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Cuberes, David and Dougan, William

University of Alicante, Clemson University

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How Endogenous Is Money? Evidence from a New Microeconomic Estimate[*]

David Cuberes
Clemson University

William R. Dougan
Clemson University

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This paper uses microeconomic data on firms' money demand and investment in physical capital for the period 1983-2006 to estimate the extent to which variation in the U.S. money supply is an endogenous response to variation in firms' demand for liquidity. We estimate a simple model in which each firm's desired money balances in any period depend on that firm's current transactions, current investment, and its planned future investment, as well as aggregate variables such as interest rates and common policy forecasts. Calculations based on our estimates suggest that only a very small fraction of the variability in the aggregate stock of money represents an endogenous response to autonomous changes in firms' investment plans.

JEL classification: E41, E51

Keywords: Money demand, money supply, endogenous money, monetary neutrality

1. Introduction

The tendency for changes in various measures of money to precede changes in aggregate nominal income and expenditure is one of the oldest and most widely known empirical relationships in economics [see, e.g., Hume (1752), Fisher (1923), Keynes (1924), and Friedman and Schwartz (1963)]. The causal significance of this correlation, however, remains a matter of contention, at least for economic systems in which "inside money" constitutes a large proportion of all monetary assets. The "classical" or monetarist view is that changes in M1 or M2 are predominantly exogenous, and that (short-run) output and (long-run) price-level fluctuations are caused by monetary fluctuations. In opposition to this interpretation stand two groups with widely divergent views of the source of real output changes: real-business-cycle (RBC) theorists and post-Keynesians.

While RBC theorists do not disagree with the monetarist proposition that "sustained inflation is always and everywhere a monetary phenomenon" (Friedman

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and Schwartz 1963), they do not subscribe to Irving Fisher's (1923) view that the business cycle is a "dance of the dollar." Instead, they maintain that any cyclical variation in the money stock represents the banking system's supply response to variation in the demand for real money balances (Long and Plosser, 1983).

A subset of post-Keynesians go beyond RBC theorists in emphasizing the extreme endogeneity of the money stock, arguing that money-supply variation is largely or even entirely induced by autonomous variation in the components of aggregate demand—particularly planned investment spending (Cottrell, 1992, surveys this literature). Whether this endogeneity is due solely to the elastic supply of bank credit alone, or in conjunction with the accommodating responses of the central bank, its fundamental cause is the expansion of bank credit in response to investment demand. According to this view, inflation—and a fortiori output fluctuations—most emphatically do not result from exogenous monetary fluctuations. This analysis can be traced back as far as the report of the Radcliffe Committee (Kaldor, 1960). Tobin (1970) presents a related, rigorously developed, argument along similar lines.

That such profound disagreements can persist in the face of numerous attempts to determine the direction of causation in the money-expenditure correlation indicates the limitations on the empirical methods used to address this issue thus far, and the potential usefulness of a completely different empirical strategy.

In this paper we propose the use of cross-section and time-series variation in individual firms' investment spending and money balances as an alternate way to estimate the endogenous component of money-supply variation. Our key identifying restriction is the assumption of perfect foresight on the part of firms, which allows us to use a firm's actual investment spending in time period $t+k$ as a measure of its planned investment spending for that period as of period t. (Under rational expectations, investment spending in period $t+k$ would be equal to planned investment for that period as of period t, plus a mean-zero error.) The inclusion of time fixed-effects in our panel allows us to eliminate the common components of aggregate money holdings and investment spending. Therefore we are able to pin down the direct influence of firms' future investment on their current money balances. It does not, however, allow us to estimate the extent to which the Federal Reserve System responds to the demand for credit by providing more liquidity to the banking system.

Our purpose is simply to estimate the extent to which firms' desire to finance future new investment induces the banking system to respond by creating new money and credit. A finding that this channel of influence on money growth is substantial would satisfy a necessary condition for overall money-supply endogeneity. If, on the other hand, exogenous variations in planned investment appear to contribute little to variations in the demand for inside money, then these variations are unlikely to be an important source of endogenous variation in monetary assets created by commercial banks or by a central bank that responds passively to the demand for new money and credit.

Our findings suggest that most of the variability in the stock of money is exogenous, confirming the findings of Friedman and Schwartz (1963) and Romer and Romer (1989). The difference between these studies and ours is that the former use macroeconomic and anecdotal data to explore the importance of endogeneity of money whereas we make use of detailed microeconomic data on firms. This allows us to pin down an explicit estimate of the degree of money endogeneity.

To our knowledge, we are the first to use firm-level data to explore the issue of endogeneity of money. By assuming that firms' expectations about their future investment prospects are a key determinant of their money demand, we implement Coleman (1996)'s suggestion "...It is perhaps possible to get money to substantially precede output by letting agents in the economy have advance information about future productivity shocks...".

The paper is organized as follows. Section 2 presents a short review of the existing literature on this topic. The theoretical benchmark on which we base our exercise is presented in Section 3. We describe the data used in the estimation in Section 4. Section 5 presents our empirical strategy and reports the main results of the paper. Finally Section 6 concludes.

2. Literature Review

The starting point of the modern literature on the causal significance of money is, of course, Friedman and Schwartz (1963), who constructed a detailed argument based on a close examination of the sources of large changes in the money stock in the U.S. over nearly a century of experience under several monetary regimes. Their findings persuaded many economists of the causal influence of money on prices in the long run, and initiated an extensive debate over the relative importance of exogenous changes in money versus autonomous shifts in desired spending as causal factors in aggregate-demand fluctuations.[1]

Tobin (1970) points up the dangers of accepting timing evidence as proofs of tests about causality. He compares an "Ultra-Keynesian model" with a "Friedman's model"[2]. In the former, changes in the money supply are just a passive response to income changes, whereas in the latter money is entirely exogenous.

A key contribution to this Keynesian-monetarist debate was Sims's (1972) use of causality in the sense of Granger (1969) to test the causal importance of money for changes in aggregate nominal income. While Sims's initial test failed to reject one-way Granger causality from money to nominal income, his later (Sims, 1980) test

[1] See Mishkin (1995) and Taylor (1995).
[2] This is a "permanent income" theory of the demand for money.

employing vector autoregression and including interest rates was unable to establish any clear causality.[3]

Cagan (1965) and King and Plosser (1984) show that it is mainly inside money that is correlated with output. This has led several authors to inquire whether observed nominal money shocks just represent endogenous responses to changes in output or in some other factor. [See Sims (1980), Litterman and Weiss (1985), Eichenbaum and Singleton (1986), and Christiano and Ljungqvist (1988).[4]]

More recently, Romer and Romer (1989) have revisited the study of the causes of money supply fluctuations and their effect on economic activity. In particular, they analyze the effect of different exogenous monetary shocks on the real economy. For instance, they show that soon after Federal Reserve Chairman Paul Volcker announced reductions in the money supply, the U.S. economy suffered two economic recessions. Using this and other historical events they argue that major depressions have been caused by autonomous movements in money stock and conclude that money is mainly exogenous.

