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Abstract: Leão (2005) has recently proposed a new explanation for the short run variability of the velocity of money based on the changes in the composition of the expenditure that occur along the business cycle. This paper presents further empirical evidence in favour of Leão's Expenditure Composition Hypothesis, and draws new implications of this hypothesis for monetary policy.

We use a VAR model to analyze the determinants of the velocity of both M1 and M3 in the USA. The main conclusion is that increases in the weight of investment and durable consumption in total expenditure raise the velocity of both narow and broad money. This is in line with the Expenditure Composition Hypothesis. Furthermore, we draw a new implication of this hypothesis for monetary policy. The more a central bank's decisions on the interest rate respond to money growth, the more volatile economic growth will be. In other words, a monetary policy strategy - like that of the ECB – which puts emphasis on money growth is de-stabilizing.

Key words: Velocity of money, monetary policy, business cycle.
JEL: E12, E32, E40, E41, E52, E58

1. Introduction

The failure of the monetarist policies in the late 1970s and early 1980s led to a new paradigm in the 1990s in both the theory and practice of monetary policy. In theory, macro-economists moved away from the Quantity Theory of money as a framework to understand the behaviour of prices and output. In practice, central banks progressively abandoned money targeting in favour of inflation targeting (McCallum, 2001 and Meyer, 2001). Today, most central banks, including the Federal Reserve and the Bank of England, do not look at monetary aggregates when making their interest rate decisions. There is, however, an important exception. The European Central Bank still stresses the importance of monetary growth, the second of its "two-pillar" policy strategy (see ECB, 2004, pp. 55-66).

This paper has two main goals. First, we use a VAR model to provide new evidence in favour of the Expenditure Composition Hypothesis recently proposed by Leão (2005). Second, we draw a new implication of this hypothesis for monetary policy. Specifically, we argue that the more a central bank's interest rate decisions respond to money growth, the more volatile economic growth tends to be. In other words, a monetary policy - like that of the ECB – which puts emphasis on money growth is de-stabilizing.

The paper is organized as follows. In section 2 we briefly explain the Expenditure Composition Hypothesis. Section 3 presents the empirical evidence. In section 4, we explore a new implication of the Expenditure Composition Hypothesis for monetary policy. Section 5 concludes.

2. The Expenditure Composition hypothesis

The pro-cyclical behaviour of the velocity of money is a well-estabilished empirical fact (see Leão, 2005, p. 120, Table 1; Mishkin, 2004, pp. 520-521). This fact is usually explained by the effect of the opportunity cost. During expansions (recessions), inflation and interest rates and hence the opportunity cost of holding money usually rise (fall), and thus velocity increases (decreases).

Leão (2005) has proposed an alternative explanation for the pro-cyclical movement of velocity. He starts 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). Since, on the other hand, the expenditures in investment and durable consumption goods move with greater amplitudes than 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. The empirical basis for this argument is illustrated in the following table.

Table 1. Cyclical amplitudes of M1 velocity, GNP and some of its components (%)

	Average, 4 cycles 1921-38		Average, 4 cycles 1949-70		Average, 3 cycles 1970-82		Average, 2 cycles 1982-01	
	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

Source: Leão (2005), Table 2, p. 121

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. Take the following example. Consider a household who receives $30 at the beginning of the month and spends them on NDGS during the month, at the rate of $1 per day. For this household, the dollar spent in the last day of the month remains idle during 29 days, the dollar spent on the 29$ 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* 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.

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.

3. Empirical Evidence

Leão (2005) tested the *Expenditure Composition Hypothesis* using a single equation framework. He first tested for co-integration and then run both long and short run equations for M1 velocity. There was evidence of cointegration between the M1 velocity, the weight of high velocity expenditures in total expenditure, and the long run interest rate. In the short run, there was a positive significant effect of the weight on the M1 velocity.

In this paper, we present further empirical evidence in favour of the *Expenditure Composition Hypothesis*. A step forward is taken in two directions. First, we use an empirical approach more in line with the literature on monetary policy – a VAR framework (Christiano et. al. 1999 provide a review). Second, we show that Leão's results for M1 velocity also apply to M3 velocity.

