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ABSTRACT

Is Inflation Always and Everywhere a Monetary Phenomenon?*

Using a sample of about 160 countries over the last thirty years we test for the quantity theory relationship between money and inflation. When analysing the full sample of countries we find a strong positive relation between the long-run inflation and money growth rate. The relation is not, however, proportional. The strong link between inflation and money growth is almost wholly due to the presence of high (or hyper-) inflation countries in the sample. The relationship between inflation and money growth for low inflation countries (on average less than 10% per annum over the last 30 years) is weak. We find that the long-run average inflation and country-specific factors have a significant influence on the strength of the relationship. We also confirm that money growth and output growth are orthogonal in the long-run; i.e. higher growth rates of money do not lead to higher growth rates of output.

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NON-TECHNICAL SUMMARY

The quantity theory of money (QTM) is based on two statements. First, in the long run there is *proportionality* between money growth and inflation, i.e. when money growth increases by x% inflation also increases by x%. Second, in the long run there is *orthogonality* between money growth on the one hand and output growth and velocity changes on the other hand, i.e. output and velocity changes are not affected by money growth.

We subject these statements to empirical tests using a sample involving most countries in the world during the last thirty years. Our findings can be summarized as follows. First, when analysing the full sample of countries we find a strong positive relation between the long run growth rate of money and inflation. This relation is not, however, proportional.

Our second finding is that this strong link between inflation and money growth is almost wholly due to the presence of high (hyper)inflation countries in the sample. The relation between inflation and money growth for low inflation countries (on average less than 10% per year over 30 years) is weak, if not non-existent. From our panel data analysis we conclude that there is no evidence for a long-term proportional relationship between money growth and inflation – as predicted by the quantity theory – for low inflation counties (i.e. yearly inflation of less than 10%). We also find, however, that this lack of proportionality between money growth and inflation is not due to a systematic relationship between money growth and output growth. We find that in accordance to the QTM assumption money growth and output growth are orthogonal in the long run, i.e. higher growth rates of money do not lead to higher growth rates of output. This finding is consistent with the large number of econometric analyses using time series of single countries. Most of these studies have found that money is neutral in the long run, i.e. does not have permanent effects on output.

A third finding (obtained from a panel data analysis) indicates that country-specific effects become increasingly important when the rate of inflation increases. We interpret this to mean that velocity accelerates with increasing inflation; thereby leading to inflation rates that exceed the growth rates of the money stock. This also explains why in cross-section regressions inflation rates increase more than proportionately to money growth in high inflation countries.

Finally, we find that in the class of low inflation countries money growth and velocity changes are inversely related, while in the class of high inflation countries the reverse holds, i.e. money growth and velocity growth are positively related. The latter confirms our interpretation of the positive correlation between money growth and fixed effects in our panel data model.

These results can be given the following interpretation. In the class of low inflation countries inflation and output growth seem to be exogenously driven phenomena, mostly unrelated to the growth rate of the money stock. As a result, changes in velocity must necessarily lead to opposite changes in the stock of money (given the definition $p + y = m + v$).

Things are very different in high inflation countries. In their case, an increase in the growth of the money stock leads both to an increase in inflation and in velocity. The latter reinforces the inflationary dynamics. This process has been well documented in empirical studies of hyperinflation and it is confirmed by our results (see Cagan, 1956).

All this leads to the conclusion that for low inflation countries we reject the proportionality prediction of the quantity theory. We confirm, however, that money and output are orthogonal in the long run.

Our results have some implications for the question of the use of the money stock as an intermediate target in monetary policy. As is well known, the European Central Bank (ECB) continues to give a prominent role to the growth rate of the money stock in its monetary policy strategy. The ECB bases this strategy on the view that 'inflation is always and everywhere a monetary phenomenon'. This may be true for the high inflation countries. Our results, however, indicate that there is no evidence for this statement in relatively low inflation environments, which happens to be a characteristic of the EMU countries. In these environments money growth is not a useful signal of inflationary conditions. It also follows that the use of the money stock as a guide for steering policies towards price stability is not going to be useful for countries with a history of low inflation.

1. Introduction

Is inflation always and everywhere a monetary phenomenon? There exists a strong consensus among economists today that when analysed over a sufficiently long period of time inflation is indeed everywhere a monetary phenomenon. This consensus has not always existed. Prior to the upsurge of inflation in the 1970s, many economists did not bother to look at the money stock when analysing the sources of the (low) inflation rates of that time. In this paper, we return to this issue using a sample of countries spanning the whole world over a period of thirty years. The central question we analyse is how the relationship between inflation and money growth is affected by the level of inflation. Put differently, does the link between inflation and the growth rate of money depend on whether countries experience low or high rates of inflation?

The view that inflation is always and everywhere a monetary phenomenon has a long tradition based on the quantity theory of money (QTM). In its simplest form, the QTM says that changes in money supply growth are followed by equal changes in the inflation rate and, by the force of the Fisher effect, in the nominal interest rate. The QTM is a measure of the extent to which the inflation movements can be explained by purely monetary forces. The one-to-one relation between inflation and money growth is a characteristic of long-run average behaviour of the model economy. These conclusions are now widely and firmly held by economists.

The QTM is based on the following equation:

$$M\,V = Y\,P; \qquad (1)$$

Where M is money supply, V is money velocity, Y is the real output and P is the price level. If we move to growth rates, we can express this equation as:

$$m + v = y + p\text{[1]}; \qquad (2)$$

where letters in lowercase denote growth rates. Thus, inflation - or the growth rate of the price level - can be expressed as:

$$p = m - y + v. \qquad (3)$$

The essence of the quantity theory of money is that it consists of two elements. First,

[1] *These are of course instantaneous rates, not average rates. For low growth rates this should not pose a problem, for high growth rates, however, we will underestimate inflation rate by just adding growth rates of money, velocity and output.*

the theory predicts that in the long run there is a *proportionality* relation between inflation and the growth rate of money, i.e. in a regression of inflation on money growth the coefficient of money is estimated to be 1. Second, it assumes that over a sufficiently long period of time output and velocity changes are *orthogonal* to the growth rate of the money stock. The main prediction follows logically from this assumption.

Thus, there are two aspects to the quantity theory. The proportionality prediction says that a permanent increase in money growth leads to an equal increase in the rate of inflation in the long run, while the orthogonality assumption says that a permanent increase in the growth rate of money leaves output and velocity unaffected in the long run[2]. In this paper we will analyse both the main assumption and the prediction of the QTM.

The QTM does not specify which definition of money supply should be used in the empirical tests of the theory. There is no theoretical reason why M1 or M2 should be used as the appropriate variable. Accordingly, many authors use both or more monetary aggregates to compare the results obtained for various definitions of money. Since the empirical literature is not consistent in its opinion about which monetary aggregate is correlated more with the price level, we will use both M1 and M2 in our study.

2. Review of the empirical literature

The existing empirical literature concerning the long-run relation between money growth and inflation can be divided into three groups. The first group uses cross-sectional data on a large number of countries over a long time span. Usually, a long-run average of money supply (or its growth rate) and of price level (or the inflation rate) is calculated and used to compute the correlation between the two. All countries are treated equally and there is no distinction according to monetary or economic regimes.

In a second kind of study, authors use long series of higher frequency data (annual or quarterly) referring to only one country in order to describe a long-run relationship between money and the price level. Sometimes results are compared with other single-country findings.

[2] *When analysing the long term quantity theory relation between money and output, researchers most often use the term* neutrality *of money. We will stick to the term* orthogonality*. Both terms are interchangeable.*

The third type of study takes a shape of a historical investigation, sometimes reaching more than two hundred years into the past. These studies often focus on only one country, but they suffer, as do the studies of the second type, from the incomparability of economic systems of a country across centuries.

Table 1 presents an overview of the representative articles of the first type of empirical studies based on cross-sections of countries. The table also describes the data sets and the results.

Authors of the articles listed in Table 1 try to either analyse data on the largest possible number of countries or focus on a smaller group of countries with similar economic systems. In the latter case, the results are applicable only to this particular group of countries; the first method is supposed to yield universal results. In most cases, the relation between the money supply and the price level is strong and positive.

Table 1: Main multi-country studies of long-run relationship between money supply and price level.

Author, year	Monetary aggregate	Prices	Data set	Time span	High – Low differentiation*	Results
Vogel (1974)	Currency + Demand deposits	CPI	16 Latin American countries	50-69, annual data	-	Proportionate changes in inflation rate within two years of changes in money growth
Dwyer and Hafer (1988)	n.a.	GDP deflator	62 countries	79-84, five-year averages	no	Strong positive correlation
Barro (1990)	Hand-to-hand currency	CPI	83 countries	50-87	no	Strong positive "association"
Pakko (1994)	Currency + Bank deposits	CPI	13 former Soviet republics	92 and 93, four-quarter averages	-	Positive relationship
Poole (1994)	Broad money	n.a.	All countries in World Bank tables	70-80 and 80-91, annual averages	no	Strong positive relationship
McCandless and Weber (1995)	M0, M1, M2	CPI	110 countries reported in IMF IFS	60-90	no	Very strong positive correlation
Dwyer and Hafer (1999)	n.a.	GDP deflator	79 countries reported in IMF IFS	87-97, two five-year averages	no	Strong and stable positive correlation

High – Low differentiation indicates whether author makes distinction between low- and high-money growth countries.

