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Abstract
The role of the Federal Reserve's monetary policy in the propagation of cycles in residential construction has long been a subject of interest to economists. This paper considers the hypothesis that it is only the unanticipated component of money supply growth that affects built-for-sale, single-family housing starts in the United States. Using quarterly data for the 1964-1977 period, tests similar to those performed by Barro [1977] and others on broader macroeconomic variables are shown to support this hypothesis.

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Unanticipated Money Supply Growth
and Single-Family Housing Starts
in the U.S.: 1964-1977

by

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Abstract

The role of the Federal Reserve's monetary policy in the propagation of cycles in residential construction has long been a subject of interest to economists. This paper considers the hypothesis that it is only the unanticipated component of money supply growth that affects built-for-sale, single-family housing starts in the United States. Using quarterly data for the 1964-1977 period, tests similar to those performed by Barro [1977] and others on broader macroeconomic variables are shown to support this hypothesis.
I. Introduction

Since the appearance of Barro's [1977, 1978] seminal studies, the macroeconomic literature has been replete with empirical tests of the neutrality of anticipated money supply changes with respect to real, aggregate economic activity, such as GNP.\(^1\) It seems as though the same motives that have spurred macroeconomists to perform and analyze the results of such tests would apply to the economist particularly interested in the transmission of monetary disturbances into real housing activity.\(^2\) The purpose of this paper is to replicate the kind of test pioneered by Barro in order to distinguish the effects of anticipated and unanticipated money supply changes on single-family housing starts. Section II contains a discussion of the general nature of these tests and their economic motivation. In Section III the discussion presented in the preceding section is tailored to the particular concerns of this paper. The results of the tests are presented in Section IV and the paper is summarized in Section V.

II. Background

Barro's initial tests of money neutrality amounted to regressing a measure of the annual unemployment rate on current and lagged values of anticipated and unanticipated annual money supply growth. Since only actual money supply growth is observable, Barro first estimated a model of the money supply process to obtain his measures of anticipated and unanticipated money supply growth. The null hypothesis that only unanticipated money supply changes matter was then tested by imposing various zero restrictions on the general regression model and performing a series of F-tests. Barro's tests seemed to confirm the neutrality hypothesis though subsequent research, which modified his procedures, found mixed results. 
There are various theoretical structures that could generate a reduced-form model in which the real variable of interest depends on unanticipated but not anticipated money supply changes, though these structures are generally not made explicit in the studies referred to earlier.\(^3/\) Perhaps the most prominent example of an explicit structural model that generates such a reduced-form is Lucas' [1973] supply model. It will be useful here to briefly summarize some of its key characteristics.

According to Lucas, the natural logarithm of a firm's output can be decomposed into the sum of two components: the log of "normal" output and the log of "cyclical" output.\(^4/\) Normal output reflects the mean, trend, and seasonal patterns of the output series while cyclical output primarily reflects the business cycle-like movements of the series. Cyclical output depends partly upon past deviations of output from its normal levels thus capturing the inertia or serial correlation of output due to, for example, costly adjustment of production. In addition, production responds to changes in the product's price relative to the general price level. However, because of imperfect information, producers must make their decisions after they have observed their product's price but before they have observed other prices. Thus, producers respond to changes in their own product's price relative to their estimate of general price level changes.

Money supply changes are assumed to change all prices proportionately. Thus, an anticipated money supply change will change the producer's output price but the producer, knowing that general prices will change proportionately, will not respond to that change. An unanticipated money supply change, however, can lead producers to falsely interpret a change in their own product's price as a relative price change to which they will respond by altering production. The response will persist over time due to the assumption that output depends upon its own past. The result of Lucas' theory is a reduced-form, linear econometric model of aggregate
output in which current cyclical output depends upon lagged output, current unanticipated money supply growth, and an unobserved (serially uncorrelated) disturbance term that reflects other influences on cyclical output. Were the model to be estimated with anticipated money supply growth among the explanatory variables, its coefficient should be equal to zero.

III. Application to Homebuilding

If one looks at a quarterly time series of single-family housing starts from 1964 on, the data distinguish between single-family homes built-for-sale and owner-initiated single-family housing starts. Lucas' theory of production presumes that the producers are motivated by profit-maximization and so, to the extent that his theory can be specialized by profit-maximization and so, to the extent that his theory would be most applicable to home production at all, it would seem as though his theory would be most applicable to the built-for-sale component of the single-family housing market. Thus the remainder of this paper will focus on the production decision of "speculative homebuilders."