Finally, Holmes and Hutton (1992) claim that many of the existing money-income tests of causality have been unsuccessful for different reasons that include the particular form of the test, the method of detrending nonstationary time series, the method of choosing lag length, and the choice of functional form. They propose the use of a multiple-rank F test which is invariant to monotonic transformations of all variables and robust over alternative distributions of the errors. They find support of prima facie causality between money and income for the 1970-1988 period.[5] However, like all the previous studies, they use aggregate data to reach these conclusions.

3. Theoretical Benchmark: Investment Plans and the Demand for Money and Credit

We begin with the unremarkable observation that firms planning to finance their investment spending with bank credit will acquire bank deposits as assets as a first step. The actual lead time between the acquisition of money balances and the initiation of investment spending is something to be estimated from the observed behavior of firms. We also assume that firms require a level of cash for normal business operations that varies positively with the level of those operations. Our model of the demand for real money balances by firms is therefore

[3] More recently, Freeman and Huffman (1991) present a general equilibrium model in which money "Granger-causes" output but this causality disappears if one introduces interest rates in the analysis.
[4] This point is also an essential element of "post-Keynesian" monetary theory. See Cottrell (1992) for a comprehensive survey.
[5] The authors underline the crucial difference between prima facie causality and causality. See Suppes (1970) for more details on this distinction.

$$\frac{M_{it}}{P_t} = f(i_t, X_{it}, I_{it}, I^e{}_{i,t+1}, \ldots, I^e{}_{i,t+k}) \qquad (1)$$

where

M_{it} represents the quantity of nominal money balances held by firm *i* in period *t*, P_t is the period-*t* price level, i_t is the short-term nominal interest rate prevailing in period *t*, X_{it} is firm *i*'s level of business operations in period *t*, and $I^e{}_{i,t+k}$ represents firm *i*'s investment spending planned for period *t+k* as of period *t*.

Each firm's planned investment spending for period *t+k* depends on the expected long-term real interest rate (r_t) and whatever other variables (Z_{it}) that are relevant to the firm's investment decision as of that same period, as expected on the basis of period-*t* information:

$$I^e{}_{i,t+k} = g(r_t, Z_{it}) \qquad (2)$$

We close the model by assuming that each firms' expectations are formed rationally in the sense of Muth (1961), so that the following relationship holds between realized and planned investment:

$$I_{i,t+k} = I^e{}_{i,t+k} + e_{i,t+k} + u_{t+k} \qquad (3)$$

where u_{t+k} is an unforecastable economy-wide shock and $e_{i,t+k}$ is a firm-specific shock. Equations (1)-(3) yield our fundamental money-demand function[6]

$$\frac{M_{it}}{P_t} = f(i_t, X_{it}, I_{it}, I_{i,t+1} + u_{t+1} + e_{i,t+1}, \ldots, I_{i,t+k} + u_{t+k} + e_{i,t+k}) \qquad (4)$$

4. Data

Our sample includes data on 25,476 firms from Compustat. Due to data availability on the different variables of interest we restrict ourselves to the period 1983-2006.[7] Since we are trying to estimate the impact of firms' investment decisions on current cash holdings it seems reasonable to assume that the appropriate frequency of the data is a quarter.

[6] This setup is similar to the one discussed in Abel and Bernanke (2005), p. 374.

[7] We eliminate from the sample banks and other financial intermediaries because they are clearly not the object of our study. We drop … observations.

Our proxy for firm's money demand or money holdings is *cash and short-term investments* (DATA 36 in Compustat).[8] This item represents cash and all securities readily transferable to cash. Firms' investment on physical capital and infrastructure is measured by the variable *capital expenditures* (DATA 90 in Compustat). This item represents cash outflow or funds used for additions to the company's property, plant, and equipment, excluding amounts arising from acquisitions.

The best proxy we could find for firm's output is a measure of its operating costs. In particular, the variable we use is *costs of goods sold* (DATA 30 in Compustat), which represents all expenses that are directly related to the cost of merchandise purchased or the cost of goods manufactured that are withdrawn from finished goods inventory and sold to customers. See the Appendix for more details on these variables.

Finally, we use M2 as our measure of money stock. This is a measure of money supply that includes M1, plus savings and small time deposits, overnight repos at commercial banks, and non-institutional money market accounts. We use this definition instead of the narrower M1 because some of the items included in our measure of firms' money demand are considered part of M2.[9] This series is obtained from the Federal Reserve of St. Louis online database. Summary statistics for all the variables described here can be found in Table 1. Table 2 displays the number of firm-quarters that have missing or negative values for these three variables. While the frequency of unrealistic negative values is very low, the presence of missing values is much more relevant. In spite of these limitations, we are able to estimate our model quite precisely, as shown in the next section.

Table 1: Descriptive statistics for the period 1983-2006 (in millions of $)

	Firms Money Demand	Firms Investment	Costs	Money Stock (M2)
Mean	269.36	55.22	238.83	12,032.46
Standard Deviation	219.11	41.14	123.49	4,165.61
Minimum	80.49	5.15	109.82	5969.8
Maximum	1072.26	229.47	647.18	20,979.2

Note: These figures represent average amounts per firm and quarter. In the case of the M2 aggregate the figure represents the average amount per quarter.

[8] Mulligan (1997) uses the same definition.

[9] When we use M1 as a monetary aggregate, the percentage of money stock held by firms is above 100% in 24 quarters.

Table 2: Number of observations with missing or negative values for the period 1983-2006

	Firms Money Demand	Firms Investment	Firms Costs
Zeros	15,950	62,546	28,322
Negative values	965	533	268
Missing	814,351	931,318	734,633
Total	1,594,316	1,594,316	1,594,316

5. Empirical Strategy

5.1. A Micro Estimate of the Elasticity of Money Demand with Respect to Investment Prospects

We estimate equation (4) in logarithmic form. We include quarterly fixed effects in our estimation to control for the effects of changes in the interest rate, the aggregate price level, or any other macroeconomic shock on firms money demand.[10] The equation we estimate is then:

$$\ln M_{it} = \eta_i + \lambda_t + \delta_1 \ln X_{it} + \sum_{s=0}^{5} \beta_s \ln I_{i,t+s} + \varepsilon_{i,t+s} \qquad (5)$$

where η_i and λ_t are country-specific fixed effects and time effects, respectively.[11]

In this specification we choose five quarter investment leads to simplify the presentation. In results not reported here we show that adding additional investment leads do not change the results significantly. In particular, the marginal effects of firms' investment on firms' money demand become insignificant around the eight-quarter lead.

In order to better understand what is being captured by the quarterly time effects assume a perfectly inelastic money supply curve and consider the following two extreme cases. In the first one, the banking system and the Federal Reserve do not

[10] One such macroeconomic shock that we cannot measure directly is any change in the money demand of households.
[11] These time effects are quarterly dummies. Since we have data for the period 1983-2006 the number of time dummies included in the estimation is 92.

accommodate at all in face of the change in the aggregate money demand. Money supply is then constant over time and the shock on firms' investment is entirely reflected in the interest rate. In this situation, the coefficients associated with these time dummies measure the change in the interest rate, whereas the β coefficients capture the fact that firms who have a high desire to save do so at the expense of firms who do not. An alternative scenario is one in which there is complete accommodation of the money supply so that interest rates do not change. In this case, the γ coefficients in (5) capture changes in the aggregate money supply and the β's are estimates of the fact that firms who have a high desire of saving can obtain the funds from the additional supply of money. If this money supply elasticity is positive (as most existing estimates suggest) the time effects in (5) capture a combination of changes in the interest rates and in the money supply.

