DOI: 10.18267/j.pep.341

ON THE RELATIONSHIP BETWEEN REAL AND NOMINAL VARIABLES IN DEVELOPED COUNTRIES

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Abstract:
The paper examines money-output and price-output relations in developed countries between 1980 and 2005. We observe that declines in the nominal monetary base are connected with a moderately below-average behaviour of the real output. The same result applies for small positive growth rates of nominal *M1* and *M2*. High growth rates of money are associated with the above-average product growth. We have some evidence that broader monetary aggregates are more closely associated with the real product than narrower monetary aggregates. As opposed to the money-output connection, we show that low inflation was accompanied by high product growth.

Keywords: consumer prices, developed countries, nominal monetary aggregates, real output

JEL classification: E31, E40, O40

1. Introduction

One of the most important and interesting problems in macroeconomics is the connection between real variables (such as the real product, industrial production, and unemployment) and nominal variables (such as the monetary aggregates and the price level). If money affects output, we call this phenomenon the non-neutrality of money. If, on the other hand, changes in money have no effects on output, then money is neutral. In economics most people believe that in the short run money is non-neutral, whereas in the long run it is neutral. In the long run, the real product stays at its potential level and the rate of unemployment equals the natural rate of unemployment. The potential product is mainly given by the factors of production and technology, and is not given by nominal variables.

The literature focusing on the relationship between real and nominal variables is extensive. There exist two fundamental studies: Friedman and Schwartz (1963) and Romer and Romer (1989). These studies are based on the *narrative approach*. Friedman and Schwartz study the monetary history in the United States between 1867 and 1960. Their analysis starts with the greenback period and ends with the discussion of the postwar rise in the velocity of money. The book shows the evolution of money, income, prices, and velocity. Friedman and Schwartz try to explain the fundamental reasons leading to the Great Depression in 1929–1933. Between 1920 and 1937, they find four periods

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of monetary shocks in which the monetary evolution was unusual under given economic conditions. They document the effects of money on the real economy. Romer and Romer (1989) somewhat differ from Friedman and Schwartz (1963) in the definition of a monetary shock. They regard as a monetary shock only situations in which the Fed attempted to reduce the product growth in order to decrease the inflation. They also provide a rigorous analysis for the postwar period. They show that monetary contractions had real effects.

Beside the narrative approach, there exists *a statistical approach* (see, for example, Attfield and Duck, 1983; Kormendi and Meguire, 1984; Duczynski, 2006). Attfield and Duck examine 11 countries and show that money affects the real output only if the money growth is unpredictable. Kormendi and Meguire study 47 countries and observe a short-run monetary non-neutrality and a long-run neutrality. Duczynski finds that correlations between the money growth and the product growth are small but statistically significantly positive in a broad sample of countries in the 1975–2000 period. Other relatively recent studies discussing the neutrality or the non-neutrality of money include Serletis and Koustas (2001), Lin and Yang (2003), and Portier (2004).

An important survey of the literature dealing with the relationship between real and nominal variables is provided in Walsh (2003, Chapter 1): McCandless and Weber (1995) study data from 110 countries in a 30-year period. They find that the correlation between inflation and the money growth rate is almost 1, varying from 0.92 to 0.96. They also conclude that there is no correlation between either money growth or inflation and the real output growth. Similarly, Geweke (1986) argues that for the United States, there is no long-run effect of money growth on real output growth. Other studies confirming the long-run neutrality of money include Boschen and Mills (1995) and Bullard and Keating (1995).

Monetary economics is also concerned with the relationship between interest rates, inflation, and money. The Fisher effect states that nominal interest rates should move together with inflation. Monnet and Weber (2001) focus on the period 1961 to 1998 in a sample of 31 countries. They observe a correlation of 0.87 between money growth and long-term interest rates. This is consistent with the Fisher effect. Mishkin (1992) examines the interest rate – inflation correlation in the U.S. data and also finds support for the Fisher effect. De Grauwe and Polan (2005) consider a sample of almost 160 countries over the previous 30 years. They find a strong positive relation between long-run inflation and the money growth rate. However, this relationship is weak in low-inflation countries.

