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THE SOURCE OF FLUCTUATIONS IN MONEY: EVIDENCE FROM TRADE CREDIT

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ABSTRACT

This paper tests the importance of technology shocks versus financial shocks for explaining, fluctuations in money. The model presented extends the theory of King and Plosser by recognizing that both money and trade credit provide transactions services. The model shows that the comovements between money and trade credit can reveal the nature of the underlying shocks. The empirical results strongly suggest that shocks to the financial system account for most of the fluctuations in money. Thus, the results cast doubt on the hypothesis that nonfinancial technology shocks are the main source of the money-income correlation.

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I. Introduction

One of the distinctive features of the real business cycle hypothesis is its explanation of the observed procyclicality of money and other financial variables. Contrary to the view prevalent during the 1970's, real business cycle (RBC) models dispute the causal role of money in the positive correlation between money and output (King and Plosser (1984), Plosser (1989)). According to the theory, fluctuations in the money stock do not stem from the actions of the monetary authority; rather, money, which is treated as a factor of production, responds passively to fluctuations in production caused by technological shocks to the nonfinancial sector. Thus, the model predicts a positive correlation between output and money, but the story is one of reverse causality.[1]

The RBC proponents offer several pieces of evidence in favor of their view. First, King and Plosser (1984) show that GNP is more strongly correlated with inside money than with outside money, supporting the view that money is endogenous. Second, the vector autoregressive studies of Sims (1980), Litterman and Weiss (1985), and Eichenbaum and Singleton (1986) find that exogenous shocks to the money stock are not an important independent source of fluctuations in output. Third, Boschen and Mills (1988) show that real variables can explain two-thirds of the variation in the growth rate of real output.

While these results cast doubt on changes in the nominal quantity of outside money as an important source of economic fluctuations, they do not refute the possibility that the financial sector can be an important source of shocks. For example, McCallum (1986) and Lacker (1990) argue that the evidence is not inconsistent with a Federal Reserve policy that targets interest rates or real variables. Moreover, the work by Bernanke (1983, 1986) and Greenwald, Stiglitz and Weiss (1984) and others suggests that shocks to the financial system

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[1]Other reverse causality explanations, based on the reaction function of the central bank, were offered twenty years ago by Tobin (1970) and Black (1972).

can play a key role in economic fluctuations. Although King and Plosser's (1984) model can accomodate such shocks, real business cycle research has proceeded on the assumption that the key shocks to the economy are from the nonfinancial sector.

This paper seeks to determine the source of the shocks to real money by studying the comovements between money and trade credit. The model presented is based on the production framework used by King and Plosser, in which bank transactions services are inputs into production and in which technological shocks buffet the production function. The key innovation of the theory is the recognition that trade credit between firms also provides transactions services, and represents a substitute for bank transactions services. A simple real business cycle model provides a framework that allows estimation of the relative importance of nonfinancial and financial shocks from the observed relationship between trade credit and money balances.

The intuition is simple. If nonfinancial technology shocks are the source of volatility in the economy, then money and trade credit should be positively related; an unbiased shock to technology should affect both factors of production in the same manner. On the other hand, if shocks to the financial sector are the source of volatility, then money and trade credit can be negatively related. Because the two types of transactions services are substitutes, the own-price effect should be negative, while the cross-price effect should be positive. If the price elasticities dominate the scale effects, then money and trade credit will move in opposite directions in response to a financial shock.

The empirical results support the hypothesis that financial shocks are the primary source of the movements in money. Money and trade credit bear a negative relationship to each other, in both the short- and the long-run. After accounting for a deterministic trend, money and trade credit appear to be cointegrated, but the cointegrating vector is negative. Thus, the nonstationary deviations of trade credit from the deterministic trend are negatively related to the stochastic trend in the real stock of money. This result suggests a re-evaluation of the source of shocks in real business cycle models.

The paper proceeds as follows. The next section discusses some of the characteristics of trade credit and how it can be used as a substitute for money. The third section presents the model and analyzes the information one can obtain from the relationships. The fourth section presents the results, and the final section concludes.

II. Trade Credit

Trade credit, which is simply accounts payable and accounts receivable, is a source of financing that arises from ordinary business activities. Trade credit is automatically created when one firm (or individual) delays payment of its bill to another firm. Furthermore, the extension of trade credit seems to be an integral part of business; accounts payable represent over 40 percent of the current liabilities of nonfinancial corporations. In a survey of the members of the Credit Research Foundation, Besley and Osteryoung (1985) found that for 87 percent of the firms, 91 to 100 percent of their goods and services are sold on credit.

The terms of trade credit are relatively stable, and the main criterion for extending credit is the creditor's selection of the customer. When interest rates rise, lenders reduce the amount of credit to new and marginal firms instead of changing the terms of credit (Nadiri (1969)). Thus, non-price rationing is an important element in trade credit. Moreover, while most firms establish credit limits for many of their customers, few ever restrict their receivables in the aggregate. Trade credit, however, involves a higher effective interest rate than credit from banks and financial markets. The most common terms for trade credit are "2/10, net 30," meaning that payment is due in 30 days, but if the firm pays within 10 days, it receives a 2 percent discount. The effective annual interest rate for these credit terms is 37 percent. Part of this high relative interest rate involves a risk premium; the average loss rate on trade credit is substantially higher than on bank credit (Ferris (1981)). However, once a firm has passed the initial ten day period, the cost of delaying payment an extra day is zero up until thirty days have passed. In many cases, when liquid assets are low, firms will allow their accounts payable to extend past thirty days. The cost of this strategy might be measured as a reputational cost. Because the practice is not uncommon, a firm that resorts to late payment on occasion probably suffers little loss of reputation.

The principal debate in the trade credit literature concerns theories of how trade credit can be used to circumvent monetary policy. The theories belong to one of two categories, net trade credit theories and gross trade credit theories. Meltzer (1960) proposed a net trade credit theory, arguing that movements in net credit could be used to redistribute money balances from those firms that have access to them to those firms that are in need of them. For U.S. data, Meltzer found that when money was tightened, firms with relatively large cash balances increased the average length of time for which credit was extended. He suggested that large, relatively liquid firms might use the extension of trade credit, rather than direct price reductions, to increase sales during peirods of tight money. Brechling and Lipsey (1963) found similar results in their study of 75 British firms. The firms reacted to tight money by lengthening their credit periods, leading to substantial changes in net credit.

