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Why Does the Velocity of Money Move Pro-cyclically?

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ABSTRACT *The velocity of money usually rises in expansions and falls in recessions This paper explains this pro-cyclical movement of velocity using two ideas: (i) during business cycles the movement of investment and consumption of durable goods has a larger amplitude than consumption of non-durable goods and services; (ii) the velocity associated with expenditure on investment and durable goods is much higher than the velocity associated with consumption of non-durable goods and services, because the former expenditures are synchronized with the attainment of money by economic agents whereas the latter are not. In this setting, the rise in the weight of expenditure in durable goods relative to the weight of non-durable goods and services, which occurs during expansions, generates an increase in the average velocity of circulation. The opposite happens during recessions and thus velocity moves pro-cyclically.*

KEY WORDS: Velocity of money; money demand; business cycle; monetary policy; endogenous money

Introduction

The short-run variability of the velocity of money is a well-established empirical fact. In particular, (detrended) velocity usually rises during business expansions and falls in recessions (see Table 1; also Mishkin, 2004, pp. 520–521).

The standard explanation for this empirical fact is based on the role of interest rates. During economic expansions, interest rates and therefore the opportunity cost of holding money tend to rise and thus velocity increases. By contrast, during recessions interest rates and hence the opportunity cost of money tend to fall and therefore (detrended) velocity declines.

This paper proposes an alternative explanation for the cyclical variability of the velocity of circulation. We start by showing that the velocity of money associated with the expenditure in investment and durable consumption goods is much *higher* than the velocity associated with expenditure in consumption of non-durable goods and services (NDGS). Because, furthermore, the expenditures in investment and durable consumption goods move with greater amplitudes than

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Table 1. Cyclical amplitudes of M1 velocity (%)

Trough	Peak	Trough	Expansion	Contraction
1921:2	1923:2	1924:2	12.4	–5.2
1924:2	1926:4	1927:4	5.5	–1.6
1927:4	1929:3	1933:2	6.5	–36.0
1933:2	1937:2	1938:2	12.8	–10.5
1949:3	1953:3	1954:2	19.7	0.0
1954:2	1957:3	1958:2	13.4	–0.9
1958:2	1960:2	1961:1	10.6	–3.1
1961:1	1969:4	1971:1	8.5	–0.1
1971:1	1973:4	1975:1	3.6	2.1
1975:1	1980:1	1980:3	20.4	–2.3
1980:3	1981:3	1982:4	7.4	–10.1
1982:4	1990:3	1991:1	–15.0	–3.4
1991:1	2001:1	2001:3	26.6	–9.5

Notes: Expansion amplitudes are equal to the peak values of M1 velocity minus their initial trough values, divided by the latter. Contraction amplitudes are equal to the trough values minus the previous peak values, divided by the latter.

Source: From 1921 until 1960, M1 velocity values at peaks and troughs are the figures of Friedman & Schwartz (1963, p. 774, Table A-5) for the corresponding years; values since 1960 were calculated from the Federal Reserve Data (FRED), and refer to detrended velocity (defined as the residual of the regression $V1_t = \alpha + \beta t + \varepsilon_t$). Cycle dates are from NBER.

the expenditures in consumption of NDGS over the business cycle, the aggregate velocity of money (which is a weighted average of the velocities of each type of expenditure) tends to change pro-cyclically—even if the velocity of each type of expenditure is constant.

In the next two sections we present the main hypothesis of the paper that one reason why the velocity of money is pro-cyclical is because the velocity of the different types of expenditure is not the same. We follow by testing this hypothesis by estimating several error correction models using M1 velocity as a dependent variable and then discuss the implications of the variability of velocity along the cycle for monetary policy in an endogenous money framework.

Why Does the Velocity of Money Move Pro-cyclically?

Our explanation for the pro-cyclical movement of velocity is based on the idea that the velocity of money used in different types of expenditure is not the same. More specifically, we will argue that, as far as the velocity of money is concerned, the different types of expenditures can be divided into two categories: on the one hand, consumption of NDGS and government expenditures, which have low velocities; on the other hand, investment, durable consumption and export expenditures, which have high velocities.

How does the fact that some types of expenditure have low velocity whereas other types of expenditure have high velocity lead to an explanation for the pro-cyclical movement of velocity? As shown in Table 2, the movements of the different types of expenditure along the business cycle have very different amplitudes. In particular, durable consumption and investment are much more volatile than NDGS. As a result, aggregate velocity (which is a weighed average of the velocities

Table 2. Cyclical amplitudes of M1 velocity, GNP and some of its components (%)

	Average, 4 cycles 1921–1938		Average, 4 cycles 1949–1970		Average, 3 cycles 1970–1982		Average, 2 cycles 1982–2001	
	Exp.	Cont.	Exp.	Cont.	Exp.	Cont	Exp.	Cont.
M1 velocity	9.3	−13.3	16.7	−1.4	14.0	−1.5	13.9	−3.0
GNP	21.2	−16.4	17.9	−1.5	12.1	−3.5	37.5	−0.9
Consumption of nondurables	16.4	−11.4	10.2	0.7	6.9	−0.4	31.7	−0.5
Consumption of services	14.4	−6.4	12.0	4.9	10.7	4.1	36.9	0.3
Consumption of durables	31.0	−27.0	24.1	−8.9	20.8	−8.0	85.4	−3.0
Gross private investment	55.4	−49.3	23.5	−9.5	29.8	−28.0	70.0	−5.3

Note: The calculation of the cyclical amplitudes of the various series for each cycle followed the method of Table 1; the figures are arithmetic means of the amplitudes obtained for the corresponding individual cycles.

Source: Figures in the last column were calculated from the Federal Reserve Data (FRED); values for M1 velocity in the 1921–1938 period were calculated from Friedman & Schwartz (1963, p. 774, Table A-5); the other data is from Sherman (1991, pp. 41, 280 and Appendixes C and D). Cycle dates are from NBER.

of each type of expenditure) tends to change in a systematic way along the business cycle.[1]

During business expansions investment and the consumption of durable goods (expenditures with high velocity) tend to increase far more than the consumption of NDGS (expenditures with low velocity). As a result, the average velocity of circulation tends to increase during business expansions. By contrast, during recessions investment and durable consumption usually decline far more than the consumption of NDGS and therefore the average (detrended) velocity of circulation tends to fall.