Regarding short-run relationships between money and output, Walsh (2003, pp. 12-13) presents simple dynamic correlations from the U.S. quarterly data from 1967 to 2000. The monetary base M0 is positively correlated with real GDP (the gross domestic product) at both leads and lags. In contrast, M2 is strongly positively correlated at lags but negatively correlated at leads.

From econometric techniques analysing the impact of money on output, we can mention St. Louis equations, Granger causality tests, and vector autoregressions (VAR). Friedman and Meiselman (1963) regressed nominal income on present and lagged values of autonomous expenditures, present and lagged values of monetary variables, and on other variables. They observed that there was a much more stable and statistically significant relationship between output and money than between output and their mea-

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sure of autonomous expenditures. Regressions of nominal income on money are often called St. Louis equations. Granger causality tests were proposed by Sims (1972). These tests are based on regressions of real income on lagged values of money, lagged values of income, and lagged values of other variables. Vector autoregressions (VAR) were introduced by Sims (1972, 1980). In this approach, a vector of output and a monetary variable is regressed on the first lag of this vector, multiplied by a matrix polynomial in the lag operator.

Concerning the Czech literature discussing monetary policy and its effects, we can mention, for example, Izák (1995) and Bulíř (1996), who deal with selected problems of the endogeneity and the exogeneity of money. Frait and Komárek (2006) examine the concept of the neutrality and the superneutrality of money. Brůna (2007) focuses on the interest rate transmission mechanism of monetary policy. Šmídková and Bulíř (2007) analyse the main communication tools of the Czech National Bank.

The paper is organized as follows. Section 2 presents some theoretical elements of the money supply and the money demand. Section 3 discusses the channels of monetary policy. Section 4 is devoted to the problem of endogenous money. Section 5 brings the main results, and Section 6 concludes.

2. The Money Supply and the Demand for Money

Before we turn to the empirics of the non-neutrality of money, we will briefly discuss some theoretical elements of the money supply and the money demand. It may be useful to add some theory to the empirics. The stock of money (M) is the sum of currency (C) and deposits (D) of commercial banks:

$$M = C + D \tag{1}$$

In the equilibrium, the money stock equals the money supply (M^S). We have different monetary aggregates (like $M1$ or $M2$) depending on what kinds of deposits are counted. Roughly speaking, $M1$ includes demand deposits only, while $M2$ includes demand deposits and time deposits. The monetary base (in the present paper denoted by $M0$) is the sum of currency and reserves of commercial banks, R:

$$M0 = C + R \tag{2}$$

By open market operations (OMO) the central bank can directly control $M0$. In this case the central bank sells or purchases government bonds. If, for example, the central bank purchases government bonds, $M0$ goes up. M^S depends on $M0$ in the following way:

$$M^S = m\ M0, \tag{3}$$

where $m=(C+D)/(C+R)=(C/D+1)/(C/D+R/D)$ is the money multiplier. Equation (3) is a traditional monetarist equation of the money supply. We directly observe that the money multiplier depends negatively on R/D. If we took a derivative of m with respect to C/D, we would find that m also depends negatively on C/D. For example, in the Great Depression in the United States in 1929–1933, people preferred currency to bank deposits and commercial banks held excess reserves. As a result, the money multiplier was low.

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In the equilibrium, the money supply (M^S) should equal the money demand (M^D):

$$M^S = M^D = M \tag{4}$$

We can write the quantity equation:

$$MV = PY, \tag{5}$$

where V is the velocity of money, P is the price level, and Y is the real product. Hence, PY is the nominal product. Monetarism is the school of thought according to which V is relatively stable and predictable. In this situation M is the major determinant of PY. In the short run M influences both P and Y, while in the long run M influences only P. Monetarism is based on the quantity theory of money. This relatively old theory claims that also Y is relatively stable, so that P is directly proportional to M. Sometimes the quantity theory of money is called the quantity theory of prices.