On the other hand, Ferris (1981) and Milbourne (1983) have proposed gross trade credit theories. In their models, uncertain delivery time generates a demand for cash balances. They proposed that more transactions could be completed with the same stock of money when firms increased their trade credit given. If every firm increased its trade credit taken by the same amount, each firm's net credit would remain unchanged. Milbourne argued that a cut in the money supply of $10 could be offset by a rise in gross trade credit of little more than fifty cents.

All of these theories and tests, however, are based on the assumption that most movements in the money stock are exogenous. The general idea behind the relationship between money balances and trade credit, though, can be embedded in a real business cycle framework to study the source of the variation in the money stock.

III. Model

In this section, an extended version of the King and Plosser (1984) model is discussed. The first part of the section sketches the features of the model, and the second part explores the equilibrium relationships under some simplifying assumptions.

A. Economic Environment

Assume that firms in the goods industry face the following production technology:

$$(1) \quad Y_{t+1} = f(K_{yt}, L_{yt}, S_t)\, \phi_t \xi_{t+1},$$

where Y_{t+1} is output in period t+1, K_{yt} is the capital stock available in period t, L_{yt} is the labor force, and S_t is the amount of transactions services. The shock to production ϕ_t is assumed known when the inputs are chosen in period t. On the other hand, ξ_{t+1} is an unexpected shock. The sequences $\{\phi_t\}$ and $\{\xi_{t+1}\}$ are assumed to be strictly positive stochastic processes. I allow for the possibility that log $(\phi_t \xi_{t+1})$ is integrated of order one (I(1)), as in King, Plosser, Stock, and Watson (1987). Because empirical evidence strongly suggests that GNP is nonstationary (Nelson and Plosser (1982)), one would expect the underlying shocks to the economy to be nonstationary as well.

The point of departure of this model is the assumption that transactions services can be produced by a combination of cash plus bank deposits and trade credit. In particular, suppose the production of transactions services within the firm is governed by:

(2) $S_t = g(M_t, A_t)$,

where M_t is the transactions services from real cash balances and bank deposits ("money") and A_t is the transactions services from real trade debt, or accounts payable. This specification is consistent with the gross trade credit theory developed by Ferris (1981). The key insight of his theory is that trade credit can lower transactions costs by separating the exchange of goods from the exchange of money. Such a separation is valuable when trading dates are uncertain. Ferris shows that trade credit can be used by trading partners to pool the trading risk in random monetary flows, lowering the precautionary demand for monetary services.

The production functions for the two types of transactions services are given by:

(3) $M_t = h(L_{mt}, K_{mt})\lambda_t$

(4) $A_t = j(L_{at}, K_{at})$

where L is the labor allocated and K is the capital allocated to the production of each service. λ_t represents the financial shock. One could interpret λ as technological change in the financial industry, resulting from technology innovations, or as changes in Federal Reserve policy that affect the production of transactions services.[2] I also allow for the possibility that log λ_t is I(1). As in King and Plosser (1984), it is assumed that production of financial services is instantaneous, but the production of goods takes time. The production of monetary transactions services take place in the financial industry; one can think of the production of trade credit transactions services as taking place in the accounting departments of the goods

[2]Alternatively, one could model the financial shocks as affecting the production of trade debt. It seems more likely, however, that the banking industry is the source of most financial shocks that affect the relative price of trade debt versus bank transactions services.

producing firms.

The model is completed by an infinite-lived representative individual who maximizes:

$$(5) \qquad U_t = E_t \sum_{i=0}^{\infty} \beta^i u(c_{t+i}, \bar{L} - L_{t+i}),$$

where β is the discount factor, c is consumption, $\bar{L}$ is total time available, and L is hours supplied. E_t is the expectation conditional on period t information. For simplicity, it is assumed that households do not require transactions services from the financial sector.

The resource constraints facing the economy are:

$$(6) \qquad c_t + K_{yt} - (1-\delta)K_{yt} + K_{mt} - (1-\delta)K_{mt} + K_{at} - (1-\delta)K_{at} \leq y_t.$$

$$(7) \qquad L_{yt} + L_{mt} + L_{at} \leq \bar{L}.$$

Thus, consumption plus total investment is limited by the amount of output, and total time allocated to the various productive activities cannot exceed total time available.

The model presented above is a typical real business cycle model, differing only in the expanded opportunites for producing transactions services.

B. Equilibrium relationships

This section analyzes the equilibrium relationship between the two types of transactions services and the two types of shocks. Because the goal is not to do a full-scale simulation of the economy, the model presented above will serve only as a guide to the economic arguments. To facilitate the analysis, simplifying assumptions along the lines of King and Plosser (1984) are made. In particular, it is assumed that (1) the depreciation rate of capital is

100 percent; (2) the production of each type of transactions service depends only on the labor input, and obeys a constant returns to scale technology. Thus, the labor requirement functions for the production of money and trade debt are:

(8a) $L_m = m\ M/\lambda.$

(8b) $L_a = a\ A,$

where m and a are positive constants.

Let us first review King and Plosser's results concerning the effects of a higher than average shock to ϕ_t or ξ_{t+1}. A positive shock to these variables leads to an increase in output in the economy. The expansion in output is accompanied by an increase in demand for factors of production, including labor and transactions services. Thus, the level of real money balances will also rise. As long as trade debt is not an inferior input, the level of trade debt should increase as well. Thus, unbiased shocks to the nonfinancial sector should lead to positive comovement of money and trade debt; both should rise during booms and fall during contractions.

The implications are even stronger if the technology shocks are nonstationary. In this case, both trade debt and money should be related to the same stochastic trend embodied in the technology shocks. Thus, the two variables should be cointegrated (in the sense of Engle and Granger (1987)), and should both be positively related to the stochastic trend. A regression of trade debt on money would yield a positive coefficient on money and a stationary error term.