3.1. Looking at the data

Table 2 shows the amplitudes of variation of V1, V3, Weight and interest rates in each phase of the US business cycle, as defined by the National Bureau of Economic Research.

Table 2. Cyclical amplitudes of the Weight, Interest rate and V1 and V3

Start	End	Phase	Weight	R	V1	V3
1960:2	1961:1	R	-1.4%	-1.7%	-1.0%	-4.9%
1961:1	1969:4	E	3.4%	6.9%	28%	-0.7%
1969:4	1970:4	R	-0.9%	-3.4%	-0.2%	-4.2%
1970:4	1973:4	E	4.5%	4.4%	10.8%	7.1%
1973:4	1975:1	R	-3.2%	-3.7%	3.9%	-1.0%
1975:1	1980:1	E	3.9%	8.7%	20.7%	2.2%
1980:1	1980:3	R	-1.6%	-5.2%	-0.6%	-2.1%
1980:3	1981:3	E	1.8%	7.7%	6.5%	1.5%
1981:3	1982:4	R	-3.3%	-8.3%	-5.5%	-8.4%
1982:4	1990:3	E	4.3%	-1.1%	1.8%	4.2%
1990:3	1991:1	R	-1.1%	-1.7%	-1.5%	-0.5%
1991:1	2001:1	E	8.6%	-0.8%	25.3%	-2.4%
2001:1	2001:4	R	-1.7%	-3.5%	-4.0%	-6.6%

Source: Gomes (2006). Cycle dates are from NBER and Data from FRED II. The cyclical amplitudes of velocity is the percentage change from start to end points. The cyclical amplitudes of the Weight and interest rates are the percentage points changes from start to end points.

As can be seen, the variable Weight is undoubtedly pro-cyclical: it increased in every expansion and decreased in every recession. The interest rate was pro-cyclical until the end of 1982, but since then it has decreased in both recessions and expansions. With only three exceptions, both M1 and M3 velocities moved pro-cyclically.

3.2. VAR Model

Following an extensive empirical literature on monetary policy, we estimate a Vector Autoregression for M1 velocity and for M3 velocity.

Consider the a structural moving average representation of the model:

$$X_t = A_0\varepsilon_t + A_1\varepsilon_{t-1} + A_2\varepsilon_{t-2} + \ldots = \sum_{i=0}^{\infty} A_i\varepsilon_{t-i} \quad (1)$$

In matrix form it is:

$$X_t = A(L)\varepsilon_t \qquad (2)$$

Where $X_t = \lfloor \Delta VM_t, \Delta IR3m_t, \Delta Weight_t, GDP_t \rfloor$ includes the Velocity of money (VM), the Gross domestic product at constant prices (GDP) , the three month interest rate (Ir3m) and the Weight (the sum of investment, durable consumption and exports divided by total aggregate expenditure). They are in log-differences form based in Leão (2005) results. A is a 4×4 matrix that defines the impulse response of endogenous variables to structural shocks and $\varepsilon_t = \left[\varepsilon_t^{VM}, \varepsilon_t^{GDP}, \varepsilon_t^{IR3m} \varepsilon_t^{Weight}\right]$ are the shocks affecting the velocity of money and the GDP, the interest rate and the weight. It is assumed that they are serially uncorrelated and orthogonal with a variance-covariance matrix normalised to the identity matrix. The VAR model corresponds to the following system:

$$\Delta Z = A_{11}(L)\varepsilon_t \qquad (3)$$

3.3. Estimation of the VAR

With the variables stationary in first differences (see Leão, 2005) and in logarithms the VAR simultaneous equations in (1), taking into account the stationary nature of the series. Because each equation has identical right-side variables, ordinary least squares (OLS) is an efficient estimation technique (Ender, 1995).

The results for the VAR for M1 velocity and M3 velocity are presented in Tables 3 and 4, respectively. The sample period ranges from 1964:4 to 2005:4.