Assume that the log of the number of built-for-sale, single-family homes started during quarter \( t \), \( y(t) \), can be decomposed into the sum of normal production, \( y^N(t) \), and cyclical production, \( y^C(t) \). Normal production reflects the average, long-run behavior of housing starts due to, for example, demographic and weather patterns. Without explicitly modelling such forces, we can summarize them by assuming that \( y^N(t) \) is representable by the linear model:

\[
y^N(t) = a_0 + a_1 T(t) + a_2 S_1(t) + a_3 S_2(t) + a_4 S_3(t), \tag{1}
\]

where \( T \) is a trend variable; \( S_1, S_2, \) and \( S_3 \) are quarterly seasonal dummies; and, \( a_0, a_1, a_2, a_3, a_4 \) are constants. Cyclical production is then the difference between \( y(t) \) and \( y^N(t) \), i.e.,
\[ y^C(t) = y(t) - a_0 - a_1 T(t) - a_2 S1(t) - a_3 S2(t) - a_4 S3(t). \]  

Following Lucas' reasoning, but viewing his representative firm as a speculative builder of single-family homes, there are three distinct forces that determine the value of \( y^C(t) \). First, current cyclical output depends systematically upon previous levels of production.\(^6\) Second, assume that the builder intends to respond positively to increases in the sales price of his product relative to the general price level. However, if we assume that the builder observes the current sales price of his homes (as he observes the price at which homes in his current inventory are being sold) but does not yet have full information about the prevailing general price level, then the builder will respond to his estimate of the relative price change. Finally, there are other effects which are summarized by a stochastic disturbance term. In terms of money supply changes, since only unanticipated money supply changes can lead producers to (mistakenly) perceive a relative price change, cyclical output will be related to money supply growth according to

\[ y^C(t) = \sum_{i=1}^{m} b(i) y^C(t-i) + c \ m^U(t) + v(t) \]  

where \( m \) is the number of lagged values of output that systematically affect current output, \( m^U \) is unanticipated money supply growth, and \( v(t) \) is a serially uncorrelated disturbance process. \( b(1), \ldots, b(m) \) and \( c \) are constants.

IV. Testing the Neutrality Hypothesis

The preceding sections sketched out a theoretical argument to suggest why it is reasonable to test for the neutrality of anticipated money supply growth with
respect to movements in built-for-sale single family housing starts along the line originally proposed by Barro. The test itself will proceed as follows. First, a measure of the cyclical component of built-for-sale, single-family housing starts will be derived. Second, the time series on money supply growth (M1) will be decomposed into its anticipated and unanticipated components. Finally, the cyclical component of the built-for-sale housing starts series will be regressed on its own past, on current anticipated money supply growth, and on current unanticipated money growth. Under the neutrality hypothesis, the coefficient on anticipated money supply growth should be equal to zero. The underlying theory discussed previously would further suggest that the coefficient on unanticipated money supply growth should be positive (though this result is not central to the neutrality proposition itself).

Quarterly values of built-for-sale single family housing starts in the U.S. were obtained for the period 1964:I through 1977:IV from the U.S. Department of Commerce's Construction Reports, C-20.\(^7\) To decompose this series into its normal and cyclical components, the natural log of the series was first regressed on a constant, a time trend, and three seasonal dummies to obtain

\[
\hat{y}^{n}(t) = 4.64 + 0.0077 T - 0.05 S1 + 0.27 S2 + 0.15 S3
\]

\[
(51.29) (3.91) (-0.61) (3.11) (1.80)
\]

where t-ratios appear in parentheses. Then \(\hat{y}^{n}(t)\) was subtracted from the log of total speculative starts, \(y(t)\), to obtain an estimate of cyclical production, \(\hat{y}^{c}(t)\).

The estimates of quarterly anticipated money supply growth, \(m^{a}(t)\), and unanticipated money supply growth, \(m^{u}(t)\), for the same period (1964:I - 1977:IV) were taken directly from Barro and Rush [1980].\(^8\) Although there has been some criticism of the model they used for this purpose, Mishkin [1982] and Hoffman, Low, and
Schlagenhauf [1982] have suggested that the results of the type of neutrality test being conducted here are likely to be quite robust with respect to reasonable variations of the money supply model. By using the Barro-Rush data we can see whether their well-known results remain intact at a more disaggregated level.