However, as stated above, our specification does not allow us to estimate the extent to which the Federal Reserve System responds to the demand for credit by providing more liquidity to the banking system. Again, our purpose is simply to estimate the extent to which firms' desire to finance future new investment induces the banking system to respond by creating new money and credit.

Table 3 presents the pooled OLS and the fixed effects estimates of (5). The first important thing to notice is that the sign and magnitude of the estimates are quite similar in the two specifications, suggesting that firm specific effects do not seem to be crucial in this exercise.

Table 3: Pooled OLS and fixed Effects Estimates

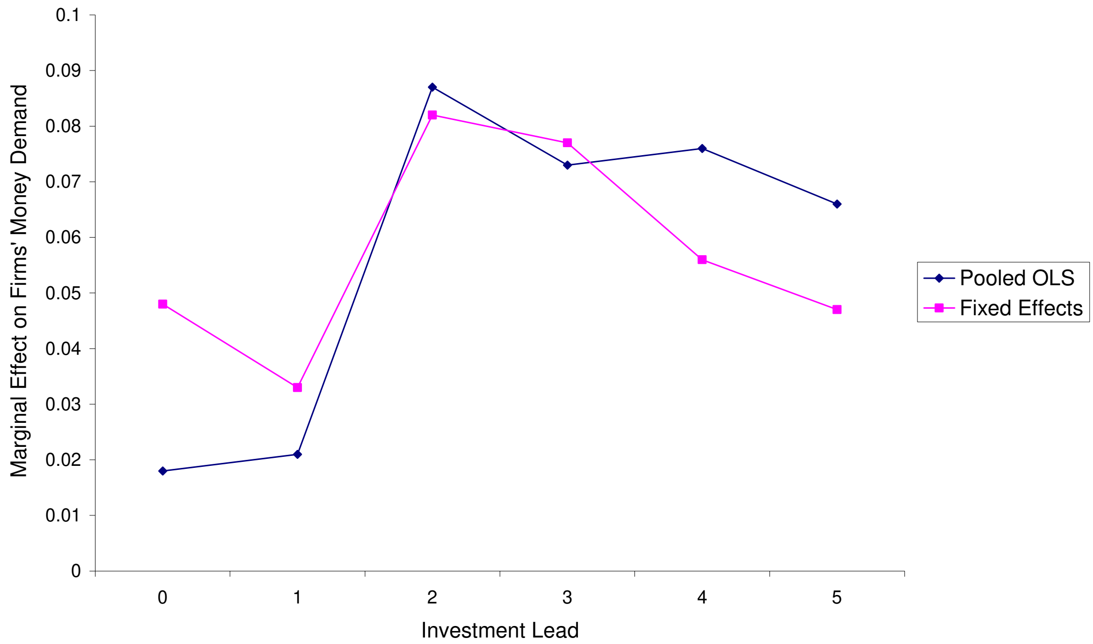
	Pooled OLS	Fixed Effects
log costs	0.381*** (0.002)	0.28*** (0.01)
$\log I_t$	0.018*** (0.006)	0.048*** (0.005)
$\log I_{t+1}$	0.021*** (0.007)	0.033*** (0.003)
$\log I_{t+2}$	0.087*** (0.006)	0.082*** (0.003)
$\log I_{t+3}$	0.073*** (0.006)	0.077*** (0.003)
$\log I_{t+4}$	0.076*** (0.007)	0.056*** (0.003)
$\log I_{t+5}$	0.066*** (0.006)	0.047*** (0.005)
constant	1.366*** (0.023)	1.476*** (0.04)
R^2	0.5	0.21
observations	503,156	503,156

*Notes: the dependent variable is the log of money demand at period t. Numbers in parentheses indicate robust standard errors. *** denotes significant at the 1% level.*

The impact of future investment on current money demand is always positive. Interestingly, this effect peaks in both cases in the second quarter and it smoothly declines after that. The size of the coefficient on the second lead is between 0.08 and 0.09, i.e. a 10% increase in planned investment two quarters form now induces firms to increase their current money demand by 0.9%.[12] Figure 1 plots these impacts.

Finally, as expected, a higher level of contemporaneous firms' costs has a positive and significant impact on the contemporaneous firms' money demand.

Figure 1: The Effect of Future Investment on Firms' Current Money Demand

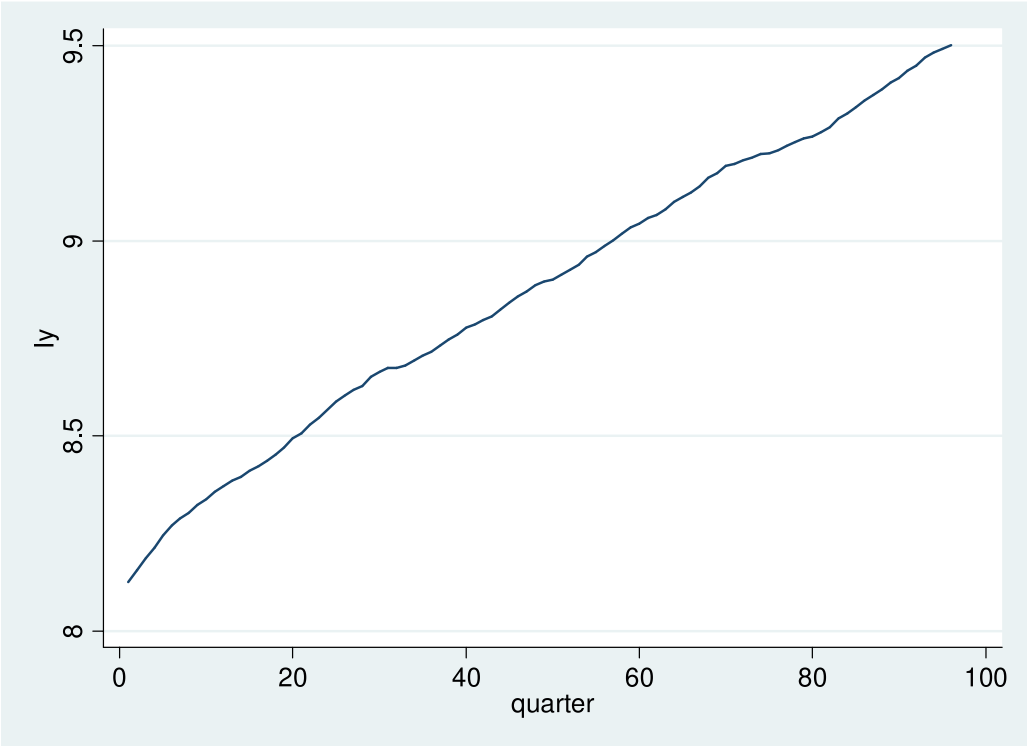


5.1. An Estimate of Firms Aggregate Money Demand

In this section we use the estimates of (6) to construct a macro estimate of firms money demand. We first collect data on aggregate GDP on each quarter in order to proxy for firms' aggregate costs. This data is obtained from the Bureau of Economic Analysis and the series (in logs) is plotted in Figure 2.