Table 3. VAR estimation with V1, GDP, interest rate and Weight:

	dvm1	GDP	Dir3m	Dweight
Constant	0.022 (0.6500)	0.004 (1.4628)	0.0249 (0.1007)	0.0069 (-0.8012)
Dvm1 (t-1)	1.1503 (12.785)	-0.0254 (-3.033)**	1.0332 (1.6365)	-0.0721 (-3.255)*
Dvm1 (t-2)	0.029 (0.1931)	0.0276 (1.934)	-1.0108 (-0.9430)	0.0718 (1.9107)*
Dvm1(t-3)	0.143 (0.9320)	0.0097 (0.6798)	0.7010 (0.6482)	0.0334 (08822
Dvm1 (t-4)	-0.325 (-3.4840)	-0.0122 (-1.4016)	-0.7435 (-1.1328)	-0.0329 (-1.4311
Dgdp(t-1)	-0.9385 (-0.674)	0.4298 (3.3071)*	-2.5461 (-0.2608)	0.00009 (0.7275)
Dgdp (t-2)	1.5937 (1.0970)	0.3673 (2.7060)*	0.2305 (0.022)	-0.00002 (-1.6137)
Dgdp(t-3)	-1.7634 (-1.2152)	-0.0939 (-0.6928)	3.5231 (0.3459)	-0.000001 (-0.1383)
Dgdp(t-4)	1.3620 (0.9829)	0.0766 (0.5922)	2.431 (0.2500)	-0.00001 (-0.1383)
dir3m(t-1)	0.0046 (0.4190)	-0.0008 (-0.8218)	-0.7959 (-10.487)*	-0.00091 (-0.3391
dir3m(t-2)	-0.0048 (-0.3674)	-0.0008 (-0.6639)	-0.6127 (-6.6154)*	-.00011 (-0.0353)
dir3m(t-3)	-0.010 (-0.7590)	-0.0016 (-1.2852)	-0.4056 (-4.3430)*	-0.0033 (-1.0350
dir3m(t-4)	-0.0044 (-0.4063)	-0.0016 (-1.5904)	-0.2055 (-2.7064)*	-0.0044 (-1.6346
dweight(t-1)	0.6884 (1.3524)	-0.041 (-0.8799)	2.8296 (0.7921)	0.00036 (0.0310)
dweight(t-2)	-0.4018 (-0.7857)	-0.0834 (-1.7455)	1.7145 (0.4777)	0.0254 (0.2154)
dweight(t-3)	0.2315 (0.4604)	-0.0068 (-0.1468)	-0.8798 (-0.2493)	0.0863 (0.7373)
Dweight(t-4	-0.2430 (-0.4823)	-0.0190 (-0.4037)	0.6458 (0.1826)	0.0475 (0.4105)
R2 (centered)	0.997	0.221	0.37	0.195
DW	1.87	1.919	2.004	1.807
F	13476.60	6.016	22.691	4.115
Nobs	166	166	166	166

Note: t statistic in parentheses. ***, **, * Denote a statistic is significant at the 1%, 5% and 10% level of significance.

Table 4. VAR estimation with V3, GDP, interest rate and Weight, GDP :