Why is the Velocity of Money Different for Different Types of Expenditure?

The velocity of money associated with the consumption of NDGS is likely to be low because households do not usually synchronize the attainment of money and the moment they make expenditure in these goods. The reason why this happens is because the small amount of money involved in each purchase of NDGS does not justify the fixed transaction cost of converting financial assets into money. Take the following example. Consider a household that receives US $30 at the beginning of the month and spends it on NDGS during the month, at the rate of US $1 per day. For this household, the dollar spent on the last day of the month remains idle during 29 days, the dollar spent on the 29th day of the month remains idle during 28 days … it is only the dollar spent in the very first day of the month that remains idle less than one day. We can therefore say that households do not tend to synchronize the attainment of cash and the moment they make expenditures in NDGS. As a result, the velocity of money associated with these expenditures is likely to be low.

By contrast, the velocity of money used to pay for investment, durable consumption and export goods is very high because households and firms tend to synchronize the attainment of money and the moment they make this kind of expenditure.

This follows because the value of each purchase of investment, durable consumption and export goods is large, it usually pays to keep the amount needed for that purchase in interest bearing assets, and incur the transaction costs of converting those assets into money only when the moment arrives to make the expenditure.

Let us first consider expenditures in investment and consumption of durable goods. Two cases can be considered—when purchases are based on credit and when purchases are based on internal finance. When purchases are based on credit, there tends to be a synchronization between the moment households/firms obtain credit, the moment money is available in the households/firms current accounts and the moment expenditures are made. On the other hand, when purchases are based on internal finance there tends to be a synchronization between the moment financial assets are converted into checkable deposits (money) and the moment expenditures are made. We can therefore say that economic agents tend to synchronize the attainment of money and the moment they pay for investment and consumption of durable goods. As a consequence, the velocity of money associated with these expenditures is likely to be very high.

The previous argument can be extended to the case of purchases of US exports by foreigners. In fact, since the holding of idle money balances involves an opportunity cost, foreigners tend to synchronize the purchase of US dollars and the moment they buy the goods and services from US exporters. As a result, the velocity of money associated with exports is also likely to be very high.

Empirical Evidence

The Velocity Function

According to the hypothesis presented in the previous sections, M1 velocity should depend positively on the weight of investment, durable consumption and exports in aggregate expenditure (which is the sum of the previous three variables plus consumption of NDGS and government expenditure). While we are mainly interested in the relationship between M1 velocity and the composition of aggregate expenditure, we need to control for other influences on M1 velocity within a multivariable modelling framework.[2] The other variables we consider are drawn from the vast literature on money demand and velocity functions. More specifically, we start with the following velocity function:

$$\underset{}{\mathrm{V1}} = f(\underset{(+)}{\mathrm{Weight}}, \underset{(+)}{\Pi}, \underset{(+)}{i^s}, \underset{(+)}{i^l}, \underset{(+)}{i^e}, \underset{(+)}{Y}, \underset{(+)}{\mathrm{M3/M1}}, \underset{(?)}{\mathrm{M1\ vol}}) \tag{1}$$

where V1 is the velocity of M1; Weight is the sum of investment, consumption of durable goods and exports divided by aggregate expenditure, π is the inflation rate; i^s is a short-term nominal interest rate, i^l is a long-term nominal rate; i^e is the return on equities; Y is real income; M3/M1 is the ratio between M3 and M1 assets, used as a proxy for non-GDP transactions; and M1Vol is a measure of M1 volatility.

The direction of the influence of the various explanatory variables on M1 velocity should be as follows. First, according to our hypothesis M1 velocity should vary positively with the variable Weight. Second, Friedman's (1969) restatement of the quantity theory of money demand suggests that velocity may vary positively with each of the four measures of the opportunity cost of holding money—the inflation rate, the short and long term nominal interest rates, and the return on equities.[3] Third, and according to the Baumol–Tobin model of the demand for transaction balances, an increase in income should lead to a less than proportional increase in money demand (because of economies of scale in monetary management) and, as a result, to a rise in M1 velocity (Baumol, 1952; Tobin, 1956). Fourth, an increase in M3/M1 (a decrease in M1/M3) may reflect a decrease in non-GDP transactions (in financial markets and/or in real estate), and thus should also lead to an increase in M1 velocity (Pollin & Schaberg, 1998; Palley, 1995; Stauffer, 2000).[4] Finally, according to Friedman (1984) M1 velocity should be negatively affected by M1 volatility because it increases uncertainty and thus the demand for more liquid assets. However, the subsequent literature on this issue has not lent much support for Friedman's claim (see Pollin & Schaberg, 1998, and the references cited therein, p. 145). Therefore, we will regard M1 volatility as exerting an ambiguous influence on M1 velocity.

Specification of the Error Correction Model

The previous velocity function will be tested using different variations of the following Error Correction Model (ECM):

$$\begin{aligned} \mathrm{V1}_t = \alpha_0 + \alpha_1 \mathrm{Weight}_t + \alpha_2 y_t + \alpha_3 i_t^l + \alpha_4 (\mathrm{M3/M1})_t + \alpha_5 \mathrm{M1\ Vol}_t \\ + \alpha_6 \mathrm{i}_t^e + \alpha_7 \pi_t + \alpha_8 i_t^s + u_t \end{aligned} \tag{2}$$

$$\begin{aligned} \Delta \mathrm{V1}_t = \beta_0 + \beta_1 \Delta \mathrm{Weight}_t + \beta_2 \Delta y_t + \beta_3 \Delta i_{t-2}^s + \beta_4 \Delta i_t^l + \beta_5 \Delta i_t^e + \beta_6 \Delta \pi_t \\ + \Sigma \gamma_i \Delta (\mathrm{M3/M1})_{t-i} + \beta_7 \Delta \mathrm{M1\ Vol}_t + \rho u_{t-1} + \varepsilon_t \end{aligned} \tag{3}$$

where y is the log of real income, u and ε are random disturbance terms and Δ is the first-difference operator.

Equation (2) says that the long-run equilibrium M1 velocity depends on the variable Weight, on income, on several measures of the opportunity cost of money, on the ratio between M3 and M1 assets, and on M1 volatility.