[12] In results not reported here we explore whether these estimates are sensitive to the inclusion of investment lags. Our results suggest that they are not. Moreover, these lags are insignificant in most of the cases.

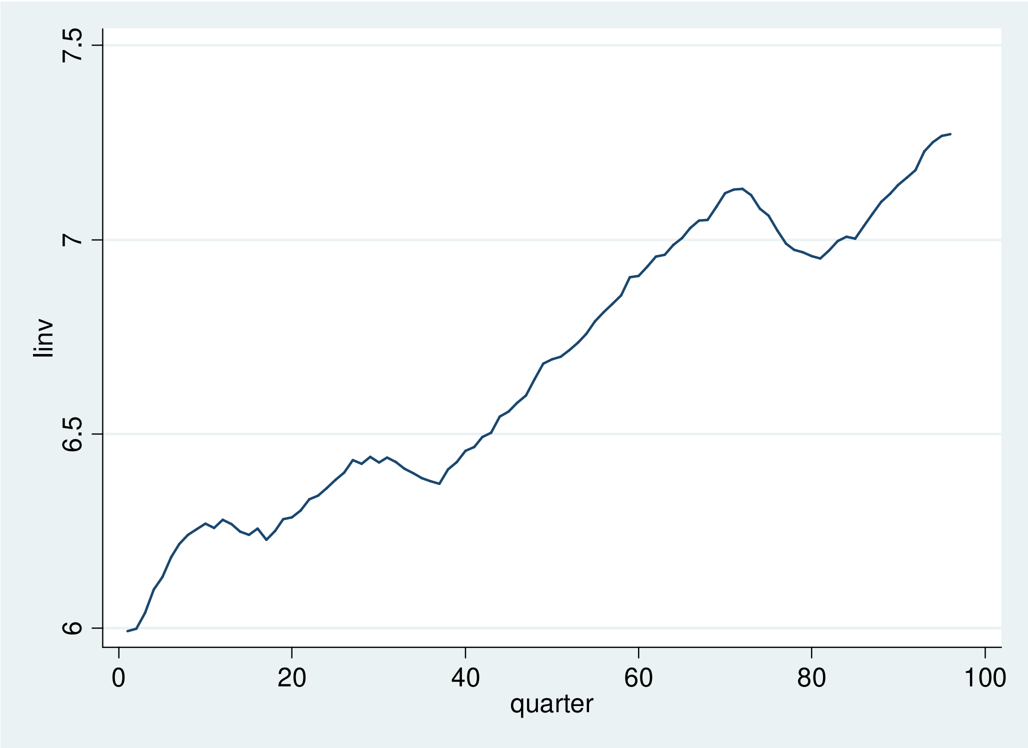
Figure 2: Seasonally Adjusted GDP



The data on aggregate investment is also from the Bureau of Economic Analysis. The specific variable we use is *Private Nonresidential Fixed Investment.* Its evolution (in logs) is displayed in Figure 3.[13]

[13] For the two variables we use the seasonally adjusted series to avoid picking up seasonal effects. Using the original series does not affect the results significantly.

Figure 3: Seasonally Adjusted Aggregate Investment



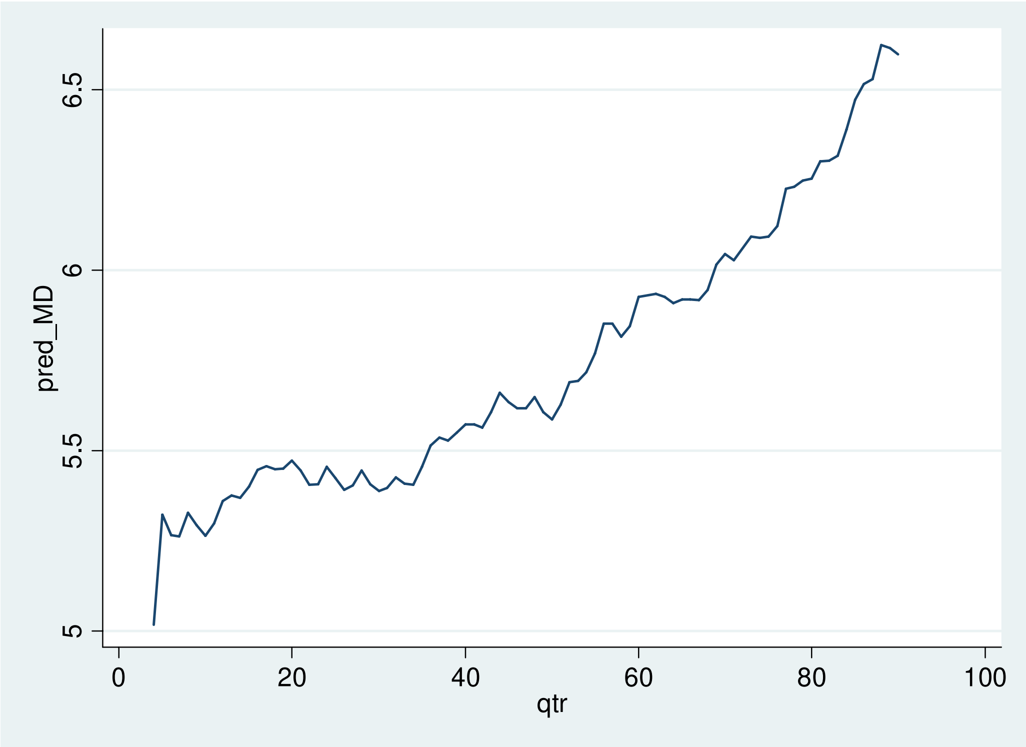
We then calculate the 'aggregate' firms' money demand as

$$\ln \hat{M}_t = \hat{\alpha} + \hat{\delta}_1 \ln X_t + \sum_{s=0}^{5} \hat{\beta}_s \ln I_{t+s} + \sum_{t=1}^{96} \hat{\gamma}_t D_t$$

where $\hat{M}_{it}$ is the estimated aggregate firms' money demand at period *t*. X_t is aggregate GDP at period *t*, and I_{t+s} is aggregate investment at period *t+s*. Finally, $\hat{\alpha}, \hat{\delta}_1, \hat{\beta}_s, s = 0,\dots,5$ and $\hat{\gamma}_t, t = 1,\dots,92$ are the fixed effect estimates of (5). [14] Figure 4 shows the evolution of our estimate of endogenous money.

[14] Since the OLS and fixed effects estimates of equation (6) are very similar we only report the results of using the latter in order to calculate the estimate of endogenous money. The results using the OLS estimates are roughly the same and they are available upon request.