The money demand, M^D, is typically assumed to be a negative function of nominal interest rates and a positive function of output:

$$M^D/P = \mathrm{f}(i,Y), \tag{6}$$

where i is the nominal interest rate. Although equation (6) has its roots in the neo-Keynesian economics, we adopt its form here. From the money demand equation and the quantity equation, the velocity of money can be written as

$$V = PY/M = Y/\mathrm{f}(i,Y). \tag{7}$$

Thus, for a given level of output, velocity depends positively on interest rates since the function f is decreasing in the interest rate.

3. The Money Channels

There exist a certain number of channels through which monetary policy can affect the real economy. These are mainly the interest rate channel, the exchange rate channel, the equity channel, the bank lending channel, and the balance sheet channel. A decrease in the money supply shifts the money supply curve in the money market to the left. This new supply curve intersects the money demand curve at a higher nominal interest rate. Some aggregate demand components - investment and consumption of durables - depend negatively on the real interest rate. Higher rates depress these components and the output level (the interest rate channel). Duczynski (2006) explains the effect of monetary policy on interest rates (the liquidity effect) based on the bond market instead of the money market and gets the same result. One problem with the interest rate channel is that investment and consumption should be sensitive to real interest rates instead of nominal interest rates, which are determined on the money market. Another problem is that sometimes interest rates may be high if we have monetary expansion because of high inflation. In an open economy with flexible exchange rates, the Mundell-Fleming model predicts that higher interest rates should lead to a financial capital inflow and an exchange rate appreciation. This pushes down net exports and output (the exchange rate chan-

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nel). Higher interest rates should also decrease prices of assets (securities and real estates). With lower wealth, households consume less and output goes down (the equity channel). A credit crunch can occur if we have monetary contraction - small firms are typically dependent on loans and a decline in the supply of credit can affect them negatively (the bank lending channel). A monetary contraction also decreases cash flows and the net worth of firms, which may magnify problems with asymmetric information in credit markets (the balance sheet channel).

4. The Endogeneity of Money

If we find a positive association between nominal money and real output, this does not necessarily mean that there is causality from money to output. Changes in money may endogenously respond to changes in output. For example, if there is a negative supply shock, then the output is low and prices are high. The central bank can accommodate the money supply – it tries to reduce inflation and decreases the money supply. As a result, there is a positive correlation of money and output – both are low at the same time. But money does not cause output in this case. King and Plosser (1984) discuss the problem of endogenous money in real business cycle models.

The narrative approach to monetary non-neutrality can better address the problem of monetary endogeneity than the statistical approach. Nevertheless, Duczynski (2006, p. 130) presents some advantages of the statistical approach. For this reason, the issue of monetary endogeneity might not be important extremely.

5. The Results

We consider all developed countries in the 1980–2005 period. The data source is the International Financial Statistics Yearbook (2002, 2007) of the International Monetary Fund. The given data are believed to be of high quality. Regarding the definition of developed countries, we follow the list presented in the International Financial Statistics Yearbook (industrial countries). The growth of the monetary base (reserve money, *M0*) is under the code 14 x. The growth of *M1* (money) is under the code 34 x. The growth of *M2* (money plus quasi money) is under the code 35l x. The growth of consumer prices is under the code 64 x. The growth of the real gross domestic product (GDP) is under the code 99bp x.

The principal research method is to consider certain intervals of the growth rates of monetary aggregates (or consumer prices) and to examine the growth rates of output in a given year (g_t) and in the subsequent year (g_{t+1}). This technique follows Duczynski (2004). Since output is a flow variable and monetary aggregates are stock variables (measured at the end of a year), g_t precedes changes in money, while g_{t+1} follows changes in money. If we, for example, observed that g_{t+1} reacted more sensitively to declines in money than g_t, this would be some indication that money changes precede output changes.

