

## **Evidence Regarding the Structure of Production**

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**Abstract:**

The Austrian approach to business cycles has seldom been examined in statistical terms. This paper first reviews the essentials of that approach. It then offers some simple regression results that seem to offer empirical support for several important Austrian propositions. Both business loans and industrial production are far more highly correlated with movements in monetary aggregates than with the rate of saving. Fluctuations in industrial production are largely explained by the changes in a trio of variables: money, departures of market interest rates from the natural rate, and relative prices. Finally, both M2 and the Austrian measure of the money stock are highly correlated with composite price indexes which include the prices of various real and financial assets in addition to the usual CPI and PPI.

**Key words:** Austrian cycle theory, money and banking, interest rates

**JEL classification:** E32, E51, E58

## Introduction

While there exists a large body of work<sup>1</sup> which explains and explores the Austrian School's theory of business cycles (hereinafter, ABCT), very little of it has been empirical work. Even less has been specifically statistical in nature<sup>2</sup>. For instance, Murray N. Rothbard's insightful survey of the early years of the Great Depression (1975) certainly may be called empirical, but only in the broadly descriptive sense. Whether the absence of statistical work by Austrians should be viewed with pride or regret is a question I choose not to address at present.

What I do propose to do is the following: 1) briefly summarize ABCT, 2) suggest some statistical issues regarding the theory that might be of interest to Austrians, 3) identify my variables and data sources, 4) explain what exercises in regression analysis I have undertaken, 5) comment on the results, and 6) propose further avenues of statistical work that might prove useful.

I would like to state emphatically that I do not consider this effort to constitute an exhaustive investigation of the subject. Far from it. This is a very modest first step, and nothing more. A further cautionary word is also in order. I do not presume that what I have found necessarily identifies *causal* relations between economic categories<sup>3</sup>. What I have found is the degree of *correlation* between certain economic magnitudes. The latter is not unimportant, but it does not necessarily establish causal links.

## ABCT in a Nutshell

The distinctive Austrian approach to business cycles is bundled within the two "universals" of macroeconomics, time and money (Garrison 2001: 47-52). Production in

a modern economy is a roundabout process. It takes time and is measured in monetary units. The intertemporal dimension of the structure of production is, and I believe quite rightly, untiringly emphasized by Austrians. They distinguish between higher-order capital goods, which function at or near the beginning of the temporal string, from lower-order consumer goods, which are the culmination of the process. The complicated and somewhat fragile production structure requires that complementary inputs be available not only in the right magnitudes but also at the right moments in time. If they are not, then projects that appeared profitable are soon revealed to be unprofitable. In other words, what appeared to be capital creation is seen in fact to be capital consumption. ABCT focuses on the “medium run”, because that is where problems arise. In the short run, the capital structure cannot be changed significantly, and in the long run all errors have been rectified. It is in the medium run that there is time enough for capital projects to be initiated and the direction of production to change, but insufficient time for any possible malinvestments to be corrected---at least not without serious repercussions. This inability to smoothly liquidate or redirect projects stems largely from the heterogeneity of most capital goods.

What is the source of the widespread “cluster of entrepreneurial errors” (Rothbard [1962] 1970: 746; 1975: 18-21) that typifies the boom-bust sequence? It is that market rates of interest are driven below the “natural rate” as result of credit expansion by the central bank. Market rates are the result of the supply of and demand for credit (or loanable funds), while the natural rate is an expression of individuals’ time preferences, that is, their preferred rate of substitution between present goods and future goods. Such

declines in market rates make it appear as if consumers have chosen to save (delay consumption) at a higher rate than before, when in fact they have not done so. Furthermore, the increased credit available at relatively low rates must appear as an increase in funding for businesses. Otherwise, no cycle will appear (Rothbard 1978: 152-53).

