components: (i) Nonresidential, and (ii) Residential. Table 2 summarizes the results of estimating the empirical model in (3). Crowding out of private investment in the face of expansionary government spending shocks is evident by the cumulative negative effect on Gross Private Domestic Investment, and Private Fixed Investment, which is statistically significant on several underlying components. The contractionary effect of government spending shocks appears generally insignificant in explaining private fixed investment. Asymmetry is established by the cumulative *difference* in the response of private investment to expansionary and contractionary government spending shocks. Where the *difference* is negative and statistically significant, higher variability of government spending shocks decreases private investment, on average, over time.

The cumulative response of private investment is generally insignificant in the face of expansionary monetary shocks. The contractionary effect of monetary policy appears also moderate on private investment, in general.[27] Further, the *difference* between the cumulative effects of expansionary and contractionary shocks is generally insignificant. Where the *difference* is significant, the direction of asymmetry varies. Accordingly, statistical

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increased availability of credit through expansionary monetary policy does not stimulate the growth of private consumption.

[26] Fixed Investment is the planned component and the change in business inventories is the unplanned component of Gross Private Domestic Investment. Given the unplanned nature of inventories, the analysis will focus on the effects of policy shocks on Private Fixed Investment.

[27] It is interesting to note the negative and significant response of investment in "Computers and Peripheral Equipment" to contractionary monetary shocks. This is consistent with a structural growth that dominates the effects of cyclical fluctuations in policy shocks.

significance does not establish a clear direction for the effect of monetary variability on private investment, on average, over time.

Given the above evidence, the *difference* between the cumulative effects of expansionary government spending and monetary shocks is negative and statistically significant for several investment components. The reduction in private investment attributed to government spending shocks generally exceeds that of monetary shocks.

**Asymmetry in the Response of Aggregate Demand to Policy Shocks**

The data under investigation decompose aggregate demand, the nominal value of Gross Domestic Product, into the following components: Goods, Durable and Nondurable, Services, and Structures.[28]

Table 3 summarizes the results of estimating the empirical model in (4). Consistent with the reduction in private spending, the cumulative effect of expansionary government spending shocks is negative, although statistically insignificant, on the demand for GDP and for Goods, both Durables and Non-Durables. That is, the reduction in private spending offsets demand expansion in the face of government spending.[29] In contrast, contractionary government spending shocks decrease the demand for Services and Structures, as evident by the positive and statistically significant cumulative response.

The combined effects differentiate the size of aggregate demand shifts in the face of expansionary and contractionary government spending shocks. This is evident by the cumulative negative and statistically significant *difference* between the effects of expansionary and contractionary government spending shocks on the demand for GDP, Goods, Durables, Services and Structures. Clearly, higher variability of government spending shocks decreases aggregate demand, on average, over time.

The cumulative effect of expansionary monetary shocks is insignificant on various measures of aggregate demand. In contrast, the cumulative effect of contractionary monetary shocks is positive and statistically significant on the demand for GDP, and Durable Goods.

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[28] Nominal values represent spending values that are distributed between quantity and price adjustments.

[29] As suggested by Barro (1974), it may be optimal for households to react to an increased deficit by increasing their saving by an equal amount. Consequently, aggregate demand may not rise. The fact that aggregate demand decreases suggests that the rise in the real return to saving increases savings appreciably in response to government spending shocks. Therefore, "private saving rises not only by enough to pay all future tax liabilities a la Barro, but also by an additional amount, thereby lowering aggregate demand...." Evans (1985).

The combined effects differentiate the size of aggregate demand shifts in the face of expansionary and contractionary monetary shocks. This is evident by the cumulative negative and statistically significant *difference* between the effects of expansionary and contractionary monetary shocks on GDP. Clearly, higher variability of monetary shocks decreases the growth of aggregate demand, on average, over time.

Given the above evidence, the *difference* between the cumulative effects of expansionary shocks to government spending and the money supply is negative and statistically significant on aggregate demand and several underlying components. In contrast, statistical significance does not differentiate demand contraction, in general, in the face of monetary and government spending shocks.

### B. Evidence of Supply-Side Asymmetry

To measure asymmetry in the shape of the supply curve, the empirical models (5) and (6) are estimated. Several measures of aggregate demand are employed: the demand for GDP, Goods, Durables and Nondurables, Services and Structures. Table 4 summarizes the sum of the distributed-lag coefficients for the positive and negative components of aggregate demand shocks.[30]

The increase in price inflation is evident by the cumulative positive and statistically significant response to expansionary demand shocks to GDP, Goods, Nondurable Goods, Services and Structures. In contrast, there is no evidence of price deflation in the face of contractionary shocks to aggregate demand, except for Nondurable goods.[31] Consistently, the *difference* between the cumulative effects of expansionary and contractionary shocks is positive and statistically significant, in general. Hence, higher variability of aggregate demand increases price inflation, on average, over time.

Supply-side asymmetry is also evident by the asymmetric response of output to aggregate demand shocks. Except for Durable Goods, output does not increase in the face of expansionary shocks to aggregate demand. In contrast, the reduction of output growth is more pronounced in the face of contractionary demand shocks. Subsequently, the *difference* between output expansion and contraction is negative and statistically significant, in general. Hence, higher variability of aggregate demand decreases output growth, on average, over time.

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[30] Detailed estimates are available upon request.

[31] Further, the negative and statistically significant response indicates downward rigidity of prices in the face of contractionary shocks to the demand for services.