A caveat concerning factor prices should be considered, though. The model outlined above implies that changes in the nominal interest rate have no effect on the ratio of trade debt to money. If the cost of holding money is more sensitive to the nominal interest rate, then increases in the nominal interest rate can lead to substitution from money to trade debt. That is, firms would hold fewer precautionary money balances, and as a result would have to resort to using trade debt more frequently.

Thus, it is important to review the behavior of interest rates in the general equilibrium model. Part of the variation in the nominal interest rate is due to variations in the real rate of interest caused by technology shocks. In particular, a positive shock to ϕ leads to a higher real interest rate, while a positive shock to ξ leads to a low real interest rate (King and Plosser (1984)). Therefore, the cyclicality of interest rates depends on which type of nonfinancial technology shock is most important. Another part of the variation in the nominal interest rates is of course the expected rate of inflation in the general price level. In the King and Plooser model with currency, prices tend to be countercyclical. As a result, the nominal interest rate is likely to be countercyclical or slightly procyclical.

While variations in interest rates may influence the short-run fluctuations in money, they cannot affect the long-run fluctuations. Even if the technology shock is nonstationary, the model predicts that the real interest rate will be stationary since rate of returns in these types of models must be stationary. As long as the rate of inflation is stationary, the nominal interest rate should be stationary. Thus, according to the model, the nominal interest rate cannot be related to the stochastic trend in money or trade debt. Hence, this generalization does not weaken the long-run implication discussed above. The empirical work presented later will, however, explore the effect of including the nominal interest rate.

Consider now the effect of variations in λ. A higher than average shock to the financial industry, $\lambda_t > 1$, will also lead to an expansion in the level of bank transactions services and an increase in the output of goods. If log λ_t is I(1), and is the only source of the stochastic trend in the economy, then the long-run relationship between output and bank financial services will be the same as in the case of shocks to the nonfinancial sector. Thus, positive comovements between output and bank transactions services are consistent with both stories. On the other hand, the relationship between trade debt and λ will be ambiguous. The positive shock to log λ leads firms to substitute away from trade debt to money, resulting in a negative effect on trade debt. In contrast, the increase in output that results from the positive shock to log λ causes an increase in the demand for all inputs, including trade debt. This scale effect leads to a positive response of trade debt. Thus, the net effect is ambiguous. If the substitution effect dominates the scale effect, the level of trade debt will depend negatively on the stochastic trend.

In general, one can obtain decision rules for trade debt and money as functions of the stochastic trends. For simplicity, assume that the only shock to the nonfinancial sector is ϕ, since, as King and Plosser argue, this shock allows money to lead real activity. Although output Y will also be nonstationary, its stochastic trend should be related to ϕ and λ (King, Plosser, Stock, and Watson (1987)). Thus, the decision rules for trade debt and money can be written as:

(9a) $$A_t = l(\underset{+}{\phi_t}, \underset{?}{\lambda_t})$$

(9b) $$M_t = n(\underset{+}{\phi_t}, \underset{+}{\lambda_t}).$$

The signs below the arguments denote the sign of the partial derivative of the function with respect to that argument. As discussed above, an increase in ϕ leads to a boom in which output, money and trade debt increase. Alternatively, an increase in λ leads to an increase in output and money, but the effect on trade debt is ambiguous. If the substitution effect outweighs the scale effect, the sign will be negative.

If we take a log-linear approximation to the decision rules in (9), we can write the long-run equilibrium levels of trade debt and money as follows:

(10a) $$\log A_t = \text{constant} + \theta_1 \log \phi_t - \theta_2 \log \lambda_t.$$

(10b) $$\log M_t = \text{constant} + \beta_1 \log \phi_t + \beta_2 \log \lambda_t.$$

By the arguments above, θ_1, β_1, and β_2 should be positive. If the substitution effect of λ outweights the scale effect on trade debt, θ_2 will also be positive (so the effect will be negative). To see the implied cointegration relationships, multiply (10b) by a parameter φ and subtract it from (10a) to obtain:

(11) $$\log A_t = \text{constant} + \varphi \log M_t + (\theta_1 - \varphi\beta_1) \log \phi_t - (\theta_2 + \varphi\beta_2) \log \lambda_t.$$

Using (11), it is easy to see the implications of the underlying shocks for the cointegration relationship. If ϕ_t is the only source of nonstationarity in the economy, then an ordinary least squares (OLS) regression of log A on log M will produce an estimate of $\varphi = \theta_1/\beta_1 > 0$. φ will take this value because it is the only one that will eliminate the nonstationary component, log ϕ_t, in the error term.

On the other hand, if λ_t is the only source of nonstationarity in the economy, then the OLS estimate of φ will be $\varphi = -\theta_2/\beta_2$, which is less than zero if θ_2 is positive. In this case, φ must be negative to eliminate the nonstationary component from the error term. Finally, if both ϕ_t and λ_t are nonstationary, then in general no value of φ will leave the error term stationary, and trade debt and money will not be cointegrated.

Thus, the model proposed above demonstrates how the comovements of money and trade credit can reveal the source of the stochastic trends in the economy. Extending the model to allow for durable capital might change the short-run relationships between the variables, but should not affect the long-run relationships. Thus the implications concerning stochastic trends should hold in the more complicated model. If the key source of shocks in the economy are technology shocks to the nonfinancial sector, then money and trade debt should be cointegrated with a positive coefficient. If, on the other hand, the key source of shocks are financial shocks, then money and trade debt can have a negative long-run relationship. The next section presents an empirical study of the relationships.

IV. Empirical Results

A. Data

The data on business holdings of money and trade debt are from the Flow-of-Funds reports of the Federal Reserve, which summarize various balance sheet items for nonfinancial business on a quarterly basis. The data extend from 1952:1 to 1990:1. The variable used for trade credit is labelled "trade debt" in the nonfinancial business balance sheets. Four monetary variables are examined. The first is the item "checkable deposits and currency" from nonfinancial business balance sheets. This variable will be referred to as "business M1." The second is "checkable deposits and currency" plus "time deposits," also from the Flow-of-Funds data. This variable will be referred to as "business M2." Finally, aggregate M1 and M2, from CITIBASE are also examined.[3] For the Flow-of-Funds data, in the fourth quarter of 1974 there was a major change in the accounting assumptions used, which causes large discontinuities in the trade debt data. The Federal Reserve Bulletin (July 1978) reported data using both methods for the fourth quarter of 1974, so I used this information to splice the trade debt series.[4] All variables are deflated by the implicit price deflator for GNP.