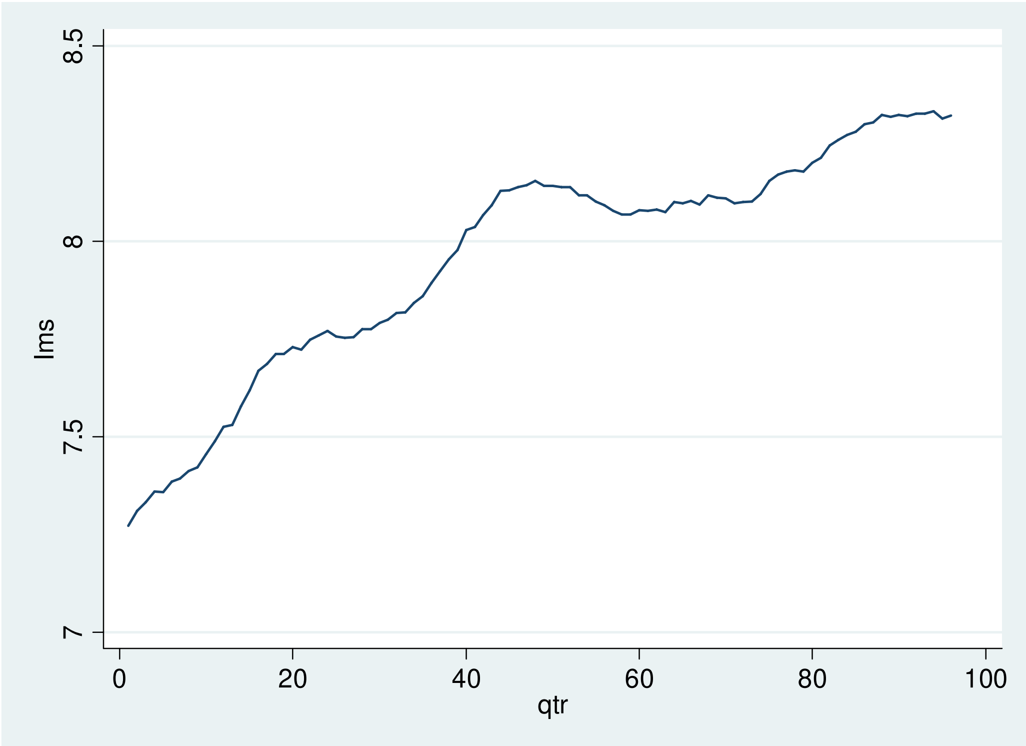
Figure 4: Firms Predicted Money Demand



5.2. Estimating Tobin effects: Comparing Predicted Money Demand and Money Supply

In this section we explore the relationship between our estimate of firms' predicted money demand and the monetary aggregate M2. We begin by plotting the evolution (in logs) of the M2 aggregate over time in Figure 5.

Figure 5: Money Stock (M2)



It is apparent from Figures 4 and 5 that the tow key series- predicted firms money demand and M2- display a positive trend, It is also interesting to notice that our estimate of endogenous money supply is more volatile than M1. Table 4 provides some summary statistics of the two series.[15]

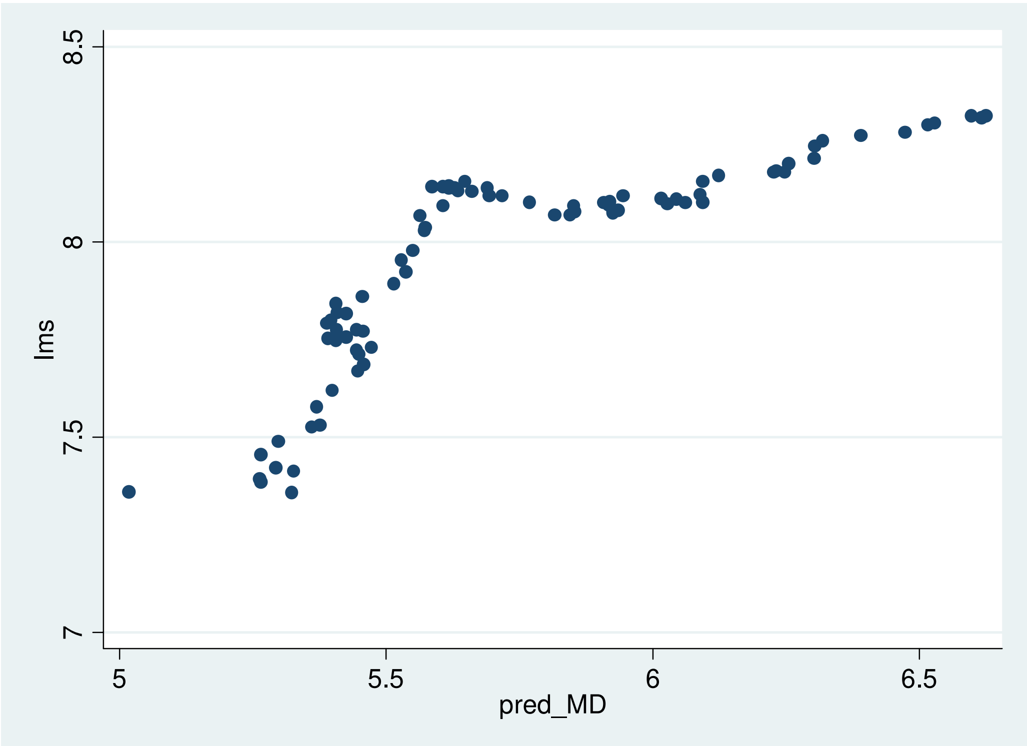
[15] Note that our estimate of endogenous money has ten less observations than M2. this is obviously due to the fact that this series comes from estimating the model in (5).

Table 4: Summary statistics for M2 and the predicted money demand

	log of money supply (M2)	log of predicted money demand
Mean	7.96	5.74
Standard deviation	0.29	0.38
Observations	96	86

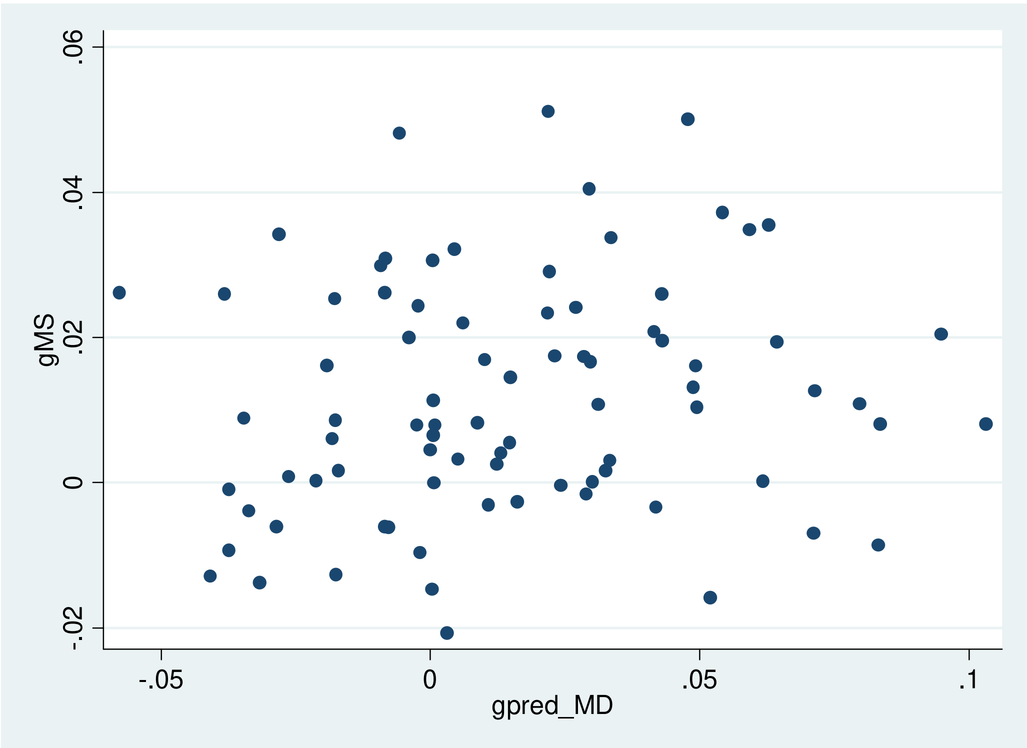
The scatter plot of the two variables (in logs) is displayed in the following figure.