The low rate of interest and abundant credit induce businesspeople to lengthen the production process. This occurs because the net present value of longer-term projects rises relative to that of shorter-term projects. Entrepreneurial demand for capital goods thus increases, and producer goods' prices rise relative to consumer goods' prices. The result is a production structure that is unsustainable. Consumers soon begin to reassert their unchanged time preferences via strong demand for consumer goods, and the prices of consumer goods begin to rise relative to those for capital goods. The resources needed to complete the projects will not be forthcoming, so many such projects cannot be completed at all, or can be completed but at a loss. The economy is being pulled in two directions. Entrepreneurs want more capital goods (and the complements to those capital goods), at the same time that consumers want more consumer goods. The needed correction comes in the form of a recession, during which many projects are liquidated and unemployment rises. Macroeconomic equilibrium can only be re-established when and if the central bank ceases to expand the supply of credit, thus allowing market rates of interest to once again be consistent with time preferences.

In short, the categories of importance to ABCT include the supply of credit, the supply of money, industrial production, capital goods, consumer goods, market rates of

interest, the natural rate of interest, and the relationship between consumer goods' prices and producer goods' prices.

### **The Data and Their Sources**

In order to investigate the correlations among these economic magnitudes, data were collected from a variety of websites. Specifically, these latter were the U.S. Bureau of Labor Statistics (<http://data.bls.gov>), the Board of Governors of the Federal Reserve System (<http://www.federalreserve.gov>), the U.S. Department of Commerce (<http://www.commerce.gov>), the Federal Reserve Bank of St. Louis (<http://www.economagic.com/fedstl.htm>), the U.S. Bureau of Economic Analysis (<http://www.bea.gov>), and the National Bureau of Economic Research (<http://www.nber.org>). The time period chosen was January 1959-December 2002, with all the data being monthly and not seasonally adjusted. Thus there are 528 observations in the data set. Each time series that involved an index, such as the CPI and PPI, was converted so that the base period was January 1959 (January 1959 = 100). The specific variables chosen were the monetary base, the M1, M2, and Austrian<sup>4</sup> measures of the money supply, commercial and industrial loans, an index of (total) industrial production, an index of consumer goods production, an index of business equipment production, the consumer price index, the producer price index, personal income, the Federal Funds rate, the long-term corporate bond rate (Moody's AAA rating), the Dow Jones Industrial Average of stock prices, the rate of saving (out of disposable personal income), the wage rates of private-sector, goods-producing workers, and an index of the rental prices of urban real estate. The time series for M1, M2, the Austrian measure of money (AUSMS),

the index of industrial production, and the index of business equipment production are illustrated in Figures 1-5 in the Appendix. In those figures, the peak and trough months for each of the cycles since 1959 are identified by vertical reference lines. The dating of said peaks and troughs are according to the National Bureau of Economic Research. The peaks as given by the NBER are April 1960, December 1969, November 1973, January 1980, July 1981, July 1990, and March 2001. The troughs are February 1961, November 1970, March 1975, July 1980, November 1982, and March 1991. Several additional variables were derived from the various series listed above: NATRATE, a proxy for the natural rate of interest (the 3-month lagged difference between consumer and producer prices); INTDIFF, the difference between the natural rate and the Federal Funds rate; and PRATIO, the ratio of consumer goods' prices to producer goods' prices.

### **Regression Results**

An implication of ABCT would seem to be that, as long as there exists a central bank which manipulates the supplies of money and credit, the rate at which people save has rather little to do with either business loans or industrial production. On the other hand, the supply of money should play a major role. Empirically is there support for this? Yes, there is, as seen in the tables that follow. The adjusted  $R^2$  numbers for saving versus total industrial production, the production of business equipment, and business loans are .461, .548, and .515, respectively. Those for the three measures of the money stock are much higher, with M2 showing the highest degree of correlation, the Austrian measure second, and M1 third.

