

The Austrian Business Cycle: a Vector Error-correction Model with Commercial and Industrial Loans¹

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Victor: I know what you're talking about. But it's not a dream—it's that you've got to make decisions before you know what's involved, but you're stuck with the results anyway.

Arthur Miller (1968) *The Price*, Act II

A vector error-correction model (VECM) of output, consumption, investment, and credit is identified and estimated employing the Johansen-Juselius (1990) procedure. Because the Austrian school views economic activity as a disequilibrium process, VECM estimates offer an empirical methodology especially amenable to interpretation through Austrian business cycle (ABC) theory. Garrison's (2001) restatement of ABC theory and his applications to historical cycles should lead to renewed interest in Austrian capital theory. According to ABC theory, recession constitutes the process of liquidating resources and production plans misallocated during the unsustainable boom. This paper finds compelling evidence of such cycles of malinvestment and liquidation in 1959-2003 U.S. data.

Austrian capital theory (Mises, 1912, 1949; Hayek, 1931;

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subsequently developed by Hayek, 1933, 1939, 1941) is used to construct and interpret a vector error-correction model estimated with U.S. macroeconomic data. Using 1959-2003 monthly data, the relationship between real output, consumption, investment, and real commercial and industrial loans is examined. When additional credit is injected into the fractional reserve banking system, the interest rate is depressed, and commercial banks increase commercial and industrial loans above and beyond aggregate savings. Production becomes more roundabout and more time—and capital—intensive as entrepreneurial managers reallocate resources away from consumer goods toward producer goods. This paper explicitly tests the main assertions of ABC theory, that increasing available credit beyond actual saving lowers, rather than increases, real output and real investment expenditure.

The rest of the paper is organized as follows. The theoretical basis is developed in section 2. Section 3 reviews applications of ABC theory in the economics literature. Data sources are documented in section 4. Section 5 develops the methodological approach applied in section 6. Section 6 presents and interprets the empirical work. This section presents tests for cointegration followed by estimates of the error-correction model. Concluding comments are presented in section 7.

The Austrian Theory of the Business Cycle

In the absence of credit expansion, market interest rates signal agents' time preference and determine the allocation of resources among producer and consumer goods, and among late-stage, middle-stage, and early-stage production. The Austrian theory of the business cycle focuses on malinvestment which is implemented when expansionary policy makes more funds available for investment than is consistent with households' time preference while simultaneously lowering interest rates. More funds created through credit expansion are available for investment, and the lower interest rate ensures these newly-available funds are allocated to lower-yielding, less productive

activities which would not have been financed or engaged in, in the absence of credit expansion. The unsustainable expansion is characterized by low interest rates, expansion of economic activity in early stages of production, as well as an increase in consumption spending, because with the lower interest rate, consumers are rewarded less for saving, and respond by saving less and consuming more. The unsustainable expansion is mistakenly perceived as a period of blessed prosperity. Although the Austrian school correctly characterizes the overexpansion as a period of wasteful overconsumption and squandering of scarce resources (Hülsmann, 2001), orthodox policy analysis frequently errs in aiming at prolonging or restoring the misallocations of the overexpansion phase, a mistaken strategy which often deepens and prolongs business cycle downturns. Hayek (1935, 136-139) and Garrison (1986, 440; 1988; 2001, 71-73) draw a fundamental distinction between ordinary changes in time preference and policy-induced changes in interest rates. Only a decrease in interest rates caused by credit expansion can drive the business cycle. According to ABC theory, there should be no cycle if the decrease in interest rates is due to a general lowering of time preference. Mises (1949, 550-566) develops a similar argument.

The Austrian school's suggested remedy is to prevent the business cycle from starting by refraining from credit expansion. If policy makers have already indulged in credit expansion, the Austrian prescription is to refrain from further credit expansion, allowing the interest rate to rise to its sustainable market level and liquidate the malinvested capital installed during the overexpansion. Because once installed, physical capital cannot costlessly be reallocated to next-best uses, the adjustment process may be prolonged and will constitute a recession, but historical evidence suggests that in the absence of policy measures which prevent or delay liquidation, such recessions seldom exceed six months in duration. Longer downturns seem to result primarily from misguided attempts to maintain labor employment at unsustainable pre-recession levels.

Unlike liquid financial capital, installed physical capital cannot be reallocated without loss of value. This cost asymmetry in converting between financial and physical capital is the basis for Bischoff's (1970) "putty-clay" model of investment. Uninvested "putty" capital, also called financial or circulating capital, is highly liquid, and can easily be moved from loan markets into productive activities. Once savings is tied up in installed physical or "clay" capital, it cannot be moved costlessly from productive activities back into loan markets, or even into alternative productive activities. Entrepreneurial planners select capital equipment designed and installed to occupy a particular place in the production structure where it is complementary with other resources (Lachmann, 1947). If the production plan is modified or abandoned, capital equipment is reallocated to next-best uses, a property Lachmann calls multiple specificity. The Austrian school emphasizes costs associated with adjusting the capital structure when interest rates rise, though it should be kept in mind that similar adjustment costs are incurred whenever labor, human capital, and raw materials are reallocated. Installed capital equipment can be thought of as the least adaptable input and the one that most often constitutes a binding constraint on the process of reallocating production in response to increases in the interest rate.

During the overexpansion phase of the business cycle, the below-market interest rate results in an economy which takes longer to produce real consumable output, but also ensures consumers are less willing to wait for their wants to be satisfied. As more resources are shifted into the earliest stages of production, other resources are shifted to the latest stages. Inevitably, the necessary proportion of resources needed in middle stages of production to bridge the gap between the earliest and latest stages of production are missing because of the combination of a too-low interest rate and a too-plentiful credit supply. This production structure is unsustainable, and must result in abandonment of much capital installed in early stages of production, and many entrepreneurial plans, as well as high labor unemployment,

even if the interest rate is kept low. Entrepreneurial plans of both producers and consumers are disrupted because they were predicated on a lower interest rate and a longer production structure, as well as the indefinite sustainability of both.

Productive resources have differing degrees of substitutability and complementarity (Garrison, 1985, 168; 2001, 49). ABC theory emphasizes the inflexibility imposed by the high cost of adjusting the production structure by reallocating installed physical capital. It is important to realize that similar kinds of inflexibility and high adjustment costs can come from other resources, particularly labor. Workers often resist seeking employment outside preferred venues. Because this source of high unemployment results from high adjustment costs which frustrate resource allocation and adjustment of the production structure, rather than from real or nominal wage or price stickiness, this potential cause of recession, though labor-based, should be recognized as Austrian rather than Keynesian. Mulligan (2002) presents evidence that labor employment is reallocated over the business cycle in a manner similar to that predicted by ABC theory for the physical capital it complements.