Figure 6: Money Stock (M2) and Predicted Money Demand



The correlation between the two series is obviously very high (0.84) but this is in large part driven by the fact that the two series have a clear positive trend. If one uses the growth rates of the two variables instead of their levels, the correlation between the two variables drops to 0.15 and turns insignificant (see Figure 7).

Figure 7: Growth Rate of Money Stock (M1) and Growth Rate of Predicted Money Demand



We next run the following simple regression:

$$g_{M_t^s} = \gamma_0 + \gamma_1 g_{\hat{M}_t^d} + \varepsilon_t \qquad (10)$$

where $g_{M_t^s}$ and $g_{\hat{M}_t^d}$ represent the growth rate of the M1 and that of the predicted money demand, respectively and ε_t is a standard error term. Table 5 shows that the coefficient on the growth rate of predicted money demand is positive but insignificant. [16]

[16] The results are very similar if we deseasonilize the data.

Table 5: A Regression of the Growth Rate of Predicted Money Demand on the Growth rate of Money Supply

growth rate of predicted money demand	0.069 (0.05)
constant	0.01*** (0.002)
R^2	0.02
observations	83

The main conclusion of this exercise is that variations in our estimate of firms money demand are a really poor predictor of the movements in the aggregate supply of money. In other words, the endogenous component of money is very small.

5.3. Different firm sizes

Mulligan (1997) reports that large firms tend to use relatively less cash than small ones. In this section we explore whether firm size is an important determinant of the degree of money endogeneity.

We classify firms in three groups: small, medium, and large according to their average costs over the period 1983-1996. We denote firms with average costs equal or smaller than the 25th percentile as small, those above the 75th percentile as large, and those in between as medium. This strategy renders 5,716 small firms, 11,408 medium ones, and 8,352 large ones.

Table 6 is an analog of Table 3 with estimates (using only fixed effects) of stage 1 for the three groups of firms.

Table 6: Stage one estimates (fixed effects)

	Small Firms	Medium Firms	Large firms
log costs	0.189*** (0.02)	0.21*** (0.01)	0.366*** (0.02)
$\log I_t$	0.1*** (0.01)	0.063*** (0.007)	-0.017* (0.009)
$\log I_{t+1}$	0.135*** (0.009)	0.057*** (0.004)	0.037*** (0.007)
$\log I_{t+2}$	0.139*** (0.008)	0.095*** (0.004)	0.056*** (0.005)
$\log I_{t+3}$	0.135*** (0.009)	0.083*** (0.004)	0.041*** (0.005)
$\log I_{t+4}$	0.062*** (0.009)	0.056*** (0.004)	0.019*** (0.006)
$\log I_{t+5}$	0.039*** (0.01)	0.054*** (0.007)	0.086*** (0.009)
constant	0.61*** (0.02)	1.507*** (0.04)	1.476*** (0.04)
R^2	0.12	0.18	0.76
observations	98,460	248,332	156,364

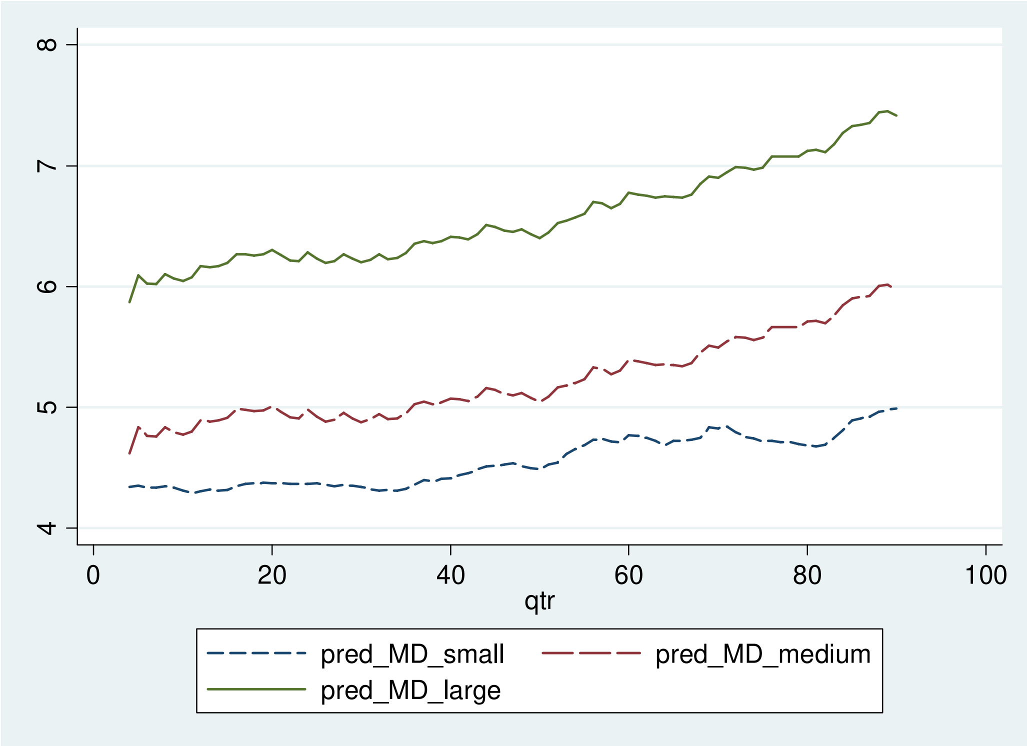
*Notes: the dependent variable is the log of money demand at period t. Numbers in parentheses indicate robust standard errors. *** denotes significant at the 1% level.*

The results of this table are not very different from those of Table 3, in which the firms' data is not classified by size. The impact of future investment on current money demand is positive in the three cases and for all leads. The only surprising negative coefficient is on the impact of current investment on current money demand for the group of large firms.

As in the aggregated case, the largest impact of investment on money demand takes place in the second quarter-lead in the three groups of firms, and it smoothly declines after that. Finally, the impact of current costs on current money demand is positive and it has a similar size in the three groups of firms.

The next step is to construct our estimate of aggregate firms' money demand for the three groups of firms. Figure 8 displays the evolution of these three estimates. Not surprisingly, larger firms demand more cash. However, the evolution of the three series over time is very similar.

Figure 8: Predicted Aggregate Money Demand for Different Firm Sizes



Finally, we regress the growth rate of the money stock M1 against the growth rate of each of the predicted money demand for each group of firms. The results are summarized in Table 7.