	Dvm3	dGDP	Dir3m	Dweight
Constant	-0.0012 (-0.6359)	0.0017 (1.1334)	-0.0763 (0.6703)	-0.0065 (-1.6442)
Dvm3 (t-1)	0.5202 (4.4196)*	-0.1199 (-1.0926)	-2.1946 (-0.3116)	-0.0020 (-0.7624)
Dvm3 (t-2)	-0.1002 (-0.7251)	-0.1199 (-1.0926)	9.9541 (1.2030)	-0.0014 (-0.4515)
Dvm3 (t-3)	0.2630 (1.8951)*	0.1235 (1.1466)	5.3780 (0.6476)	-0.0044 (-1.3810)
Dvm3 (t-4)	-0.0788 (-0.6657	-0.0377 (-0.4018)	-4.3394 (-0.6121)	-0.0051 (-1.9014)
Dgdp(t-1)	-0.2901 (-1.6035)	0.4245 (2.9552)*	4.9943 (0.4612)	-1.2918 (-3.4304)
Dgdp (t-2)	0.3736 (1.8745)	0.4687 (2.9620)*	-8.4784 (-0.7109)	0.7980 (1.9241)
Dgdp(t-3)	-0.1660 (-0.8309)	-0.1819 (-1.1468)	4.9270 (0.4121)	-0.8540 (-2.0537)
Dgdp(t-4)	0.2210 (1.1703)	0.1176 (0.7846)	7.2663 (0.6428)	0.0138 (0.0352)
dir3m(t-1)	-0.0013 (-1.026)	-0.0009 (-0.9033)	-0.7145 (-9.7145)*	-0.4297 (-1.7547)*
dir3m(t-2)	-0.0009 (-0.6092)	-0.0007 (-0.6495)	-0.4826 (-5.2469)*	-0.3685 (-1.2808)
dir3m(t-3)	-0.0018 (-1.2207)	-0.0014 (-1.2184)	-0.2994 (-3.2478)*	-0.4589 (-1.5890)
dir3m(t-4)	0.00017 (0.1359)	-0.00150 (-1.4719)	-0.1162 (-1.5063)*	0.2468 (1.0013)
dweight(t-1)	-0.0326 (-0.5357)	-0.0513 (-1.0607)	3.4593 (0.9476)	-0.1352 (-1.0648)
dweight(t-2)	-0.0603 (-1.0037)	-0.0889 (-1.8617)	0.9778 (0.2717)	-0.0683 (-0.5460)
dweight(t-3)	-0.0682 (-1.1351)	-0.0051 (-0.1077)	-1.4482 (-0.4028)	0.0875 (0.7005)
Dweight(t-4	-0.0440 (-0.7320	-0.0307 (-0.6437)	1.1064 (0.3070)	-0.0641 (-0.5116)
R2 (centered)	0.233	0.209	0.36	0.174
DW	1.924	1.94	2.016	1.89
F	11.398	11.211	21.44	4.382
Nobs	166	166	166	166

Note: t statistic in parentheses. ***, **, * Denote a statistic is significant at the 1%, 5% and 10% level of significance.

3.4. Variance decomposition

Based on the results above, we obtained the variance decomposition for the parsimonious model for three different forecasting horizons. We used the Choleski factorisation orthogonalized innovations. The order used was Weight→ VM, since it is the logical ordering. Each order explains the preponderance of its own forecast error variance for the ordering.

Tables 5 and 6 present the variance decompositions for V1 and V3, respectively. They allow us to compare the size of the effects of the weight, the GDP, and the interest rate on both velocities.

Table 5. Variance decomposition of V1

Quarters ahead	Weight	GDP	Interest rate	V1
1	0.01049	0.0039	0.0422	0.08012
2	0.00211	0.00082	0.07146	0.09590
3	0.00082	0.000025	0.0414	0.11418
4	0.00034	0.00011	0.0549	0.13920
5	0.00111	0.00041	0.0012	0.1546
6	0.00123	0.00017	0.0036	0.16580

Table 6. Variance decomposition of V3

Quarters ahead	Weight	GDP	Interest rate	V3
1	0.01599	0.00754	0.026204	0.0070
2	0.00451	0.00145	0.05893	0.00089
3	0.00303	0.001453	0.01259	0.00095
4	0.00044	0.00014	0.04125	0.00044
5	0.00059	0.00012	0.002150	0.00003
6	0.00075	0.00023	0.006176	0.00020

As can be seen, the variable Weight explains a significant part of the variance of both velocities, much higher than any other variable.

4. Implications for Monetary Policy

This section presents an implication for monetary policy of the Expenditure Composition Hypothesis which was not considered by Leão (2005).