**Table 1**  
**Total Industrial Production**

<u>Ind. Var.</u>	<u>Adj. R<sup>2</sup></u>
SAVRATE	.461
M1	.879
M2	.930
AUSMS	.909

**Table 2**  
**Production of Business Equipment**

<u>Ind. Var.</u>	<u>Adj. R<sup>2</sup></u>
SAVRATE	.548
M1	.878
M2	.938
AUSMS	.919

**Table 3**  
**Commercial and Industrial Loans**

<u>Ind. Var.</u>	<u>Adj. R<sup>2</sup></u>
SAVRATE	.515
M1	.926
M2	.984
AUSMS	.948

In a related issue, Austrians focus on *relative prices*---rather than any single index of the price level----*interest rate differentials*, and the *supply of money* and/or credit as the key forces that drive production. If one models industrial production as a function of a) the difference between the Federal Funds rate and the proxy for the natural rate, b) the ratio of the CPI to the PPI, and c) the supply of money, one finds high degrees of correlation, as seen in Table 4. Moreover, the algebraic signs of the parameter coefficients are as expected: positive for money and the ratio of prices and negative for the interest rate differential. In addition, all the t-tests indicate statistical significance at



the 99% confidence level.

**Table 4**  
**Total Industrial Production**

<u>Ind. Variables</u>	<u>Adj. R<sup>2</sup></u>	<u>t-statistics</u>
PRATIO, INTDIFF, M1	.922	12.842, -16.823, 16.449
PRATIO, INTDIFF, M2	.950	9.180, -14.638, 26.657
PRATIO, INTDIFF, AUSMS	.956	6.972, -23.108, 29.644

Similar results are seen if one substitutes the production of business equipment as the dependent variable (Table 5).

**Table 5**  
**Production of Business Equipment**

<u>Ind. Variables</u>	<u>Adj. R<sup>2</sup></u>	<u>t-statistics</u>
PRATIO, INTDIFF, M1	.912	12.956, -12.984, 14.466
PRATIO, INTDIFF, M2	.948	8.358, -9.834, 26.812
PRATIO, INTDIFF, AUSMS	.947	6.963, -16.770, 26.291

Alternatively, one might argue that some measure of credit should be used as an explanatory variable instead of a measure of the money stock. Commercial and industrial loans were taken as the measure of credit available. The results, shown in Tables 6 and 7 below, do not differ much from the foregoing regressions involving money insofar as total industrial production is concerned. However, using credit instead of money (along with relative prices and interest rate differentials) leads to a noticeably higher degree of correlation with the production of business equipment.

**Table 6**  
**Total Industrial Production**

<u>Ind. Variables</u>	<u>Adj. R<sup>2</sup></u>	<u>t-statistics</u>
PRATIO, INTDIFF, COMLOANS	.952	8.339, -11.033, 27.677

**Table 7**  
**Production of Business Equipment**

<u>Ind. Variables</u>	<u>Adj. R<sup>2</sup></u>	<u>t-statistics</u>
PRATIO, INTDIFF, COMLOANS	.967	5.793, -5.486, 37.654

Credit in the form of business loans may be a key driving force behind industrial production, and in particular the production of capital equipment, but the overall level of prices is determined by the money supply (Rothbard 1983: 29-41). Austrians obviously have no quarrel with such a proposition, but they may approach the issue in a manner that distinguishes them from the more orthodox, mainstream economists. In his survey of the early years of the Great Depression, for example, Rothbard brings attention to the following:

The economists who emphasized the importance of a stable price level were thus especially deceived, for they should have concentrated on what was happening to the supply of money....The trouble did not lie with particular credit on particular markets (such as stock or real estate); the boom in the stock and real estate markets reflected Mises' trade cycle: a disproportionate boom in the prices of titles to capital goods, *caused* by the increase in money supply attendant upon bank credit expansion....That the boom was largely felt in the capital goods industries can be seen by the quadrupling of stock prices over the period. (1975: 154)

Rothbard goes on to cite with approval Carl Snyder's "Index of the General Price Level, which includes all types of prices (real estate, stocks, rents, and wage rates, as well as wholesale prices)....Stability was therefore achieved only in consumer and wholesale prices, but these were and still are the fields considered especially important by most economic writers" (1975: 154). It would seem from the foregoing that an index of prices that included consumer prices, producer prices, *and* (at least) stock prices is very much in keeping with Austrian thought regarding business cycles.