Table 7: A Regression of the Growth Rate of Predicted Money Demand on the Growth rate of Money Supply

	Small firms	Medium firms	Large firms
growth rate of predicted money demand	-0.053 (0.066)	0.057 (0.42)	0.056 (0.42)
constant	0.01*** (0.002)	0.01*** (0.002)	0.01*** (0.002)
R^2	0.007	0.027	0.027
observations	86	86	86

In all three cases the contribution of the growth rate of endogenous money to the growth rate of M1 is insignificant. Moreover, the differences between the coefficients do not seem to differ in any important way. This suggests that firm size is not driving the main result of the paper: the endogenous component of money is very small.

5.5. Different periods

In this section we explore whether the endogenous component of money becomes more or less relevant as time goes by. The fact that firms rely less on cash at the end of the studied period than at the beginning may suggest that endogenous money becomes less important. Our strategy is to split the sample period in two intervals: 1983-1995 and 1995-2006 and redo our two-stage calculations in each subperiod.

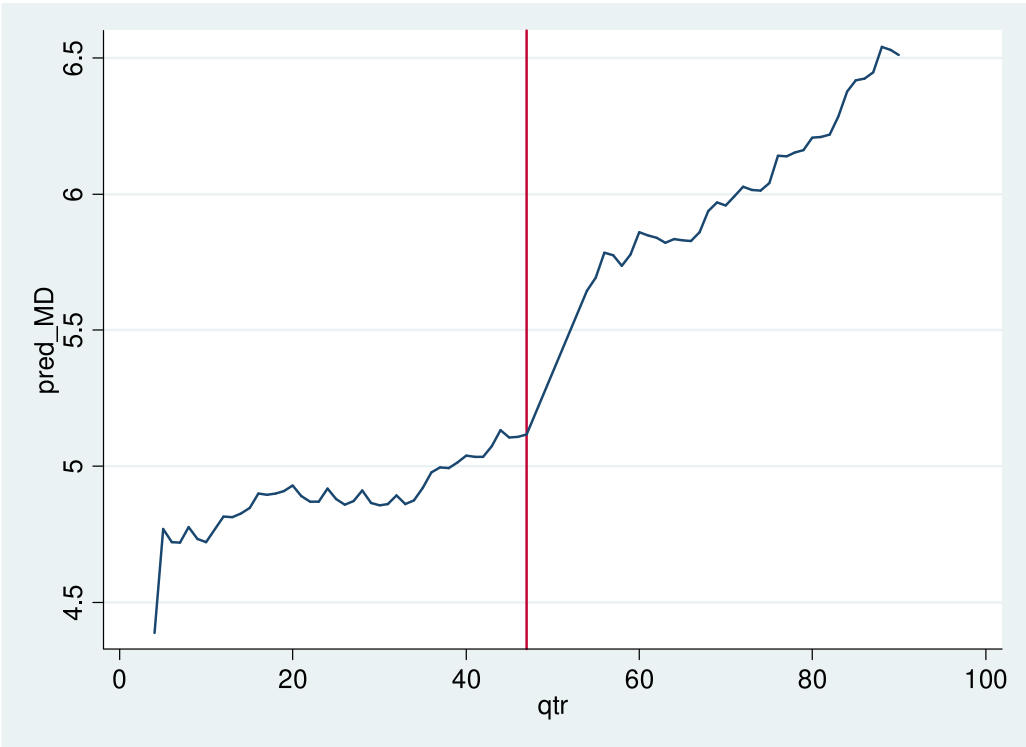
The first-stage fixed effect estimates are displayed in Table 8. The magnitude of the impact of investment leads on current money demand seems to be larger in the 1996-2006 subperiod than in the 1983-1995 one. Another interesting difference is that while the maximum effect is still on the second lead in the second subperiod, it is now the fourth lead the one that has the largest impact in the first subperiod.

Table 8: A Regression of the Growth Rate of Predicted Money Demand on the Growth rate of Money Supply

	Period 1983-1995	Period 1996-2006
log costs	0.193*** (0.15)	0.251*** (0.01)
$\log I_t$	0.011* (0.006)	0.052*** (0.006)
$\log I_{t+1}$	0.012*** (0.005)	0.048*** (0.005)
$\log I_{t+2}$	0.064*** (0.004)	0.083*** (0.004)
$\log I_{t+3}$	0.067*** (0.004)	0.074*** (0.004)
$\log I_{t+4}$	0.074*** (0.004)	0.049*** (0.004)
$\log I_{t+5}$	0.042*** (0.006)	0.032*** (0.006)
constant	0.95*** (0.038)	0.99*** (0.034)
R^2	0.07	0.16
observations	220,903	251,812

The next step is to construct our estimate o aggregate firms' money demand for the two subperiods. Figure 9 displays the evolution of this estimate. The vertical line displays the separation between the two subperiods. In the two intervals the slope is clearly positive, but we do observe a significant acceleration in the predicted money demand in the second subperiod.

Figure 9: Predicted Aggregate Money Demand at Different Time Intervals



Finally, we run a regression of the growth rate of the money stock M2 against the growth rate of aggregate firms' money demand for each subperiod. The results are summarized in Table 9.

Table 9: A Regression of the Growth Rate of Predicted Money Demand on the Growth rate of Money Supply at Different Periods

	Period 1983-1995	Period 1996-2006
growth rate of predicted money demand	0.015 (0.056)	0.099** (0.047)
constant	0.017*** (0.002)	0.03 (0.002)
R^2	0.004	0.08
Observations	41	36

The first subperiod (1983-1995) seems to be in line with the previous results of our paper. Firms predicted money demand does not seem to matter to predict the observed variations in the money stock. Interestingly, this is no longer true in the second subperiod (1996-2006). In this case, the relationship between the growth rate of M1 and that of endogenous money is positive and significant at the 5% level. However, it is worth noting that the magnitude of this correlation is rather small. Our estimates suggest that an increase in one percentage point in the growth rate of firms' predicted money demand is associated with an increase in 0.1 percentage points in the growth rate of M1.

6. Conclusion

In this paper we make use of microeconomic data on firms money demand and their investment in physical capital and infrastructures to obtain an estimate of endogenous money in the U.S. during the period 1983-2006.

We consider a framework in which firms planning to finance their investment spending with bank credit will acquire bank deposits as assets as a first step. After estimating the elasticity of firms money demand with respect to their current and future investment prospects we calculate a proxy of the aggregate money demand for firms. Finally we regress changes in the stock of money against changes in our measure of firms money demand and conclude that the latter only explains a small fraction of the variability of the former.

We then explore whether considering firms of different sizes alters our results. We find that endogenous money is insignificant even when we control for firm size. Finally, we split our time horizon in two halves to inquire whether the extent of money endogeneity has changed over time. Somewhat surprisingly, we find that the component of endogenous money is larger- although economically unimportant- in the 1996-2006 subperiod than in the 1983-1995 one.

The results of this paper suggest that even when one uses microeconomic data to explore the issue of endogenous money, a very small fraction of the variation in the U.S. money stock is driven by firms' behavior. This exercise confirms the results of Friedman and Schwartz (1963) and Romer and Romer (1989) - money is largely exogenous.