Qualitative Applications and Earlier Empirics

ABC theory is unmatched in offering persuasive qualitative explanations of historic business cycles. This fact by itself makes a powerful case for the Austrian school, which should be accepted as the dominant macroeconomic policy paradigm. Curiously, ABC theory was once the leading theory (Haberler, 1937). More recently ABC theory has been dismissed (e.g., Friedman, 1969, 261-284; 1993; Hummel, 1979; Yeager, 1986, 378; Tullock, 1987, 1989; Cowen, 1997; Wagner, 2000) or simply ignored. In response, an Austrian literature of defense, apology, and counterattack has developed (Salerno, 1989; Garrison, 1996, 2001; Cwik, 1998; Block, 2001). Although their analysis of investment as a driver of recession owes little to the Austrian school, Chari, Kehoe, and McGrattan (2002) conclude the Great Depression was caused by labor

market rigidities, and that investment frictions played a minor role. Holcombe (2001) discusses some reasons why Austrian macroeconomics is undervalued by the neoclassical and Keynesian mainstream.

Rothbard's (1963) monumental study of the inflationary roots of the Great Depression persuasively argues that credit expansion created an unsustainable investment boom in the 1920s, and that in the 1930s government policy frustrated the efforts of economic agents to liquidate inefficient capital, resulting in a protracted secondary contraction. Poor policy transformed what would have been a routine recession into the Great Depression by preventing prompt liquidation of overinvestment.² Valuable resources which could have been used for more productive purposes, and for output more urgently desired by consumers, instead were tied up in fruitless and counterproductive attempts to maintain high levels of labor employment in the same industries which had already overexpanded through the malinvestment boom. Rothbard shows inflation and credit expansion continued sporadically well into the 1930s, effectively preventing any general liquidation of malinvested capital. Rather than facilitate liquidating malinvestment, easy credit policies ensured more malinvestment. The misallocation of productive resources was further exacerbated by

²The expression "routine recession" is distinctively non-Austrian. ABC theory claims recessions can be avoided by simply avoiding inflationary credit expansion; thus, in the Austrian view, recessions are always attributable exclusively to misconduct by the monetary authority, supporting arguments for private control over money and credit issue. ABC theory also offers an explanation of why some recessions are longer than others: continued poor fiscal and monetary policy frustrates private agents' efforts to liquidate malinvested capital. This is precisely why the Great Depression (Rothbard 1963; Anderson 1949, 324-499), the 1970s stagflation (O'Driscoll and Shenoy, 1976), and the 1990s Japanese recession (Powell, 2002) lasted so long, and thus cannot be considered routine in any context.

governmental efforts to restore and maintain artificially high prices through cartelization and price controls. Rothbard shows that the monetary base increased well into the 1930s and his measure of the money supply is similar to MZM (Rothbard, 1978).³

Rothbard's view contrasts markedly with Friedman and Schwartz's (1963) conclusion that the secondary contraction was caused by the Federal Reserve System's failure to provide *enough* liquidity. Friedman and Schwartz find that the main problem during the depression was that the M1 money supply shrank, even though the monetary base grew. Table 1 summarizes some of the evidence cited by Keynesian, monetarist, and Austrian authors. It is difficult to avoid the conclusion that the Austrian explanation is the most encompassing, even though ABC theory focuses on the unsustainable expansion which precedes a recession, because the Austrian view also explains why some

³Money zero maturity (MZM) consists of all monetary assets which can be used immediately as media of exchange without waiting for conversion into a more liquid purchasing medium, the zero maturity property. In practice in the U.S., this includes all M2 assets except time deposits, and includes all money market mutual funds, even those held by institutions, which are part of M3.

Rothbard's (1962:88) measure of the money supply is based on currency in circulation plus demand deposits, which add up to M1, plus time deposits, plus the capital of savings and loan institutions, plus life insurance net policy reserves, used to proxy cash surrender liabilities of life insurance companies (Rothbard 1962:85). The major difference between Rothbard's monetary aggregate and MZM is the treatment of time deposits. Rothbard argues that time deposits enjoy *de facto* zero maturity because the contractual requirement that they cannot be withdrawn less than thirty days after being demanded by the depositor is rarely asserted (Rothbard 1962:83-84).

Table 1. Competing Views of the Great Depression

Keynesian	Monetarist	Austrian
<p>Liquidity trap created once nominal interest rates became low enough; bank demand for excess reserves became perfectly elastic. Monetary base doubled between 1929-39; monetary policy was expansionary, but excess reserves accumulated in banks. Demand for loans depressed due to unfavorable business outlook. Banks did not buy short-term securities because nominal yields were so low.</p>	<p>Real interest rates extremely high due to price deflation: e.g., CPI fell 10% in 1931 and 1932. Indicates contractionary policy. Growth in monetary base mostly attributable to currency held by public, unavailable to be loaned out, rather than bank reserves. "Flight to quality" greatly increased demand for short-term Treasury securities, depressing their yield. Fed tightened discount lending policy in 1931, and doubled reserve requirement between 1936-37, triggering a secondary recession.</p>	<p>Expansionary monetary policy depressed interest rates and created unsustainable investment boom throughout late 1920s. Monetary policy was intermittently both expansionary and contractionary throughout the 1930s. Government intervention initiated under the Hoover administration between 1930-32 delayed liquidation of malinvested capital. Price fixing, fiscal stimulus, and inconsistent monetary activism continued and extended under the Roosevelt administration, prevented liquidation of malinvested capital, prolonging the contraction.</p>
Keynes, 1936; Hicks, 1939; Modigliani, 1944	Friedman and Schwartz 1963, 411-419.	Rothbard, 1962; Garrison, 2001

recessions are prolonged through poor policy intervention.⁴ The monetarists are simultaneously to be applauded for introducing the first evidence of contractionary policy over three decades after the start of the recession, as well as to be scolded for selectively ignoring very real evidence of expansionary policy, which remains irrefutable.

The Austrian perspective can be interpreted as intermediate between the Keynesian, emphasizing a liquidity trap which made expansionary monetary policy ineffective, and the monetarist, which criticizes the Fed for unwittingly implementing a contractionary policy. The Austrian school blames the expansionary policy of the 1920s for the onset of the Depression, and active government and central bank

⁴The author is much indebted to Sudha Shenoy for a highly enlightening conversation on the state of understanding of the causes of the Great Depression prior to the publication of Friedman and Schwartz's *Monetary History of the United States* (1963). It simply was not clear whether monetary policy had been expansionary or contractionary during the thirties until this definitive study was published with its huge volume of previously unavailable monetary data. Until then, armchair-Keynesians were free to presume facts supported their conclusions. Rothbard's (1963) reliance on subsequently ignored monetary aggregates and proxies was largely necessitated by the unavailability of more widely accepted data prior to the publication of the *Monetary History*. Rothbard (1978) explains and justifies his choice of data, but see also Anderson (1949, 125-502) for a contemporary account of the Great Depression.