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[3]The aggregate M1 and M2 nominal variables were constructed by multiplying the Business Condition Digest real variables by the CPI.

[4]Using dummy variables instead of splicing does not change the results presented below.

B. Results

Before estimating any relationships, it is informative to look at plots of the data. Figure 1 plots the raw data (in logs) for real trade debt and real business M1 and Figure 2 plots the raw data for real trade debt and real business M2, while Figure 3 and Figure 4 plot the data after deterministic seasonals and a linear time trend have been removed from the variables.

Figures 1 and 2 show that real trade debt trends upward relative to both definitions of real money from 1952 to 1982. Business M1 actually falls during this period. After 1982, money holdings show an unprecedented increase, while trade debt declines. All variables show substantial seasonal variability.

Figures 3 and 4, which present the detrended, deterministically de-seasonalized data, show very interesting patterns. All variables manifest highly persistent variations, but the variations in trade debt tend to be in the opposite direction of the variations in the two monetary variables. For example, in the periods 1955-57, 1959-60, 1969-70, and 1978-81 the level of real money balances held by firms fell, while the level of real trade debt rose. The peaks in trade debt occurred in the quarters 1956:3, 1960:3, 1969:4, 1974:2 1980:1, and 1981:2; each of these peaks occurred during "credit crunches" (as defined by Eckstein and Sinai (1986). The unprecedented rise in real money relative to trend beginning in 1982 was accompanied by a decline in real trade debt. In general, when money balances rise, trade debt falls, and when money balances fall, trade debt rises.

Consider now a statistical analysis of the data to determine whether the series indeed bear a negative relationship, as suggested by the plots. The first step is to test for the nonstationarity of the series. Table 1 reports augmented Dickey-Fuller tests for several relevant series. All series, except the interest rate on commercial paper, are deflated by the implicit price deflator and are in logs.

Figure 1: Real Trade Debt and Money (M1)

Raw Data (in logs) : Quarterly 1952:1 – 1990:1

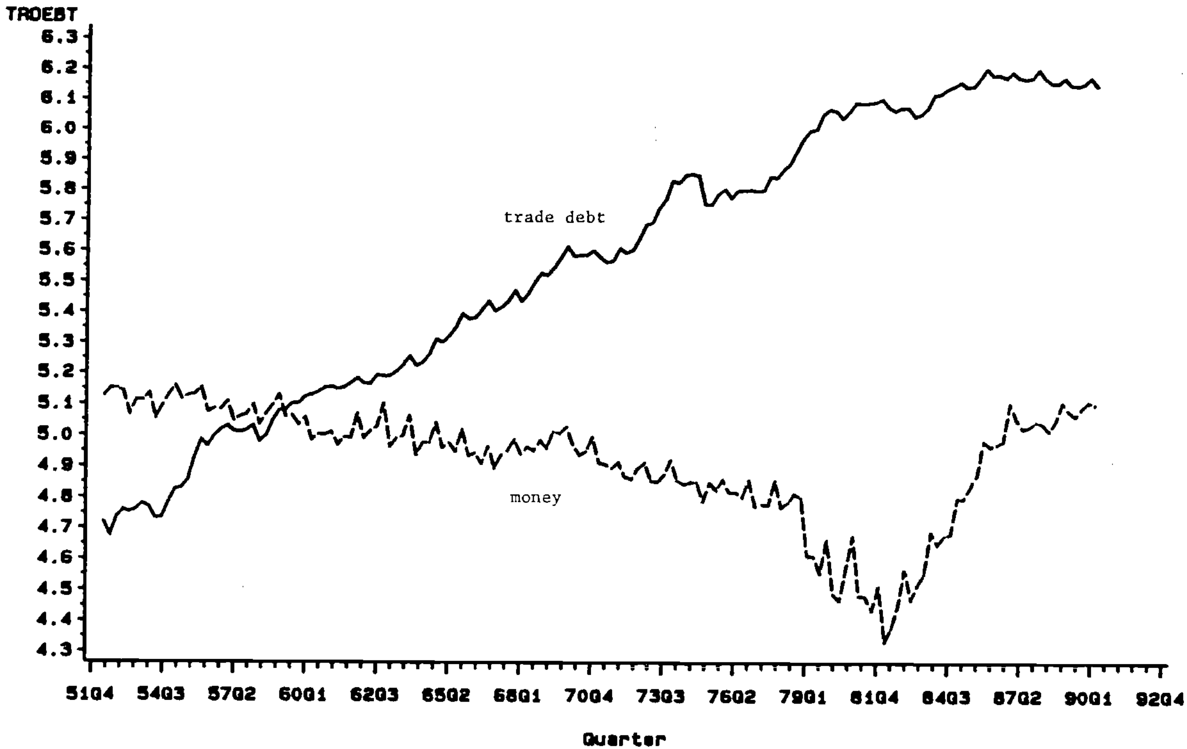

Figure 2: Real Trade Debt and Money (M2)

