On the Empirics of the Nonneutrality of Money: Cross-Country Evidence

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Abstract

The paper first challenges the traditional view that money is long-run neutral; it is shown that chronic monetary contractions were associated with significantly below-average output growth rates. The paper then examines the average per capita output growth performance across countries in the years with extremely high growth rates of money, in the years with declines in monetary aggregates, and in the years with declines in the price level in the 1970-1990 period. The mean output growth performance is significantly below the cross-country long-run average in all these situations. There is some tendency of money changes to precede output changes and some tendency of broader monetary aggregates to be more strongly associated with real output than narrower monetary aggregates.

JEL classification: E31, E32, N10

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1. Introduction

One of the most important problems in macroeconomics is whether nominal money changes influence real output changes. The standard view is that money is neutral in the long run but nonneutral in the short run. Kormendi and Meguire (1984) and Barro (1997, Chapter 18) provide evidence for the long-run neutrality of money. A number of studies examine the short-run association between money and output. Friedman and Schwartz (1963) show that money mattered in the United States in the period before World War II. Apart from banking panics, they identify four periods of monetary shocks (January-June 1920, October 1931, June 1936-January 1937, and the passivity of the Fed in the Depression years 1929-1931) in which the monetary movement was unusual given economic conditions. They document that these monetary shocks were important determinants of the real economic activity. Romer and Romer (1989) use a somewhat different criterion for monetary shocks. They add a relevant

analysis for the postwar period, following the narrative approach of Friedman and Schwartz. In their analysis the Romers study cases in which the Fed intended to cause a recession in order to decrease inflation (October 1947, September 1955, December 1968, April 1974, August 1978, and October 1979). They show that these contractionary measures really had significant effects on real output. Several other studies have examined the impact of unanticipated money changes (for the United States, see Barro, 1978; for the United Kingdom, see Attfield, Demery, and Duck, 1981; for Canada, see Wogin, 1980; for a cross-country analysis, see Attfield and Duck, 1983, and Kormendi and Meguire, 1984).

The present paper complements the existing literature by providing evidence from all countries for which we have data in the 1970-1990 period. The data source for money and prices is the *International Financial Statistics Yearbook* (IFS), 1997, of the International Monetary Fund. The monetary variables include the monetary base (code 14 – reserve money[1] – in the IFS), money (code 34 in the IFS), and money plus quasi money (code 35l in the IFS).[2] The price level is measured by consumer prices (code 64 in the IFS). The data source for real output per capita is the Summers-Heston data set, Mark 5.6 (see Summers and Heston, 1991, and the web site http://pwt.econ.upenn.edu/, RGDPCH variable).

The paper first challenges the traditional view that there is no association between nominal money and real income in the long run. It is shown that frequent monetary contractions were associated with significantly below-average growth rates of output per capita. The paper then examines the average output growth performance in years with extremely high money growth rates. It is shown that the average per capita output growth rate in these situations was significantly below the cross-country long-run average. A similar analysis is made for declines in monetary aggregates. Again, the average output growth rates are found significantly below the cross-country long-run average. Broader monetary aggregates are found to be more strongly associated with real output than narrower monetary aggregates. If T is the year of a fall of a monetary aggregate, the average per capita output growth behavior between T and T+1 tends to be more adverse than the behavior between T-1 and T. This is some evidence that money changes precede output changes, an important fact which is otherwise difficult to document. It is also shown that the output growth performance is below the cross-country long-run average long before and long after the declines in monetary aggregates take place. In addition, it is demonstrated that declines in prices are on average associated with significantly below-average output growth rates.

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[1] Reserve money also includes currency outside deposit money banks.
[2] Money is approximately M1 and money plus quasi money is approximately M2.

The present paper is oriented towards a statistical description. The paper tries to address a number of important questions, although it cannot provide absolutely convincing evidence that changes in money cause changes in real output.[3]

2. Long-run (non)neutrality

We have data for average annual per capita output growth rates, g (in %), and average annual money growth rates, m (in %), for 85 countries in the 1969-1990 period. There exists a negative association between the given variables:

$$g = 1.92 - 0.014 \text{ m,} \qquad (1)$$
$$(7.32) \ (-2.22)$$

where the R^2 value is 0.06 (t-statistics are in parentheses). In the lowest quintile of money growth rates, the average annual per capita output growth is 1.65%. In the second lowest, third lowest, fourth lowest, and the highest quintiles, the average growth rates are 1.70%, 1.64%, 1.75%, and 1.07%, respectively. The cross-country average growth rate for the whole sample is 1.60%. Thus the only notable difference of the long-run per capita output growth rate from the cross-country average appears for the highest quintile of money growth rates. In this quintile, the standard deviation of per capita output growth rates is 2.06%. This makes the average in this quintile not statistically different from 1.60% at a 10% significance level in a one-tail test (the t-statistic is 1.06, and the critical value is 1.34). The difference is significant at a 25% level, where the critical value is 0.69.