### C. The Combined Evidence of Demand and Supply Asymmetries

What are the combined effects of demand and supply asymmetries on the stabilizing results of monetary and government spending shocks? To answer, the empirical models (7) and (8) are estimated using output and price data for GDP, Goods, Durable Goods, Nondurable Goods, Services and Structures. Table 5 summarizes the sum of the distributed-lag coefficients for the positive and negative components of the shocks to government spending and the money supply.[32]

Demand contraction (attributed to the reduction in private spending) determines that price inflation, in general, decreases in the face of expansionary government spending shocks.[33] Price flexibility insulates real output growth from the effects of government spending shocks. Accordingly, the cumulative response of output growth to expansionary government spending shocks is statistically insignificant, in general. Price deflation appears less pronounced in the face of contractionary government spending shocks. Further, the cumulative response of output growth to contractionary government spending shocks is statistically insignificant, in general.

Given the above evidence, the *difference* between the effects of expansionary and contractionary government spending shocks on price inflation is negative and statistically significant for GDP, Goods, Durable Goods, Nondurable Goods, Services and Structures. Clearly, higher variability of government spending shocks decreases price inflation, on average, over time. The cumulative *difference* between the response of output growth to expansionary and contractionary government spending shocks is generally insignificant.

Despite larger demand contraction relative to expansion, the upward flexibility of price is generally in sharp contrast to downward rigidity in the face of monetary shocks. This evidence is consistent with a kinked supply curve in the face of monetary shocks. Consistently, the cumulative effect of expansionary monetary shocks is insignificant on output growth. In contrast, the cumulative effect of contractionary monetary shocks on output growth is positive and statistically significant, in general. Hence, the effects of monetary shocks in decreasing real output growth appear persistent.

The *difference* between the response of price inflation to expansionary and contractionary monetary shocks is positive and statistically significant for GDP, Goods, and Nondurable Goods. Clearly, higher variability of monetary shocks increases price inflation, on average, over time. Consistently, the *difference* between the cumulative response of output growth to expansionary and contractionary monetary shocks is negative and statistically significant for

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[32] Detailed estimates are available upon request.

[33] This evidence is consistent with the results of earlier research. Dwyer (1982) found no evidence that increasing current or past budget deficit raises the price level, a consequence that one would expect if aggregate demand rises.

GDP and Services. Hence, higher variability of monetary shocks decreases output growth, on average, over time.

Given the above evidence, the difference between the cumulative effects of expansionary shocks to government spending and the money supply on price inflation is negative and statistically significant for GDP, Goods, Durable Goods, Services and Structures. That is, price inflation is more pronounced in the face of expansionary monetary shocks. Generally, the difference between the cumulative effects of expansionary shocks to government spending and the money supply on output growth is statistically insignificant. Further, the *difference* between the cumulative effects of contractionary shocks to government spending and the money supply on price inflation is positive and statistically significant for GDP, and Services. That is, price deflation is more pronounced in the face of contractionary government spending shocks. Consistently, output reduction is generally larger in the face of contractionary monetary shocks compared to government spending shocks.

## V. Summary and Conclusion

Demand-side stabilization policies focus on varying the growth of government spending and/or the money supply to stabilize economic conditions. Traditionally, the debate has centered on the relative effectiveness of monetary and fiscal tools in achieving demand stabilization. More recently, however, supply-siders have challenged the success of short-term demand management policies. Instead, they have advocated macroeconomic policies promoting long-term growth.

This paper seeks to provide evidence on the potential limitations of demand-side stabilization policies and to contribute to the debate over the preferred focus of macroeconomic policy-stabilizing cycles in economic activity or the promotion of long-term growth. Using quarterly data for the U.S., the analysis evaluates asymmetry in demand shifts in response to expansionary and contractionary shocks to government spending and the money supply. The reduction in private spending dominates the increase in aggregate demand attributed to expansionary government spending shocks. Further, demand contraction exceeds expansion in the face of monetary shocks.

The results of demand-stabilizing policies are further complicated by adjustments on the supply side of the economy. Prices are more flexible to adjust downward to absorb demand contraction in the face of government spending shocks. In contrast, asymmetry in price adjustment dominates asymmetry in the size of demand shifts in the face of monetary shocks. Accordingly, price inflation exceeds deflation and output contraction exceeds expansion in the face of monetary shocks.

The paper's evidence represents the average time-series response to policy fluctuations around the economy's steady-state trend in the sample period under investigation. Such evidence should not imply that every fiscal expansion is guaranteed to reduce aggregate demand and every monetary expansion is likely to be inflationary. Instead, the evidence of asymmetry indicates that the stabilizing effects of demand policies are dependent on the state

of the business cycle. During recessions, when demand is below capacity level, the adverse effects are likely to be less pronounced and expansionary policies are likely to be more effective in stimulating aggregate demand. Clearly, the variability of expansionary shocks has exceeded what is necessary to stimulate the economy during recessionary periods.[34]

Mindful of the desirable effects of discretionary policies, the paper's analysis presents evidence that challenges the desirability of demand management stabilization policies on several grounds. Higher variability of government spending decreases private spending and, therefore, the growth of aggregate demand, on average, over time. Accordingly, efforts to stimulate demand are dominated by the crowding out of private spending in the face of expansionary government spending shocks. On the other hand, higher variability of the money supply is likely to increase price inflation and moderate output growth, on average, over time. This evidence challenges the neutrality of monetary policy in the long run. In light of these adverse effects, maintaining steady growth of government spending and the money supply is more desirable. Subsequently, macroeconomic policies are better focused on growth promotion than on stabilization. By addressing capacity limitation on the supply side, the economy can realize steady growth that stabilizes demand and reduces the risk of recessionary and boom conditions.