Therefore, I constructed three composite price indexes (January 1959 = 100) and

found the correlation between each and the supply of money. The first, COMPIND1, was made up of the CPI and PPI, weighted equally. The second, COMPIND2, was composed of the CPI, the PPI, the Dow Jones Industrial Average expressed as an index number, and an index of urban real estate rental prices, with the four components weighted equally. The third, COMPIND3, was composed of the CPI, the Dow Jones Industrial Average expressed as an index number, an index of wage rates paid to private-sector, goods-producing workers, and the index of urban real estate rental prices, weighted equally. The regression results appear in Tables 8, 9, and 10. As additional categories of prices are added, the correlation with M1 declines considerably, while the correlation with M2 remains about the same, and the correlation with the Austrian measure of money rises substantially.

**Table 8**  
**The Price Level (CPI and PPI---weighted equally)**

<u>Ind. Var.</u>	<u>Adj. R<sup>2</sup></u>
M1	.946
M2	.952
AUSMS	.893

**Table 9**  
**The Price Level (CPI, PPI, DJIA, and CITYRENT---weighted equally)**

<u>Ind. Var.</u>	<u>Adj. R<sup>2</sup></u>
M1	.892
M2	.946
AUSMS	.947

**Table 10**  
**The Price Level (CPI, DJIA, WAGEIND, and CITYRENT---weighted equally)**

<u>Ind. Var.</u>	<u>Adj. R<sup>2</sup></u>
M1	.899
M2	.954
AUSMS	.954

It does seem obvious that that any given individual might spend his or her excess money balances in any of several directions: on consumer goods, on productive inputs such as capital equipment or labor, or on assets such as stocks, bonds, or real estate. To track fully the effects of increases in the money stock, one should take all these possibilities into account. One recent article that discusses a number of these effects is Callahan and Garrison (2003).

### **Summary and Conclusions**

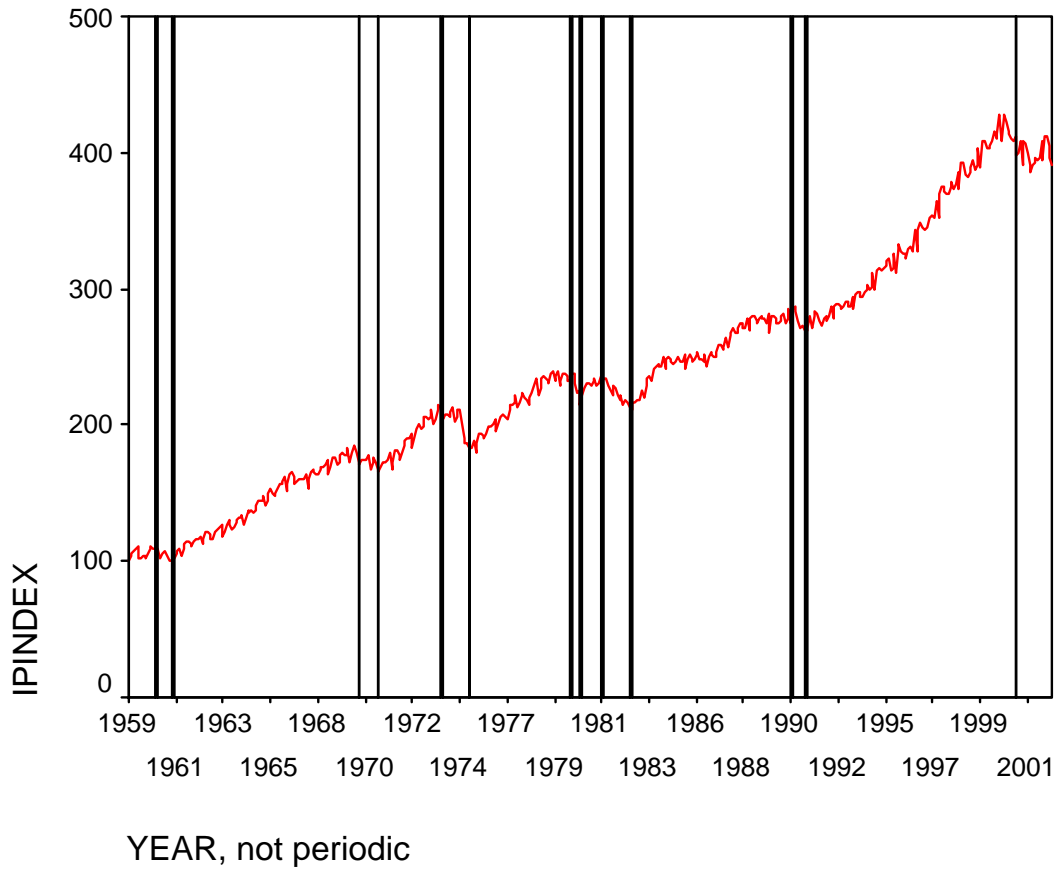
Certain propositions that are distinctively, even if not uniquely, Austrian have been examined in the context of a large data set covering the period 1959-2002. Several appear to be supported empirically, some very strongly so. Specifically, industrial production, the production of business equipment, and commercial and industrial loans are poorly correlated with the rate of saving, but strongly correlated with monetary growth. The fluctuations in both total industrial production and the production of business equipment are well captured by movements in a trio of explanatory variables: money, relative prices, and the difference between the Federal Funds rate and the natural rate of interest. Finally, on theoretical grounds the best index of overall prices would seem to be one which includes the prices of stock shares, real estate, and/or wage rates in addition to the usual consumer and producer price indexes. Both the Austrian measure of money and M2 are