It is important to realize that the lack of a positive relationship between the long-run growth rates of money and output does not necessarily imply the long-run neutrality of money. The key point is that we do not have observations with an extremely low long-run growth rate of money between 1969 and 1990 (the minimum growth is achieved in Switzerland and is equal to 4.1%). However, we do have observations with extremely low money growth rates for shorter periods (which are still sufficiently long to be considered in a long-run perspective). Let us consider those countries which contracted high-powered money in at least 5 years in the period 1970-1990 and for which the Summers-Heston data on per capita output are available for the year preceding the first contraction and for the year of the

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[3] It is well known that money may endogenously respond to the real economy. See, for example, King and Plosser (1984).

last contraction. Table 1 presents a sample of 14 countries that satisfy this criterion. Table 1 presents the time period between the year preceding the first contraction and the year of the last contraction, the average annual per capita output growth rate, g, in the given period, and the average inflation rate, π (based on the consumer price index).

The average of g for the countries in Table 1 is –1.00% (standard deviation 2.53%). The test for a difference of this mean from the cross-country long-run average, 1.48%,[4] results in a t-statistic equal to 3.67. Thus there exists a strongly significant negative association between the frequency of monetary contractions and the long-run growth rate of real output per capita.

The direction of causality between money and output is, of course, difficult to identify. In fact, high-powered money is determined solely by the central bank and is thus less endogenous than broader monetary aggregates. Despite this, the central bank policy can be endogenously given by the real economic situation. For example, if there is a fall in output, the demand for money decreases, which pushes up the price level. It may be natural if the central bank responds by monetary tightening to a fall in output. Inflation data can provide some information on whether this effect was likely to be present. It is hard to argue that this effect was present if inflation was low. With low average inflation, there was no clear reason for so dramatic monetary tightening as frequent falls in high-powered money. Out of the 14 countries that frequently contracted, long-run annual inflation over critical years was below 5% in Bahrain, Chad, Kuwait, Saudi Arabia, Seychelles, and Switzerland. The average long-run per capita output growth performance of these countries was –2.1% per year. Except for Switzerland, these countries are developing countries for which the inflation rate below 5% is really low. The central banks in these countries would definitely have done a better job if not cutting high-powered money.

To summarize, this section provides strong evidence that frequent declines in high-powered money are associated with below-average long-run growth rates of real output per capita. This finding substantially changes the traditional view that there is no connection between real and nominal variables in the long run.

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[4] This number differs from the previous average (1.60%) because the average is now computed for all countries for which *at least some* Summers-Heston data are available between 1969 and 1990. The average is weighted according to the number of years for each country for which the data exist.

3. Short-run nonneutrality

We consider all countries for which there are at least some annual observations between 1970 and 1990.[5] For monetary aggregates, this condition is satisfied for 141 countries. We examine how the growth rate of real output per capita behaved on average in the years of very high money growth rates, in the years of declines in monetary aggregates, and in the years of declines in the price level. We also examine how output behaved in the years preceding and following monetary and price declines.

Extremely high money growth

There are 63 annual observations with the growth rates of money exceeding 100%. The highest number of observations occurs for Argentina (14), Brazil (9), Chile (7), Nicaragua (6), Peru (6), and Israel (5). The average per capita output growth rate for the given 63 observations is –1.55% (standard deviation 12.02%). The given mean is significantly below the cross-country long-run average (1.48%); the corresponding t-statistic is 2.00, which is just equal to the critical value for a 2.5% significance level in a one-tail test.[6] It seems that very large monetary expansions are harmful for economic growth. It is plausible that rapid monetary expansions lead to chaos in the real economy and disrupt the real economic structure. On the other hand, it is also possible that problems in the real economy lead to high monetary growth rates (a fall in the tax revenue in recessions may result in higher seignorage needs). It is left for future research to determine which direction of causality is more important.