Finally, it is worth noting that the paper's analysis has considered the implications of policy variability assuming symmetric distribution of the shocks over time. Future research should evaluate the effects of stabilization policies for varying size demand shocks, i.e., allowing policy shocks to be asymmetrically distributed in the face of variability impinging on the stochastic structure of the economic system.

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[34] As suggested by Barro (1989), "…. if everyone thinks that a budget deficit makes them wealthier, the resulting expansion of aggregate demand raises output and employment and, therefore, makes people wealthier. This result holds if the economy begins in a state of 'involuntary unemployment'."

Table 1. Asymmetry in the Response of Private Consumption to Monetary and Government Spending Shocks

| Dependent Variables | $\sum posg_{t-j}$ | $\sum negg_{t-j}$ | $\sum posm_{t-j}$ | $\sum negm_{t-j}$ | $\sum posg - \sum negg$ | $\sum posm - \sum negm$ | $\sum posg - \sum posm$ | $\sum negg - \sum negm$ |
|---|---|---|---|---|---|---|---|---|
| Personal Consumption Expenditures | -0.40 | 0.28 | -0.21 | 0.78* | -0.68* | -0.99* | -0.19 | -0.50 |
| | (-1.56) | (0.76) | (-0.68) | (2.36) | (-2.65) | (-3.20) | (-0.74) | (-1.36) |
| (i) Durable Goods | -0.59 | 1.83 | -0.042 | 2.12* | -2.42* | -2.16 | -0.55 | -0.29 |
| | (-0.60) | (1.39) | (-0.03) | (1.76) | (-2.46) | (-1.54) | (-0.56) | (-0.22) |
| Motor Vehicle and Parts | 0.24 | 4.46 | -1.50 | 2.58 | -4.22* | -4.08 | 1.74 | 1.88 |
| | (0.12) | (1.59) | (-0.55) | (0.73) | (-2.11) | (-1.50) | (0.87) | (0.67) |
| Furniture and other Household Equipment | -0.87** | 0.74 | 0.96 | 0.47 | -1.61* | 0.49 | -1.83* | 0.27 |
| | (-1.67) | (1.33) | (1.30) | (0.73) | (-3.09) | (0.66) | (-3.51) | (0.49) |
| Other Durable | -1.24 | -0.83 | 0.29 | 3.055* | -0.41 | -2.77* | -1.53** | -3.89* |
| | (-1.35) | (-0.63) | (0.23) | (2.73) | (-0.45) | (-2.19) | (-1.67) | (-2.95) |
| (ii) Nondurable Goods | -0.41** | 0.0055 | 0.30 | 0.44 | -0.42** | -0.14 | -0.71* | -0.43) |
| | (-1.64) | (0.015) | (0.86) | (1.31) | (-1.66) | (-0.40) | (-2.84) | (-1.19) |
| Food | -0.42** | -0.14 | 0.077 | 0.50 | -0.28 | -0.42 | -0.50* | -0.64* |
| | (-1.65) | (-0.41) | (0.25) | (1.41) | (-1.10) | (-1.37) | (-1.95) | (-1.87) |
| Clothing and Shoes | -0.64 | 0.29 | 0.028 | 0.56 | -0.93* | -0.53 | -0.67 | -0.27 |
| | (-1.55) | (0.49) | (0.023) | (0.51) | (-2.25) | (-0.44) | (-1.62) | (-0.46) |
| Gasoline and Oil | -1.75 | -1.66 | 1.40 | 0.66 | -0.09 | 0.74 | -3.15* | -2.32 |
| | (-1.51) | (-1.00) | (0.86) | (0.47) | (-0.078) | (0.45) | (-2.72) | (-1.39) |
| Fuel Oil and Coal | -3.24** | -2.033 | -0.078 | 5.17* | -1.21 | -5.25* | -3.16 | -7.20* |
| | (-1.67) | (-0.73) | (-0.029) | (2.19) | (-0.62) | (-1.95) | (-1.63) | (-2.59) |
| Other Nondurable Goods | -0.22 | 0.45 | 0.27 | 0.099 | -0.67* | 0.58* | -0.49** | 0.35 |
| | (-0.84) | (1.48) | (0.91) | (0.39) | (-2.56) | (1.94) | (-1.87) | (1.15) |
| (iii) Services | -0.098 | 0.17 | 0.23 | -0.035 | -0.27** | 0.27 | -0.33* | 0.21 |
| | (-0.67) | (0.80) | (1.12) | (-0.20) | (-1.83) | (1.29) | (-2.24) | (0.96) |
| Housing | -0.013 | 0.15 | -0.016 | 0.16 | -0.16 | -0.18 | 0.003 | -0.01 |
| | (-0.11) | (0.88) | (-0.097) | (1.11) | (-1.38) | (-1.067) | (0.025) | (-0.059) |
| Household Operation | -0.41 | 0.051 | -0.55 | 0.47 | -0.46 | -0.97 | 0.14 | -0.42 |
| | (-0.75) | (0.065) | (-0.72) | (0.70) | (-0.84) | (-1.27) | (0.26) | (-0.53) |
| Electricity and Gas | -0.97 | 0.25 | -0.73 | 0.49 | -1.22 | -1.22 | -0.24 | -0.24 |
| | (-0.87) | (0.15) | (-0.47) | (0.36) | (-1.094) | (-0.78) | (-0.22) | (-0.14) |
| Other Household Operation | 0.22 | 0.24 | -0.66** | 0.71* | -0.02 | -1.37* | 0.88* | -0.46 |
| | (0.84) | (0.64) | (-1.80) | (2.22) | (-0.076) | (-3.73) | (3.36) | (-1.23) |
| Transportation | -0.48 | 0.61 | -0.17 | -0.32 | -1.09** | 0.15 | -0.31 | 0.93 |
| | (-1.022) | (0.90) | (-0.26) | (-0.56) | (-2.32) | (0.23) | (-0.66) | (1.37) |
| Medical Care | -0.38 | -0.13 | 0.37 | -0.32 | -0.25 | 0.69 | -0.75* | 0.19 |
| | (-1.25) | (-0.30) | (0.87) | (-0.86) | (-0.82) | (1.62) | (-2.47) | (0.44) |
| Other Services | 0.14 | 0 .89** | 0.23 | 0.069 | -0.75* | 0.16 | -0.09 | 0.82** |
| | (0.43) | (1.81) | (0.50) | (0.17) | (-2.30) | (0.35) | (-0.28) | (1.67) |