Responding to Keynesian assertions largely unsupported by data that monetary policy had been unambiguously and ineffectively expansionary, Friedman and Schwartz concluded that policy had been almost unambiguously contractionary. This conclusion does not square entirely with the facts, however, many of which Friedman and Schwartz were the first to document. Policy was inconsistent, as Rothbard shows, providing some support for Keynesian claims, and this inconsistent expansionary-contractionary policy provided an especially difficult environment for entrepreneurs' liquidation of malinvested capital, delaying recovery for nearly ten years. In an important sense, both Keynesians and monetarists failed to see the forest for the trees.

policy for transforming what would have been a short recession into a decade-long ordeal. The Austrian school goes beyond the monetarist school in emphasizing the real discoordination and resource misallocation forced by government and central bank activism, resulting in persistent and abnormally high unemployment.

Because he was not an academic, Harwood (1932) focused only on the unsustainable aspects of inflation, not on how it created an overextended production structure. Economic historian William Graham Sumner (1891) also recognized that inflation precipitated economic downturns. Harwood was an important precursor of monetarism, and in his theory of the business cycle, the root cause was any excess of investment spending over saving. Such an imbalance can only be introduced through systematic expansion of the money supply, which allows banks to lend funds for business investment in excess of the savings they hold on deposit. He argued that the amount might be small initially, but would necessarily grow over time, as producers' goods face increased demand due to initial increases in credit, bidding up their price.

Harwood agreed with Mises and Hayek that unsustainable expansion comes about primarily because the interest rate is kept artificially low. Like Friedman, he largely disregarded the impact of localized distortions, recognizing that they occur, but arguing that their impact distorting the allocation of productive resources must be negligible. This is a major difference between Harwood and Friedman on the one hand and Mises and Hayek on the other.

O'Driscoll and Shenoy (1976) present an account of the stagflation of the 1970s. At the time, stagflation presented a difficulty to prevailing Keynesian orthodoxy. One Keynesian solution was to use expansionary fiscal and monetary policy to fight recession. This strategy was implemented during the 1970s but only made things worse, to the puzzlement of Keynesians. O'Driscoll and Shenoy note credit expansion increases nominal demand at the point the newly-created money is injected, distorting the price vector and the allocation of

resources, especially of capital which cannot be easily reallocated. Credit expansion always increases consumption expenditures because any new money increases nominal income in some households. Firms engaging in early-stage production find resource prices bid up, and resources bid away, by firms selling directly to consumers. Unemployment starts in early-stage industries even as prices continue to be bid up by continued injections of cheap credit. Wainhouse (1984) presents what may be one of the first econometric studies of ABC theory. Hughes (1997) and Cwik (1998) apply ABC theory to explaining the first Gulf War recession. Garrison (2001, 145-164), in the most important contribution to Austrian macroeconomics since 1949, also provides persuasive accounts of both the Great Depression and the stagflation of the 1970s using the Austrian model.

Carilli and Dempster (2001) argue that ABC theory places undue reliance on economic agents misperceiving credit expansion as a real increase in loanable funds. They suggest that even if rational agents correctly anticipate inflation, agents maximize profits under uncertainty by taking advantage of the market interest rate whenever it falls below the underlying rate of time preference. Keeler (2001) used standardized quarterly data for eight U.S. business cycles, finding monetary shocks did cause cycles which were propagated through relative price changes, including nominal interest rates.

Powell's (2002) account of the Japanese recession of the 1990s is especially noteworthy because he focuses on exactly how expansionary monetary and fiscal policy recommended to spur recovery, actually lengthened and deepened Japan's recession. His conclusion is that monetarist policy prescriptions proved only marginally less ineffective than Keynesian ones. As with the Great Depression, poor policy prescriptions transformed what should have been a brief recession into a decade-long ordeal. Mulligan (2002) used sectoral labor data as indicators of resource allocation among industrial sectors. Resources are reallocated among early, middle, and late stages of production in response to changes in nominal interest rates, as ABC

theory predicts. Callahan and Garrison (2003) explain the 1990s technology boom and subsequent recession of 2001-2002 in terms of ABC theory, pointing to specific Cantillon effects created when excess liquidity was injected into localized markets, showing how markets temporarily inflated prices for computer programmers and web developers, real estate in certain cities, and stocks of computer technology firms. Cochrane, Call, and Glahe (2003) argue that the location and timing of credit injection are especially critical in determining where and how far the production structure will overexpand, and what will be the nature and timing of the inevitable collapse.

In marked contrast to orthodox neoclassical and Keynesian accounts of the business cycle, ABC theory presents a consistent and coherent explanation of the causes and propagation mechanisms of the business cycle. Though more typically qualitative than quantitative, the explanatory successes of ABC theory have proved robust over an impressive time period and range of specific applications. This remarkable success makes it even more puzzling that ABC theory has not been enthusiastically embraced by non-Austrians, and that it has yet to emerge as the dominant macroeconomic policy paradigm.

Data

This section documents the data used for econometric estimation and motivates the choice of data. All data are from the Federal Reserve Bank of St. Louis Federal Reserve Economic Data (FRED-II) website.

a. Output Index: The industrial production index (FRED-II series INDPRO) is used, reinitialized at January 1959 = 100. This series estimates value added in mining, manufacturing, and utilities industries, excluding virtually all services.

b. Consumption Index: Annualized real personal consumption

expenditures is observed monthly for January 1959 to March 2003 and reported by the U.S. Department of Commerce Bureau of Economic Analysis (FRED-II series PCEC96). This was converted to an index with January 1959 = 100. Consumption spending includes both consumption goods and services.

c. Investment Index: An investment index is imputed based on the difference between total real output and real consumption. Monthly percent growth rates are computed for the industrial production index and the consumption index. It is assumed that any real output produced which is not consumer goods is producer goods. The percent growth rate of the consumption index is subtracted from the percent growth rate of the industrial production index. The resulting difference is taken as the imputed percent growth rate for real investment. Starting with January 1959 = 100, the imputed real investment index for period $t + 1$ is constructed by multiplying the index for period t times one plus the imputed percent growth rate.

d. Credit Index: Commercial and industrial loans at all commercial banks is observed monthly and reported by the Board of Governors of the Federal Reserve System (FRED-II series BUSLOANS). This nominal value is adjusted for changes in the price level. The producer price index (PPI) for all commodities is used as a deflator, which is observed monthly and reported by the U.S. Department of Labor Bureau of Labor Statistics (FRED-II series PPIACO). The deflated series is converted to an index with January 1959 = 100.⁵

⁵A potential criticism of commercial and industrial loans as a measure of credit expansion is that credit injected through capital markets is ignored. During expansions, credit is injected into the stock market, dramatically inflating equity prices. However, almost all credit allocated to capital markets goes to purchase already-issued equities. Additions to capital-market credit contribute to inflating stock market prices and indices, but very little becomes available for investment

The Error-correction Methodology

This paper proposes the error-correction model as an econometric methodology especially amenable to interpretation by the Austrian school. Error-correction models provide estimates of both a structural or equilibrium process *toward which* adjustment is generally effected, and the error-correction or disequilibrium adjustment process *through which* adjustment is effected toward the hypothesized equilibrium. Even if one rejects the reality of any hypothesized equilibrium, estimates of the disequilibrium adjustment process still warrant interest.