There are 122 observations with the growth rates of money between 50% and 100%. The average per capita output growth rate in this situation is 1.74% (standard deviation 7.79%), which is slightly above the cross-country long-run average. The difference from the cross-country long-run average is insignificant (the t-statistic is 0.37).

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[5] The first growth rate applies for a change between 1969 and 1970.
[6] This finding is consistent with my other study (Duczynski, 2001), in which I show that the correlation coefficients between money growth rates and per capita output growth rates were negative in high-inflation countries.

This section considers the average behavior of the real output growth rate in the years of falling money (as well as high-powered money and money plus quasi money) in the 1970-1990 period. It is also examined how the output growth behaved in the years preceding and following monetary declines.[7]

Table 2 summarizes the per capita output growth performance in the year of a fall in high-powered money (this year is denoted by T) and in the years preceding and following the decline (from T-4 to T+6). For each year, the table contains the number of observations (n), the standard deviation (s), the average growth rate (g), the difference of the average growth rate from the cross-country long-run average (g-g_{LR}), and the t-statistic testing the difference of the given average growth rate from the cross-country long-run average. [It should be noted that the cross-country long-run average differs for different years (for example, for T-1, it applies for the 1969-1989 period and is different from the average in the 1970-1990 period). There is a tendency of the cross-country long-run average growth to be lower if the sample contains more recent years.] Tables 3 and 4 contain similar statistics for falls in money and falls in money plus quasi money.

For all monetary aggregates, the output growth in T and T+1 is strongly significantly below the cross-country long-run average. An interesting finding is that the output growth tends to be below average long before and long after the monetary decline takes place. There is, in particular, no tendency for rapid economic growth sometime after the money falls. In other words, present output losses from monetary contractions are not compensated by future output gains. This is a symptom of the long-run nonneutrality of money.[8] In any case, a precise interpretation of the below-average output behavior before and after T is difficult. One explanation is that money growth rates are autocorrelated over time;[9] thus these growth rates are below average both before T and after T; if money changes cause output changes, the output growth rates are also below average before and after T. Fischer (1979) discusses a model in which money is nonneutral and in which output changes precede money changes; this could possibly explain the behavior of output before T. The behavior of output after T

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[7] Money is a stock variable (the growth rate of which is measured from end-of-year data), while output is a flow variable. The growth rate of output in T (i.e., between T-1 and T) reflects the output growth both in T-1 and T; the output growth between T-1 and T thus precedes on average the growth of money in T.

[8] In Duczynski (2001) I observe that the correlation coefficient of per capita output growth and a one-and-half-lag value of money growth in the sample of developed countries in 1951-1990 is marginally significantly negative on average, which is in turn a symptom of the long-run neutrality of money.

may mean that the effects of monetary policy are persistent. Finally, the behavior before and after T may reflect a tendency of low-growth countries to have frequent monetary contractions; there may be causality from long-run output growth to money.

The value of g-g_{LR} is lower in T+1 than in T for all monetary aggregates (although for money the difference is negligible). For high-powered money, the difference between T and T+1 is significant at a 5% level in a one-tail test (the t-statistic is 1.70 and the critical value is 1.65). For money plus quasi money, the difference is significant at a 25% level in a one-tail test (the t-statistic is 1.00 and the critical value is 0.68). For small positive growth rates of money in T (see the text below and Table 5), there is also a lower value of g-g_{LR} in T+1 than in T. The difference is significant at a 10% level in a one-tail test (the t-statistic is 1.49 and the critical value is 1.29). Thus there is some evidence that money changes precede output changes. This evidence is consistent with my other study (Duczynski, 2001), in which I find that in a sample of developed countries in 1951-1990, half-lag growth rates of money (or money plus quasi money) tended to be more highly correlated with per capita output growth rates than half-lead growth rates of money.