Notes:

- Empirical Model:

$$Dcs_t = a_0 + \sum_{j=0}^{6} a_{1j} posg_{t-j} + \sum_{j=0}^{6} a_{2j} negg_{t-j} + \sum_{j=0}^{6} a_{3j} posm_{t-j} + \sum_{j=0}^{6} a_{4j} negm_{t-j} + \eta_{ct}$$

- *posg, negg* denote expansionary and contractionary shocks to the growth of government spending around its steady-state (full-equilibrium) value.
- *posm, negm* denote expansionary and contractionary shocks to the growth of the money supply around its steady-state (full equilibrium) value.
- $\sum (posd - negd)$, $d = g, m$ approximates asymmetry in the response of private consumption to policy shocks.
- $\sum (posg - posm)$ approximates the relative effects of expansionary government spending and monetary shocks on private consumption.
- $\sum (negg - negm)$ approximates the relative effects of contractionary government spending and monetary shocks on private consumption.
- t-ratios are in parentheses.
- * and ** denote statistical significance of the cumulative effects at the five and ten percent levels, respectively.

Table 2. Asymmetry in the Response of Private Investment to Monetary and Government Spending Shocks

| Dependent Variables | $\sum posg_{t-j}$ | $\sum negg_{t-j}$ | $\sum posm_{t-j}$ | $\sum negm_{t-j}$ | $\sum posg - \sum negg$ | $\sum posm - \sum negm$ | $\sum posg - \sum posm$ | $\sum negg - \sum negm$ |
|---|---|---|---|---|---|---|---|---|
| Gross Private Domestic Investment | 1.034 | -0.0075 | 0.94 | 1.27 | -1.027 | -0.33 | -1.97* | -1.28 |
| | (-1.51) | (-0.0076) | (1.15) | (1.44) | (-1.50) | (-0.40) | (-2.88) | (-1.29) |
| Private Fixed Investment | -1.25 | 1.37 | 1.62 | 0.22 | -2.62* | 1.40 | -2.87* | 1.15 |
| | (-1.60) | (1.21) | (1.48) | (0.23) | (-3.35) | (1.28) | (-3.67) | (1.016) |
| (i) Nonresidential | -0.87 | 0.74 | 1.29 | 0.50 | -1.61* | 0.79 | -2.16* | 0.24 |
| | (-1.23) | (0.73) | (1.30) | (0.58) | (-2.28) | (0.80) | (-3.05) | (0.24) |
| Structures | 0.55 | 1.011 | 0.84 | -0.17 | -0.46 | 1.01 | -0.29 | 1.18 |
| | (0.60) | (0.76) | (0.65) | (-0.15) | (-0.50) | (0.78) | (-0.32) | (0.89) |
| Nonresidential Buildings, Including Farm | 0.88 | 1.91 | 0.75 | -0.12 | -1.03 | 0.87 | 0.13 | 2.03 |
| | (0.83) | (1.36) | (0.51) | (-0.093) | (-0.97) | (0.59) | (0.12) | (1.45) |
| Utilities | -2.01* | -0.71 | -0.64 | 1.63 | -1.30 | -2.27** | -1.37 | -2.34** |
| | (-2.04) | (-0.50) | (-0.47) | (0.63) | (-1.32) | (-1.67) | (-1.39) | (-1.64) |
| Mining Exploration, Shafts, and Wells | -0.45 | 0.87 | -2.22 | 1.57 | -1.32 | -3.79 | 1.77 | -0.70 |
| | (-0.14) | (0.18) | (-0.48) | (0.39) | (-0.41) | (-0.82) | (0.55) | (-0.14) |
| Other Structures | 8.06* | 7.86 | -3.44 | 1.79 | 0.20 | -5.23 | 11.5* | 6.07 |
| | (2.13) | (1.44) | (-0.65) | (0.39) | (0.053) | (-0.99) | (3.04) | (1.11) |
| Producers' Durable Equipment | -1.89* | 0.47 | 2.11* | 0.20 | -2.36* | 1.90** | -4.00* | 0.27 |
| | (-2.49) | (0.43) | (1.98) | (0.22) | (-3.11) | (1.78) | (-5.27) | (0.25) |
| Information Processing and Related Equipment | -1.01 | 0.46 | 1.016 | 1.90** | -1.47** | -0.88 | -2.026* | -1.44 |