The structural relationships among the four macroeconomic variables will be normalized with respect to the first three: output, consumption, and investment. These three variables will each be expressed in terms of the fourth, commercial and industrial loans. The resulting vector of structural equations is:

$$\begin{aligned} Y_t &= a_1 + b_1 L_t + e_{1t} \\ C_t &= a_2 + b_2 L_t + e_{2t} \\ I_t &= a_3 + b_3 L_t + e_{3t} \end{aligned}$$

where a is the intercept, indicating average output, consumption, and investment in the absence of any commercial and industrial lending, b is the slope indicating the extent to which increases in commercial and industrial lending increase output, consumption, and investment, and e is an additive regression residual or error. Because the data are dimensionless constants, the coefficients and residuals are also dimensionless. The vector error correction model is:

projects, through initial public offerings and initial sales of corporate bonds and commercial paper. Furthermore, commercial and industrial loans proxy the two latter forms of credit very well.

$$\Delta Y_t = \Theta_1(Y_{t-1} - a_1 - b_1L_{t-1}) + \Psi_1(C_{t-1} - a_2 - b_2L_{t-1}) + \Xi_1(I_{t-1} - a_3 - b_3L_{t-1}) + \alpha_{11}\Delta Y_{t-1} + \beta_{11}\Delta Y_{t-2} + \dots + \alpha_{12}\Delta C_{t-1} + \beta_{12}\Delta C_{t-2} + \dots + \alpha_{13}\Delta I_{t-1} + \beta_{13}\Delta I_{t-2} + \dots + \alpha_{14}\Delta L_{t-1} + \beta_{14}\Delta L_{t-2} + \dots + u_{1t}$$

$$\Delta C_t = \Theta_2(Y_{t-1} - a_1 - b_1L_{t-1}) + \Psi_2(C_{t-1} - a_2 - b_2L_{t-1}) + \Xi_2(I_{t-1} - a_3 - b_3L_{t-1}) + \alpha_{21}\Delta Y_{t-1} + \beta_{21}\Delta Y_{t-2} + \dots + \alpha_{22}\Delta C_{t-1} + \beta_{22}\Delta C_{t-2} + \dots + \alpha_{23}\Delta I_{t-1} + \beta_{23}\Delta I_{t-2} + \dots + \alpha_{24}\Delta L_{t-1} + \beta_{24}\Delta L_{t-2} + \dots + u_{2t}$$

$$\Delta I_t = \Theta_3(Y_{t-1} - a_1 - b_1L_{t-1}) + \Psi_3(C_{t-1} - a_2 - b_2L_{t-1}) + \Xi_3(I_{t-1} - a_3 - b_3L_{t-1}) + \alpha_{31}\Delta Y_{t-1} + \beta_{31}\Delta Y_{t-2} + \dots + \alpha_{32}\Delta C_{t-1} + \beta_{32}\Delta C_{t-2} + \dots + \alpha_{33}\Delta I_{t-1} + \beta_{33}\Delta I_{t-2} + \dots + \alpha_{34}\Delta L_{t-1} + \beta_{34}\Delta L_{t-2} + \dots + u_{3t}$$

$$\Delta L_t = \Theta_4(Y_{t-1} - a_1 - b_1L_{t-1}) + \Psi_4(C_{t-1} - a_2 - b_2L_{t-1}) + \Xi_4(I_{t-1} - a_3 - b_3L_{t-1}) + \alpha_{41}\Delta Y_{t-1} + \beta_{41}\Delta Y_{t-2} + \dots + \alpha_{42}\Delta C_{t-1} + \beta_{42}\Delta C_{t-2} + \dots + \alpha_{43}\Delta I_{t-1} + \beta_{43}\Delta I_{t-2} + \dots + \alpha_{44}\Delta L_{t-1} + \beta_{44}\Delta L_{t-2} + \dots + u_{4t}$$

Note the expressions in parentheses are lagged residuals from the structural equations, and thus could be represented simply by (e_{t-1}) s. These are the errors which the disequilibrium adjustment process of the error correction model attempts to explain. The upper-case Greek letters are the structural adjustment or disequilibrium adjustment terms, which weight the error-correction processes and so indicate the importance of the past changes in the explanatory variables in effecting adjustment toward the hypothesized equilibrium. The equilibrium represented by the structural equations is generally never realized, and if realized, is not persistent. If equilibrium is ever reached, that is represented by zero residuals in the structural equations for those observations, an event both rare and fortuitous. Whenever residuals are non-zero, that is, whenever the system is in disequilibrium, which generally will be for virtually every observation, the non-zero residual in period t results in an adjustment back toward equilibrium in period $t+1$, represented by the error-correction processes. The error-correction processes can be thought of as indicating how the data processes can

best be represented as adjusting to maintain the long-run equilibrium.

Conventional inference is valid in an error-correction model even when the structural variables are nonstationary, provided the residuals are white-noise processes with no serial correlation. Adding a sufficient number of lagged difference terms in the disequilibrium adjustment process is generally sufficient to guarantee white-noise errors.⁶

The Vector Error-correction Model

This section presents and interprets empirical estimates based on a simple parameterization of ABC theory. In the subjectivist theory of a capital-using economy, entrepreneurial planners act as the subjects of productive activities, creating real consumable output as the object (Garrison, 1985, 164-165; 2001, 15). Interest rates facilitate intertemporal coordination of productive resources by clearing the loanable funds market (Garrison, 1986, 440; 2001, 39). In this regard disequilibrium interest rates play the same role as prices in signaling opportunities for entrepreneurial discovery (Kirzner, 1984a, 146; 1984b, 160-161; 1997), and individual entrepreneurs respond by maintaining the production structure by reallocating resources.

a. Unit Root and Cointegration Tests

⁶Jarque-Bera (1980) tests of normality of the Cholesky-orthogonalized residuals (Lütkepohl 1991) strongly suggest the residual series are not multivariate normal. Normality is a sufficient rather than a necessary condition for white-noise errors and valid VECM estimates. The Johansen-Juselius procedure estimates the VECM by maximum likelihood, imposing the most nearly normal character possible on the residuals. Non-normal residuals can be interpreted as evidence of specification error, and from the perspective of the Austrian school, specification error is necessarily present in all econometric models because subjective use-value is inherently unobservable.