For a given interval of the growth rate of a monetary aggregate (or consumer prices) we compute the average g_t and g_{t+1} for all observations. We compare these averages to long-run average growth rates of real output in developed countries in 1980–2005 and 1981–2006, respectively. These are equal to 2.53% and 2.61%, respectively. Since we consider a sample of 23 developed countries, we have some advantage over studies fo-

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cusing on one country only or on a small number of countries: random effects existing in individual countries are averaged out in the present study. Despite the fact that the applied research technique is relatively simple, we can provide some useful information on the *fundamental problem* – the relationship between real and nominal variables. It is sometimes a good strategy to keep the analysis as simple as possible.

Declines in Monetary Aggregates

Table 1 presents the results for declines in the monetary base (*M0*), *M1*, and *M2*. Table 2 then shows the source data for declines in *M1*. The average g_t and g_{t+1} are below the total long-run average for declines in *M0*. Similarly, the average g_{t+1} is below the total average for declines in *M1*. For *M0* and g_t , this fact is marginally statistically significant, as measured by the t-statistic. For *M0* and g_{t+1}, and *M1* and g_{t+1}, this result is statistically significant. Mainly for *M0* we have a robust result because of the relatively high number of observations. Thus, we have good evidence that money and output are positively connected. For *M2* this is, however, not confirmed due to a low number of observations.

Table 1
The Average Product Behaviour for Declines in Monetary Aggregates *M0*, *M1*, and *M2*

	M0	*M1*	*M2*
g_t	2.17	2.73	2.68
s_t	1.83	2.38	2.50
n_t	94	27	18
t_t	1.91	-0.44	-0.25
g_{t+1}	2.06	1.49	2.64
s_{t+1}	2.09	2.47	2.40
n_{t+1}	94	26	18
t_{t+1}	2.55	2.31	-0.05

Notes: g_t denotes the average product growth in the year of a monetary decline (in %); s_t is the corresponding standard deviation (in %); n_t is the number of observations; t_t is the t-statistic testing the statistical significance of the difference of g_t from the total average growth rate, 2.53%; g_{t+1} denotes the average product growth in the year following a monetary decline, and s_{t+1}, n_{t+1}, and t_{t+1} are variables analogous to s_t, n_t, and t_t. t_{t+1} relates to the total average growth rate of 2.61%.

Money changes precede output changes for *M1* and to some small extent for *M0* since the effect on g_{t+1} is more important than the effect on g_t. The average of g_t and g_{t+1} is 2.12% for *M0* and 2.11% for *M1*. Thus, the effect of *M0* on output is comparable to the effect of *M1* on output. However, a smaller change in *M1* is sufficient to generate this effect – the average fall in *M0* is 9.2%, while the average decline in *M1* is only 2.4%. This is evidence that *M1* (a broader aggregate) is more connected with output than *M0* (a narrower aggregate).

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Table 2
Declines of *M1*

country	year	$\Delta M1/M1$ (%)	g_t (%)	g_{t+1}(%)
Australia	1982	-0.2	0.7	-0.6
Austria	1981	-2.5	-0.1	1.9
Canada	1981	-0.5	3.7	-3.2
Denmark	1992	-0.9	0.6	n/a
	1994	-1.4	5.5	2.8
Germany	1981	-1.5	0.1	-1.0
Greece	2000	-4.0	4.1	4.1
Iceland	2001	-2.0	3.9	-0.1
Ireland	1982	-1.3	2.3	-0.2
	1991	-1.7	1.9	3.3
	1997	-17.4	10.8	8.6
Japan	1980	-2.0	3.6	3.2
	1983	-0.1	2.3	3.8
Netherlands	1981	-2.4	-1.5	-1.1
New Zealand	1996	-4.5	3.1	2.6
Spain	1992	-2.0	0.7	-1.2
Switzerland	1980	-0.1	4.4	1.6
	1981	-0.4	1.6	-1.4
	1985	-2.5	3.4	1.6
	1989	-2.7	4.3	3.7
	1990	-1.6	3.7	-0.8
	1991	-1.7	-0.8	-0.1
	2000	-2.1	3.0	1.3
	2004	-5.6	2.3	1.9
United States	1995	-0.9	2.7	3.6
	2000	-1.7	4.1	1.2
	2005	-0.9	3.2	3.3

Note: In this table g_t denotes the real output growth rate in the year of a monetary decline, while g_{t+1} denotes the real output growth rate in the subsequent year. This notation is analogous to the other tables, where we, however, work with averages across developed countries.