| | (-1.19) | (0.38) | (0.86) | (1.84) | (-1.73) | (-0.75) | (-2.39) | (-1.19) |
| Computers and Peripheral Equipment | 1.84 | 4.81** | 4.15** | -6.65* | -2.97** | 10.8* | -2.31 | 11.46* |
| | (1.029) | (1.86) | (1.66) | (-3.05) | (-1.66) | (4.32) | (-1.29) | (4.43) |
| Other Information Processing | -1.63* | -0.26 | 1.60 | 0.079 | -1.37* | 1.52 | -3.23* | -0.34 |
| | (-2.31) | (-0.26) | (1.47) | (0.092) | (-1.94) | (1.40) | (-11.84) | (-0.34) |
| Industrial Equipment | -1.47* | -0.11 | 0.68 | 1.35 | -1.36* | -0.67 | -2.15* | -1.46 |
| | (-2.13) | (-0.085) | (0.71) | (1.61) | (-1.97) | (-0.70) | (-3.12) | (-1.13) |
| Transportation and Related Equipment | -3.27** | 1.56 | 2.63 | 0.15 | -4.83* | 2.48 | -5.9* | 1.41 |
| | (-1.93) | (0.64) | (1.11) | (0.073) | (-2.85) | (1.047) | (-3.48) | (0.58) |
| Other Producers' Durable Equipment | -1.66 | 1.28 | 1.064 | 1.54 | -2.94* | -0.48 | -2.72* | -0.26 |
| | (-1.32) | (0.71) | (0.60) | (1.00) | (-2.34) | (-0.27) | (-2.17) | (-0.14) |
| (ii) Residential | -0.50 | 4.22* | 0.92 | 0.56 | -4.72* | 0.36 | -1.42 | 3.66 |
| | (-0.31) | (1.87) | (0.42) | (0.29) | (-2.93) | (0.16) | (-0.88) | (1.62) |
| Structures | -0.49 | 4.31** | 0.90 | 0.62 | -4.8* | 0.28 | -1.39 | 3.69 |
| | (-0.31) | (1.88) | (0.41) | (0.32) | (-3.037) | (0.13) | (-0.88) | (1.61) |
| Single Family | -1.097 | 3.40 | 0.31 | 0.80 | -4.50* | -0.49 | -1.41 | 2.60 |
| | (-0.63) | (1.35) | (0.13) | (0.37) | (-2.58) | (-0.20) | (-0.81) | (1.032) |
| Multi Family | -1.87 | 5.32** | 0.84 | -2.18 | -7.19* | 3.02 | -2.73 | 7.50* |
| | (-0.90) | (1.77) | (0.29) | (-0.86) | (-3.46) | (1.043) | (-1.31) | (2.50) |
| Other Structures | -1.65 | 1.28 | 1.063 | 1.55 | -2.93* | -0.49 | -2.71* | -0.27 |
| | (-1.31) | (0.71) | (0.60) | (0.46) | (-2.33) | (-0.27) | (-2.15) | (-0.15) |
| Producers' Durable Equipment | -1.50 | 1.14 | 1.20 | 1.014 | -2.64* | 0.19 | -2.70* | 0.13 |
| | (-1.45) | (0.75) | (0.83) | (0.81) | (-2.55) | (0.13) | (-2.61) | (0.083) |

Notes:

- Empirical Model

$$Dis_t = b_0 + \sum_{j=0}^{6} b_{1j} posg_{t-j} + \sum_{j=0}^{6} b_{2j} negg_{t-j} + \sum_{j=0}^{6} b_{3j} posm_{t-j} + \sum_{j=0}^{6} b_{4j} negm_{t-j} + \eta_{it}$$

- *posg, negg* denote expansionary and contractionary shocks to the growth of government spending around its steady-state (full-equilibrium) value.
- *posm, negm* denote expansionary and contractionary shocks to the growth of the money supply around its steady-state (full equilibrium) value.
- $\sum (posd - negd)$, $d = g, m$ approximates asymmetry in the response of private investment to policy shocks.
- $\sum (posg - posm)$ approximates the relative effects of expansionary government spending and monetary shocks on private investment.
- $\sum (negg - negm)$ approximates the relative effects of contractionary government spending and monetary shocks on private investment.
- t-ratios are in parentheses.
- * and ** denote statistical significance of the cumulative effects at the five and ten percent levels, respectively.