In turn, equation (3) describes the short-run behaviour of M1 velocity and is a dynamic error correction form where the coefficients measure the short-run responses of M1 velocity to changes in Weight, in income, in the several measures of the opportunity cost, in M3/M1 and in M1 volatility. The finding of a statistically significant positive sign for the coefficient of Weight should be interpreted as evidence that the velocities associated with investment, consumption of durable goods and exports are higher than the velocities associated with the other two types of expenditure, consumption of NDGS and government expenditures. Finally, the parameter ρ that appears on the disturbance term u_{t-1} is the error correction coefficient and measures the extent to which actual M1 velocity adjusts each period to clear disequilibrium in short-term velocity.

Estimation of the Error Correction Model

The ECM described above can be estimated using a two-step procedure. In the first step, the long-run M1 velocity equation (2) is estimated by ordinary least squares

(OLS) and the residuals are calculated. In the second step, the short-run M1 velocity equation (3) is estimated with u_{t-1} replaced by the residuals of step one.

Estimates of M1 velocity parameters are reliable only if the non-stationary) variables included in (2) are cointegrated. Three approaches have been used for testing whether or not non-stationary series are cointegrated: single-equation static regressions, proposed by Engle & Granger (1987), vector auto regressions by Johansen (1995) and single-equation conditional error correction models (ECM), associated with the works of Sargan and Hendry (for a detailed discussion, see Ericsson & Mackinnon, 2002). In this paper we will use the ECM procedure, which studies cointegration by testing the significance of the error correction mechanism in equation (3), i.e. H0: ρ=0.[5]

Empirical Results I

We use quarterly data for the USA, 1982:3–2003:3 taken from the Federal Reserve Economic Data (FRED). This allows us to avoid the well-known structural break in M1 velocity in the early 1980s (see, for example, Pollin & Schaberg, 1998). All series are seasonally adjusted. Using Dickey–Fuller tests to check for stationarity, shown in Table 3, all variables were found to have unit-roots. We therefore converted them into stationary series by taking first differences. Afterwards, we ran regressions using the ECM specified in equations (2) and (3).

Equation (2.1) in Table 4 presents the estimates of the coefficients of equation (2). Using the lagged residuals of that equation as an error correction mechanism, equations (3.1A) and (3.1B) in Table 5 are two alternative estimations of the (short run) equation (3)—the first including all regressors, the second excluding the regressors that turned out to be jointly redundant (see last row of Table 5). As can be seen from the *t*-statistics of the error correction terms, we cannot reject the hypothesis of no cointegration between the variables included in equation (2).

Table 3. Unit roots tests (1982:3–2003:3)

Variables	Description	Level	First differences
Weight	Sum of real fixed private investment, real personal consumption expenditures in durable goods, and real exports of goods and services divided by the previous three series plus real personal consumption expenditures in services and in non-durable goods, and real government consumption expenditures and gross investment	−0.7431	−3.939820*
V1	Real GDP divided by Real M1 (Real M1 is nominal M1 divided by the GDP price deflator)	−1.083261	−3.638470*
i^l	Moody's seasoned Aaa corporate bond yield	−2.560699	−6.791002*
M3/M1	Nominal M3 divided by nominal M1	0.148441	−2.153906**
i^s	3-month treasury bill rate	−2.120601	−3.906376*
y	Log of disposable personal income	−2.513961	−5.214189*
LSP	Log S&P 500 composite: total return: monthly dividend reinvestment	−2.286172	−8.232076*
π	First difference of the log of the consumer price index	−1.534717	−6.317811*
M1vol	Eight-quarter moving standard deviation of the change in the log of M1	−1.471416	−6.611922*

Notes: *Significant at the 1% level; **Significant at the 5% level.

Table 4. Long-run coefficient estimates, US 1982:3–2003:3; dependent variable: V1

Regressors	Equation (2.1)	Equation (2.2)	Equation (2.3)	Equation (2.4)	Equation (2.5)	Equation (2.6)
Constant	−0.37	2.60	1.62	−1.71	−1.82	−2.02
Weight	0.16	0.18	0.19	–	0.17	0.18
Y	−0.43	−0.91	−0.44	2.24	–	–
i^l	0.15	0.18	0.10	0.23	0.13	0.13
M3/M1	0.67	0.66	0.64	0.66	0.61	0.61
M1vol	−0.11	−0.16	−0.23	−0.15	−0.15	–
LSP	0.68	0.76	–	–	–	–
π	−0.13	−0.08	–	–	–	–
i^s	0.05	–	–	–	–	–

Therefore, the estimations carried out are not reliable. (We arrive at the same conclusion if we exclude the short-term interest rate from the long-run equation, and estimate instead the long-run equation (2.2) and the corresponding short-run equations (3.2A) and (3.2B)).

By contrast, if we take a more Keynesian stance (recall footnote 3) and exclude the rate of return on equities, the short-term interest rate and the rate of inflation, a cointegration relationship emerges between the other variables of equation (2). Equation (2.3) in Table 4 presents the long-run estimates of the coefficients of such an equation. As expected, in the long-run M1 velocity is positively associated with the variable Weight, the long-run interest rate, the ratio between M3 and M1 assets, and negatively associated with M1 volatility. However, a negative long-run association between income and M1 velocity appears, which is in contradiction with the transactions demand for money model of Baumol–Tobin.

Using the lagged residual of equation (2.3) as an error correction mechanism, equations (3.3A) and (3.3B) in Table 5 are two alternative estimations of (the short-run) equation (3). Equation (3.3A) supports our hypothesis: after taking into account the effect of the other variables mentioned in the literature, it shows that the variable Weight still has a positive significant effect on short-run M1 velocity. Apart from Weight, M1 velocity is also positively influenced by the ratio between M3 and M1 assets, and negatively affected by the (two-period lagged) short-term interest rate.[6] Equation (3.3A), however, shows that in the short-run M1 velocity is not significantly affected by changes in income, in the long-term nominal interest rate, in the return on equities and in the inflation rate. (Note as Weight is statistically significant whereas income is not, this may be interpreted as evidence that the short-run movement of velocity along the cycle is related with the hypothesis proposed in this paper rather than with the Baumol–Tobin model.)

Afterwards, a standard F-test was performed, and showed that inflation, the return on equities and income were jointly redundant regressors (see last row of Table 5). Therefore, we estimated equation (3.3B), and again found a statistically positive coefficient for the variable Weight.