For the 5 observations with the largest decline in *M0*, the average g_t is 2.40% (standard deviation 1.08%), and the average g_{t+1} is 4.10% (standard deviation 2.68%). For the 5 observations with the largest decline in *M1*, the average g_t is 4.92% (standard deviation 3.38%), and the average g_{t+1} is 4.18% (standard deviation 2.62%). For the 5 cases with the greatest decline in *M2*, the average g_t is 3.22% (standard deviation 1.79%), and the average g_{t+1} is 1.78% (standard deviation 0.63%). Except for *M2* and g_{t+1}, we have no evidence that large money declines are harmful for the output growth. It is likely that the size of the money decline is not important for the behaviour of real output.

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Small Positive Growth of Money

Table 3 shows the results for small positive growth rates of *M0*, *M1*, and *M2*. We choose the interval of money growth rates between 0 and 5%. We may justify this interval by the following consideration: For the largest economy – the United States, *M1* grew in the interval between 0 and 5% in 42% of cases. This is a high number. Therefore, it would not be appropriate to consider a broader interval, such as between 0 and 7.5%. On the other hand, a narrower interval than between 0 and 5% would mean a low number of observations, which would leave the results less robust statistically.

Table 3
The Average Product Behaviour for Small Positive Growth Rates (between 0 and 5%) of Monetary Aggregates

	M0	*M1*	*M2*
g_t	2.41	2.18	1.80
s_t	1.94	2.14	1.83
n_t	119	81	118
t_t	0.67	1.47	4.33
g_{t+1}	2.58	2.13	2.04
s_{t+1}	2.13	1.79	1.90
n_{t+1}	119	83	120
t_{t+1}	0.15	2.44	3.29

Note: The notation of variables follows the notation used in Table 1.

As indicated in Table 3, small growth rates of money are connected with below-average behaviour of output for *M1* and *M2*. As measured by the t-statistics, the results are marginally statistically significant for *M1* and g_t, significant for *M1* and g_{t+1}, and strongly significant for *M2* and g_t and g_{t+1} . Consequently, we have again some evidence that money and output are positively associated. For *M0*, the connection between money and output is weak and insignificant. Thus, *M1* and *M2* (broader aggregates) are more strongly associated with output than *M0* (a narrower aggregate). For *M2* (a broader aggregate), the effects on output are somewhat more important than for *M1* (a narrower aggregate).

There exists only a very weak tendency of money changes to precede output changes for *M1* since the effect on g_{t+1} is slightly more important than the effect on g_t . (We must compare these numbers with 2.53% for g_t and 2.61% for g_{t+1} .) In comparison, this tendency is not at all observed for *M2*.

High Growth of Money

Table 4 presents the results for the fast growth rates of *M0*, *M1*, and *M2* – above 15%. The average product behaviour is above the total long-run average both for g_t and for g_{t+1} for all of these aggregates. As measured by the t-statistics, the results are marginally statistically significant for *M0* and g_t and g_{t+1} and for *M1* and g_{t+1}, and significant for *M1* and g_t and *M2* and g_t. The results are insignificant for *M2* and g_{t+1}. Thus, we have again

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good evidence that nominal money and real output are positively associated. Here the money changes do not precede output changes since the effects (as compared to the total long-run averages) on g_{t+1} are not notably higher than the effects on g_t.