A common finding of these studies is that countries with slow money growth (and low inflation) tend to create a horizontal cluster close to the origin. None of the papers surveyed here, however, has attempted to analyse this phenomenon or to study how the level of inflation affects the relation between money growth and inflation.

An interesting conclusion can be drawn from the article of Dwyer and Hafer (1999). These authors compare the relation between average money growth and average inflation rate in two periods: 1987-1992 and 1993-1997. In the second period the average inflation rate (across all countries in the sample) is lower. The lowering of the average inflation rate leads to the creation of two horizontal clusters of observations close to the origin. Thus, the problem of a weakening relation between money growth and inflation, as we progress towards a zero money growth, may be associated with the average money growth of a country.

The second type of empirical study uses single country time series analysis. Within this class of studies, a first approach has been to analyse the long-term quantity theory relationship after transforming time series into the frequency domain. Representative papers are Lucas (1980), Mills (1982) and Summers (1983). These studies tend to confirm the proportionality prediction of the quantity theory, although their methodology has been criticised by McCallum (1984) and Rolnick and Weber (1995). McCallum (1984) warns that the association of high-frequency time series with long-run economic propositions is not always warranted.

More recently, researchers have taken a second and more satisfactory approach in analysing the time series properties of inflation, output and money. This consists in explicitly testing coefficients restrictions implied by the quantity theory in vector autoregression models. Important papers using this approach are Geweke (1986), Stock and Watson (1988), King and Watson (1992), Boschen and Mills (1995). These authors confirm the long run orthogonality between output and money for the US economy. Similar results for G-7 countries were obtained by Weber (1994).

Articles designed to test the QTM using the data of one or a few countries (the second type) often overlap with the third type of studies - very long-term historical analyses of the relation between money and prices or investigations of this relation in a particular period in the past. One such long historical analysis is by Smith (1988) who explores the relation between money and prices in the British colonies.

Studies analysing a large set of countries typically do not take into account differences between countries. However, Rolnick and Weber (1995) show that such a disregard can change the results of estimations. The authors prove that the strength of the long-run relationship between money and prices differs across countries operating under different monetary standards. When compared with fiat standards, commodity standards result in lower correlations of money growth and inflation, a higher correlation with output growth and a lower correlation of various monetary aggregates with each other. Inflation, money growth and output growth are generally lower under commodity standards than under fiat standards.

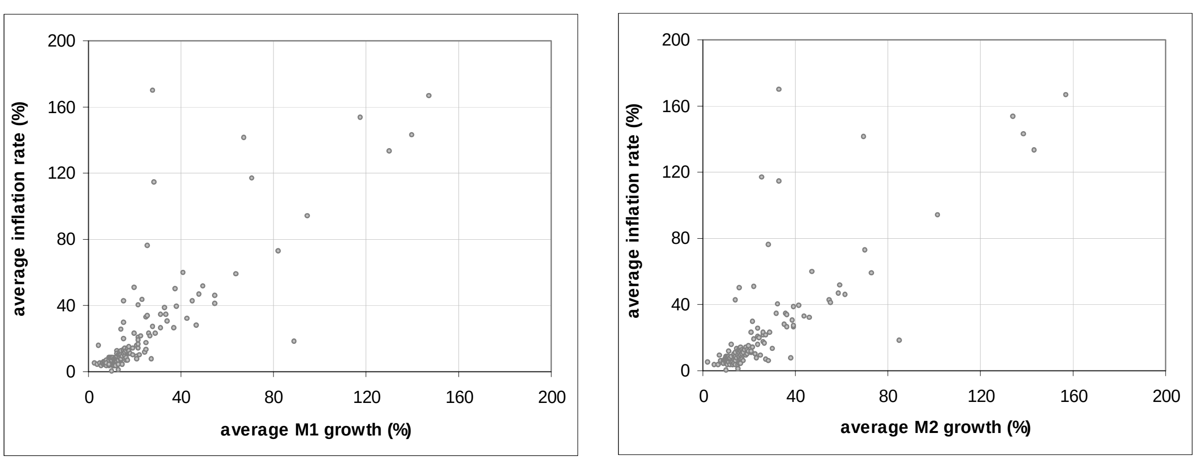
3. Cross section evidence: the long run

In this section we test the quantity theory using cross section data of thirty-year averages of money growth, inflation and output growth. We expect that thirty years is a sufficiently long period to be considered as ‘long run’. Therefore, we assume that our sample of data is sufficiently long to detect the type of relationship predicted by the quantity theory. First, we present the data in section 3.1 and then proceed to the regression analysis (section 3.2).

3.1. The data

To explore the relationship between money growth and inflation we choose the largest available sample of countries (165 and 159 for the regressions of inflation on the growth rates of M1 and M2, respectively), covering the years 1969 - 1999. We use the International Financial Statistics of the IMF as the source of our data and we test the theory using two monetary aggregates, M1 and M2. Inflation is measured as a percentage increase of the consumer price index. Not all observations are shown in these graphs – five observations with average inflation rate above 200% p.a. were omitted. Including them would compress the remainder of the chart too much.

Figure 1: Inflation and the average growth of M1 and M2, 1969-1999.



In Figure 1 we present the full sample of observations on average annual inflation and money growth rates. As in the previously reviewed studies, the observations are clustered around the 45° line. The correlation between average inflation and average M1 growth is 0.877 and 0.89 for M2. Thus, the results are very similar to those obtained by Vogel (1974), Dwyer and Hafer (1988), Barro (1990), Poole (1994), McCandless and Weber (1995) and Dwyer and Hafer (1999).

We also observe that most of the observations are grouped in the lower-left part of the chart, close to the origin. To detect whether the relation between money supply growth and the inflation rate may vary between subsamples we divide the set of all observations into groups in the following way: we start with a sample consisting of countries with inflation and money growth below 10%. Afterwards, we progressively expand the sample by adding the observations of the next classes, i.e. 10% to 20%, 20% to 30% and so on. We show a selection of scatter diagrams in Figure 2, Figure 3 and Figure 4.

It is immediately evident from the successive scatter diagrams that the positive relation between inflation and money growth seems to become more pronounced as we add observations of high inflation countries to the sample. For low inflation countries (less than 10%) the scatter diagram forms a shapeless, almost horizontal cloud. Thus, the relation between inflation and money growth obtained for the lowest inflation countries appears to be quite different from the results for the full sample.

Figure 2: Inflation and money supply growth lower than 10%.

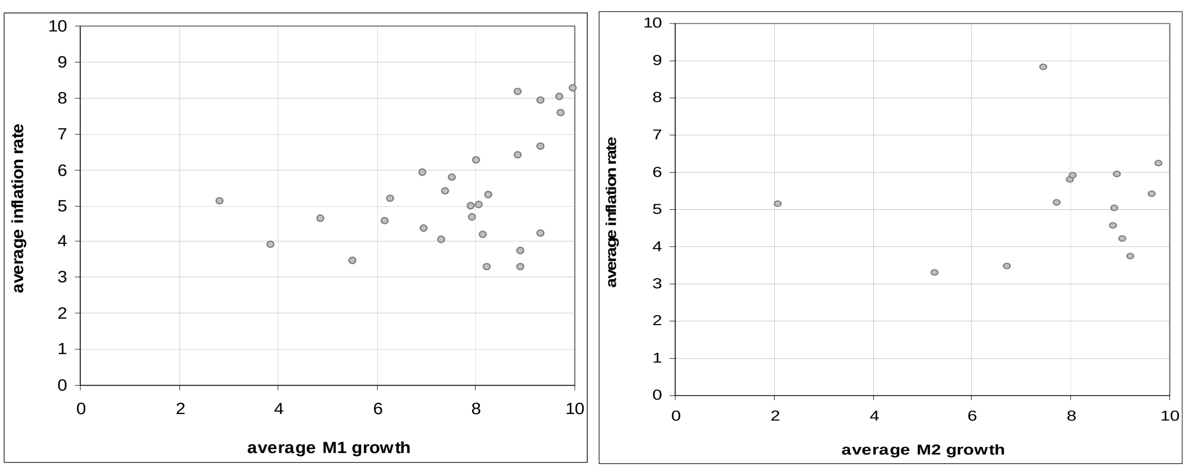


Figure 3: Inflation and money supply growth from 0% to 20%.