Raw Data (in logs) : Quarterly 1952:1 – 1990:1

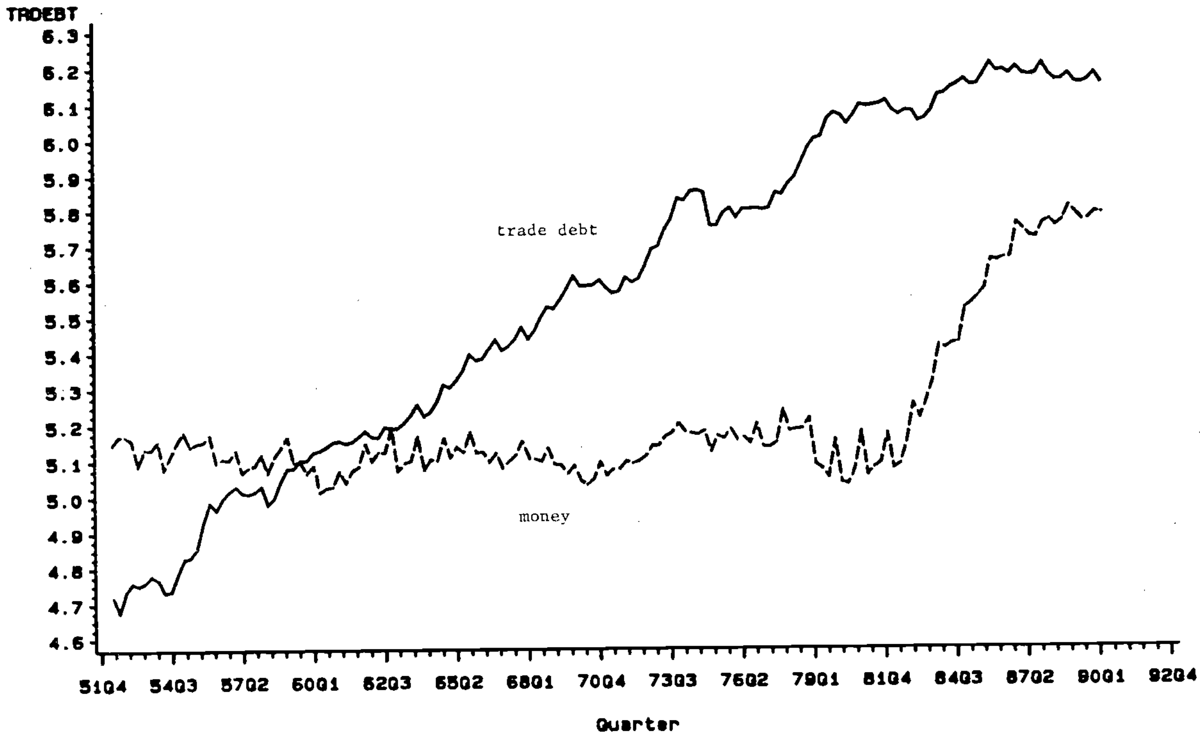

Figure 3: Real Trade Debt and Money (M1)

Adjusted Data: Quarterly 1952:1 – 1990:1

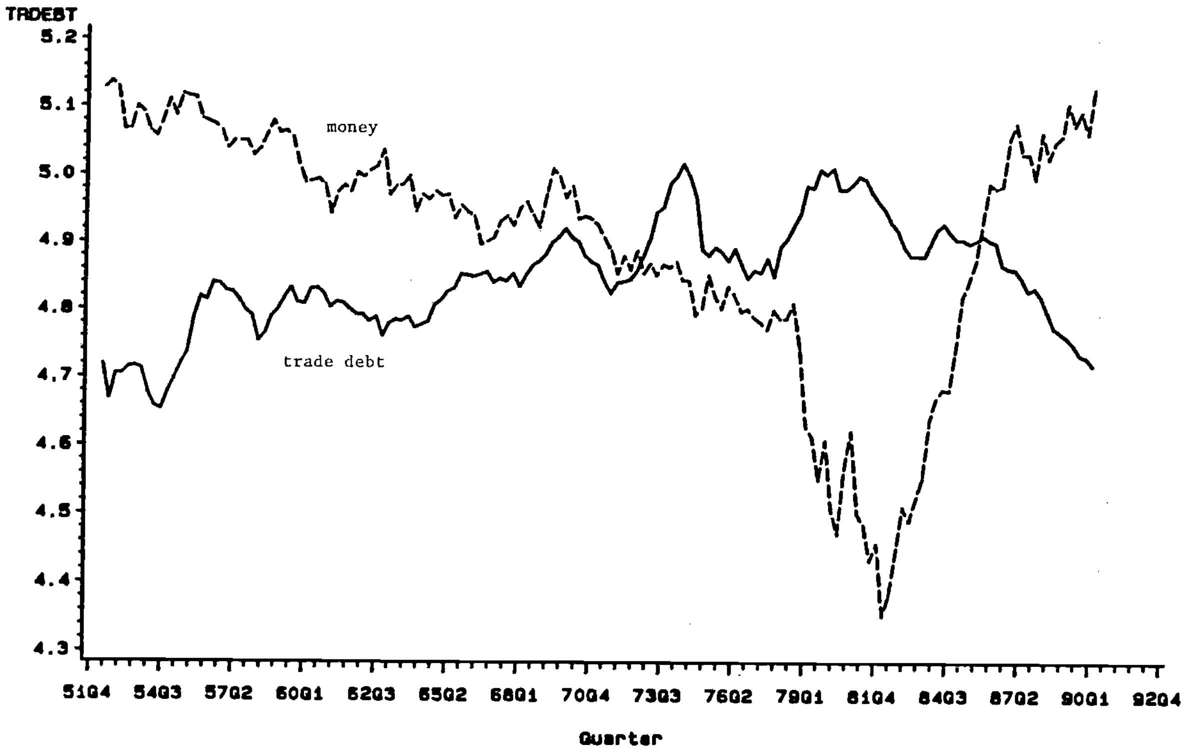

Figure 4: Real Trade Debt and Money (M2)