Most macroeconomic time series display an increasing trend, and unit root tests were developed to identify this characteristic. Stationary time series are said to have zero roots or be integrated of order zero $I(0)$. Non-stationary series may have a unit root or be first-order integrated $I(1)$. Unit root series become $I(0)$ when first-differenced. Regressions estimated with non-stationary data will not generally have the white-noise residuals needed for valid inference. The regression could be estimated in first-differences, but then any long-term information carried by the levels of the variables is lost. Error-correction models overcome this difficulty by estimating a regression in first-differences augmented by error-correction terms, the lagged differences between the actual and estimated value of the left-hand-side variable, collectively referred to as the error-correction process, also called the disequilibrium adjustment process. The coefficients on the undifferenced variables constitute the cointegrating vector or structural relationship. A sufficient number of lagged error-correction terms are added to guarantee white-noise errors and valid inference (Davidson and McKinnon, 1993, 720-730; Kennedy, 1998, 266-270).

Table 2 reports augmented Dickey-Fuller (1979) and Phillips-Perron (1988) unit-root tests for each variable. The augmented Dickey-Fuller results with 48 lags indicate output, investment, and commercial and industrial loans are all $I(1)$, but that consumption may be $I(2)$ or integrated of higher order. Phillips-Perron tests indicate all variables are $I(1)$.

Table 3 reports Johansen-Juselius tests for cointegration. Results of the trace test, a likelihood ratio, indicate a stable, cointegrated relationship among the system of four macroeconomic variables with three cointegrating vectors.

Because the four variables in the model are cointegrated, ordinary least squares estimates of the structural relationships have the property of superconsistency.

Table 2. Unit Root Tests
January 1959-December 2003

Augmented Dickey-Fuller Tests

<i>Variable</i>	Levels		First differences	
	<u>Intercept</u>	<u>Intercept + trend</u>	<u>Intercept</u>	<u>Intercept + trend</u>
Industrial Prod Index	0.7050	-1.1001	*** -3.5254	** -3.6559
Consumption Index	2.6358	1.3121	-1.3826	-2.5878
Investment Index	-0.3907	-2.9062	*** -3.5876	** -3.6919
Credit Index	-0.4277	-2.9557	** -3.2375	* -3.3631
Critical Values ²	1%	-3.4459	1%	-3.9810
	5%	-2.8677	5%	-3.4209
	10%	-2.5701	10%	-3.1329

Phillips-Perron Tests

5 lag truncation for Bartlett kernel (Newley and West 1987)

Industrial Prod Index	0.5148	-1.4103	*** -16.9202	***-16.9411
Consumption Index	6.1908	1.5984	*** -27.8791	***-29.8532
Investment Index	-0.8417	-2.6552	*** -19.6974	***-19.6153
Credit Index	-0.6497	-2.4878	*** -19.8052	***-19.8242
Critical values	1%	-3.4448	1%	-3.9795
	5%	-2.8672	5%	-3.4202
	10%	-2.5698	10%	-3.1324

Notes:

1. Rejection of the null hypothesis of a unit root [$H_0: x \sim I(1)$; $H_A: x \sim I(0)$] at the 10%, 5%, and 1% significance levels indicated by *, **, and ***.
2. ADF critical values from MacKinnon (1991).
3. Results of the Phillips-Perron tests suggest four index series are $I(1)$ processes.

Table 3. Tests for Cointegration among Indexes of Industrial Production, Consumption, Investment, and Commercial and Industrial Loans
December 1959-December 2003
(491 observations after adjusting endpoints with 48 lag intervals)

Hypothesized # <u>CE(s)</u>	Maximum <u>Eigenvalue</u>	Trace <u>Statistic</u>	5% Critical <u>Value</u>	1% Critical <u>Value</u>
None **	0.087577	85.59848	53.12	60.16
At most 1 *	0.035336	40.59756	34.91	41.07
At most 2 *	0.031952	22.93381	19.96	24.60
At most 3	0.014134	6.989258	9.24	12.97

Notes:

1. Critical values from Osterwald-Lenum (1992).
2. *(**) denotes rejection of the null hypothesis at the 5%, (1%) level.
3. Trace test indicates three cointegrating equations at 5% significance level.
4. 48 lag intervals in disequilibrium adjustment process (48 lagged first-differences).
5. Trend assumption: No deterministic trend (restricted constant).

b. The Cointegration Space

The error-correction methodology distinguishes between permanent or long-run effects measured by the coefficient estimates of the cointegrating vectors, and transitory or short-run effects measured by the coefficients of the disequilibrium adjustment process. First consider the long-run relationships. The estimate of the vector error correction

model (VECM) is reported in Table 4. To facilitate interpretation, the three vectors are solved for output, consumption, and investment, each explained by commercial and industrial loans. These three structural equations can be thought of as long-run relationships identifying an equilibrium toward which the error correction process adjusts after any exogenous disturbance. Coefficients on the forty-eight lagged difference terms are not reported, partly due to space limitations, and also because individual coefficient estimates hold limited interest. The implications of the disequilibrium adjustment process can be inferred from impulse response graphs (Figure 1).

The slope coefficient in the structural equation for the industrial production index is not significant at the 5% level, indicating credit expansion as measured by commercial and industrial loans does not permanently affect real output.⁷ The slope coefficient in the structural equation for consumption is positive and significant, indicating credit expansion permanently increases real consumption expenditures. This result is consistent with ABC theory, which suggests consumers save less in response to the lower interest rate. The slope coefficient for investment is negative and significant, suggesting that credit expansion

⁷ABC theory is a theory of the unsustainable boom brought about by credit expansion, and asserts that sustained credit expansion pushes the system above its sustainable level of output. Thus, the effect of credit expansion on output should be positive during the expansion phase, and negative during the ensuing bust. The VECM coefficient estimate is not statistically significant because the two effects cancel out over time as recorded in the historical data.

That real output is lower than it would be in the absence of credit expansion can be inferred from the significantly negative coefficient on investment. It is unambiguous that less investment means less capital equipment and therefore less output. The historical output series is what it is, and does not experience a secular fall, even while experiencing several recessions. Nevertheless, output could potentially be higher, if credit expansion did not systematically frustrate the accumulation of productive, long-lived capital.