Table 4
The Average Product Behaviour for the Rapid Growth of Monetary Aggregates – above 15%

	M0	*M1*	*M2*
g_t	3.03	3.20	3.45
s_t	2.41	2.36	2.81
n_t	71	95	69
t_t	-1.75	-2.77	-2.72
g_{t+1}	3.13	3.05	2.94
s_{t+1}	2.22	2.51	3.04
n_{t+1}	71	94	70
t_{t+1}	-1.97	-1.70	-0.91

Note: The notation of variables follows the notation used in Table 1.

The average growth for the fast growth of money is 35.8% for *M0*, 24.0% for *M1*, and 24.4% for *M2*. *M1* and *M2* (broader aggregates) are more strongly associated with the real product than *M0* (a narrower aggregate) since the larger growth of *M0* is necessary to generate a comparable effect on output.

For the 5 highest growth rates of *M0*, the average g_t is 3.36% (standard deviation 3.64%). The average g_{t+1} is 4.62% (standard deviation 1.58%). For the 5 highest growth rates of *M1*, the average g_t *is 4.24%* (standard deviation 4.64%). The average g_{t+1} is 3.62% (standard deviation 2.94%). For the 5 highest growth rates of *M2*, the average g_t is 4.04% (standard deviation 4.66%). The average g_{t+1} is 4.10% (standard deviation 3.79%). The averages of product growth rates are here somewhat higher than total averages in Table 4. This is again some evidence that the product growth depends positively on the money growth.

For *M1* and *M2*, we document the dependence of g_t and g_{t+1} on money growth rates in Figures 1-4 in the Appendix. These dependences are roughly positive except for the outlying observations. The outliers are the following: in Figure 1, Iceland, 1983, *gM1* = 78.2% and g_t = -2.1%; in Figure 2, Ireland, 1998, *gM1* = 25.2% and g_{t+1} = 10.9%; in Figure 3, Ireland, 1997, *gM2* = 19.5%, and g_t = 10.8%, and Iceland, 1983, *gM2* = 80.1%, and g_t = -2.1%; in Figure 4, Ireland, 1996, *gM2* = 15.6% and g_{t+1} = 10.8%, Ireland, 1998, *gM2* = 17.8% and g_{t+1} = 10.9%, and Iceland, 1982, *gM2* = 70.3% and g_{t+1} = -2.1%.

Consumer Prices

The connection between consumer price growth rates and output growth rates is documented in Table 5. For deflations, both g_t and g_{t+1} are below the total long-run average. This result is statistically significant for g_t and marginally significant for g_{t+1}, but we have only a low number of observations to make this finding robust. For small positive

DOI: 10.18267/j.pep.341

inflations – below 2%, we have a somewhat above-average behaviour of output both for g_t and g_{t+1}. This observation is marginally statistically significant for g_t and strongly significant for g_{t+1}. For higher inflations – above 5%, the output growth is below average both for g_t and g_{t+1}. This finding is statistically significant for g_t and strongly significant for g_{t+1}. These results are relatively robust due to a high number of observations. Thus, we have some evidence that low positive inflation is probably good for the product growth. This evidence differs from the evidence concerning the monetary aggregates.

Table 5
The Average Product Behaviour for Declines in Consumer Prices, Small Inflation (between 0 and 2%), and Higher Inflation (above 5%)

	Deflation	Small inflation	Higher inflation
g_t	1.83	2.78	2.13
s_t	1.20	1.96	2.34
n_t	12	140	170
t_t	2.02	-1.51	2.23
g_{t+1}	1.99	3.15	1.90
s_{t+1}	1.21	2.06	2.36
n_{t+1}	12	142	170
t_{t+1}	1.77	-3.12	3.92

Note: The notation of variables follows the notation used in Table 1.