Adjusted Data: Quarterly 1952:1 – 1990:1

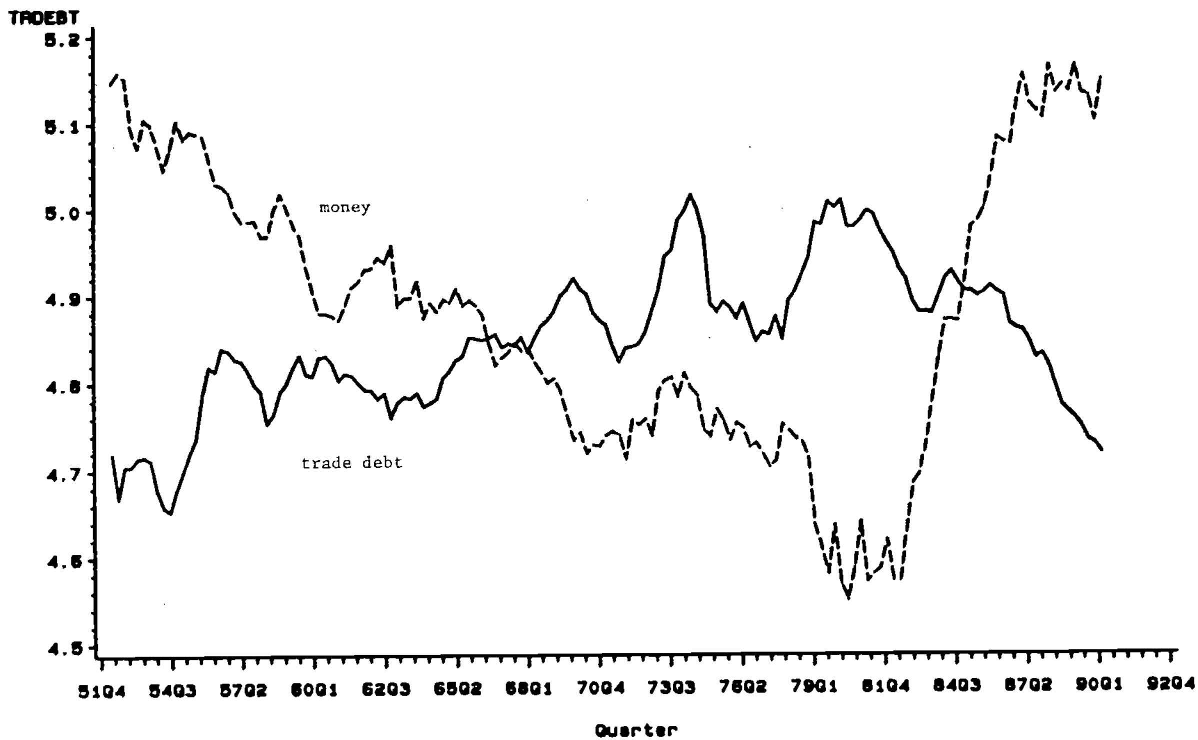

Table 1
Augmented Dickey-Fuller Tests
1953:2-1990:1

Variable	Test statistic	Variable	Test statistic
Trade debt	-1.56	Aggregate M1	-0.710
Business M1	-1.68	Aggregate M2	-0.382
Business M2	-0.502	Commercial paper rate	-2.10

Note: All variables, except the commercial paper rate, have been deflated with the GNP deflator. Four lags and a drift term were included in the tests. Seasonal dummy variables were included in the tests involving the balance sheet data. The critical value for the five percent significance level is -3.44.

According to Table 1, none of the test statistics warrant a rejection of the presence of a unit root at conventional significance levels. All variables appear to have a unit root. Note that contrary to the predictions of the real business cycle model, the interest rate on commercial paper seems to be nonstationary.

Since all the series in question seem to have stochastic trends, the proper way to proceed is to examine whether there are any cointegrating relationships between the series. Recall that the theory presented in the previous section offers strong predictions about the cointegrating relationships between trade debt and money. Table 2 reports empirical results regarding the cointegrating relationships.

The test statistics presented in the first column of numbers in Table 2 suggest that trade debt is cointegrated with three of the four definitions of money: business M1, business M2, and aggregate M1. The relationship seems to be the strongest between trade debt and business M2. One cannot, however, reject noncointegration between trade debt and aggregate M2 and

Table 2
Cointegration Tests
1952:1-1990:1

Variables	Test Statistic	Coefficent on 2nd var.	R^2
Trade debt, business M1	-4.37	-0.284	0.988
Trade debt, business M2	-5.26	-0.320	0.991
Trade debt, aggregate M1	-4.01	-0.567	0.987
Trade debt, aggregate M2	-2.21	-0.178	0.980
Trade debt, commer. paper rate	-2.01	0.022	0.989
business M1, aggregate M1	-4.08	1.87	0.863
business M2, aggregate M2	-1.30	0.394	0.460

All tests allow for a deterministic trend, and include four lags in the test. The critical value for the five percent significance level is -3.83 and the ten percent significance level is -3.54. The critical values are taken from Engle and Yoo's (1989) table for cointegration tests with deterministic trends.

between trade debt and interest rates. The results also show that business M1 has a common stochastic trend with aggregate M1, but that business M2 has a different stochastic trend from aggregate M2. The difference could be due to the fact that the variable "business M2" contains all time deposits held by business, including large time deposits, which are not included in aggregate M2.

The second column of numbers in Table 2 shows the coefficient estimates from the OLS regression of the first variable listed in the table on the second variable. Standard errors are not reported because of the presence of serial correlation. For every definition of money, the coefficient estimate is negative. Recall from the analysis of equation (11) in the previous section that the only case in which money and trade debt should be negatively related is when the source of the stochastic trend is shocks to the financial sector. Any scale effects seem to be well captured by the deterministic trend, so that the substitution effect dominates in the response to the stochastic trend. Thus, not only are trade debt and money cointegrated, but they have a negative long-run relationship. These comovements indicate that the key source of fluctuations in money is not technology shocks to the goods industry, but rather shocks to the financial sector.

The remainder of this section will analyze the relationship between trade debt and money in more detail, examining the robustness of the results and the dynamic elements of the relationship. For ease of exposition, the analysis will concentrate on only one definition of money - business M2. Business M2 is chosen because the results in Table 2 indicate that it is mostly closely related to trade debt.