Table 4. Vector Error Correction Model
 Industrial Production, Consumption, and Investment
 explained by Commercial and Industrial Loans
 December 1959-December 2003 (491 observations after adjusting endpoints)

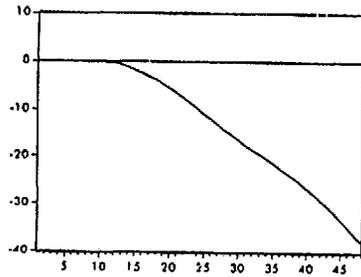
Cointegrating equations				
	Industrial Production <u>Index</u>		<u>Consumption Index</u>	<u>Investment Index</u>
Constant	-248.4555 (174.647) [-1.42262]		-459.6424 (190.536) ***[-2.41236]	200.7268 (2.24949) *** [89.2322]
Index of Commercial & Industrial Loans	3.407440 (1.88005) *[1.81242]		5.402801 (2.05110) ***[2.63410]	-1.015573 (0.02422) *** [41.9390]
Error Correction Process				
		<i>Summary Statistics</i>		
	<u>_(IIP)</u>	<u>_(Cons)</u>	<u>_(Invest)</u>	<u>_(C & I Loans)</u>
Cointegrating Eq 1 (in_(IIP)) disequilibrium adjustment coefficients _	-0.148849 (0.08697) *[-1.71141]	-0.377618 (0.08391) ***[-4.50008]	0.036580 (0.04271) [0.85652]	-0.063900 (0.04339) [-1.47281]
Cointegrating EQ 2 (in_(Cons)) disequilibrium adjustment coefficients _	0.136683 (0.08214) *[1.66411]	0.360550 (0.07925) ***[4.5981]	-0.037930 (0.04033) [-0.94046]	0.063729 (0.04097) [1.55538]
Cointegrating EQ 3 (in_invest)) disequilibrium adjustment coefficients _	-0.638940 (0.66308) [-0.96360]	-2.808482 (0.63974) ***[-4.39003]	0.389831 (0.32559) [1.19730]	-0.622957 (0.33077) *[-1.88334]
Adjustment R-square	0.262236	0.097498	0.175421	0.183564
F-statistic (zero slopes)	***1.897779	***1.272863	***1.537332	***1.567884
Akaike information criteria	0.262236	0.097498	0.175421	0.183564
Schwarz criteria				
Logarithm of likelihood function adjusted for degrees of freedom				-1208.483
Akaike information criterion				8.160826
Schwarz criterion				14.95548

Notes:

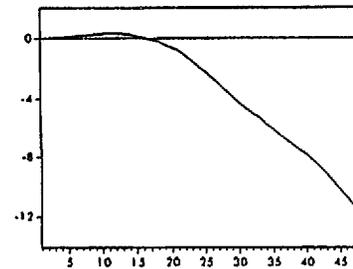
1. Standard errors in (); t-statistics in [].
2. 10%, 5%, and 1% significance indicated by *, **, and ***.

Figure 1. VECM Cumulative Impulse Response Functions
Cumulative Response to Cholesky One Standard Deviation Innovations
in Commercial and Industrial Loans over 48 months

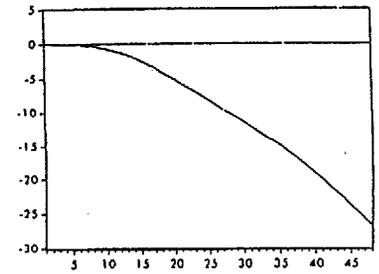
Accumulated Response
of Industrial Production
to Commercial and Industrial Loans



Accumulated Response
of Consumption
to Commercial and Industrial Loans



Accumulated Response
of Investment
to Commercial and Industrial Loans



permanently *lowers* investment expenditure.⁸ ABC theory suggests that credit expansion shifts resource allocation away from middle stages of production toward early and late stages (consumption). The suggested interpretation is that the shifting of resources from middle to early stages has little or no net effect on aggregate investment, while the concomitant shifting of resources from middle to late stages, that is, into consumption spending, has a negative impact on investment. Taken together, the two reallocative movements brought about by credit injection have a negative impact on investment spending, and this negative impact has historically exceeded any net additions to investment coming directly from the injection of newly-created credit.

Adjusted R-squares for the disequilibrium adjustment processes in the cointegrating vector are very low. In spite of the low R-squares, disequilibrium adjustment terms [Θ , Ψ , and Ξ] are significant at the 5% level, only in the disequilibrium adjustment process for consumption. This is an especially interesting result, which is easy to account for according to ABC theory. Apparently market disequilibria, measured by non-zero residuals in the three structural equations, effect correction chiefly through changes in consumption spending. Below-equilibrium consumption, measured by *positive* residuals in the consumption equation, results in positive adjustments to consumption accompanied by decreases in industrial output and investment, as indicated by significantly negative coefficients on the disequilibrium adjustment terms. Consumption itself adjusts upward, as indicated by the significantly positive coefficient. Little or no adjustment occurs through total output or through investment, suggesting that credit-induced increases in consumption generally occur at the expense of investment

⁸This is the key result of the paper. Although credit expansion did not make output greater or less than it was because it unambiguously lowered investment, we can infer that credit expansion made output less than what it would have been. These are the positive net costs associated with the misallocation of resources caused by credit expansion during the unsustainable boom.

and output, rather than as additions to them. Consumer behavior is highly responsive to market disequilibria, but producer behavior exhibits much more inertia, likely due to the fixed capital embodied in the production structure.⁹

c. Disequilibrium adjustment

Impulse response functions measure the strength of the disequilibrium adjustment processes working through each variable. In contrast to the structural coefficients of the cointegration space, the disequilibrium adjustment process is a short-run phenomenon. The fact that disequilibrium adjustment is effected downward on output, consumption, and investment, whenever there is a positive shock to commercial and industrial loans, is strong support for ABC theory.

Cumulative impulse response functions illustrate that increases in commercial and industrial loans force a large downward adjustment on output (40 standard deviations after four years), consumption (25 standard deviations after four years), and investment (12 standard deviations after four years). A one standard-deviation increase in the commercial and industrial loans index results in the other variables in the system to adjust to restore equilibrium. Although the investment index rises initially by as much as 0.36 standard deviations after twelve months, it falls drastically from there on. The index of industrial

⁹Granger causality tests (Granger 1969) indicate consumption is endogenous with respect to the remaining three exogenous variables. This test is strongly dependent on the VECM estimate and the maintained hypothesis that all relevant variables have been included in the VECM (Davidson and MacKinnon, 1993, 686). This outcome supports the interpretation that most adjustment to disequilibrium occurs through consumption, rather than investment, due to the high costs of adjusting the production structure characterized by multi specific capital. The lagged difference terms play little role in adjusting consumption spending toward equilibrium.

production remains almost unchanged for about twelve months and then falls dramatically, and the consumption index adjusts downward after only three months. The interpretation suggested by ABC theory is that credit expansion, manifested by exogenous shocks to commercial and industrial loans, causes scarce capital resources to be misallocated over an unsustainably long and low-yielding production structure. Too much capital is allocated to early and late stages, with too little allocated to the critical middle stages which are necessary to transform early stage goods-in-process into late-stage consumable output. This culture of waste and misallocation permanently shifts the economy into a lower growth trajectory.¹⁰

Conclusion

This paper presents evidence of cointegration among real output, consumption, investment, and commercial and industrial loans. This finding implies a close, stable relationship among these four macroeconomic variables. ABC theory is applied to interpret these empirical regularities. A simple vector error-correction model is specified and presented, and demonstrated to have a great deal of explanatory power over 1959-2003 historical data.