6. Conclusion

The relationship between real and nominal variables is a fundamental problem in macroeconomics. This paper examines money-output and price-output relations in developed countries in 1980–2005. We do not have a sufficient number of observations for declines in *M2* and to some extent in *M1*, but we observe that declines in *M0* (the monetary base) are associated with moderately low output growth. For declines in *M1*, we observe a statistically significant association between money and subsequent output growth rates. For small positive growth rates of *M1* or *M2* we also get a positive association between money and output – the output growth is somewhat below average in this case and this effect is practically statistically significant. For small positive growth rates of *M0* we observe no effect on output. High growth rates of monetary aggregates (*M0*, *M1*, and *M2*) are connected with high product growth. This observation can be theoretically explained by the money channels discussed in Section 3 if we replace a monetary contraction with a monetary expansion. We have some evidence that broader monetary aggregates (*M2* and *M1*) tend to be more closely associated with the real product than narrower monetary aggregates (*M0* and *M1*).

In particular, for a fall of *M0*, the difference of the average growth of real output in the given year from the total long-run average in developed countries, Δg_t, is -0.36%, and the difference of the average growth of real output in the subsequent year from the total long-run average in developed countries, Δg_{t+1}, is -0.55%. For a fall of *M1*, Δg_t is 0.20%, and Δg_{t+1} is –1.12%. For a fall of *M2*, Δg_t is 0.15%, and Δg_{t+1} is 0.03%. Here this result is not robust because of the low number of observations. For the small positive

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growth of *M0*, Δg_t is -0.12%, and Δg_{t+1} is -0.03%. For the small positive growth of *M1*, Δg_t is -0.35%, and Δg_{t+1} is -0.48%. For the small positive growth of *M2*, Δg_t is -0.73%, and Δg_{t+1} is -0.57%. For the rapid growth of *M0*, Δg_t is 0.50%, and Δg_{t+1} is 0.52%. For the rapid growth of *M1*, Δg_t is 0.67%, and Δg_{t+1} is 0.44%. For the rapid growth of *M2*, Δg_t is 0.92%, and Δg_{t+1} is 0.33%.

The possible influence of inflation on output stands in some contrast to the money-output relation. Periods of deflation are likely to be harmful for the product growth, but we had only a low number of observations to make this evidence stronger. We show that low inflation (below 2%) was probably good for growth, while high inflation (above 5%) was associated with low growth. In particular, for the low inflation, Δg_t was 0.25%, and Δg_{t+1} was 0.54%. For the high inflation, Δg_t was -0.40%, and Δg_{t+1} was -0.71%.

An important question is whether money changes precede output changes. This tendency was practically not observed for declines of *M0* and *M2*, but it was observed for declines of *M1*. For small positive growth rates of *M0*, *M1*, and *M2*, this tendency was practically not found out. For the rapid growth of money, money changes also did not precede output changes. Rather, the opposite was the case for *M2*.

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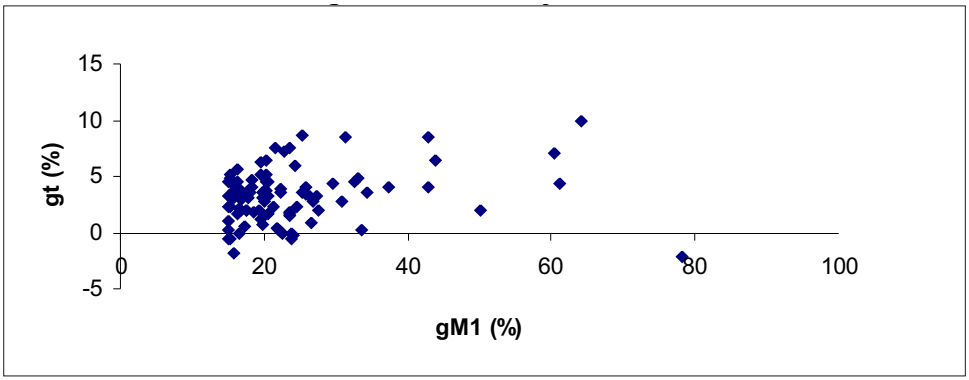
APPENDIX:

Figure 1:
The Dependence of the Real Output Growth on the Growth of Nominal M1 for the Rapid Growth of Money.