The robustness of the results is tested in two ways. First, the comovements between money and trade credit are examined after accounting for variations in the nominal interest rate. Second, the effect of changing the sample period is studied. Consider first including the commercial paper rate (CP) in the regression of trade debt (TD) on business M2 (M). The estimates are:

$$(12)\quad TD_t = \underset{(56)}{0.0106}\ \text{Trend} - \underset{(-9.0)}{0.235}\ M_t + \underset{(5.5)}{0.0109}\ CP_t + \text{seasonal dummies} + z_t.$$

$$DW = 0.217, \quad R^2 = 0.993, \qquad \text{Test statistic for cointegration} = -4.28$$

(T-statistics are shown in parenthesis; however, the presence of serial correlation means that they are biased.) The estimates show that even when interest rates are included in the regression, real money balances still negatively affect the level of trade debt. The coefficient on money is only slightly smaller in magnitude than the one reported in Table 2. Thus, the negative comovement is not just a consequence of the effects of variations in the nominal rate of interest.

A second possible explanation for the negative relationship is that the dramatic behavior of money after 1982 is dominating the results. Therefore, it is informative to estimate the relationship trade debt and real money omitting the period 1983 to 1990. The estimates of the regression of trade debt on real money for the period 1952:1 to 1982:4 are:

$$(13) \quad TD_t = \underset{(107)}{0.0115}\,\text{Trend} - \underset{(-2.9)}{0.266}\,M_t + \text{seasonal dummies} + z_t.$$

$$DW = 0.206, \qquad R^2 = 0.989, \qquad \text{Test statistic for cointegration} = -3.99$$

The test statistic for the cointegration test is -3.99, so that one can still reject noncointegration. Furthermore, the coefficient estimate is similar to the one estimated for the entire sample. Thus, the negative relationship stands even when the last eight years are omitted.

Consider now the dynamic relationship between trade debt and business M2 contained in the vector error correction model (VECM) associated with the cointegrated system. The model, including the parameters of the cointegrating vector is estimated using FIML, which produces fully-efficient estimates of the coefficients and appropriate T-statistics. The estimates for the period 1953:2 - 1990:1 are presented below:

$$(14) \quad TD_t = \underset{(45)}{0.0113}\,\text{Trend} - \underset{(-5.0)}{0.378}\,M_t + \text{seasonal dummies} + z_t.$$

$$(15) \quad \Delta TD_t = \underset{(-3.5)}{-0.160}\,z_{t-1} + \underset{(3.7)}{.32}\,\Delta TD_{t-1} + \underset{(3.0)}{.24}\,\Delta TD_{t-2} + \underset{(.76)}{.090}\,\Delta TD_{t-3} + \underset{(1.5)}{.016}\,\Delta TD_{t-4}$$

$$+ \underset{(2.9)}{.19}\, \Delta M_{t-1} - \underset{(-.34)}{.020}\, \Delta M_{t-2} + \underset{(1.09)}{.068}\, \Delta M_{t-3} + \underset{(1.4)}{.077}\, \Delta M_{t-4} + \text{seasonal dummies.}$$

$$(16) \quad \Delta M_t = \underset{(-.74)}{-0.046}\, z_{t-1} - \underset{(-.37)}{.051}\, \Delta TD_{t-1} - \underset{(-1.4)}{.23}\, \Delta TD_{t-2} - \underset{(-.21)}{.030}\, \Delta TD_{t-3} - \underset{(-1.7)}{.23}\, \Delta TD_{t-4}$$

$$+ \underset{(.20)}{.019}\, \Delta M_{t-1} - \underset{(-.23)}{.020}\, \Delta M_{t-2} - \underset{(-.43)}{.035}\, \Delta M_{t-3} + \underset{(6.5)}{.55}\, \Delta M_{t-4} + \text{seasonal dummies.}$$

(T-statistics are in parenthesis.)

Several results are noteworthy. First, the FIML estimates of the cointegrating vector shown in equation (14) are similar to the OLS estimates presented in Table 2 above. The T-statistic indicates that the estimate is quite precise. Thus, trade debt is positively related to a deterministic trend and negatively related to money. Second, the error correction term z_{t-1} has a significant negative effect on trade debt, but essentially no effect on money. It seems that trade debt is doing most of the adjusting to maintain the long-run relationship. The fact that money does not respond to the error correction term implies that money is weakly exogenous to the system. On the other hand, while none of the coefficients on the error correction term or the lagged trade debt terms in equation (16) are individually significant, one can reject the joint hypothesis that they are all zero. (The likelihood ratio statistic is 21.4.) Thus, there is feedback between the two variables. Finally, the highly significant effect of the fourth lag of money growth in the money equation implies a significant amount of stochastic seasonality in money growth that is not captured by the seasonal dummy variables.

Because it is difficult to interpret the coefficients in a VECM, the usual procedure for studying the short-term relationship is to calculate the impulse response functions implied by the estimates. The functions are calculated with money ordered first, since it is weakly exogenous.[5] The paths shown in Figure 5 illustrate the effect of a one-standard deviation negative shock to money

Figure 5 shows clearly that a negative shock to money, which leads to a permanently lower level of money, is accompanied by a permanent rise in trade debt. Trade debt shows a slight hump shape in response, but even in the short-run the two variables move in opposite directions. The jagged path of money is due to the stochastic seasonality mentioned earlier. Trade debt converges to a higher level and money to a lower level as a consequence of the initial shock.

To summarize the results so far, there seems to be a significant negative relationship between money and trade debt in both the short-run and long-run. The theory presented in the previous section interprets this result as implying that most of the movements in money are due to financial shocks. Thus, the data are inconsistent with the real business cycle explanation for the procyclicality of money.

What do these results imply about the source of shocks to GNP? Recall from the theoretical section that if there is one stochastic trend in the economy, real money and real GNP should be cointegrated. In combination with the results presented above, cointegration between money and GNP would imply that shocks to the financial sector are the source of the stochastic trend in GNP.

Table 3 shows the test statistics for the cointegration tests between the various (real) monetary variables and trade debt and real GNP (Y). According to the test statistics shown in Table 3, one fails to reject noncointegration at the five percent level in every case. Only in the

[5]The method used is the one described by Cochrane (1991) in his appendix, in which the VECM is rerun with the current value of ΔM included in the equation for ΔTD. The program had trouble converging, so I constrained several terms to be zero. These terms were chosen based on joint exclusion tests. The terms set to zero were: in the equation for trade debt, $\Delta TD(-3)$, $\Delta M(-2)$; and in the equation for money, z(-1), $\Delta M(-1)$, $\Delta M(-2)$, $\Delta M(-3)$, $\Delta TD(-1)$, and $\Delta TD(-3)$.