As can be seen from Tables 5 and 7 and Figures 1 and 2, several indicators and tests show that the estimations carried out are statistically sound. First, the

Table 5. Error correction models for M1 velocity, US, 1982.3–2003.3; dependent variable: ΔV1 [with the exception of the last row, *t*-statistics in parenthesis; for the positive (negative) *t*-statistics, the corresponding critical values at the 5% and 1% levels are approximately equal to 1.67 (−1.67) and 2.39 (−2.39), respectively]

Regressors	Equation (3.1A)	Equation (3.1B)	Equation (3.2A)	Equation (3.2B)	Equation (3.3A)	Equation (3.3B)
Constant	−0.02 (−1.49)	−0.01 (−2.64)	−0.01 (−1.39)	−0.01 (−2.44)	−0.02 (−1.61)	−0.01 (−2.31)
ΔWeight	0.07 (3.24)	0.07 (3.95)	0.07 (2.94)	0.07 (3.68)	0.08 (3.30)	0.08 (3.91)
$\Delta i^s(-2)$	−0.04 (−2.82)	−0.04 (−3.11)	−0.03 (−2.40)	−0.03 (−2.71)	−0.03 (−2.54)	−0.03 (−2.82)
ΔM1vol	−0.05 (−1.02)	–	−0.06 (−1.12)	–	−0.07 (−1.32)	−0.07 (−1.45)
ΔM3/M1	1.04 (9.64)	1.08 (10.5)	1.04 (9.44)	1.08 (10.34)	1.04 (9.43)	1.02 (9.76)
ΔM3/M1 (−1)	0.49 (2.78)	0.50 (3.20)	0.53 (2.97)	0.54 (3.37)	0.52 (2.93)	0.50 (3.20)
ΔM3/M1 (−2)	0.53 (2.81)	0.54 (3.20)	0.50 (2.60)	0.52 (3.01)	0.54 (2.78)	0.55 (3.25)
Δy	0.06 (0.1)	–	0.09 (0.13)	–	0.22 (0.35)	–
Δi^l	0.02 (1.22)	–	0.02 (1.23)	–	0.02 (1.16)	0.02 (1.45)
ΔLSP	0.03 (0.39)	–	0.05 (0.51)	–	−0.02 (−0.26)	–
$\Delta\pi$	−0.01 (−0.73)	–	− 0.003 (−0.26)	–	0.0003 (0.02)	–
U1(−1)	−0.018 (−4.02)*	−0.017 (−4.35)*	–	–	–	–
U2(−1)	–	–	−0.16 (−3.67)*	−0.16 (−3.93)*	–	–
U3(−1)	–	–	–	–	−0.16 (−3.92)*	−0.16 (−3.98)*
Lags of ΔV1**	9	9	9	9	9	9
F-test for redundant variables (*p*-values in parenthesis)	[$\Delta\pi$,Δy, ΔM1vol, ΔLSP,Δi^s] 0.97 (0.44)	–	[$\Delta\pi$,Δy, ΔM1vol, ΔLSP,Δi^s] 1.08 (0.38)	–	[$\Delta\pi$,Δy, ΔLSP] 0.08 (0.97)	–

Notes: *The correspondent 1%, 5% and 10% asymptotic critical values for the τ-ECM test are equal to (see Ericsson & Mackinnon, 2002): −5.34, −4.72 and −4.39 (equations (3.1A) and (3.1B)); −.17, −4.56 and −4.23 (equations (3.2A), (3.2B)); −4.79, −4.19 and −3.86 (equations (3.3A) and)3.3B)).

**The equations include several lags of the dependent variable (ΔV1) in order to control for serial correlation

t-statistics of the error-correction terms of the short-run equations (3.3A) and (3.3B) lead to the rejection of the null hypothesis of no cointegration at the 10% level. Second, the adjusted R^2 is high. Third, the Breusch–Godfrey test shows the absence of auto-correlation and the ARCH test shows that the residual variances are not autocorrelated. Fourth, the RESET test shows that there are no significant specification errors. Finally, tests based on recursive estimation of

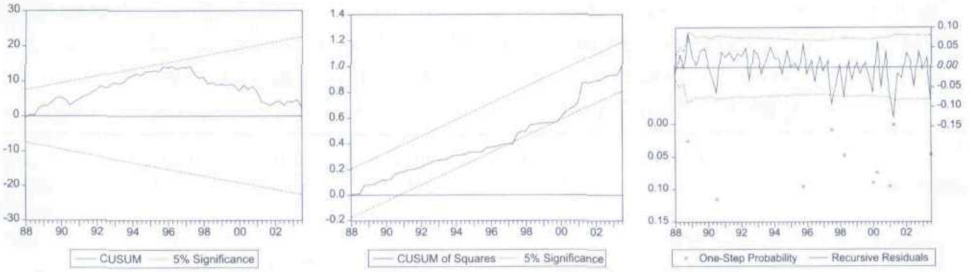

Figure 1. Stability tests for equation (3.3A)

the coefficients (the CUSUM and CUSUMQ tests and the one-step forecasts) suggest parameter constancy over the sample period. The Chow breakpoint and the Chow forecast tests point to the same conclusion. (The former was successively performed using all periods as breakpoints; in Table 7 we only show the results for the periods for which the CUSUMSQ and the one-step forecast tests were not unequivocal about the stability of the parameters.)

Empirical Results II

In order to explore further the robustness of our results, we estimated additional variations of the ECM specified in equations (2) and (3). The last three columns of Table 4 present the long run equations. For each of these long-run equations, Table 6 presents two short-run equations—one with all regressors mentioned in the literature, and another excluding the regressors that turned out to be redundant. Some brief comments on the results follow.

Equation (2.4) is a long-run equation that excludes the variable Weight. As can be seen from the *t*-statistics of the error correction mechanisms of equations (3.4A) and (3.4B), the result is that cointegration is no longer found. On the other hand, several tests (in particular, the Chow breakpoint test, and the CUSUMSQ) reveal significant parameter instability over the sample period. Both these facts reinforce our belief in the importance of the variable Weight for the explanation of M1 velocity even in the long run.