strongly correlated with such a composite price index.

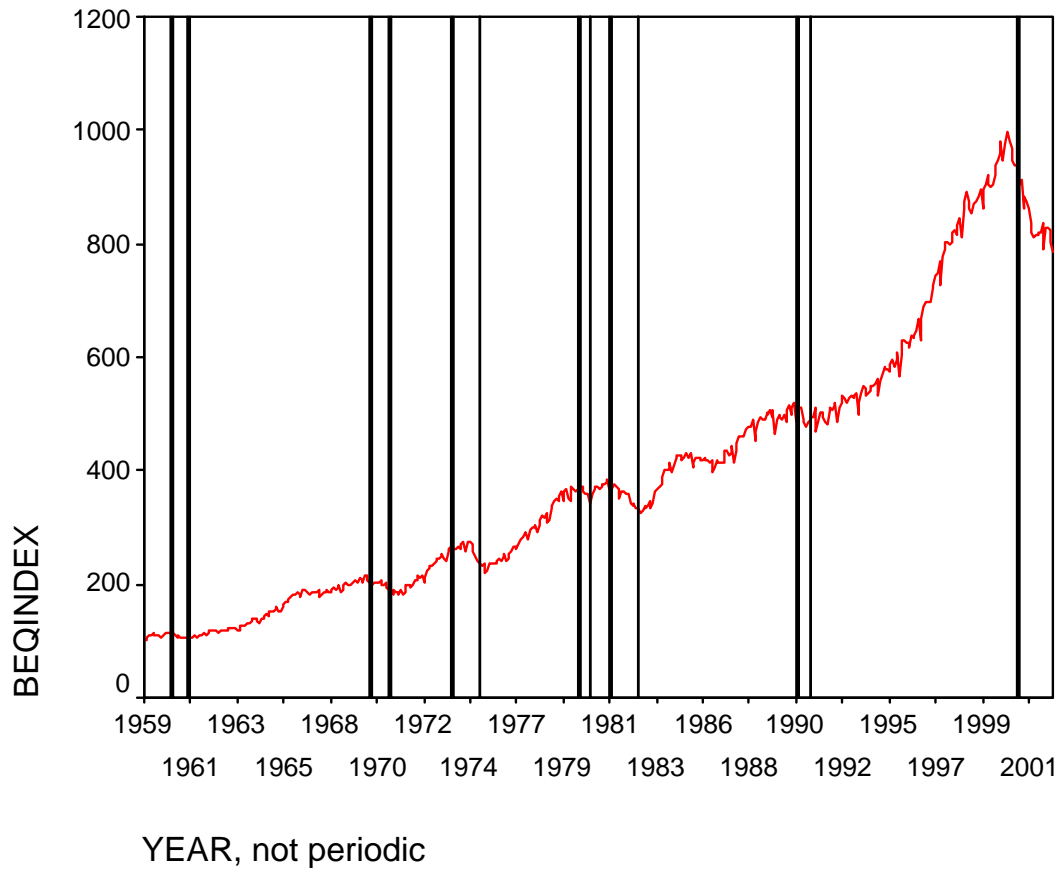
Unless Austrians want to eschew empirical work altogether, there is much more to be done. This paper has barely scratched the surface of the topic. For instance, one might look carefully at the *timing* of the relative price movements. In the early boom period do capital goods' prices rise faster than consumer goods' prices? Is this reversed once the unsustainable nature of many projects is recognized and the contraction begins? In addition, is there perhaps a better way to identify the natural rate of interest? Precisely which categories of prices should be included in the composite price index? And in what proportions? The potential questions are many.