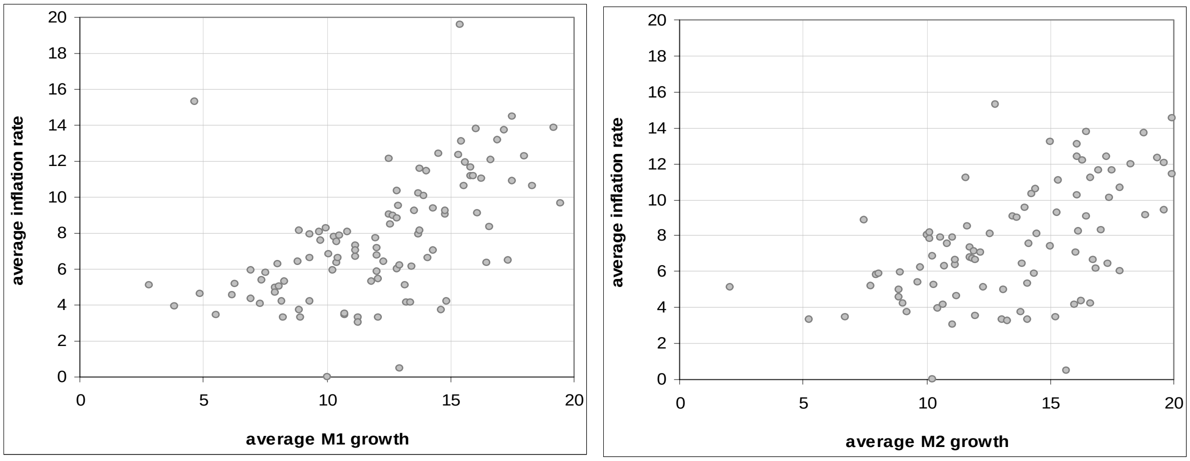
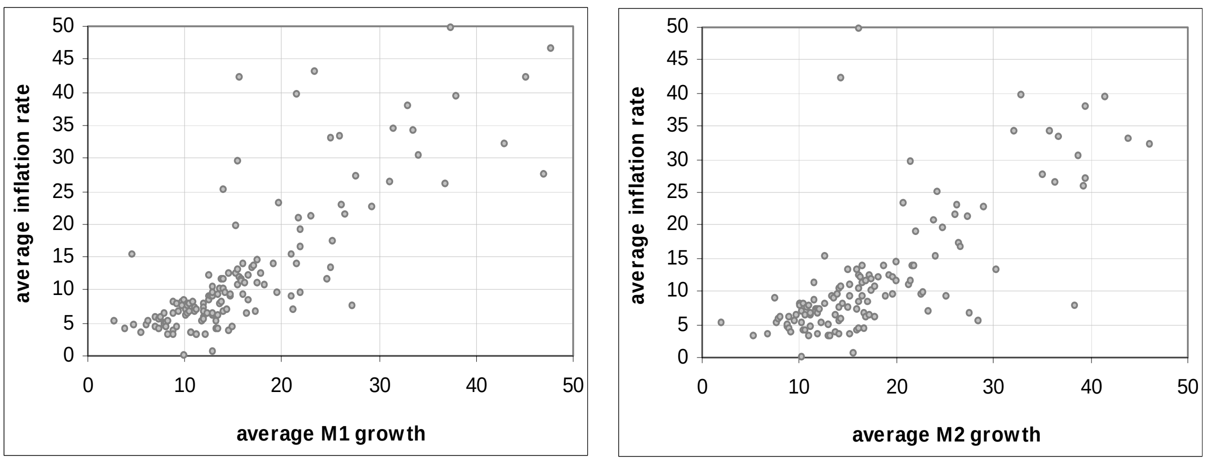


Figure 4: Inflation and the money supply growth from 0% to 50%.



3.2. Cross-section empirical analysis.

In this section we test both the proportionality prediction and the orthogonality assumption of the Quantity Theory of Money. We first analyse the whole sample (sections 3.2.1 to 3.2.3). We then analyse different subsamples according to the level of inflation (section 3.2.4).

3.2.1. Univariate regression

We start by estimating a simple univariate regression equation relating the long-term average inflation rate to the long-term average money supply growth (where the long term is 30 years)[3]. The first sample (M1) contains 165 countries, the second (M2)

[3] *Some of the time series used in calculations of average differ in their length. We have re-estimated all equations using a sample consisting of time series with at least 20 observations. The results are very similar to those obtained for the full sample and are not reported here. They can be obtained at request from the authors.*

159. The estimated equation was specified as follows:

$$p_i = \alpha_0 + \alpha_i m_i + \varepsilon_i. \tag{4}$$

The results of an OLS estimation are shown in Table 2 and Table 3. We observe that the growth rates of M1 and M2 have the right sign and are highly significant. We note, however, that the coefficients of M1 and M2 exceed one, and significantly so. The size of this coefficient, as predicted by the quantity theory of money, should be one. However, for the full sample of countries analysed over the 30-year period, we reject this hypothesis.

The scatter diagrams (Figure 1) indicate that there are a few outliers. These may affect the results. In particular, there are three points in the upper left corner with more than 120% inflation and money growth of 70% or less, and one point close to the horizontal line with money growth of about 100% and less than 20% inflation. We removed these four points and re-estimated the model. The results are shown in appendix (tables A.2 and A.3). It can be seen that the results are basically unchanged.

Table 2: Regression results for the full sample (money supply defined as M1).

Variable	Coefficient	Std. Error	t-Statistic	Prob.	Test α_1=1	
C	-19.7450	5.8758	-3.3604	0.0010	**t-Stat**	**Prob.**
m1	2.1018	0.1161	18.1068	0.0000	9.492	0.0000
Adjusted R-squared		0.667250	Akaike info criterion		11.12050	
Durbin-Watson stat		2.476225	Prob(F-statistic)		0.000000	

Table 3: Regression results for the full sample (money supply defined as M2).

Variable	Coefficient	Std. Error	t-Statistic	Prob.	Test α_1=1	
C	-22.2485	6.5192	-3.4127	0.0008	**t-Stat**	**Prob.**
m2	2.0015	0.1173	17.0643	0.0000	8.539	0.0000
Adjusted R-squared		0.657745	Akaike info criterion		11.21928	
Durbin-Watson stat		2.185256	Prob(F-statistic)		0.000000	

From observing the graphs of the residuals (Figure 5 and Figure 6) it can be concluded that the regressions may exhibit statistical problems. The figures show that the residuals grow as the independent variable increases. Thus, the model is subject to a cross-sectional heteroskedasticity.

Figure 5: Residuals from the first regression (inflation and M1 growth).

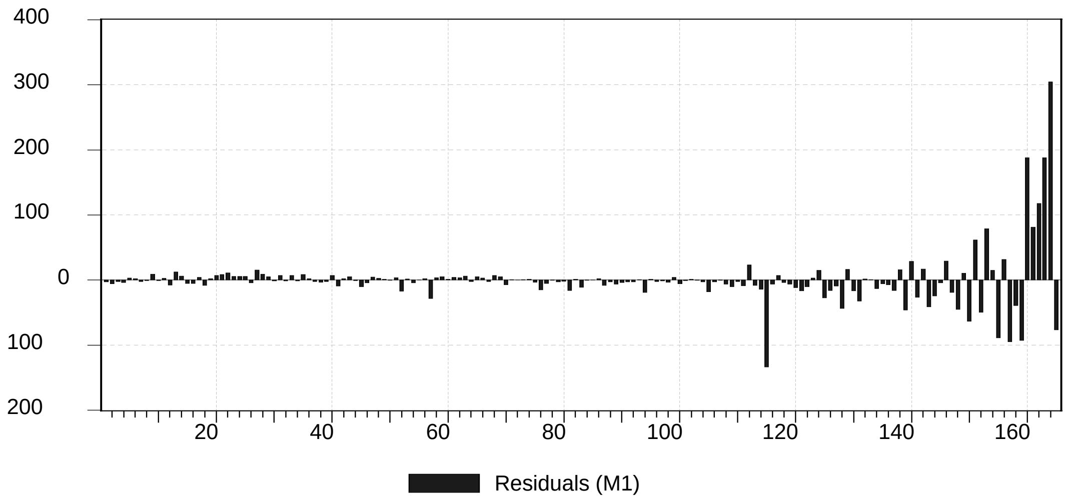
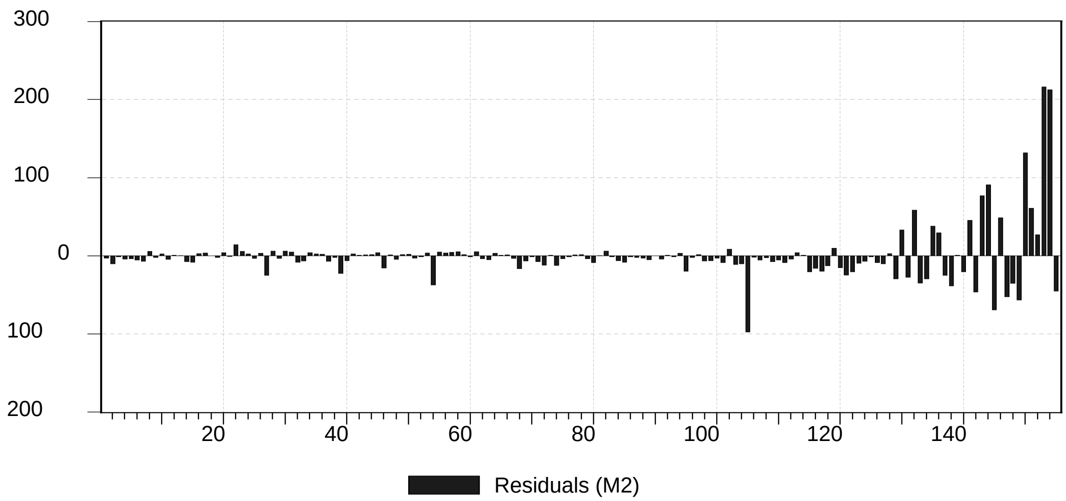


Figure 6: Residuals from the second regression (inflation and M2 growth).