Equation (2.5) is a long-run equation that excludes income. (The motivation for this equation was that the coefficient of income in our basic long-run equation—equation (2.3)—has a negative sign, a result that is contradictory with the Baumol–Tobin money demand function.) As can be seen from equations (3.5A) and (3.5B)—which according to the tests presented in table 7 and in figures 5 and 6 are

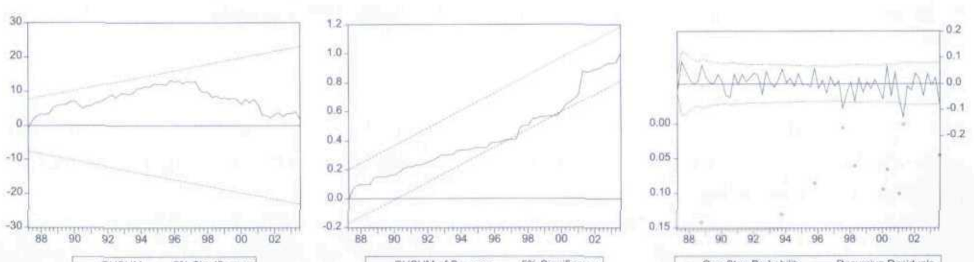

Figure 2. Stability tests for equation (3.3B)

Table 6. Error correction models for M1 velocity, US, 1982.3–2003.3; dependent variable: ΔV1 [with the exception of the last row, t-statistics in parenthesis; for the positive (negative) *t*-statistics, the corresponding critical values at the 5% and 1% levels are approximately equal to 1.67 (–1.67) and 2.39 (–2.39), respectively]

Regressors	Equation (3.4A)	Equation (3.4B)	Equation (3.5A)	Equation (3.5B)	Equation (3.6A)	Equation (3.6B)
Constant	–0.02	–0.005	–0.02	–0.01	–0.013	–0.015
	(–1.81)	(–0.87)	(–1.76)	(–2.06)	(–1.3)	(–2.77)
ΔWeight	0.05	0.06	0.08	0.08	0.076	0.075
	(2.27)	(2.71)	(3.46)	(3.82)	(3.35)	(4.15)
$\Delta i^s(-2)$	–0.02	–	–0.03	–0.03	–0.03	–0.03
	(–1.89)		(–1.6)	(–2.63)	(–2.36)	(–2.78)
ΔM1vol	–0.02	–	–0.07	–	–0.11	–0.14
	(–0.52)		(–1.39)		(–2.06)	(–3.07)
ΔM3/M1	1.12	1.05	1.01	1.02	0.83	0.84
	(10.01)	(9.85)	(9.21)	(9.77)	(6.61)	(7.03)
ΔM3/M1 (–1)	0.53	0.53	0.52	0.49	–0.67	–0.66
	(2.80)	(3.21)	(2.93)	(3.20)	(–3.87)	(–4.25)
ΔM3/M1 (–2)	0.40	0.3	0.55	0.54	–0.56	–0.55
	(2.05)	(1.82)	(2.88)	(3.21)	(–3.0)	(–3.43)
Δy	0.64	–	0.24	–	0.16	–
	(0.97)		(0.37)		(0.26)	
Δi^l	0.03	0.04	0.02	–	0.0072	–
	(1.91)	(2.94)	(1.48)		(0.49)	
ΔLSP	0.05	–	–0.001	–	–0.09	–
	(0.50)		(–0.01)		(–0.046)	
$\Delta\pi$	0.006	–	0.0005	–	0.0028	–
	(0.44)		(0.04)		(–0.22)	
U4(–1)	–0.08	–0.07	–	–	–	–
	(–2.68)*	(–2.42)*				
U5(–1)	–	–	–0.18	–0.17	–	–
			(–3.98)*	(–3.97)*		
U6(–1)	–	–	–	–	–0.26	–0.26
					(–4.27)*	(–4.4)*
Lags of ΔV1**	9	9	9	9	9	9
F-test for redundant variables (*p*-values in parenthesis)	[$\Delta\pi$, Δy, ΔM1vol, ΔLSP, Δi^s] 1.28 (0.28)	–	[$\Delta\pi$, Δy, ΔM1vol, ΔLSP, Δi^*] 0.60 (0.66)	–	[$\Delta\pi$, Δy, ΔLSP, Δi^*] 0.6 (0.66)	–

Notes: *The correspondent 1%, 5% and 10% asymptotic critical values for the τ-ECM test are equal to (see Ericsson & Mackinnon, 2002): –4.58, –3.98 and –3.66 (equations (3.4A), (3.4B), (3.5A) and (3.5B));–4.35, –3.76 and –3.44 (equations (3.6A) and (3.6B)).

**The equations include several lags of the dependent variable (ΔV1) in order to control for serial correlation.

statistically valid—with the exclusion of income the hypothesis of no cointegration can be rejected at the 5% level. This fact casts doubt on the long-run effect of income on M1 velocity.

Finally, equation (2.6) is the long-run equation of the ECM for which the strongest results were obtained. As can be seen from the *t*-statistics of the error correction mechanisms of equations (3.6A) and (3.6B)—which according to the tests

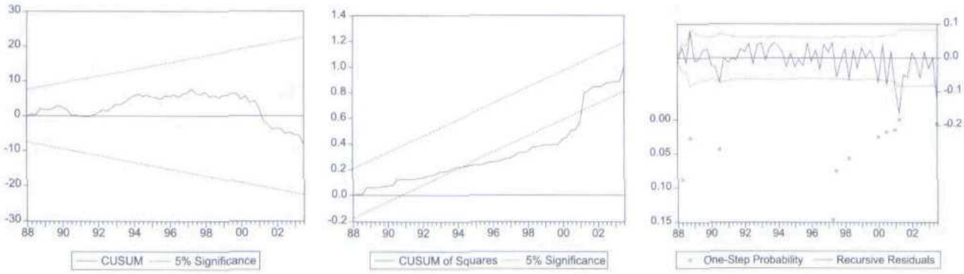

Figure 3. Stability tests for equation (3.4A)

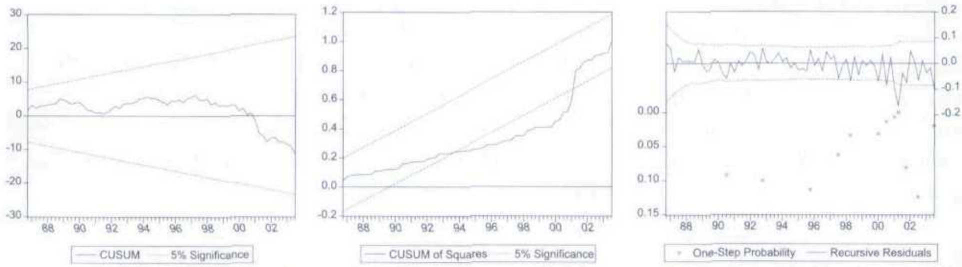

Figure 4. Stability tests for equation (3.4B)