An interesting question is whether broader monetary aggregates are more strongly associated with real output than narrower monetary aggregates. Out of the aggregates considered, high-powered money is the narrowest aggregate, whereas money plus quasi money is the broadest aggregate. It is really the case (for T and T+1) that g-g_{LR} is the lowest for money plus quasi money falls, higher for money falls, and the highest for high-powered money falls. Between high-powered money and money, the difference is strongly significant for T (the t-statistic is 2.67) and less significant for T+1 (the t-statistic is 1.02). Between money and money plus quasi money, the difference is insignificant for T (the t-statistic is 0.52) and nearly significant in a one-tail test at a 5% level for T+1 (the t-statistic is 1.63). Between high-powered money and money plus quasi money, the difference is strongly significant (the t-statistics are 2.74 for T and 2.51 for T+1). The tendency of broader monetary aggregates to be more strongly associated with real output than narrower monetary aggregates accords with my findings in Duczynski (2001), where I observe that correlations between output changes and money-plus-quasi-money changes are higher than correlations between output changes and money changes (or high-powered-money changes).[10]

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[9] The frequency of declines in money in the whole sample is 8.8%. The frequency of declines in money in the years preceding declines is 21.1%. Thus money changes are autocorrelated.
[10] However, I observe no statistical difference between money-output correlations and high-powered-money-output correlations.

Small positive growth of money

Table 5 presents the statistics if there is a small positive growth rate (between 0 and 3%) of money in T. There is still a significantly below-average output growth behavior in T+1. As expected, the value of g-g_{LR} is significantly higher than in cases of falling money in T (the t-statistics for the difference in means are 3.00 for T and 1.79 for T+1).

Declines in consumer prices

Table 6 shows the output statistics if there are declines in consumer prices in T. Consumer prices are measured as period averages for each year. The output growth rate is significantly below average in T, and there is some tendency of the output growth rate to be low both before and after T. The price level is found to be procyclical. This stands in contrast to Duczynski (2001), where the price level was observed to be countercyclical in the sample of developed countries in 1951-1990. If the price level is procyclical, the importance of monetary shocks for output fluctuations seems greater than the importance of supply shocks.[11]

4. Conclusion

This paper considers a large number of countries in the 1970-1990 period (all for which the data are available). There exists a strongly statistically significant short-run association between nominal money and real output if the increments in money are extremely high or low (negative). Both extremely high growth rates and negative growth rates of money are connected with significantly below-average per capita output growth rates. For falls in monetary aggregates, the association between money and real output tends to be stronger for broader than for narrower monetary aggregates. In particular, the association between money (M1) and real output is stronger than the association between the monetary base (M0) and real output. The connection between money plus quasi money (M2) and real output is stronger than the connection between money and output. For a fall of money plus quasi money in T, the average growth rate of per capita output between T-1 and T is about 3 percentage points below the long-run cross-country average; the average per capita output growth rate between T and T+1 is about 4 percentage points below the long-run cross-country average. The

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[11] Most studies come to the conclusion that the price level was procyclical before World War II and countercyclical thereafter (see Backus and Kehoe, 1992, or Smith, 1992).

differences of the per capita output growth rates from the long-run cross-country averages are strongly statistically significant in these situations (with the t-statistic around 5 for the growth between T-1 and T, and the t-statistic around 6 for the growth between T and T+1). This observation is consistent with the notion that money changes cause output changes, although it is also possible that money endogenously responds to the real economic activity.

Even small positive growth rates (between 0 and 3%) of money are associated with below-average per capita output growth rates. As expected, the behavior of output growth is not as adverse in these situations as in the cases of falling money.

There exists some tendency of money changes to precede output changes. If T is the year of a fall of a monetary aggregate, the behavior of the real output growth is typically more adverse between T and T+1 than between T-1 and T. This observation indicates that there probably is some causality from money to output.[12]

An important observation is that falling prices are accompanied by significantly below-average per capita output growth rates (the average growth rate of real output per capita in the years with falling consumer prices is more than 2 percentage points below the long-run cross-country average growth rate). Since real business cycle models predict a countercyclical behavior of the price level, they can be consistent with the observed evidence only if negative supply shocks are typically accompanied by tight monetary policy and/or if there is a significant endogenous decline in money multipliers during negative supply shocks.

Another finding is that the per capita output growth rate tends to be below the cross-country long-run average long before and long after the money declines. The fact that the growth of output is not fast sometime after the money falls suggests that money is nonneutral in the long run (if the money falls, present output losses are not compensated by future output gains). A similar conclusion can be drawn from examining countries that frequently contracted the monetary base. Over the periods of frequent monetary contractions, the average long-run per capita output growth rate was significantly below the cross-country long-run average. This observation substantially changes the traditional view that there is no association between real and nominal variables in the long run.

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[12] Money can still be endogenous, but the fact that money changes precede output changes is more difficult to explain in the framework with no causality from money to output.