Figure 5: Impulse Response Functions

Money ordered first; Neg. shock to money

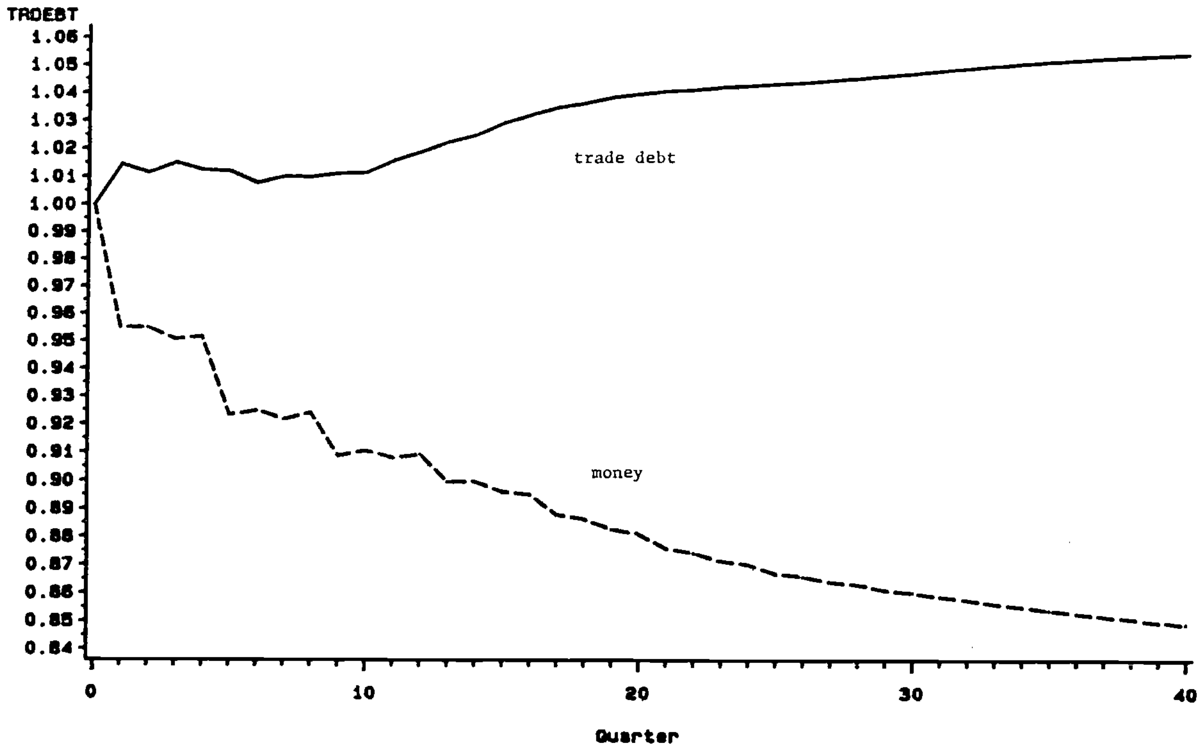

Table 3
Cointegration Tests

Variables	Test statistic	Variables	Test statistic
Y, business M1	-2.56	Y, aggregate M1	-2.43
Y, business M2	-2.84	Y, aggregate M2	-3.77
Y, trade debt	-2.56		

All tests included a deterministic trend; those tests involving Flow-of-Funds data also included seasonal dummy variables. The regression of residuals contained two lags. The critical value for the five percent significance level is -3.83 and for the ten percent level is -3.54.

case of Y and aggregate M2 can one reject at the ten percent level. Hence, while there is some evidence for a common stochastic trend between output and M2, neither output nor aggregate M2 is cointegrated with trade debt and the other definitions of money. Thus, the stochastic trend shared by business M2 and trade debt is not the only stochastic trend affecting output. This result is not surprising, since one would expect other shocks, such as oil prices, government spending and taxes, to be important determinants of the stochastic behavior of real output. That is, GNP is probably driven by more than one stochastic trend. The presence of more than one stochastic trend in real GNP, though, does not imply that financial shocks are unimportant, only that they are not dominant in the stochastic behavior of GNP.

If the nonfinancial shocks are important, however, it is more difficult to explain the observed cointegrating relationship between money and trade credit. As discussed earlier, money and trade credit should not in general be cointegrated in the presence of two stochastic trends. One possible explanation for the finding of cointegration is that the other shocks have little impact on the financial variables because the scale effects are small, or are well-represented by a deterministic trend. Under this scenario, most of the deviations of trade debt and money from the deterministic trend are due to substitution effects.

In any case, the negative relationship between money and trade credit suggests that shocks to the financial system are the key determinant of fluctuations in money. The results, however, do not distinguish between shocks to the nominal money supply and other types of shocks. Other potentially important financial shocks are credit controls, bank failures, deregulation, changes in reserve requirements, and technological innovation. These latter types of shocks could easily be incorporated into a real business cycle model, as they do not rely on sticky prices for a transmission mechanism.

V. Conclusions

This paper has presented a simple theoretical extension of King and Plosser's real business cycle model with transactions services as an input. The theoretical analysis shows that comovements between money and trade debt can potentially reveal the source of the fluctuations in money. The empirical results indicate that money and trade debt are negatively related in both the short- and the long-run. Thus, the primary impetus to money seems to be financial shocks that change the cost of bank transactions services relative to trade debt. However, this impetus is not the only nonstationary trend in real output.

The results suggest that it would be fruitful to incorporate a financial sector in calibrated real business cycle models. One could then study the responses of aggregate variables to shocks to the financial sector. In a sense, shocks to the banking industry are more plausible as sources of business fluctuations than shocks to the goods industry because of the central role of banks in the economy. Banking services are used by all sectors of the economy, whereas with the notable exception of oil, most goods are an input for only a fraction of the other sectors. Thus, incorporation of the theories of Bernanke (1983) and others into real business cycle models could enhance our understanding of business cycle fluctuations.

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