Table 3. Asymmetry in the Response of Aggregate Demand to Monetary and Government Spending Shocks

| Dependent Variables | $\sum posg_{t-j}$ | $\sum negg_{t-j}$ | $\sum posm_{t-j}$ | $\sum negm_{t-j}$ | $\sum posg - \sum negg$ | $\sum posm - \sum negm$ | $\sum posg - \sum posm$ | $\sum negg - \sum negm$ |
|---|---|---|---|---|---|---|---|---|
| Gross Domestic Product | -0.49 | 0.34 | 0.078 | 0.73** | -0.83* | -0.65** | -0.57** | -0.39 |
| | (-1.62) | (0.78) | (0.22) | (1.87) | (-2.74) | (-1.84) | (-1.88) | (-0.89) |
| Goods | -0.79 | 0.23 | 0.53 | 0.88 | -1.02* | -0.35 | -1.32* | -0.65 |
| | (-1.53) | (0.31) | (0.72) | (1.39) | (-1.98) | (-0.48) | (-2.56) | (-0.88) |
| Durable Goods | -1.15 | 0.91 | 0.67 | 1.77** | -2.06* | -1.10 | -1.82* | -0.86 |
| | (-1.33) | (0.73) | (0.55) | (1.68) | (-2.38) | (-0.90) | (-2.10) | (-0.69) |
| Nondurable Goods | -0.58 | -0.26 | 0.38 | 0.24 | -0.31 | 0.14 | -0.95* | -0.50 |
| | (-1.31) | (-0.41) | (0.62) | (0.45) | (-0.70) | (0.23) | (-2.15) | (-0.79) |
| Services | 0.031 | 0.32** | -0.041 | 0.18 | -0.29* | -0.22 | 0.072 | 0.14 |
| | (0.23) | (1.64) | (-0.22) | (1.098) | (-2.14) | (-1.19) | (0.53) | (0.72) |
| Structures | -0.73 | 2.92* | 1.084 | 0.81 | -3.65* | 0.27 | -1.81** | 2.11 |
| | (-0.73) | (2.049) | (0.78) | (0.67) | (-3.65) | (0.20) | (-1.81) | (1.48) |

Notes:

- Empirical Model

$$Dds_t = c_0 + \sum_{j=0}^{6} c_{1j} posg_{t-j} + \sum_{j=0}^{6} c_{2j} negg_{t-j} + \sum_{j=0}^{6} c_{3j} posm_{t-j} + \sum_{j-0}^{6} c_{4j} negm_{t-j} + \eta_{dt}$$

- *posg, negg* denote expansionary and contractionary shocks to the growth of government spending around its steady-state (full-equilibrium) value.
- *posm, negm* denote expansionary and contractionary shocks to the growth of the money supply around its steady-state (full equilibrium) value.
- $\sum (posd - negd)$, $d = g, m$ approximates asymmetry in the response of agggregate demand to policy shocks.
- $\sum (posg - posm)$ approximates the relative effects of expansionary government spending and monetary shocks on aggregate demand.
- $\sum (negg - negm)$ approximates the relative effects of contractionary government spending and monetary shocks on aggregate demand.
- t-ratios are in parentheses.
- * and ** denote statistical significance of the cumulative effects at the five and ten percent levels, respectively.

Table 4. Asymmetry in the Response of Output and Price to Aggregate Demand Shocks

| Aggregate Demand Measure | Dependent Variable | $\sum posd_{t-j}$ | $\sum negd_{t-j}$ | $\sum (posd - negd)$ |
|---|---|---|---|---|
| Gross Domestic Products | Price | 0.79* | -0.038 | 0.83* |
| | | (2.74) | (-0.11) | (2.87) |
| | Output | 0.24 | 1.27* | -1.03* |
| | | (1.01) | (4.024) | (-4.33) |
| Goods | Price | 0.55* | 0.084 | 0.47* |
| | | (2.46) | (0.37) | (2.084) |
| | Output | 0.39 | 0.73** | -0.34 |
| | | (1.14) | (1.80) | (-0.99) |
| Durable Goods | Price | -0.17 | 0.25 | -0.42** |
| | | (-0.76) | (1.24) | (-1.88) |
| | Output | 0.74* | 1.069* | -0.33 |
| | | (2.08) | (3.58) | (-0.92) |
| Nondurable Goods | Price | 1.36* | 0.65** | 0.71** |
| | | (3.21) | (1.69) | (1.68) |
| | Output | 0.29 | 0.93** | -0.64 |
| | | (0.60) | (1.89) | (-1.32) |
| Services | Price | 2.027* | -1.76* | 3.79* |
| | | (3.52) | (-2.74) | (6.58) |
| | Output | -0.55 | 2.33* | -2.88* |
| | | (-1.22) | (3.69) | (-6.39) |
| Structures | Price | 0.62* | -0.32 | 0.94* |
| | | (3.36) | (-1.023) | (5.094) |
| | Output | 0.29 | 1.33* | -1.04* |
| | | (1.12) | (2.90) | (-4.017) |

Notes:

- Empirical Models:

$$Dp_t = d_0 + d_1 E_{t-1} Dq_t + d_2 E_{t-1} Dd_t + \sum_{j=0}^{6} d_{3j} posd_{t-j} + \sum_{j=0}^{6} d_{4j} negd_{t-j} + \sum_{j=0}^{6} d_{5j} Dqs_{t-j} + \eta_{pt}$$

$$Dy_t = e_0 + e_1 E_{t-1} Dq_t + e_2 Dy_{t-1} + \sum_{j=0}^{6} e_{3j} posd_{t-j} + \sum_{j=0}^{6} e_{4j} negd_{t-j} + \sum_{j=0}^{6} e_{5j} Dqs_{t-j} + \eta_{yt}$$

- *posd, negd* denote expansionary and contractionary shocks to the growth of aggregate demand around its steady-state (full-equilibrium) value.
- $\sum (posd - negd)$, approximates asymmetry in the response of the dependent variable, output or price, to aggregate demand shocks.
- t-ratios are in parentheses.
- * and ** denote statistical significance of the cumulative effects at the five and ten percent levels, respectively.