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Appendix

Definitions of Variables

DATA36="Cash and Short-Term Investments" (Statement of Cash Flows)

- This item represents cash and all securities readily transferable to cash as listed in the current asset section.
- For banks and savings and loans this includes cash and due from banks and federal funds
- This item also includes:

1. Accrued interest combined with short-term investments
2. Brokerage firms' good faith and clearing-house deposits
3. Cash in escrow
4. Cash segregated under federal and other regulations
5. Certificates of deposit included in short-term investments by the company
6. Certificates of deposit reported as a separate item in current assets
7. Commercial paper
8. Gas transmission companies' special deposits
9. Government and other marketable securities (including stocks and bonds listed as short-term)
10. Margin deposits on commodity futures contracts
11. Marketable securities
12. Money-market fund
13. Repurchase agreements shown as a current asset
14. Real estate investment trusts shares of beneficial interest
15. Restricted cash shown as a current asset
16. Term deposits
17. Time deposits and time certificates of deposit (savings accounts shown in current assets)
18. Treasury bills listed as short-term

- This item excludes:

1. Accrued Interest not included in short-term investment by the company (included in Receivables -- Current -- Other)
2. Bullion, bullion in transit, uranium in transit (included in Inventories -- Raw Materials)
3. Commercial paper issued by unconsolidated subsidiaries to the parent company (included in Receivables -- Current -- Other)
4. Money due from sale of debentures (included in Receivables -- Current -- Other)
5. Short-term investments at equity (included in Current Assets -- Other -- Excluding Prepaid Expense)

DATA90="Capital Expenditures" (Statement of Cash Flows)

- This item represents cash outflow or funds used for additions to the company's property, plant, and equipment, excluding amounts arising from acquisitions.
- This item includes:

1. Any items included in property, plant and equipment on the Balance Sheet
2. Expenditures for capital leases
3. Increase in funds for construction
4. Increase in Leaseback Transactions
5. Logging roads and timber
6. Reclassification of inventory to property, plant, and equipment

- This item excludes:

  1. Capital expenditures of discontinued operations
  2. Changes in property, plant, and equipment resulting from foreign currency fluctuations when listed separately
  3. Decreases in funds for construction presented as a use of funds
  4. Deposits on property, plant and equipment
  5. Net assets of businesses acquired
  6. Property, plant, and equipment of acquired companies
  7. Property, plant and equipment for real estate investment trusts
  8. Software costs (unless included in property, plant and equipment on the Balance Sheet)

- This item contains a Combined Figure data code when:

  1. Capital expenditures are combined with another item for a company reporting a Working Capital Statement (Format Code = 1), a Cash by Source and Use of Funds Statement (Format Code = 2), or a Statement of Cash Flows (Format Code = 7)
  2. Capital expenditures are combined with another item in the Investing Activities section on a Statement of Cash Flows (Format Code = 7)
  3. Capital expenditures are reported in a section other than Investing Activities on a Statement of Cash Flows (Format Code = 7)
  4. Capital expenditures are reported net of the sale of property, plant, and equipment and the resulting figure is negative. For companies reporting either a Working Capital Statement (Format Code = 1) or Cash by Source and Use of Funds Statement (Format Code = 2), effects of the negative figure are included in Use of Funds -- Other. For companies reporting either a Cash Statement by Activity (Format Code = 3) or a Statement of Cash Flows (Format Code = 7), effects of the negative figure are included in Sale of Property, Plant, and Equipment and Sale of Investments -- Loss (Gain).

- This item is not available for banks.

DATA30="Costs of Goods Sold"

- This item represents all expenses that are directly related to the cost of merchandise purchased or the cost of goods manufactured that are withdrawn from finished goods inventory and sold to customers. For banks and savings and loans this item represents interest expense and provision for loan losses. The total operating costs for nonmanufacturing companies are considered as Cost of Goods Sold if a breakdown is not available
- This item includes the following expenses when broken out separately. If a company allocates any of these items to Selling, General, and Administrative Expense, we will not include them in Cost of Goods Sold:

1. Agricultural, aircraft, automotive, radio and television manufacturers' amortization of tools and dies
2. Airlines' mutual aid agreements
3. Amortization of deferred costs (i.e., start-up costs)
4. Amortization of software costs and amortization of capitalized software costs
5. Amortization of tools and dies where the useful life is two years or less
6. Banks' interest expense on deposit
7. Cooperatives' patronage dividends
8. Customer-sponsored research and development expense for research and development companies
9. Departmental costs
10. Direct costs (when a separate Selling, General, and Administrative figure is reported) 8/2003 Chapter 5 -- Data Definitions 53
11. Direct labor
12. Distribution and editorial expenses
13. Expenses associated with sales-related income from software development
14. Expenses of equity method joint ventures if reported as operating expenses
15. Extractive industries' lease and mineral rights charged off and development costs written off
16. Freight-in
17. Heat, light, and power
18. Improvements to leased property
19. Insurance and safety
20. Labor and related expenses reported above a gross profit figure (including salary, pension, retirement, profit sharing, provision for bonus and stock options, and other employee benefits)
21. Land developers' investment real estate expense
22. Lease expense
23. Licenses
24. Maintenance and repairs
25. Operating expenses
26. Real estate investment trusts' advisory fees

27. Reimbursement for out of pocket expenses when reported as part of Cost of Goods Sold on the Income Statement
28. Rent and royalty expense
29. Restaurants' franchise fees
30. Salary expense
31. Stock based compensation when no gross profit figure is reported or when it is reported above a gross profit figure
32. Supplies
33. Taxes other than income taxes
34. Terminals and traffic
35. Transportation
36. Warehouse expense
37. Write-downs of oil and gas properties
38. Compustat North America User's Guide 8/2003

- This item excludes:

1. Amortization of deferred financing costs (included in Interest Expense)
2. Amortization of intangibles (included in Depreciation and Amortization)
3. Amortization of negative intangibles (included in Nonoperating Income [Expense])
4. Company-sponsored research and development expense (included in Selling, General, and Administrative Expense)
5. Depreciation when allocated to cost of goods sold per the company report
6. Depreciation which should be allocated to Selling, General and Administrative Expense
7. Excise taxes are excluded from Cost of Goods Sold and from Sales (Net) for cigar, cigarette, liquor, oil and rubber industries
8. Financial service industries' labor and related expenses (when reported either above or below a gross profit figure) (included in Selling, General, and Administrative Expense)
9. Foreign exchange adjustments reported before Pretax Income (included in Nonoperating Income [Expense])
10. Idle plant expense (included in Nonoperating Income [Expense])
11. Labor and related expenses reported below a gross profit figure (including salary, pension, retirement, profit sharing, provision for bonus and stock options, and other employee benefits)
12. Miscellaneous expense (included in Nonoperating Income [Expense])
13. Operating expenses (when no Selling, General, and Administrative Expense figure is available)
14. Paper mills' cost of delivery expenses
15. Purchase discounts received (netted against Cost of Goods Sold)
16. Rent expense for retail companies (included in Selling, General, and Administrative Expense)
17. Royalty trusts and royalty and trust administrative expenses for royalty trust companies (included in Selling, General, and Administrative expenses)