The White-test confirms our prediction – we reject the null hypothesis of the absence of heteroskedasticity. The details of the White-test are shown in Table 4. The results of estimation with heteroskedasticity consistent standard errors are almost identical with the previous ones and are not reported here.

Table 4: White test for both regressions.

M1				
	F-statistic	31.29423	Probability	0.0000
	#Obs*R-squared	45.98231	Probability	0.0000
M2				
	F-statistic	25.08444	Probability	0.0000
	#Obs*R-squared	38.69086	Probability	0.0000

3.2.2. Multivariate regression

In this section we introduce the growth of output as an additional explanatory variable. The quantity theory predicts that when we control for the growth rate of the money stock, an increase in output will tend to reduce the rate of inflation, i.e. we expect the coefficient of output in equation 5 to be negative:

$$p_i = \beta_0 + \beta_1 m_i + \beta_2 y_i + \mu_i. \tag{5}$$

Table 5: Results of the OLS estimation of $p_i = \beta_0 + \beta_1 m1_i + \beta_2 y_i + \mu_i$.

White HCSE&Covariance			Included observations: 116		
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**	**Test β_1=1**
C	4.1342	17.5336	0.2359	0.8140	Prob.
m1	1.6393	0.1608	10.1949	0.0000	0.00012
y	-2.8263	3.4759	-0.8131	0.4179	
Adjusted R-squared		0.8581	Akaike info criterion		11.4386
Durbin-Watson stat		1.7925	Prob(F-statistics)		0.0000

Table 6: Results of the OLS estimation of $p_i = \beta_0 + \beta_1 m2_i + \beta_2 y_i + \mu_i$.

White HCSE&Covariance			Included observations: 109		
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**	**Test β_1=1**
C	18.888	18.7343	1.0082	0.3156	Prob.
m2	1.4511	0.1642	8.8362	0.0000	0.0070
y	-5.1216	3.5564	-1.4401	0.1528	
Adjusted R-squared		0.8230	Akaike info criterion		11.7164
Durbin-Watson stat		1.6375	Prob(F-statistics)		0.0000

The results of the OLS estimation (see Table 5 and Table 6) can be interpreted as follows. The sign of the estimated coefficient of output growth has the expected sign and is surprisingly large in value, but is not significant. Therefore, we cannot decisively confirm that output has no impact on inflation in any country. For sure, the inclusion of output growth affects the estimated coefficient of the money stock to a small degree. Differences in output growth have undetermined explanatory power for cross-country differences in inflation. We shall return to this issue in section 3.2.4, where we divide the countries according to their inflation level and investigate the relationship between money, output and inflation within various subsamples.

3.2.3. The orthogonality assumption

As we mentioned earlier, the quantity theory predicts that over a sufficiently long period, changes in the growth rate of money do not affect output growth. If money growth affects output growth, then this effect is temporary. Over the time horizon of 30 years considered here these temporary output effects of monetary expansions must have disappeared. In order to test the orthogonality assumption we estimated the following equation:

$$y_i = \gamma_0 + \gamma_1 m_i + \eta_i. \quad (6)$$

The results (presented in Table 7 and Table 8) suggest that one cannot reject the orthogonality assumption of the quantity theory of money. Over the thirty-year period considered here money growth seems to have no effect whatsoever on the growth rate of output. Thus, the quantity theory view that money cannot affect output in a permanent way is confirmed.

Table 7: Results of the OLS estimation of $y_i = \gamma_0 + \gamma_1 m1_i + \eta_i$.

White HCSE&Covariance			Included observations: 116	
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	4.0508	0.2553	15.8615	0.0000
m1	-0.0054	0.0022	-2.5119	0.0134
Adjusted R-squared	0.0441	Akaike info criterion		4.6993
Durbin-Watson stat	1.8769	Prob(F-statistics)		0.0134

Table 8: Results of the OLS estimation of $y_i = \gamma_0 + \gamma_1 m2_i + \eta_i$.

White HCSE&Covariance			Included observations: 109	
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	4.0736	0.2707	15.0459	0.0000
m2	-0.0046	0.0020	-2.2285	0.0279
Adjusted R-squared	0.0354	Akaike info criterion		4.7615
Durbin-Watson stat	1.7961	Prob(F-statistic)		0.0279

3.2.4. *The quantity theory and the level of inflation*

One of the main hypotheses we want to test in this paper is whether the quantity theory holds better (or less so) for different levels of inflation. We start the analysis by presenting the recursive estimations of the coefficients of m1 and m2 in both the univariate and the bivariate (which includes output) regressions, taking into account that we have ordered the observations in ascending order of the rate of inflation. This allows us to check for the stability of that coefficient. We show the recursive coefficient estimates in Figure 7.

We observe that the estimates exhibit large instability as we increase the sample from low to high money growth (high inflation) countries. For low levels of money growth the coefficient is close to zero or negative. Therefore, we achieve additional confirmation that the relation between the average money supply growth and average inflation rate is not stable across our sample of countries.

Figure 7: Recursive estimates of m1 and m2 from Tables 2 and 3.

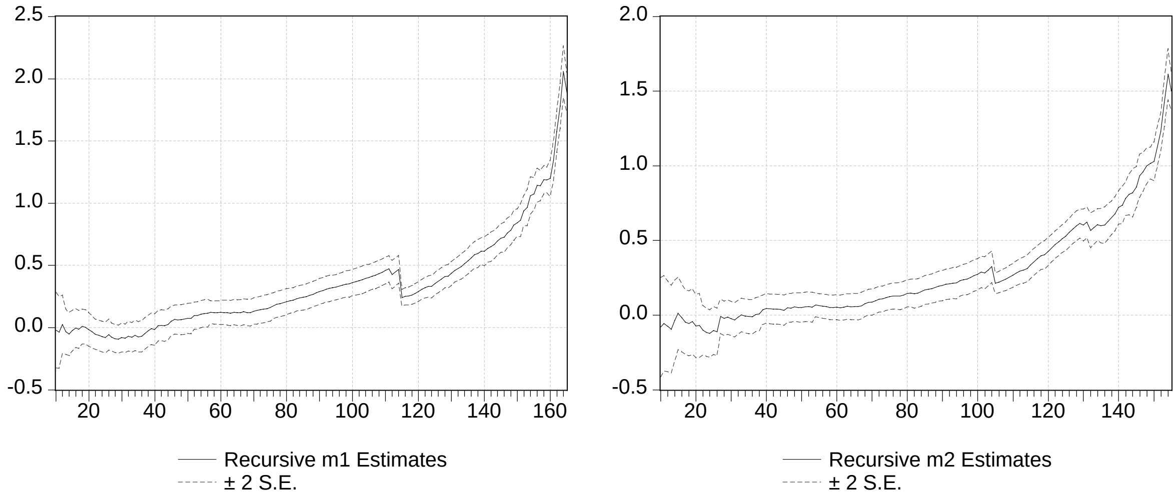
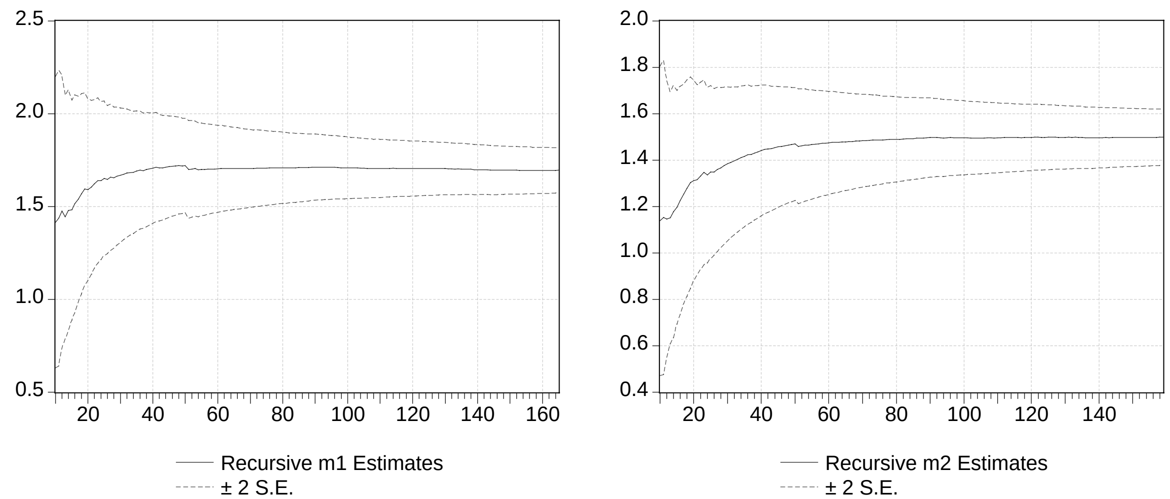


Figure 8: Recursive estimates of m1 and m2, calculated in reversed order.