DOI: 10.18267/j.pep.341

Figure 2:
The Dependence of the lead real Output Growth on the Growth of Nominal M1 for the Rapid Growth of Money.

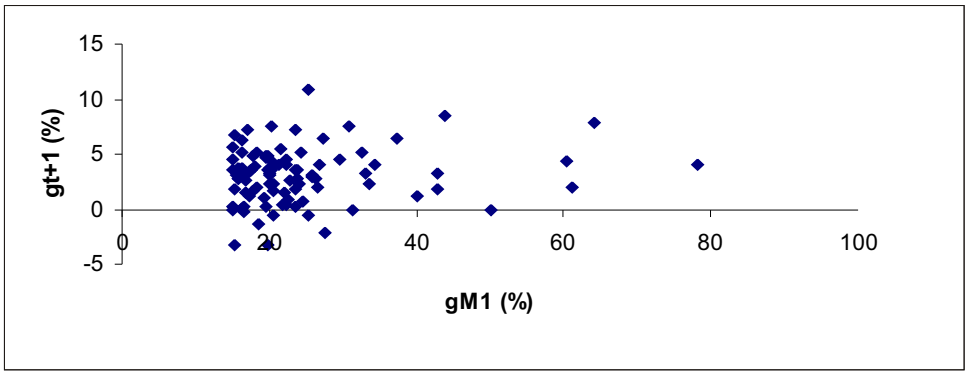


Figure 3:
The Dependence of the Real Output Growth on the Growth of Nominal M2 for the Rapid Growth of Money.

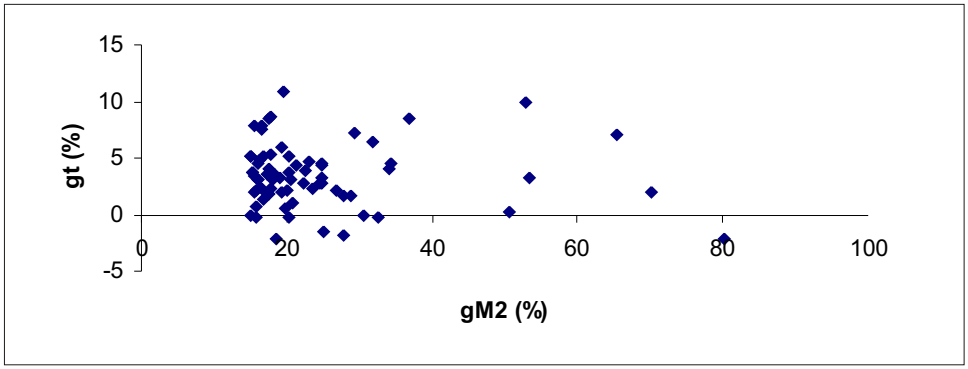
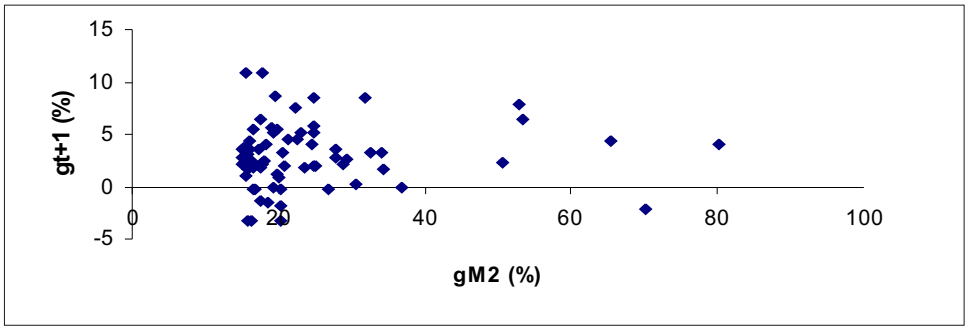



Figure 4:
The Dependence of the Lead Real Output Growth on the Growth of Nominal M2 for the Rapid Growth of Money.