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Table 1: Average annual long-run per capita output growth, g, and average annual long-run inflation, π, for countries that contracted high-powered money at least five times in 1970-1990 (the time period starts with the year preceding the first contraction and ends in the year of the last contraction).

country	period	g (%)	π (%)
Bahrain	1976-1988	-2.58	4.5
Chad	1972-1990	-2.77	1.9*
Kuwait	1982-1989	-5.80	2.0
Madagascar	1970-1990	-2.61	13.4
Malawi	1974-1990	0.40	16.1*
Mauritania	1974-1990	-1.24	7.2*
Myanmar	1969-1987	1.64	8.7
New Zealand	1974-1990	0.24	12.2
Papua N.G.	1977-1986	-1.03	6.8
Rwanda	1970-1989	0.64	8.7
Saudi Arabia	1978-1989	-5.29	0.2
Senegal	1978-1990	0.26	6.4
Seychelles	1980-1987	2.18	3.3
Switzerland	1978-1989	1.95	3.3

Note: Inflation data are available from 1983 for Chad, from 1980 for Malawi, and from 1985 for Mauritania.

Table 2: The average behavior of the per capita output growth for falls in high-powered money in T.

	n	s (%)	g (%)	g-g$_{LR}$ (%)	t-stat.
T-4	242	6.71	1.35	-0.57	1.32
T-3	246	6.84	0.67	-1.14	2.61
T-2	248	7.25	0.90	-0.87	1.89
T-1	250	7.64	1.31	-0.34	0.70
T	245	6.36	0.45	-1.03	2.53
T+1	239	6.82	-0.74	-2.05	4.65
T+2	232	6.58	0.22	-0.95	2.20
T+3	216	6.89	0.70	-0.41	0.87
T+4	201	6.38	0.14	-0.87	1.93
T+5	175	6.33	-0.09	-1.01	2.11
T+6	163	6.04	0.14	-0.79	1.67

Table 3: The average behavior of the per capita output growth for falls in money in T.

	n	s (%)	g (%)	g-g$_{LR}$ (%)	t-stat.
T-4	179	7.02	1.16	-0.76	1.45
T-3	182	6.80	0.73	-1.08	2.14
T-2	185	7.12	-0.21	-1.98	3.78
T-1	188	8.33	0.38	-1.27	2.09
T	186	6.72	-1.24	-2.72	5.52
T+1	182	6.76	-1.42	-2.73	5.45
T+2	176	6.82	-0.21	-1.38	2.68
T+3	163	6.44	-0.09	-1.20	2.38
T+4	155	6.74	0.24	-0.77	1.42
T+5	141	7.32	0.98	0.06	-0.10
T+6	125	6.02	0.50	-0.43	0.80

Table 4: The average behavior of the per capita output growth for falls in money plus quasi money in T.

	n	s (%)	g (%)	g-g$_{LR}$ (%)	t-stat.
T-4	95	7.59	1.87	-0.05	0.06
T-3	97	7.63	1.11	-0.70	0.90
T-2	99	6.38	0.41	-1.36	2.12
T-1	98	8.75	1.29	-0.36	0.41
T	94	6.51	-1.68	-3.16	4.71
T+1	96	7.26	-2.85	-4.16	5.61
T+2	92	7.67	-0.33	-1.50	1.88
T+3	84	5.60	0.18	-0.93	1.52
T+4	81	7.32	-0.32	-1.33	1.64
T+5	68	8.34	0.17	-0.75	0.74
T+6	59	5.95	-1.18	-2.11	2.72

Table 5: The average behavior of the per capita output growth for small positive growth rates of money (0-3%) in T.

	n	s (%)	g (%)	g-g$_{LR}$ (%)	t-stat.
T-1	136	6.22	0.54	-1.11	2.08
T	135	6.80	1.05	-0.43	0.73
T+1	130	4.68	-0.19	-1.50	3.65

Table 6: The average behavior of the per capita output growth for declines in consumer prices in T.

	n	s (%)	g (%)	g-g$_{LR}$ (%)	t-stat.
T-2	72	6.74	-0.18	-1.95	2.45
T-1	73	7.67	0.52	-1.13	1.26
T	71	6.67	-0.74	-2.22	2.80
T+1	69	8.43	1.12	-0.19	0.19
T+2	66	6.36	-0.42	-1.59	2.03
T+3	57	5.87	1.30	0.19	-0.24
T+4	46	5.45	-0.41	-1.42	1.77