When calculated in reversed order (starting from highest inflation countries and subsequently adding lower inflation observations), the recursive estimates of m1 and m2 very quickly reach their full sample values (Figure 8). Adding observations with lower inflation rates does not change the estimates.

The next step in the analysis consists in performing Chow breakpoint tests to detect structural breaks in the sample. Results of these tests are shown in Table 9. We find that four subsamples can be distinguished. Thus, we re-estimated the model for four separate subsamples. The results are shown in Table 10.

Table 9: Chow tests for bivariate equations $p_i = \beta_0 + \beta_1 m_i + \beta_2 y_i + \mu_i$ (subsamples start with given observation numbers).

m1	Chow breakpoint test*: **42 77 102**		
F-statistic	3.8248	Probability	0.0003
Log likelihood ratio	33.1675	Probability	0.0001
m2	Chow breakpoint test*: **39 69 99**		
F-statistic	9.4520	Probability	0.0000
Log likelihood ratio	68.6339	Probability	0.0000

*Note: Observations respond to the following inflation rates:
M1: **42**-8.43%, **77**-17.42%, **102**-73.62%; **M2**: **39**-9.24%, **69**-16.32%, **99**-135.94%.

We observe that for low inflation countries we do not obtain significant coefficients of m1 or m2. As we pass to higher inflation countries, growth of M1 or M2 becomes significant and more important in determining the inflation rate. This confirms our previous analysis indicating that the results of the high inflation countries dominate the results obtained for the full sample. When we disregard the high inflation countries, the coefficients of the money growth in the inflation equations tend to be much lower and most often insignificant.

Table 10: Results of estimation of the bivariate equations: $p_i = \beta_0 + \beta_1 m_i + \beta_2 y_i + \mu_i$.

		m1			
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**	**Test β_1=1**
Sample: 1 41					
C	6.4967	0.8880	7.3159	0.0000	**prob.**
m1	0.0648	0.0666	0.9734	0.3365	0.0000
y	**-0.3779**	0.1098	-3.4414	0.0014	
Sample 42 76					
C	10.9201	2.5047	4.3598	0.0001	**prob.**
m1	0.0961	0.1556	0.6175	0.5413	0.0000
y	-0.1746	0.1379	-1.2660	0.2147	
Sample: 77 101					
C	14.9328	6.9665	2.1435	0.0434	**prob.**
m1	**0.6679**	0.1672	3.9959	0.0006	0.0596
y	-0.8149	1.3383	-0.6089	0.5489	
Sample: 102 116					
C	110.7516	76.8182	1.4417	0.1750	**prob.**
m1	**1.3536**	0.2313	5.8517	0.0001	0.1523
y	13.4526	19.4823	0.6905	0.5030	

m2					
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**	**Test β_1=1**
Sample: 1 38					
C	6.8623	1.2779	5.3700	0.0000	**prob.**
m2	-0.0012	0.0977	-0.0121	0.9904	0.0000
y	-0.2050	0.1203	-1.7050	0.0970	
Sample: 39 68					
C	8.2702	1.8568	4.4541	0.0001	**prob.**
m2	0.2457	0.1087	2.2614	0.0320	0.0000
y	-0.2759	0.1622	-1.7010	0.1004	
Sample: 69 98					
C	34.8497	8.9731	3.8838	0.0006	**prob.**
m2	**0.7734**	0.2086	3.7072	0.0010	0.1165
y	**-7.0549**	1.7960	-3.9281	0.0005	
Sample: 99 109					
C	252.8749	112.4488	2.2488	0.0547	**prob.**
m2	**0.9719**	0.2587	3.7566	0.0056	0.9165
y	11.8033	23.7318	0.4974	0.6323	

We also note that in the subsample of low inflation countries, output growth has a significantly negative effect on inflation. This output effect on inflation tends to disappear in higher inflation countries. In these countries the growth rate of money becomes increasingly important. The only exception is the m2 third subsample, in which output growth has a surprisingly large and negative effect on inflation.

We conclude this section by noting that over the long term (thirty years) the orthogonality assumption of the quantity theory is confirmed, i.e. money growth has no permanent effect on output growth. The prediction of proportionality, however, is not maintained. For the sample as a whole we find that the coefficient of money is systematically higher than 1. **When we split the sample into subsamples according to the level of the rate of inflation, we find a very low and insignificant coefficient of money in the class of low inflation countries. Thus for low inflation countries the quantity theory prediction that inflation is a monetary phenomenon is not confirmed.** Things are very different in the class of high inflation countries. There we find a coefficient of money growth significantly higher than 1. Thus, in this group of countries, money growth has a more than proportional effect on inflation.

The picture that emerges from this analysis is the following. In the class of low inflation countries a higher growth rate of money does not lead to an increase in inflation in the long run, nor does it affect the rate of growth of output. This suggests that there must be a negative correlation between money growth and velocity growth. This conclusion follows from the fact that $m+v=p+y$ is an identity.

We also found that in the class of high inflation countries money growth has a more than proportional effect on inflation, without affecting output growth. The same quantity theory identity suggests that money growth and velocity growth are positively correlated. This phenomenon can easily be interpreted by the hyperinflationary dynamics, i.e. an increase in the growth rate of the money stock leads to an acceleration of velocity, which in turn reinforces the hyperinflationary dynamics. This phenomenon has been well documented in studies of hyperinflation (see e.g. Cagan (1956)).

The negative correlation between money growth and velocity growth in the class of low inflation countries is more difficult to interpret. One interpretation relies on the liquidity effect of an increase in the money growth, i.e. when the growth of money increases this leads to a decline in the nominal interest rate which in turn increases the demand for money (reduces velocity). This liquidity effect, however, occurs only in the short run. In our sample we relate thirty-year average growth rates of money and velocity. It is difficult to believe that the short term liquidity effect can be sustained over thirty years.

A second interpretation is the following. In the class of low inflation countries velocity changes are exogenously driven. They are determined by technological and institutional changes in the payments system. These are mostly unrelated to growth rate of the money stock. Since according to our previous results, output growth and inflation rates are disconnected from money growth, it follows that money growth adjusts to exogenous shocks in velocity in the class of low inflation countries.

4. Panel data evidence: less than the long run

In this section we use panel data models in order to further explore the relation between the money supply growth and the inflation rate. The use of panel data implies that we now look at the relation between money growth and inflation over shorter horizons (typically a year). This introduces the need to check for the existence of unit roots in the annual data. The results of the unit root tests are shown in appendix, table A.4. Our panels seem to be heterogeneous. It means that some of the time series are stationary, while others are not. This heterogeneity appears even within cross-sections. Unfortunately, in such a situation we cannot apply standard procedures of handling nonstationarity of panel models, since they are designed to be used with homogeneous panels.

We proceed as follows. Firstly, we investigate the contemporaneous relationship between money and inflation by pooling yearly- and country-observations. Secondly, we specify and estimate a fixed effect model using yearly observations of all the countries in the sample. Thirdly, we examine the same models with different time aggregation and dummy variables.

To investigate the contemporaneous influence of the money growth on the inflation rate we estimated the following panel data model:

$$p_{it} = \alpha_0 + \alpha_1 \, m_{it} + \varepsilon_{it}; \tag{7}$$

where p is the inflation rate, i is the index of the country and t is the time index. m_{it} denotes the percentage change of money supply during year t.

We applied this model to both the M1 and M2 definitions of money. Due to data availability, the second panel is slightly smaller than the first one. The yearly data are the same as those we used to compute the average rates, analysed in detail in previous sections. In Table 11 we present the results of the estimations.

The results of the estimation give us a very rough indication of the influence of the money supply change on the inflation rate in the same year. Contrary to the results of the cross-section estimation of long-term averages, the contemporaneous impact of money growth on inflation is weak. All estimates are significantly different from zero. Both models were estimated using (iterated) GLS, assuming the presence of cross-section (cross-country) heteroskedasticity. Sufficient reasons for this were given in the previous section. We report the weighted statistics.

Table 11: Estimation of the contemporary relation between the M1 and M2 growth and the inflation rate.