Table 5. Asymmetry in the Response of Output and Price to Monetary and Government Spending Shocks

| Dependent Variable | $\sum posg_{t-j}$ | $\sum negg_{t-j}$ | $\sum posm_{t-j}$ | $\sum negm_{t-j}$ | $\sum posg$ $-\sum negg$ | $\sum posm$ $-\sum negm$ | $\sum posg$ $-\sum posm$ | $\sum negg$ $-\sum negm$ |
|---|---|---|---|---|---|---|---|---|
| **Gross Domestic Product** | | | | | | | | |
| Price | -0.60* | 0.81* | 1.30* | -0.46* | -1.41* | 1.76* | -1.90* | 1.27* |
| | (-2.95) | (3.21) | (2.56) | (-2.46) | (-6.93) | (3.47) | (-9.34) | (5.03) |
| Output | -0.14 | 0.079 | -0.34 | 0.72 | -0.22 | 1.06* | 0.20 | -0.64 |
| | (-0.38) | (0.16) | (-0.83) | (1.57) | (-0.59) | (-2.59) | (0.54) | (-1.31) |
| **Goods** | | | | | | | | |
| Price | -0.74* | -0.0013 | 0.78** | 0.097 | -0.74* | 0.68 | -1.52* | -0.098 |
| | (-2.34) | (-0.0027) | (1.75) | (0.29) | (-2.34) | (1.53) | (-4.81) | (-0.20) |
| Output | -0.56 | -0.093 | 0.018 | 0.90 | -0.47 | -0.88 | -0.58 | -0.99 |
| | (-0.92) | (-0.10) | (0.023) | (1.39) | (-0.77) | (-1.13) | (-0.95) | (-1.068) |
| **Durable Goods** | | | | | | | | |
| Price | -0.66** | 0.30 | 0.14 | 0.30 | -0.80* | -0.16 | -0.80* | 0.00 |
| | (-1.78) | (0.54) | (0.27) | (0.77) | (-2.16) | (-0.31) | (-2.16) | (0.00) |
| Output | -1.098 | 0.33 | 0.67 | 1.72 | -1.43 | -1.05 | -1.76 | -1.39 |
| | (-0.95) | (0.19) | (0.22) | (1.35) | (-1.24) | (-0.34) | (-1.53) | (-0.80) |
| **Nondurable Goods** | | | | | | | | |
| Price | -0.81* | -0.16 | 1.28* | -0.05 | -0.65 | 1.33* | -2.09* | -0.11 |
| | (-2.02) | (-0.26) | (2.26) | (-0.12) | (-1.62) | (2.35) | (-5.21) | (-0.18) |
| Output | -0.16 | -0.44 | -0.50 | 0.29 | 0.28 | -0.79 | 0.34 | -0.73 |
| | (-0.27) | (-0.52) | (-0.67) | (0.47) | (0.47) | (-1.06) | (0.57) | (-0.86) |
| **Services** | | | | | | | | |
| Price | -0.28** | 0.36 | 0.02 | -0.23 | -0.64* | 0.25 | -0.30** | 0.59* |
| | (-1.79) | (1.52) | (0.09) | (-1.40) | (-4.09) | (1.13) | (-1.92) | (2.49) |
| Output | 0.25 | -0.075 | -0.23 | 0.25 | 0.33** | -0.48* | 0.48* | -0.33 |
| | (1.37) | (-0.28) | (-0.98) | (1.31) | (1.78) | (-2.05) | (2.63) | (-1.21) |
| **Structures** | | | | | | | | |
| Price | -1.75* | -0.30 | 0.82 | 0.61 | -1.45* | 0.21 | -2.57* | -0.91 |
| | (-3.60) | (-0.41) | (1.19) | (1.19) | (-2.98) | (0.30) | (-5.29) | (-1.24) |
| Output | -0.56 | 4.12** | -0.20 | -0.0033 | -4.68* | -0.20 | -0.36 | 4.12** |
| | (-0.38) | (1.89) | (-0.11) | (-0.0021) | (-3.17) | (-0.11) | (-0.24) | (1.89) |

Notes:

- Empirical Models:

$$Dp_t = f_0 + f_1 E_{t-1} Dq_t + f_2 E_{t-1} Dg_t + f_3 E_{t-1} Dm_t + \sum_{j=0}^{x} f_{4j} posg_{t-j} + \sum_{j=0}^{x} f_{5j} negg_{t-j} + \sum_{j=0}^{x} f_{6j} posm_{t-j} + \sum_{j=0}^{x} f_{7j} negm_{t-j} + \sum_{j=0}^{x} f_{8j} Dqs_{t-j} + \eta_{pt}$$

$$Dy_t = g_0 + g_1 E_{t-1} Dq_t + g_2 Dy_{t-1} + \sum_{j=0}^{x} g_{3j} posg_{t-j} + \sum_{j=0}^{x} g_{4j} negg_{t-j} + \sum_{j=0}^{x} g_{5j} posm_{t-j} + \sum_{j=0}^{x} g_{6j} negm_{t-j} + \sum_{j=0}^{x} g_{7j} Dqs_{t-j} + \eta_{pt}$$

- *posg, negg*, denote expansionary and contractionary shocks to the growth of government spending around its steady-state (full equilibrium) value.
- *posm, negm.*, denote expansionary and contractionary shocks to the growth of the money supply around its steady-state (full-equilibrium) value.
- t-ratios are in parentheses.
- * and ** denote statistical significance of the cumulative effects at the five and ten percent levels, respectively.