## Appendix

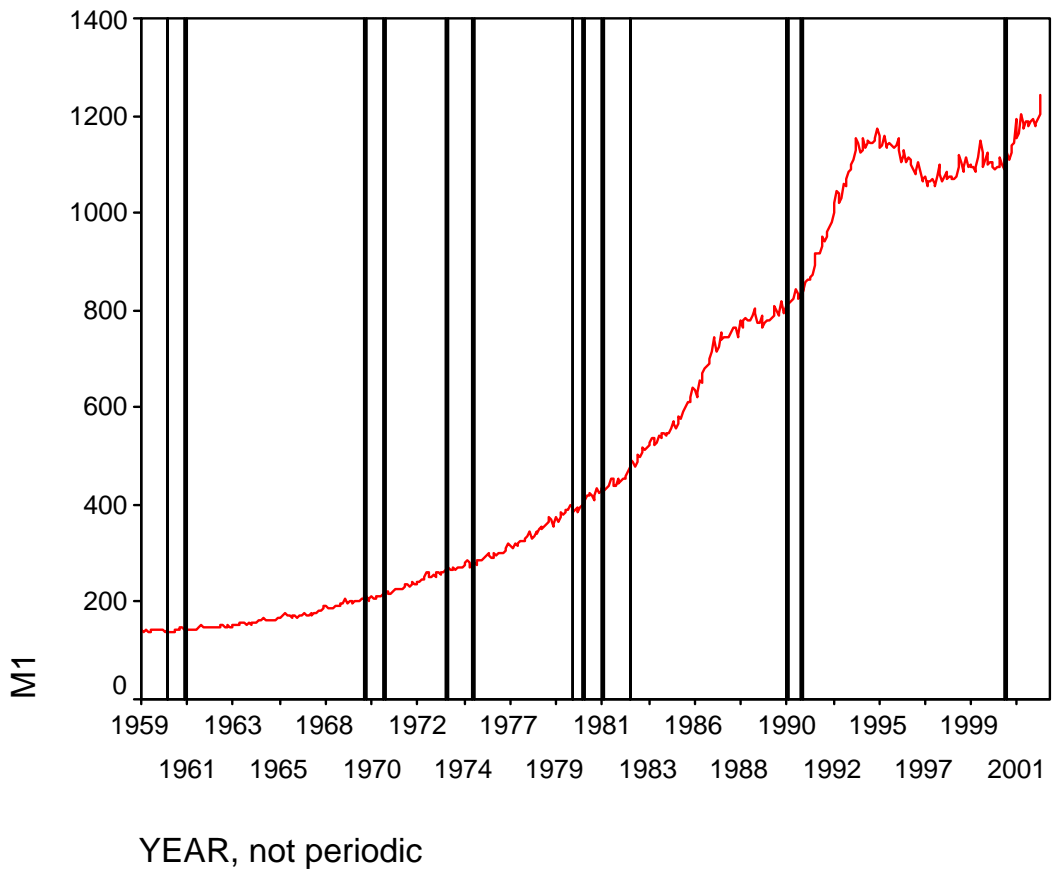
**Figure 1**  
**Index of Industrial Production---Cycle Peaks/Troughs**