Method: Iterated GLS (Cross Section Weights)

First panel-M1			Total panel observations: 3567	
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	4.8869	0.1386	35.2541	0.0000
m1	0.1968	0.0082	24.0340	0.0000
Adjusted R-squared	0.0446	Durbin-Watson stat		0.9537
Prob(F-statistic)	0.0000			
Second panel-M2			Total panel observations 3436	
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	3.5390	0.1699	20.8222	0.0000
m2	0.2899	0.0098	29.4528	0.0000
Adjusted R-squared	0.1366	Durbin-Watson stat		1. 0797
Prob(F-statistic)	0.0000			

The next step consisted in specifying a fixed effect model:

$$p_{it} = \beta_{0i} + \beta_1 m_{it} + \xi_{it}; \quad (8)$$

where β_1 is common for all countries and each country gets its own constant β_{0i}. The latter represent time-invariant, country-characteristic factors, which influence the inflation rate. These country specific factors include the long term growth rates and trend changes in velocity. The model was estimated using GLS, assuming the presence of cross-section heteroskedasticity. The results are shown in Table 12. We find significant but small effects of money growth on inflation. The coefficient of M1 is only 0.096 while the coefficient of M2 is 0.2.

Table 12: Estimation of fixed effects.

M1				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
m1	0.0961	0.0073	13.2381	0.0000
Adjusted R-squared	0.3033	Durbin-Watson stat		1.0627
M2				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
m2	0.2005	0.0039	51.1270	0.0000
Adjusted R-squared	0.6392	Durbin-Watson stat		1.2290

In Figure 9 and Figure 10 we show the fixed effects (vertical axis) and relate these with the average money growth rates of each country (horizontal axis). The relation appears to be highly nonlinear. That is why we also show the relation on a logarithmic scale in the right-hand-side panel.

We find that there is a strong correlation between the average money growth rates and the fixed effects (the correlation coefficients are 0.69 and 0.67 for M1 and M2 respectively). The non-linear nature of this relation implies that as the average growth rates of money increase, the fixed effects (country specific effects) tend to increase more than proportionately. One possible interpretation runs as follows: when money growth becomes very high, the dynamics of hyperinflation is set in motion, producing strong increases in the velocity of money. This then tends to increase inflation more than proportionately (see the classic paper of Cagan (1956)).

Figure 9: Fixed Effects and money growth (M1). Left panel – prime data, right panel – logs.

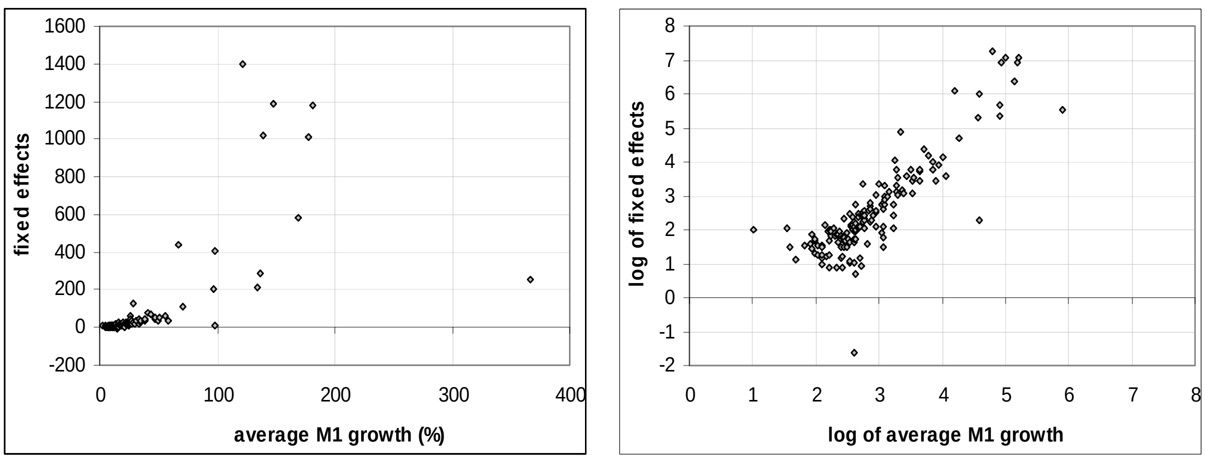
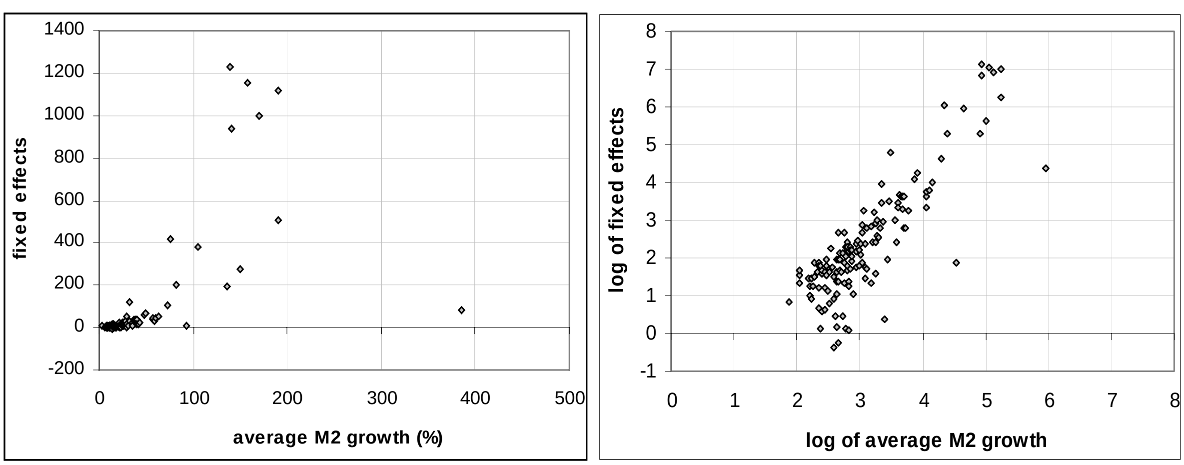


Figure 10: Fixed effects and money growth (M2).



In a situation in which a panel is constructed of time series representing single countries (or large companies, industries) and we want to make predictions for one cross-section or a group of them, it is usually advisable to use a fixed effects model. In such situation we cannot assume that the observations are randomly drawn from a certain underlying (common) distribution, and therefore determining the individual characteristics of cross-sections is important in interpreting the results of the estimation.

A clear sign of the situation in which a fixed effects model should be preferred is correlation between fixed effects and the regressor. If there is correlation, then the random effects estimator is inconsistent, since it ignores this correlation. Therefore, after observing high correlation between fixed effects and the money growth, we shall omit the estimation of the random effects model (see Verbeek (2000)).

To back up our conclusion, we could perform the Hausman test. However, the test is not informative in this case. We estimate only one parameter (we have one regressor), which implies that we have to use critical values from a χ^2 distribution with only one degree of freedom. Therefore, our test statistic is very likely to fall in the confidence interval and make us accept the null hypothesis of no difference between random and fixed effects models. We will, therefore, rely solely on the strong correlation between money growth and fixed effects as the argument in favour of the fixed effects model.

The next step in the analysis consists in testing for different effects of money growth on inflation depending on the level of inflation. In order to do so we created six dummies for increasing levels of inflation (D1: 0 to 10%, D2: 10% to 20%, ..., D6: more than 50%.) We then multiplied these dummies by *m* to obtain a slope coefficient (coefficient of m) for each group of inflation. The panel data model was re-estimated including these dummies. We show the results in Table 13. All slope coefficients are significant for both m1 and m2. As predicted, they are higher for countries with higher average inflation rates. The differences are quite substantial. Countries with low inflation (less than 10% per year) exhibit very low coefficients of money growth. Only the high inflation countries have coefficients that come close to the one predicted by the quantity theory of money.

Table 13: Estimation of panels with distinction between inflation groups (fixed effect models).

Variable	Coeff.	Prob. β=0	Variable	Coeff.	Prob. β=0
m1*D1	0.0604	0.0000	**m2*D1**	0.1663	0.0000
m1*D2	0.0605	0.0010	**m2*D2**	0.1446	0.0000
m1*D3	0.5880	0.0000	**m2*D3**	0.6794	0.0000
m1*D4	1.2343	0.0000	**m2*D4**	0.8346	0.0000
m1*D5	1.0738	0.0000	**m2*D5**	0.6890	0.0000
m1*D6	1.1470	0.0000	**m2*D6**	1.2248	0.0000
benchmark	0.0961		**benchmark**	0.2005	

The final step in our analysis of the panel data is applying different levels of time aggregation. We start with a panel constructed of non-overlapping, two-year averages of money growth and inflation. We then pass to averages over three and more years, finishing with a panel built of six-year averages. By analysing these panels, we want to see how the influence of money growth on inflation changes as we pass through increasing levels of time aggregation. We expect that, as the QTM is a long run relationship, the influence of money growth on inflation increases with the level of time aggregation.

We first estimate the following model:

$$p_{i\tau n} = \delta_{0n} + \delta_{1n}\, m_{i\tau n} + \zeta_{i\tau n}; \qquad (9)$$

where *i* denotes country and τ denotes the number of observation of the *n*-period average.