Central bank's responses to money growth accentuate the business cycle

Suppose the central follows the following interest rate rule:

$$R = r_N + \beta(\pi-\pi^*) + \gamma(y-y^*) + \alpha(g_M - g_{M^*}) \quad (1)$$

$\beta, \gamma > 0; \alpha \geq 0$

Where R is the nominal interest rate set by the central bank, r_N is the (nominal) natural interest rate, $(\pi-\pi^*)$ is the deviation of inflation from the target, $(y-y^*)$ is the output gap, g_M is the growth rate of money and g_{M^*} is the central bank's target for money growth.

If $\alpha = 0$, the last term disappears and the expression becomes the standard Taylor rule: the central bank sets the interest rate equal to the nominal natural interest rate plus a response to deviations of inflation and/or output from their respective targets. This corresponds to the policy stance of both the Federal Reserve and the Bank of England. For instance, according to Greenspan (2004, p. 35) "rules that relate the setting of the federal funds rate to deviations of output and inflation from their respective targets …. do seem to capture the broad contours of what we did over the past decade and a half."

By contrast, the ECB has an explicit reference value for money growth (g_{M*}=4.5%), and therefore its α is positive: the ECB will raise interest rates if money growth persistently exceeds its reference value.

What are the implications of a positive α? Suppose there is a negative investment shock that starts a recession. Typically, the growth of non-durable consumption goods and services (NDGS) will not be significantly affected. By contrast, along with the fall in investment, the decline in output will often be associated with a marked reduction in the consumption of durable goods. In other words, recessions tend to be associated with sharp declines in high velocity expenditures (low-intensive in money), and almost no slow down in the growth rate in high-velocity expenditures. (high-intensive in money) As a result, recessions are often associated with relatively high money growth.

What will be the response of the ECB? During the recession, output growth - and possibly inflation – will go down below their targets and this will press for a reduction in the interest rates. However, the investment-driven recession is associated with high money growth, and this will counter the case for an interest rate cut. In other words, while the first two elements of the interest rate rule are counter-cyclical, the last one works pro-cyclically. The addition of a response to money growth to an otherwise standard Taylor rule makes monetary policy less counter-cyclical – and therefore accentuates the business cycle.

The Monetary Policy of the ECB during 2002

The stance of the monetary policy of the ECB during 2002 is a perfect illustration of what has just been said. Output growth in the euro area fell from 4% in late 2000 continuously down to less than 1% in the beginning of 2002, where it persistently stood during the whole year. Inflation also fell during 2001 and in 2002 it remained only marginally above the 2% target. However, the ECB refused to cut interest rates during the whole year of 2002. Interest rates were kept unchanged at 3.25%. Why? The ECB monthly bulletin of July 2002 was quite clear about this: “All in all, the upward risks to future price stability stemming from the monetary pillar are becoming increasingly apparent”. Indeed, money growth stood persistently around 8% during the whole year of 2002, far above its reference value, and the ECB viewed this as a threat to future price stability.

Only after one year of high growth rates of money without any alarming increase in inflation did the ECB changed its stance. During the first seven months of 2003, it cut interest rates three times down to 2% in order to stimulate the economy.
The result was sluggish output growth in 2002. However, if the ECB was aware of the *Expenditure Composition Hypothesis* it would have acted promptly in early 2002 instead of waiting for a year. Indeed, beginning in mid 2001 investment and durable consumption experienced large and persistent negative growth rates. Hence, the *Expenditure Composition Hypothesis* would have suggested that the high growth rates of money were likely to be associated with declines in velocity, posing no threat to price stability. Interest rate cuts in early 2002 would have been made and a higher, non-inflationary, growth would have followed.

4. Conclusion

Using a VAR model to analyze the determinants of the velocity of both M1 and M3 in the USA, we found evidence backing Leão’s *Expenditure Composition Hypothesis*.

Increases in the weight of investment and durable consumption in total expenditure raise the velocity of both narrow and broad money.

On the other hand, we drew a new implication for monetary policy of the Expenditure composition Hypothesis. The more a central bank's interest rate decisions respond to money growth, the more volatile economic growth will be. In other words, a monetary policy which puts emphasis on money growth - like that of the ECB – is de-stabilizing.

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