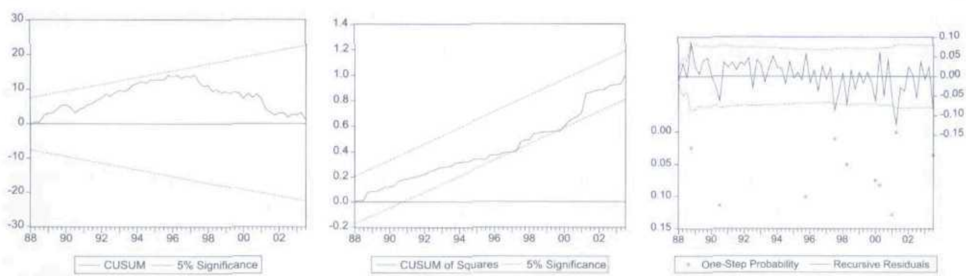

Figure 5. Stability tests for equation (3.5A)

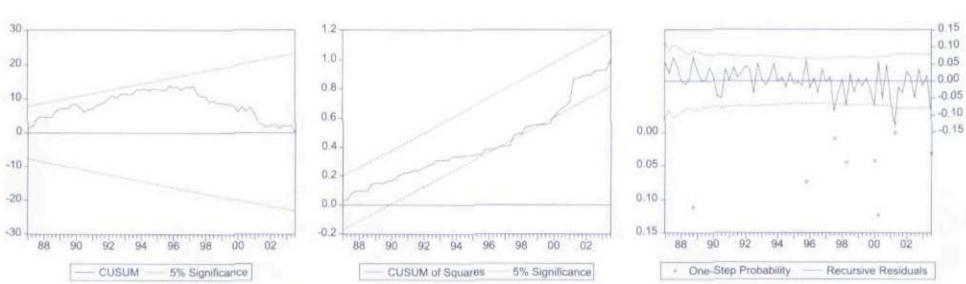

Figure 6. Stability tests for equation (3.5B)

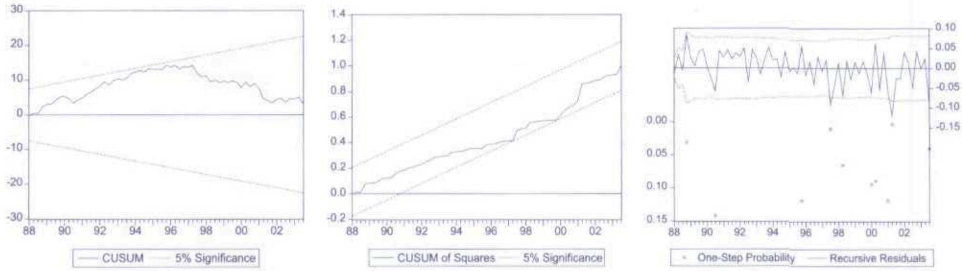

Figure 7. Stability tests for equation (3.6A)

presented in Table 7 and in Figures 7 and 8 are statistically valid—the hypothesis of no cointegration between the variables included in (2.6) can be rejected at around the 1% level.

Taken together, the results of these ECMs are broadly consistent with our previous conclusions. First, in the long run M1 velocity is positively associated with the variable Weight, the long-run interest rate, the ratio between M3 and M1 assets, and negatively associated with M1 volatility. (The long-run association between income and M1 velocity is not clear). On the other hand, the variable Weight has a positive significant effect on M1 velocity in the short-run.

Implications for Monetary Policy in an Endogenous Money Framework

This section draws two implications from the fact that the velocity of money changes over the cycle along with the weight of investment, durable consumption and exports in aggregate expenditure. First, we argue that this fact supports the view, long held by post-Keynesian economists, that money-targeting strategies are not viable. Second, we try to show that the fact that velocity depends on the composition of demand can be useful for the conduct of monetary policy in practice.

Monetary Targeting is not Viable

'For a money-targeting strategy to be viable, at least two conditions must be met: (a) central banks have full control of the money supply and (b) there is a stable relationship between the money supply and money income' (Fontana & Palacio-Vera, 2003, pp. 52–53). In what follows we start by summarizing the well-known reasons why these conditions are unlikely to hold in practice and we then point out that the fact that velocity depends on the composition of demand adds one further reason to be suspicious about condition (b).

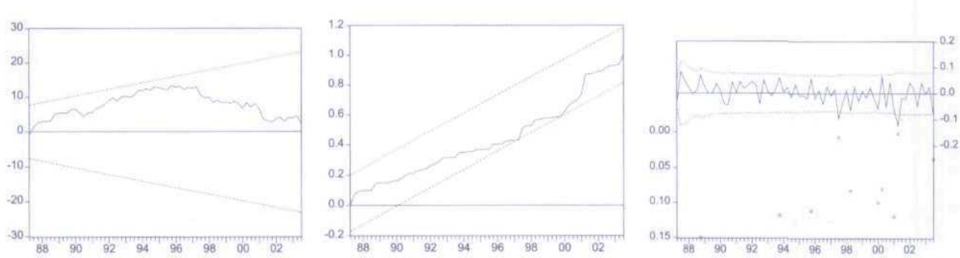

Figure 8. Stability tests for equation (3.6B)

Table 7. Error correction models for M1 velocity: main indicators and statistics (p-values in parenthesis, BG= Breusch–Godfrey)