Table 14: Estimation results for various levels of time aggregation.

n	m1	$\delta \neq 0$	m2	$\delta \neq 0$	max. τ	# Obs.
1	0.0961	✓			*30*	*3567*
2	0.2651	✓			*15*	*1719*
3	0.3361	✓			*10*	*1138*
4	0.4892	✓			*7*	*864*
5*	0.5782	✓			*6*	*758*
6	0.3890	✓			*5*	*637*
30	2.1018	✓			*1*	*164*
1			0.2005	✓	*29*	*3174*
2*			0.3520	✓	*14*	*1497*
3*			0.4189	✓	*9*	*935*
4*			0.4567	✓	*7*	*803*
5*			0.4869	✓	*5*	*559*
6*			0.4618	✓	*4*	*448*
30			2.0015	✓	*1*	*152*

Note: The first column refers to the number of periods used in constructing averages. Column “max. t” gives the number of observations of n-period averages for each cross-section (each country) in the panel.

* Iterating until convergence was not possible

There are five such models to estimate for each definition of money growth. Results are reported in Table 14. For the purpose of clarity, only the most important statistics are presented. To compare with the extreme cases (no time aggregation and complete time aggregation), previously obtained estimates are presented as well.

Let us start with the analysis of the impact that the growth rate of M1 has on inflation. The second column in Table 14 gives us the estimate of the coefficient of m1. We see that the coefficient of the one-yearly observations (n=1) is the smallest. The coefficient increases with time aggregation and achieves a maximum for n=5 (five-year averages). This coefficient, however, remains well below one. Similar results are obtained for m2. Thus, as should be expected, we find that much of the effect of money growth on inflation is realised over time horizons exceeding one-year. However, the coefficient of money growth is not close to 1 for any of the estimated panel models.

Table 15 presents the correlation coefficients of the average growth rates of the money stocks and the fixed effects. Surprisingly, this correlation tends to increase with the level of time aggregation (at least until we reach 4- to 5-yearly averages). Thus, the link between the country specific effects on inflation and the average money growth tends to be higher for the 4- to 5-yearly averages than for the yearly observations. One would have expected that as the time aggregation increases the ability of the money growth to explain inflation increases, thereby reducing country specific effects. However, this result could also be due to the fact that, as countries are caught in the hyperinflation dynamics, the relative importance of velocity acceleration increases. This effect may in fact become more pronounced when analysing longer time horizons.

Table 15: Correlation of fixed effects with the average growth of M1 and M2.

***n* =**	**1**	**2**	**3**	**4**	**5**	**6**
m1	0.6942	0.5774	0.5830	0.8365	0.8790	0.8416
m2	0.6570	0.5802	0.9009	0.8795	0.7249	0.3943

Our final test consisted in estimating a panel data model with different levels of time aggregation and different levels of inflation. The model was specified as follows:

$$p_{it} = \varphi_0 + \varphi_{1j}\, m_{itj}\, D_j + \omega_{it}; \qquad (10)$$

where φ_0 is common for all observations, D_j denotes the dummy variable and j is the number of the inflation group ($j=1, \ldots, 6$).

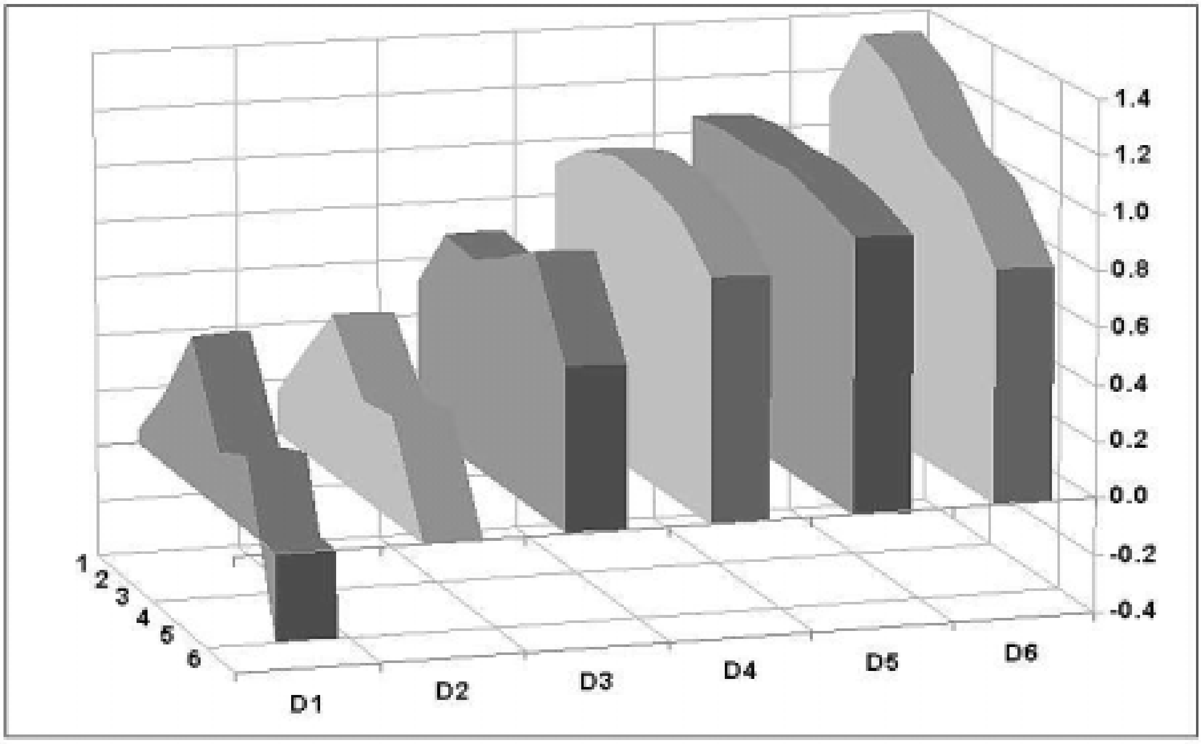
The model allows us to study how the level of time aggregation affects the coefficients of money growth. The quantity theory of money predicts that with increasing time aggregation the effect of money growth on inflation increases. Similarly, the model allows us to study how the level of inflation affects the coefficients of money growth for different levels of time aggregation. We show the full results in appendix, in Tables A.4 and A.5. Here we concentrate on the coefficients of m1 and m2, which are shown in Table 16. We also show coefficients for m1 in Figure 11. A similar figure showing coefficients for m2 can be found in the appendix. The results lend themselves to the following interpretation. First, the coefficients of money growth increase with the level of inflation, and reach a value close to 1. This value is reached when yearly inflation is between 30% and 40% (D4), for all levels of time aggregation. Second, time aggregation increases the value of the coefficients of m1 and m2 for the low inflation countries. When we move from one-yearly averages to three-yearly averages, we see that the coefficients of the low inflation countries (D1) increase to approximately 0.5. Further time aggregation, however, reduces this coefficient. Thus, the prediction of the quantity theory that in the long run movements of money and prices are proportional does not seem to be borne out for the low inflation countries.

Table 16: Estimated coefficients of m1 and m2 for different levels of inflation (D1...D6) and different levels of time aggregation (1...6 years).

	1	2	3	4	5	6
M1						
D1	0.0465	0.2486	0.5322	0.2004	0.2555	-0.3061
D2	0.1574	0.3684	0.5747	0.3440	0.3685	0.0007*
D3	0.5159	0.7576	0.7377	0.8163	0.9060	0.5807
D4	0.9162	1.0300	1.0739	1.0583	1.0128	0.8550
D5	1.0592	1.0728	1.0603	1.0707	1.0228	0.9662
D6	1.1105	1.3864	1.3130	1.1136	1.0463	0.8265
M2						
D1	0.1641	0.3883	0.4276	0.2608	0.3174	0.0906*
D2	0.2032	0.3545	0.4067	0.3367	0.3760	0.2198
D3	0.4601	0.6920	0.7156	0.6161	0.6715	0.5730
D4	0.7051	0.8183	0.9595	0.8692	0.9416	0.7937
D5	0.9821	0.9126	1.1264	0.9446	0.9960	1.0382
D6	1.1001	1.1797	0.9623	0.9903	1.0348	0.8241

** Not significant at 5% level*

Figure 11: Slope coefficient of M1 growth across time aggregation and inflation groups.



D1: $p\in[0\%, 10\%)$, D2: $p\in[10\%, 20\%)$, D3: $p\in[20\%, 30\%)$, D4: $p\in[30\%, 40\%)$, D5: $p\in[40\%, 50\%)$, D6: $p\geq 50\%$

5. Conclusions

The quantity theory of money is based on two statements. First, in the long run there is *proportionality* between money growth and inflation, i.e. when money growth increases by x% inflation also increases by x%. Second, in the long run there is *orthogonality* between money growth on the one hand and output growth and velocity changes on the other hand, i.e. output and velocity changes are not affected by money growth.

We subjected these statements to empirical tests using a sample involving most countries in the world during the last thirty years. Our findings can be summarised as follows. First, when analysing the full sample of countries we find a strong positive relation between the long run growth rate of money and inflation. However, this relation is not proportional.