Finally, $y^*_c(t)$ was regressed on $y^*_c(t-1), y^*_c(t-2), m^a(t)$, and $m^u(t)$ with the following result:

$$y^*_c(t) = 1.19 y^*_c(t-1) - 0.37 y^*_c(t-2) - 0.00008 m^a(t) + 0.005 m^u(t)$$

(5)

$$R^2 = 0.83, \text{ DF } = 47, \text{ SSE } = 0.421$$

In (5), t-statistics appear in parentheses. This regression reveals that the coefficient on anticipated money growth is not significantly different from zero at the 93 percent significance level and above. The hypothesis that the coefficient on unanticipated money supply growth is equal to zero can be rejected at the ten-percent significance level (but not at the five-percent level). Further, the coefficient on unanticipated money growth is positive, as a Lucas-type model would suggest. The first-order autocorrelation coefficient on the model's residuals is -0.098 which suggests that they are serially independent. Finally, the magnitudes of the coefficients on $y^*_c(t-1)$ and $y^*_c(t-2)$ indicate that $y^*_c(t)$ is a stable process displaying damped oscillations in response to a money supply shock.

The test results thus show that the neutrality results that Barro obtained with respect to the unemployment rate and GNP extend to the production of single-family homes by speculative homebuilders. A more tenuous conclusion that could be drawn is that the data support the view of speculative homebuilders acting in a manner much like the representative firms modelled by Lucas [1973].
V. Summary and Conclusions

Much attention has been focused by macroeconomists on the question of whether or not anticipated money supply changes are neutral with respect to movements in real aggregate economic activity. Employing a strategy devised by Barro [1977], this paper has reconsidered this question as it pertains to the quarterly construction of single-family homes by speculative homebuilders in the United States. The test results support the view that unanticipated, but not anticipated, money supply changes generate movements in the construction of these homes. Further, these movements persist beyond the period of the initial shock. Although this result was not explicitly tied to a theory of the underlying structure of the market, it seems as though a structure developed along the lines of Lucas' [1973] supply model could be supported by the data.
Notes

1/ See, for example, Attfield and Duck [1983], Hoffman and Schlagenhauf [1982], Liederman [1980], and Mishkin [1982].

2/ These motives include the desire to understand the sources of business cycles and the potential for monetary policy to mitigate undesirable swings in economic activity.

3/ In defense of this approach, Barro [1977, p. 101] argues that "the proposition that only the unanticipated part of money movements has real effects is clearly more general than the specific setting of these models."

4/ Unless otherwise noted, from hereon references to output will be taken to mean the natural log of output.

5/ These distinctions are defined in the Department of Commerce's Construction Reports, C-20 series. Owner-initiated single-family homes include owner-built and owner-contracted homes. Homes which are built-for-sale can be viewed as homes to which a "for-sale" sign is attached upon the start of construction. Since these homes are generally built in anticipation of future sales their producers are often referred to as "speculative homebuilders."

6/ As noted earlier, one way to rationalize the presence of lagged output as an explanatory variable here would be to assume the presence of adjustment costs in production. Blinder and Fischer [1981] and Lucas [1975] have described other economic mechanisms through which deviations of output from its normal level can display serial correlation.

7/ The starting point of 1964:I reflects the beginning of the publication of this time series while the concluding point corresponds to the end of the time series of the money supply decomposition published by Barro and Rush.
Barro and Rush regressed the actual quarterly and seasonally adjusted growth rate of M1 on: a constant, six lagged values of itself, three lagged values of the unemployment rate, and a measure of the size of the federal budget deficit relative to its "normal level". The predicted values derived from this regression defined the anticipated money growth series and the residuals formed the unanticipated money growth series.

One issue that frequently arises in discussions of such tests is whether the money supply equation and the output equation should be estimated jointly rather than in two distinct steps as Barro, Barro and Rush, and we have done. While the joint estimation procedure will generally be more efficient, it is a nonlinear, maximum likelihood procedure that can be vary burdensome computationally. In the absence of serially correlated disturbances in the two equations, the two-step procedure will yield consistent estimates. The joint estimation procedure is described more fully by Mishkin [1982].

The number of lagged values of output that should be included is somewhat arbitrary since the model does not specify the nature of the adjustment costs precisely. Two lags were chosen here because additional lagged values entered without adding significant explanatory power to the regression.
References