## Econometric Methodology

The surprise terms that enter models (2) through (4) are unobservable, necessitating the construction of empirical proxies before estimation can take place. Thus, the empirical models include equations that describe the process generating the growth in private consumption, private investment, government spending, the money supply, and aggregate demand. The predictive values from these equations are the proxies for agents' expectations of the change in these variables.

Obtaining a proxy for agents' forecasts follows the results of the endogeneity test suggested by Engle (1982). Given the evidence of endogeneity, variables in the forecast equations are based on the results of a formal causality test.

Anticipated aggregate demand growth is generated by taking the fitted values of a reduced-form equation for the change in the log value of the aggregate demand measure in which the explanatory variables include four lags of the change in the short-term (3-month Treasury bill) rate, and four lags of the change in the log value of real output, the price level, and the energy price.

Agents' forecasts of the growth in private consumption and private investment are approximated using four lags of the short-term interest rate and four lags of the change in the log value of real output, the price level, the energy price, and private consumption or private investment itself.

Agents' forecast of the growth in government spending and the money supply is approximated using four lags of the change in the short-term interest rate and four lags of the change in the log-value of real output, the price level, the energy price, government spending and the money supply.

Testing for structural break following the suggestions of Dufour (1982) supports structural break in the money growth equation between 1973 and 1974. Exchange rates of industrial countries, including the United States, have been floating following the Bretton Woods Agreement in 1973. The monetary policy regime is likely to have been affected by the shift in the exchange rate regime. To account for structural break, dummy variables interact with regressors in the forecast equation describing monetary growth. Surprises that enter the empirical models are then formed by subtracting agents' forecasts from the actual growth in each variable.

The positive and negative components of demand shocks are defined for joint estimation, following the suggestions of Cover (1992), as follows:

$$negd_t = -\frac{1}{2}\{abs(Dds_t) - Dds_t\}$$

$$posd_t = \frac{1}{2}\{abs(Dds_t) + Dds_t\} \qquad d = g, m$$

where $Dds_t$ is the demand shock, as specified above, and $negd_t$ and $posd_t$ are its negative and positive components. Shocks are distributed symmetrically with a zero mean, indicating equal probability of realizing positive and negative shocks over the sample period. Shocks are randomly distributed, i.e., uncorrelated and orthogonal to variables in the information set.

To estimate the empirical models in (5) through (8), agents' forecasts of government spending and the money supply follow the procedure described above. In addition, a proxy for agents' forecast of the energy price is necessary. The energy price is exogenous according to the results of the test suggested by Engle (1982). Obtaining a proxy for ex-ante forecast of the energy price is complicated by the assumption that the generating process experienced a structural change between 1973 and 1974. This assumption is suggested by the results of a formal test in Dufour (1982). For both the period 1970.I–1973.IV and the period 1974.I–1996.III, the generating process is modeled as a fourth-order autoregressive process. The proxy for energy price surprises is then formed by subtracting these forecasts from the actual change in the energy price.

Upon accounting for the dummy variable in the forecast equations of the energy price and the money supply, the estimated equations (2) through (8) are structurally stable. To obtain efficient estimates and to ensure correct inferences (i.e., to obtain consistent variance estimates), the empirical models in (2) through (4), (7) and (8) or (5) and (6) are estimated jointly with the equations that determine proxy variables following the suggestions in Pagan (1986) using 3SLS. The instruments list for estimation includes four lags of the change in the interest rate and four lags of the change in the log value of real output, the price level, government spending, and the money supply, as well as the current and four lags of the log value of the energy price.

The results of Engle's (1982) test for serial correlation in simultaneous-equation models are consistent with the presence of fourth-order autoregressive errors in some models. To correct for serial correlation, it is assumed that the error term follows an AR(4) process. To filter out serial correlation, the estimated model is transformed through the filter $(1-\rho_1 L^1-\rho_2 L^2-\rho_3 L^3-\rho_4 L^4)$ where $\rho_i$ are the estimates of the serial correlation parameters and $L^i$ are the lag operators such that $L^i X_t = X_{t-i}$. The estimated residuals from the transformed models have a zero mean and are serially independent.

The paper's qualitative evidence remains robust in a number of exercises that include varying the variables in the information and the instruments lists, varying the lag length of the shocks and variables in the model, and using a 2-step estimation procedure. Details are available upon request.

**Data Sources**

- Real Output: the real value of aggregate output as measured by the real value of GDP, Goods, Durables and Nondurables, Services, and Structures.
- Aggregate Demand: the nominal value of aggregate output as measured by the nominal value of GDP, Goods, Durables and Nondurables, Services, and Structures.
- Price Level: the price of aggregate output as measured by the deflator for GDP, Goods, Durables and Non-Durables, Services, and Structures.
- Private Consumption: the real value of private purchases of goods and services for consumption.
- Private Investment: the real value of private purchases of goods and services for investment.
- Money: the sum of currency outside banks and private sector demand and time deposits.
- Interest Rate: the 3-month Treasury bill rate.
- Government Spending: the real value of government purchases of goods and services for consumption and investment.
- Energy Price: the producer price index of energy and related products.

Quarterly disaggregated data for real output, aggregate demand, the price level, private consumption, and private investment are from the National Income and Product Accounts (NIPA's) Tables. Quarterly series for the money supply, government spending, and the interest rate are from the *International Financial Statistics*, available on tape from the International Monetary Fund. Quarterly data for the energy price are from the Citibase data tape.

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