Cointegration analysis identifies a stable long-term relationship or cointegrating vector, which constitutes a dynamic equilibrium entrepreneurial planners have generally effected adjustment toward during the 1959-2003 observation period. This equilibrium is not

¹⁰Variance decomposition functions indicate that after 48 months, approximately 20% of the variance in industrial production, consumption, and investment is attributable to variation in business and commercial loans over the period studied. Interestingly, while significant variation seems to transfer from industrial production to commercial and industrial loans, very little variation seems to be transmitted from consumption or investment to commercial and industrial loans.

necessarily ever realized. The market process consists of entrepreneurial planners effecting adjustment toward a dynamic equilibrium they continuously redefine. The prevailing term structure of interest rates determines resource allocation among early, middle, or late stages of production, allocating resources and production in accordance with consumers' time preference and available investment alternatives. Estimates of a stable long-run relationship using U.S. data provide convincing support for ABC theory as an encompassing explanation of intertemporal resource allocation, production, and employment.

ABC theory is founded on the concept of a sustainable, market-determined interest rate, and predicts negative consequences when that equilibrium is persistently disturbed. Economists and lay people are well aware of these consequences: the periodic high unemployment associated with the business cycle. The policy prescriptions of the Austrian school are unmistakable: first, never disturb the interest rate with credit expansion or monetary inflation, and second, after the first policy prescription has been violated, never interfere with entrepreneurial planners' efforts to liquidate suboptimal production plans as rapidly as possible. As long as economists and policy makers believe the business cycle can be avoided through the activism of charismatic central bankers, recessions will be inevitable.

References

- Bischoff, Charles W. 1970. "A Model of Nonresidential Construction in the United States." *American Economic Review* 602: 10-17.
- Breusch, T.S., L.G. Godfrey. 1986. "Data Transformation Tests." *Economic Journal* 96: 47-58.
- Callahan, Gene, Roger Garrison, W. Roger. 2003. "Does Austrian Business Cycle Theory Help Explain the Dot-com Boom and Bust?" *Quarterly Journal of Austrian Economics* 62: 67-98.
- Carilli, Anthony M., Gregory M. Dempster. 2001. "Expectations in Austrian Business Cycle Theory: an Application of the Prisoner's Dilemma." *Review of Austrian Economics* 144: 319-330.
- Cowen, Tyler. 1997. *Risk and Business Cycles*. London: Routledge.
- Cwik, Paul. 1998. "The Recession of 1990: a Comment." *Quarterly Journal of Austrian Economics* 12: 85-88.
- Davidson, Russell; James G. McKinnon. 1993. *Estimation and Inference in Econometrics*. New York: Oxford University Press.
- Dickey, D.A.; W. A. Fuller. 1979. "Distribution of the Estimators for Autoregressive Time Series with a Unit Root." *Journal of the American Statistical Association* 74: 427-431.
- Federal Reserve Bank of St. Louis. 2003. Federal Reserve Economic Data FRED-II, <<<http://research.stlouisfed.org/fred2/>>> 1-4-2003.
- Friedman, Milton, Anna J. Schwartz. 1963. *A Monetary History of the United States 1867-1960*. Princeton: Princeton University Press and NBER.

Garrison, Roger W. 1978. "Austrian Macroeconomics: a Diagrammatical Exposition." In Spadaro, Louis M. ed. *New Directions in Austrian Economics* pp. 167-204. Kansas City: Sheed Andrews & McMeel.

Garrison, Roger W. 1985. "A Subjectivist Theory of a Capital-Using Economy." In O'Driscoll, Gerald P., Mario Rizzo. *The Economics of Time and Ignorance* pp. 160-187. New York: Routledge.

Garrison, Roger W. 1986. "The Hayekian Trade Cycle Theory: a Reappraisal." *Cato Journal* 62: 437-453.

Garrison, Roger W. 1988. "The Austrian Theory of the Business Cycle in Light of Modern Macroeconomics." *Review of Austrian Economics* 3: 3-29.

Garrison, Roger W. 1995. "Equilibrium and Entrepreneurship." *Advances in Austrian Economics* 2: 67-78. Greenwich, Connecticut and London: JAI Press.

Garrison, Roger W. 2001. *Time and Money: the Macroeconomics of Capital Structure*. London: Routledge.

Granger, C.W.J. 1969. "Investigating Causal Relationships by Econometric Models and Cross-spectral Methods." *Econometrica* 37: 424-438.

Haberler, Gottfried. [1937] 1960. *Prosperity and Depression: a Theoretical Analysis of Cyclical Movements* 2nd ed. Cambridge: Harvard University Press.

Harwood, E.C. [1932] 1974. *Cause and Control of the Business Cycle* 10th ed. Great Barrington, Massachusetts: American Institute for Economic Research, *Economic Education Bulletin* 149.

Hayek, F.A. 1931. *Prices and Production* 1st ed.

Hayek, F.A. [1933] 1966. *Monetary Theory and the Trade Cycle*. New York: Augustus M. Kelley.

Hayek, F.A. [1935] 1967. *Prices and Production* 2nd ed. New York: Augustus M. Kelley.

Hayek, F.A. [1939] 1969. *Profits, Interest, and Investment, and Other Essays on the Theory of Industry Fluctuations*. Reprint, New York: Augustus M. Kelley.

Hayek, F.A. 1941. *The Pure Theory of Capital*. Chicago: University of Chicago Press.

Hicks, J.R. [1939] 1946. *Value and Capital: an Inquiry into Some Fundamental Principles of Economic Theory* 2nd ed. Oxford: Clarendon Press.

Hughes, Arthur M. 1997. "The Recession of 1990: an Austrian Explanation." *Review of Austrian Economics* 101: 107-123.

Hülsmann, Jörg Guido. 2001. "Garrisonian Macroeconomics." *Quarterly Journal of Austrian Economics* 43: 33-42.

Hummel, Jeffrey Rogers. 1979. "Problems with Austrian Business Cycle Theory." *Reason Papers* 5: 41-53.

Jarque, C.M.; A.K. Bera. 1980. "Efficient Tests for Normality, Homoskedasticity, and Serial Independence of Regression Residuals." *Economics Letters* 6: 255-259.