Statistics	Equation (3.3A)	Equation (3.3B)	Equation (3.4A)	Equation (3.4B)	Equation (3.5A)	Equation (3.5B)	Equation (3.6A)	Equation (3.6B)
Adjusted R^2	0.86	0.87	0.85	0.84	0.90	0.87	0.86	0.87
BG(1)	1.34	1.55	3.16	0.18	2.34	1.60	0.11	0.64
	(0.25)	(0.21)	(0.11)	(0.66)	(0.13)	(0.21)	(0.74)	(0.42)
BG(2)	3.82	3.56	4.72	2.02	4.08	2.27	4.32	4.42
	(0.15)	(0.17)	(0.12)	(0.36)	(0.13)	(0.32)	(0.12)	(0.11)
BG(3)	4.58	4.21	6.27	2.39	5.43	4.68	4.78	4.55
	(0.21)	(0.24)	(0.10)	(0.49)	(0.14)	(0.20)	(0.19)	(0.21)
BG(4)	4.62	4.23	6.36	3.04	5.52	4.93	4.83	4.56
	(0.33)	(0.37)	(0.18)	(0.55)	(0.24)	(0.30)	(0.31)	(0.34)
ARCH(1)	0.14	0.06	1.14	3.21	0.13	0.12	2.7	1.53
	(0.71)	(0.80)	(0.28)	(0.10)	(0.71)	(0.73)	(0.1)	(0.22)
ARCH(2)	0.71	0.70	1.41	3.42	0.81	1.06	2.63	1.57
	(0.70)	(0.71)	(0.49)	(0.18)	(0.67)	(0.59)	(0.27)	(0.46)
ARCH(3)	0.80	0.81	1.39	3.87	0.92	1.09	6.42	3.84
	(0.85)	(0.85)	(0.71)	(0.28)	(0.82)	(0.78)	(0.1)	(0.28)
ARCH(4)	1.25	1.20	1.82	4.34	1.27	1.09	6.23	4.5
	(0.87)	(0.88)	(0.77)	(0.36)	(0.87)	(0.90)	(0.18)	(0.35)
Ramsey RESET test (fit^2)	0.002 (0.97)	0.001 (0.97)	0.0006 (0.99)	0.28 (0.60)	0.012 (0.91)	0.001 (0.97)	0.42 (0.51)	0.54 (0.47)
Ramsey RESET test (fit^3)	0.66 (0.52)	0.51 (0.60)	0.38 (0.68)	1.14 (0.32)	0.78 (0.46)	0.71 (0.50)	2.11 (0.13)	0.93 (0.40)
Chow breakpoint test 1996:4	1.58 (0.10)	1.50 (0.13)	1.81 (0.04)	2.22 (0.01)	1.34 (0.20)	1.33 (0.21)	1.44 (0.16)	1.45 (0.15)
Chow breakpoint test 1997:1	1.54 (0.11)	1.47 (0.14)	1.75 (0.06)	2.17 (0.01)	1.30 (0.23)	1.37 (0.19)	1.41 (0.17)	1.41 (0.17)
Chow breakpoint test 1997:2	1.54 (0.11)	1.48 (0.14)	1.81 (0.04)	2.17 (0.01)	1.32 (0.22)	1.37 (0.19)	1.41 (0.16)	1.41 (0.16)
Chow forecast test 2001:3	0.90 (0.53)	0.90 (0.53)	1.54 (0.16)	1.63 (0.12)	0.98 (0.47)	0.95 (0.48)	1.0 (0.45)	0.95 (0.49)
Chow forecast test 2002:3	1.38 (0.24)	1.36 (0.25)	2.10 (0.07)	1.84 (0.11)	2.03 (0.08)	1.48 (0.21)	1.54 (0.19)	1.44 (0.23)

Condition (a). In modern economies, money is created when banks grant loans and is extinguished when loans are paid off. As a consequence, money supply growth—rather than being exogenously set by the central bank—is ultimately determined by the aggregate net borrowing of the economy. Central banks can affect the rate of expansion of the money supply only indirectly, by influencing the level of net lending to the non-banking sector. Condition (a) will be met only if this indirect influence of the central bank on the rate of expansion of the money supply is very strong.

How strong is it likely to be in practice? There are two views on this question. There are those—the horizontalists—who argue that, on a day-to-day basis, central banks have to accommodate any demand for reserves (because the maintenance of the solvency of the banking system is their most important function), and so monetary growth is solely determined by the non-banking sector (Kaldor, 1986). On the other hand, there are those—the structuralists—who emphasize that, beyond the very short-run, there is some degree of non-accommodation (Pollin, 1991): 'over longer periods the monetary authorities have the upper hand ... the central bank [may] control the money supply ... through a proper knowledge of the demand for money function, and by persistently setting the interest rate at the relevant level' (Lavoie, 1992, p. 205). However, since this demand for money function may shift unpredictably through time the degree of control over the money supply will never be complete, even beyond the short-run.

Condition (b). Even if central banks can somehow affect the money supply beyond short periods, by changing interest rates, money-targeting strategies will still not be viable because the relationship between the money supply and money income is bound to be unstable. (For empirical evidence, see, for example, Blinder (1998).) There are at least two reasons that may explain that instability and thus render money targeting undesirable.

First, because 'the velocity [V] of such an aggregate [M1] varies substantially in response to small changes in interest rates, target ranges for M1 growth [are not] reliable guides for outcomes in nominal spending [M1.V] and inflation ... in response to an unanticipated change in spending and hence in the quantity of money demanded, a small variation in interest rates would be sufficient to bring money back to path but not to correct the deviation in spending' (Greenspan, 1997, pp. 4–5, quoted in Fontana & Palacio-Vera, 2003, p. 58). In turn, the large interest rate elasticity of velocity can be attributed to financial innovations and liability management practices (Pollin, 1991).

Second, the results obtained in this paper seem to indicate that the velocity of money changes significantly from period to period as a result of changes in the composition of aggregate demand. Therefore, even if velocity is inelastic with respect to changes in interest rates, money growth targets will still remain unreliable guides for nominal spending and thus for the conduct of monetary policy.

Dependence of Velocity on the Composition of Aggregate Demand and the 'Information Variable' Approach to Monetary Policy

The so-called 'information variable' approach to monetary policy argues that central banks should not design monetary policy on the basis of one single variable—such as the money supply—but instead exploit all relevant sources of information (Friedman, 1988). In this setting, the idea that the velocity of money changes with the composition of aggregate demand may lead us to draw either of the two following implications for the conduct of monetary policy.