**Figure 2**  
**Index of Business Equipment Production---Cycle Peaks/Troughs**

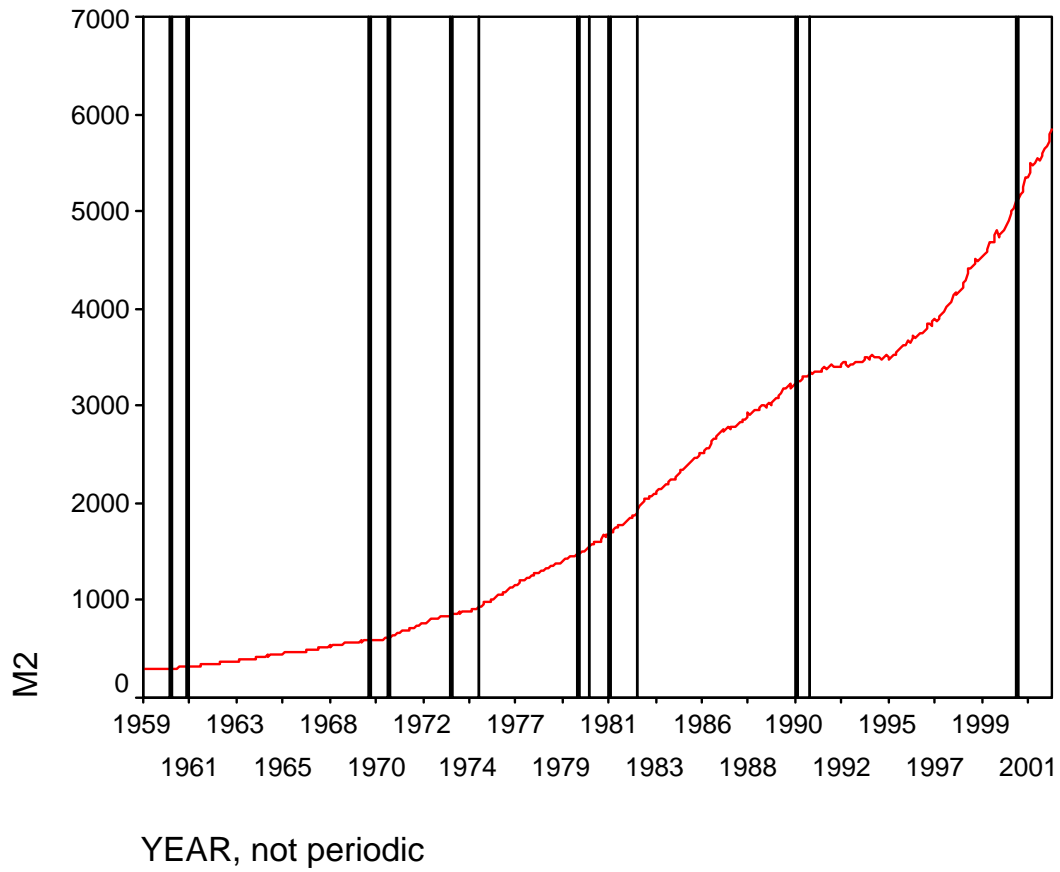


**Figure 3**  
**Money Supply---M1---Cycle Peaks/Troughs**

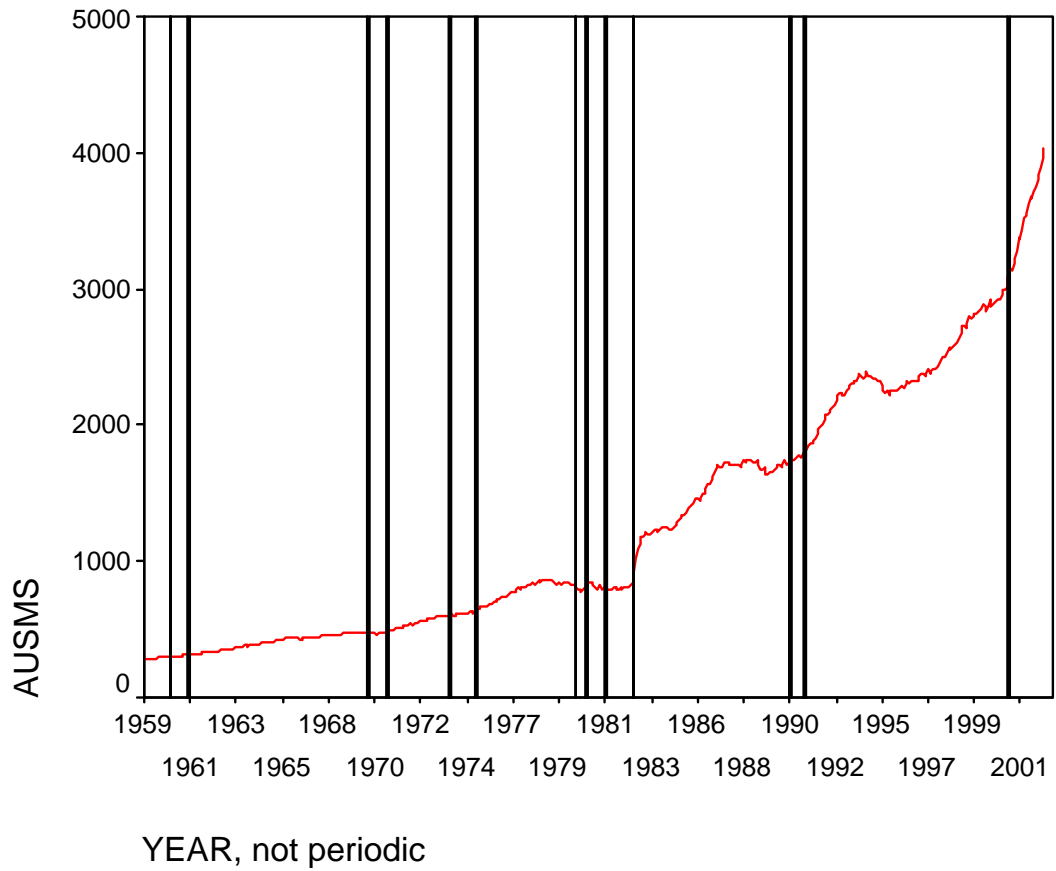




**Figure 4**  
**Money Supply—M2---Cycle Peaks/Troughs**



**Figure 5**  
**Money Supply---Austrian Measure---Cycle Peaks/Troughs**



## Notes

1. A few of the numerous notable examples include seminal treatments like Hayek (1933; 1935; 1941) and Mises ([1953] 1971: 349-66; [1949] 1966: 538-86), as well as the more recent efforts of Rothbard (1975), Garrison (2001), Horwitz (2000), Cochran and Glahe (1999), and Lewin (1999).
2. Two of the exceptions are Wainhouse (1984) and Hughes (1997).
3. I do not even opt for “Granger-causality”, as did Wainhouse (1984). I recognize that tests of Granger-causality are exercises in the *post hoc, ergo propter hoc* fallacy.
4. As suggested by Salerno (1987: 1-6; 2004) and Rothbard (1978: 143-56; 1983: 254-62), the Austrian conception of money is here taken to include currency held by the public, demand deposits, other checkable deposits, U.S. government deposits, and deposits due to foreign banks and foreign official institutions. Ideally, overnight repurchase agreements, overnight Eurodollar accounts, and U.S. savings bonds should also be included but are excluded due to the fact that government data 1) combine term repurchase agreements and term Eurodollars with the overnight categories and 2) no longer include numbers for the stock of savings bonds.

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