Johansen, Søren 1995. *Likelihood-based Inference in Cointegrated Vector Auto-regressive Models*. Oxford: Oxford University Press.

Johansen, Søren, Katerina Juselius. 1990. "Maximum Likelihood Estimation and Inference on Cointegration— with Applications to the Demand for Money." *Oxford Bulletin of Economics and Statistics* 52: 169-210.

Keeler, James P. 2001. "Empirical Evidence on the Austrian Business Cycle Theory." *Review of Austrian Economics* 144: 331-351.

Kennedy, Peter. 1998. *A Guide to Econometrics* 4th ed. Cambridge: MIT Press.

Keynes, John Maynard. 1936. *The General Theory of Employment, Interest, and Money*. New York: Harcourt Brace & Co.

Kirzner, Israel M. 1984a. "Prices, the Communication of Knowledge, and the Discovery Process." In Leube, K.R. and Zlabinger, A.H. eds. *The Political Economy of Freedom: Essays in Honor of F.A. Hayek*. Amsterdam: Philosophia Verlag. Reprinted 1992 in Kirzner, *The Meaning of Market Process* pp. 139-151. London: Routledge.

Kirzner, Israel M. 1984b. "Economic Planning and the Knowledge Problem." *Cato Journal* 42. Reprinted 1992 in Kirzner, *The Meaning of Market Process* pp. 152-162. London: Routledge, 1992.

Kirzner, Israel M. 1992. *The Meaning of Market Process*. London: Routledge.

Kirzner, Israel M. 1997. "Entrepreneurial Discovery and the Competitive Market Process: An Austrian Approach." *Journal of Economic Literature* 35: 60-85.

Lachmann, Ludwig M. 1947. "Complementarity and Substitution in the Theory of Production." *Economica* 14: 108-119.

Lachmann, Ludwig M. 1956. *Capital and Its Structure*. London: Bell & Sons. Reprinted 1978 Kansas City: Sheed Andrews and McMeel.

Lombardo, Gary A., Robert F. Mulligan. 2003. "Resource Allocation: A Hayekian Paradigm for Maritime Conglomerates." *Quarterly Journal of Austrian Economics* 61: 3-21.

Lütkepohl, Helmut. 1991. *Introduction to Multiple Time Series Analysis*. Heidelberg: Springer Verlag.

MacKinnon, James G. 1991. "Critical Values for Cointegration Tests." Ch. 13 in Engle, R.F.; and Granger, C.W.J. eds. *Long-run Economic Relationships: Readings in Cointegration*. Oxford: Oxford University Press.

Miller, Arthur. 1968. *The Price*. New York: Viking.

Mises, Ludwig von. [1912] 1980. *The Theory of Money and Credit*. Indianapolis: Liberty Classics.

Mises, Ludwig von. [1949] 1998. *Human Action* 5th ed. Auburn: Ludwig von Mises Institute.

Modigliani, Franco. 1944. "Liquidity Preference in the Theory of Interest and Money." *Econometrica* 12: 45-88. Reprinted 1960 in Hazlitt, Henry (ed.) *The Critics of Keynesian Economics* pp. 132-184. Princeton: Van Nostrand.

Mueller, Antony P. 2001. "Financial Cycles, Business Activity, and the Stock Market." *Quarterly Journal of Austrian Economics* 41: 3-22.

Mulligan, Robert F. 2002. "A Hayekian Analysis of the Term Structure of Production." *Quarterly Journal of Austrian Economics* 52: 17-33.

Mulligan, Robert F. 2003. "An Empirical Examination of Austrian

Business Cycle Theory.” Western Carolina University, Department of Business Computer Information Systems and Economics.

Mulligan, Robert F. 2004. “Accounting for the Business Cycle: Nominal Price Rigidities, Factor Heterogeneity, and Austrian Capital Theory.” Western Carolina University, Department of Business Computer Information Systems and Economics.

Newley, W., and K. West. 1987. “A Simple Positive Semi-definite, Heteroskedasticity and Autocorrelation Consistent Covariance Matrix.” *Econometrica* 55: 703-708.

O'Driscoll, Gerald P., and Mario Rizzo. 1995. *The Economics of Time and Ignorance*. New York: Routledge.

O'Driscoll, Gerald P., and Sudha R. Shenoy. 1976. “Inflation, Recession, and Stagflation.” In Dolan, Edwin G. (ed.) *The Foundations of Modern Austrian Economics*, 185-211. Kansas City: Sheed & Ward.

Osterwald-Lenum, Maurice. 1992. “A Note with Quantiles of the Asymptotic Distribution of the Maximum Likelihood Cointegration Rank Test Statistics.” *Oxford Bulletin of Economics and Statistics* 54: 461-472.

Phillips, P.C.B., and P. Perron. 1988. “Testing for a Unit Root in Time Series Regression.” *Biometrika* 75: 335-346.

Powell, Benjamin. 2002. “Explaining Japan's Recession.” *Quarterly Journal of Austrian Economics* 52: 35-50.

Rothbard, Murray N. [1962] 2000. *America's Great Depression* 5th ed. Auburn: Ludwig von Mises Institute.

Rothbard, Murray N. [1963] 2000. *Man, Economy, and State*. Auburn: Ludwig von Mises Institute

Rothbard, Murray N. 1978. "Austrian Definitions of the Supply of Money." In Spadaro, Louis M. (ed.) *New Directions in Austrian Economics*, pp. 143–156. Kansas City: Sheed Andrews and McMeel. Also published in *The Logic of Action*, Vol. I.

Salerno, Joseph T. 1989. "Comment on Tullock's 'Why Austrians are Wrong about Depressions.'" *Review of Austrian Economics* 3:141-145.

Salerno, Joseph T. 2001. "Does the Concept of Secular Growth Have a Place in Capital-based Macroeconomics?" *Quarterly Journal of Austrian Economics* 43: 43-62.

Sumner, William Graham. 1891. *The Financier and the Finances of the American Revolution*. 2 vols. New York: Dodd and Mead.

Tullock, Gordon. 1987. "Why the Austrians are Wrong about Depressions." *Review of Austrian Economics* 2: 73-78.

Tullock, Gordon. 1989. "Reply to Comment by Joseph T. Salerno." *Review of Austrian Economics* 3: 147-149.

Wagner, Richard E. 1999. "Austrian Cycle Theory: Saving the Wheat while Discarding the Chaff." *Review of Austrian Economics* 121: 65-80.

Wainhouse, Charles E. 1984. "Empirical Evidence for Hayek's Theory of Economic Fluctuations." In Siegel, Barry N. ed. *Money in Crisis: the Federal Reserve, the Economy, and Monetary Reform*. San Francisco: Pacific Institute for Public Policy Research. Yeager, Leland 1986. "The Significance of Monetary Disequilibrium." *Cato Journal* 6: 369-399.