On the one hand, that idea suggests that the interpretation of the information conveyed by the evolution of the money stock about the likely behaviour of the aggregate demand should take into account the changes in its components. For instance, if there is a fall in aggregate demand due to sharp reductions in investment and consumption of durable goods (as often happens during recessions), and, at the same time, the money stock keeps rising at significant rates, the central bank should not interpret this as necessarily meaning that the decline in demand is temporary, that there soon will be a rebound, and that therefore an interest rate cut may be dangerously inflationary. Instead, because the upward course of the money stock is accompanied by sharp declines in the high-velocity components of aggregate demand, the average velocity of circulation will fall, and no resumption in nominal spending should be expected. As a result, an interest rate cut would probably be needed in spite of the fact that the money stock is growing at relatively rapid rates.

In January 2004 the European Central Bank (ECB) decided to keep interest rates unchanged. Let us look at this decision in the light of our analysis. Despite a stagnant economy (+1.5% change in GDP since March 2001) and an appreciation of the euro in trade-weighted terms of 22% since March 2001 that had been squeezing net exports, the ECB decided not to cut interest rates. One important reason behind this decision was that an interest rate cut would risk fuelling the already high growth rates of liquidity (narrow and broad money had been increasing at annual rates of around 7% since March 2001). However, if the ECB had taken into account that the sharp falls in investment and durable goods consumption (–6.1% and –13.6% since March 2001, respectively) were leading to declines in velocity, and that as a result the growth in liquidity would not be inflationary, perhaps an interest rate cut would have been decided instead (data from ECB, 2002, 2003 and 2004).

A different—more extreme—implication may be drawn from the idea that the velocity of money changes with the composition of aggregate demand. It may lead us to believe that the velocity of money is very erratic and that, therefore, the link between the course of the money stock and that of nominal spending is very weak. If this is true, then central banks should ignore the path of the money stock because it will not supply any relevant information about the behaviour of aggregate demand.[7] Instead, monetary policy should be based on adjusting interest rates in order to keep aggregate demand growing in line with supply-side capacity growth, 'a framework which can be traced to Chapter 21 of Keynes's (1936) General Theory' (see Dalziel, 2002, p. 511).

Conclusion

There are significant differences in the velocity of money of the different types of expenditure. This result has the following implication: the changes in the composition of aggregate demand that occur along the business cycle bring about significant changes in the average velocity of money.

As far as monetary policy is concerned, two types of lessons may be drawn. First, we have a further reason to suspect about the viability of monetary targeting regimes. On the other hand, we may argue that in the conduct of monetary policy central banks should either ignore the path of the money supply, or—at the very least—examine that path in light of other information (namely, the weight of the high-velocity components of aggregate demand) so as to avoid the risk of overestimating its relevance.

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Notes

1. The overwhelming evidence that durable consumption and investment have greater cyclic amplitudes than NDGS has been clearly emphasized by R. J. Barro: 'most of the movement of output in the business cycle is in a component we call investment or, more broadly, durables—I would want to include consumer durables and inventories. If you look at consumer non-durables and services, they move very little' (see Snowdon *et al.*, 1994, p. 274). These facts may in turn be (at least partly) explained by the accelerator principle.
2. In this way we avoid the omission of any important regressor and thereby comply with the encompassing principle (i.e. we show the significance of our explanatory variable in a regression where we also give a chance to the other variables to show the proportion of the variability of M1 velocity that is attributable to their own behaviour). For surveys of econometric studies of velocity and money demand functions, see Laidler (1993) and Ericsson (1998).
3. Friedman arrives at this conclusion by developing an 'analysis of the demand for money … formally identical with that of the demand for any consumption service' (Friedman, 1969, p. 52): given tastes, the individual maximizes utility subject to his budget constraint (permanent income) and the relative return on assets that are alternative to money (bonds, equities and goods). With some simplifying assumptions (see Friedman, 1969, pp. 53–58), and considering short-term as well as long-term bonds, this optimization problem leads to the following demand function for money:

$$(M / p)^{\mathrm{d}} = (\pi, i^{\mathrm{s}}, i^{\mathrm{l}}, i^{\mathrm{e}}, w, Y) \tag{1A}$$

which can be also written in the form of a velocity function:

$$V = (pY) / M^{\mathrm{d}} = h((\pi, i^{\mathrm{s}}, i^{\mathrm{l}}, i^{\mathrm{e}}, w, Y) \tag{1B}$$

where M is money (however defined), p is the price level, w is the ratio between human wealth and all other forms of wealth (a ratio that is fixed) and V is the velocity of money.

Keynesian economists tend to take a different view on this issue. First, instead of considering many assets as alternative to money and including their returns separately in the money demand and velocity functions, Keynesian economists tend to lump financial assets into one big category (bonds) because they regard their returns as generally moving together. Second, Keynesian economists do not to view money and goods as substitutes, and therefore do not include the return on goods relative to money (inflation) as a term in the money demand and velocity functions (on these two—and other—differences between Keynesian and monetarist theories of the demand for money, see Mishkin (2004, pp. 530–531)).
4. Why? Non-GDP real estate transactions (e.g. existing-home transactions) require the transfer of funds through checkable accounts, and thus lead to an increase in the demand for M1 but not for M3 assets. On the other hand, 'even after recognizing that very little *financial market trading* requires the transfer of funds through transaction accounts … the increase in such trading can be so substantial that it nevertheless must yield a significant … increase in the demand for M1 [relative to M3 assets]' (Pollin & Schaberg, 1998, p. 139; for evidence, pp. 149–151). We can therefore conclude that an increase in non-GDP transactions may lead to an increase in M1/M3; and, conversely, that a decrease in non-GDP transactions may cause a decrease in M1/M3—that is an increase in M3/M1. On the other hand, the fact that a decrease in non-GDP transactions reduces the demand for M1 leads in turn to an increase in the income-velocity of M1.
5. The theoretical underpinning for this procedure is the Engle Representation Theorem, which says that if a set of variables is cointegrated then there exists a valid error correction representation of the data.
6. Two points should be noted. First, the contemporaneous short-term interest rate was not statistically significant. On the other hand, the two-period lagged short-term interest rate should have a positive instead of a negative effect on M1 velocity. We have not found an explanation for this statistical result; it may however be somehow offset by the positive sign of the opportunity cost variable in the long-run equation.
7. This seems to be the view taken both in the USA and in the UK. For example, Arestis and Sawyer (2002, p. 539) argue that in the day-to-day setting of monetary policy in the UK 'the money supply is not mentioned, and the demand for money [and velocity] is viewed as either unstable (Treasury) or is treated residually (Bank of England)'.

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