Our second finding is that this strong link between inflation and money growth is almost wholly due to the presence of high (hyper)inflation countries in the sample. The relation between inflation and money growth for low inflation countries (on average less than 10% per year over 30 years) is weak, if not non-existing. From our panel data analysis we conclude that there is no evidence for a long-term proportional relationship between money growth and inflation, as predicted by the quantity theory, for low inflation counties (i.e. yearly inflation of less than 10%). We also find, however, that this lack of proportionality between money growth and inflation is not due to a systematic relationship between money growth and output growth. We find that in accordance to the QTM assumption money growth and output growth are orthogonal in the long run., i.e. higher growth rates of money do not lead to higher growth rates of output. This finding is consistent with the large number of econometric analysis using time series of single countries. Most of these studies have found that money is neutral in the long run, i.e. does not have permanent effects on output.

A third finding (obtained from a panel data analysis) indicates that country specific effects become increasingly important when the rate of inflation increases. We interpret this to mean that velocity accelerates with increasing inflation; thereby leading to inflation rates that exceed the growth rates of the money stock. This also explains why in cross-section regressions inflation rates increase more than proportionately to money growth in high inflation countries.

Finally, we found that in the class of low inflation countries money growth and velocity changes are inversely related, while in the class of high inflation countries the reverse holds, i.e. money growth and velocity growth are positively related. The latter confirms our interpretation of the positive correlation between money growth and fixed effects in our panel data model.

These results can be given the following interpretation. In the class of low inflation countries inflation and output growth seem to be exogenously driven phenomena, mostly unrelated to the growth rate of the money stock. As a result, changes in velocity must necessarily lead to opposite changes in the stock of money (given the definition $p + y = m + v$).

Things are very different in high inflation countries. In their case, an increase in the growth of the money stock leads both to an increase in inflation and in velocity. The latter reinforces the inflationary dynamics. This process has been well documented in empirical studies of hyperinflations and it is confirmed by our results (see Cagan (1956)).

All this leads to the conclusion that for low inflation countries we reject the proportionality prediction of the quantity theory. We confirm, however, that money and output are orthogonal in the long run.

Our results have some implications for the question of the use of the money stock as an intermediate target in monetary policy. As is well known, the European Central Bank continues to give a prominent role to the growth rate of the money stock in its monetary policy strategy. The ECB bases this strategy on the view that “inflation is always and everywhere a monetary phenomenon”. This may be true for the high inflation countries. Our results, however, indicate that there is no evidence for this statement in relatively low inflation environments, which happens to be a characteristic of the EMU countries. In these environments money growth is not a useful signal of inflationary conditions. It also follows that the use of the money stock as a guide for steering policies towards price stability is not going to be useful for countries with a history of low inflation.

Barro, Robert (1990): “Macroeconomics”, 3rd edition, New York, Wiley.

Boschen, J. and Mills, L., (1988), Tests of the Relation Between Money and Output in Real Business Cycle Models, Journal of Monetary Economics, 22: 355-374.

Cagan, Phillip, (1956): “The Monetary Dynamics of Hyperinflation” in: Milton Friedman (ed.) “Studies in the Quantity Theory of Money”, Chicago, University of Chicago Press, pp. 25-117.

Davidson, Russell and James G. MacKinnon (1993): “Estimation and Inference in Econometrics”, Oxford University Press

Dwyer, Gerald P. Jr. and R. W. Hafer (1988): “Is Money Irrelevant?”, Federal Reserve Bank of St. Louis Review 70, May/June 1988, pp. 3-17.

Dwyer, Gerald P. Jr. and R. W. Hafer (1999): “Are Money Growth and Inflation Still Related?”, Federal Reserve Bank of Atlanta Economic Review, Second Quarter 1999.

Fitzgerald, Terry J. (1999): “Money Growth and Inflation: How Long is the Long-Run?”, Federal Reserve Bank of Cleveland Economic Commentary, 1 August 1999.

Friedman, Milton, and Anna Schwartz, (1963): “A Monetary History of the United States, 1867-1960”, Princeton, Princeton University Press.

Geweke, J., (1986), The Superneutrality of Money in the United States: Interpretation of the Evidence, Econometrica, 54:1-21.

King, R., and Watson, M., (1992), Testing Long Run Neutrality, NBER Working Paper, no. 4156.

Lucas, Robert E. Jr. (1980): “Two Illustrations of the Quantity Theory of Money”, American Economic Review Vol. 70, No. 5, December 1980, pp.1005-1014.

McCallum, Bennett T. (1984): “On Low Frequency-Estimates of Long-Run Relationships in Macroeconomics”, Journal of Monetary Economics 14 (1984) 3-14.

McCandless, George T. Jr. and Warren E. Weber (1995): “Some Monetary Facts”, Federal Reserve Bank of Minneapolis Quarterly Review Vol. 19, No. 3, Summer 1995, pp. 2-11.

Pakko, Michael R. (1994): “Inflation and Money Growth in the Former Soviet Union”, International Economic Contributions, February 1994, Federal Reserve Bank of St. Louis.

Poole, William (1994): “Keep the M in Monetary Policy”, Jobs & Capital, Winter 1994, Milken Institute for Job & Capital Formation.

Smith, Bruce D. (1988): “The Relationship Between Money and Prices: Some Historical Evidence Reconsidered”, Federal Reserve Bank of Minneapolis Quarterly Review Vol. 12, No. 3, Summer 1988.

Stock, J., and Watson, M., (1988), Interpreting the Evidence on Money Income Causality, Journal of Econometrics, 40:161-182.

Verbeek, Marno, (2000): “A Guide to Modern Econometrics”, Chichester, Wiley.

Vogel, Robert C. (1974): “The Dynamics of Inflation in Latin America, 1950-1969”, American Economic Review 64, March 1974, pp. 102-114.

Wallace, Neil (1998): “A Dictum for Monetary Theory”, Federal Reserve Bank of Minneapolis Quarterly Review Vol. 22, No. 1, Winter 1998, pp. 20-26.

Weber, A., (1994), Testing long-run neutrality: empirical evidence for G6-countries with special emphasis on Germany, Carnegie Rochester Conference Series on Public Policy, 41: 67-117.

6. Appendix

Table A.1: List of countries.

BAHAMAS	FIJI	MALDIVES	SOUTH AFRICA
BAHRAIN	FINLAND	MALI	SPAIN
BANGLADESH	GABON	MALTA	SRI LANKA
BARBADOS	GAMBIA	MAURITANIA	ST. KITTS AND NEVIS
BELARUS	GEORGIA	MAURITIUS	ST. LUCIA
BELGIUM	GERMANY	MEXICO	ST. VINCENT & GRENS.
BELIZE	GHANA	MOLDOVA	SUDAN
BENIN	GREECE	MONGOLIA	SURINAME
BHUTAN	GRENADA	MOROCCO	SWAZILAND
BOLIVIA	GUATEMALA	MOZAMBIQUE	SWEDEN
BOTSWANA	GUINEA-BISSAU	MYANMAR	SWITZERLAND
BRAZIL	GUYANA	NAMIBIA	SYRIA
BULGARIA	HAITI	NEPAL	TANZANIA
BURKINA FASO	HONDURAS	NETHERLANDS	THAILAND
BURUNDI	HUNGARY	NETHERLANDS ANTILLES	TOGO
CAMBODIA	ICELAND	NEW ZEALAND	TONGA
CAMEROON	INDIA	NICARAGUA	TRINIDAD AND TOBAGO
CANADA	INDONESIA	NIGER	TUNISIA
CAPE VERDE	IRAN	NIGERIA	TURKEY
CENTRAL AFRICAN REP.	IRELAND	NORWAY	UGANDA
CHAD	ISRAEL	OMAN	UKRAINE
CHILE	ITALY	PAKISTAN	UNITED KINGDOM
CHINA: MAINLAND	JAMAICA	PANAMA	UNITED STATES
CHINA:HONG KONG	JAPAN	PAPUA NEW GUINEA	URUGUAY
COLOMBIA	JORDAN	PARAGUAY	VANUATU
CONGO, DEM. REP. OF	KAZAKHSTAN	PERU	VENEZUELA
CONGO, REPUBLIC OF	KENYA	PHILIPPINES	YEMEN
COSTA RICA	KOREA	POLAND	ZAMBIA
COTE D IVOIRE	KUWAIT	PORTUGAL	ZIMBABWE
CROATIA	KYRGYZ REPUBLIC	QATAR	
CYPRUS	LAOS	ROMANIA	
CZECH REPUBLIC	LATVIA	RUSSIA	

Table A.2: Additional cross-section regressions for M1

All countries, no constant

Variable	Coefficient	Std. Error	t-Statistic	Prob.
m1	1.884591	0.099418	18.95618	0.0000
R-squared	0.646239	Akaike info criterion		11.17569
Durbin-Watson stat	2.303712	Log likelihood		-915.4065

Outliers removed

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-21.20078	5.694025	-3.723339	0.0003
m1	2.137694	0.113345	18.86007	0.0000
Adjusted R-squared	0.690482	Akaike info criterion		11.04971
Durbin-Watson stat	2.616327	Prob(F-statistic)		0.000000

Outliers removed, no constant

Variable	Coefficient	Std. Error	t-Statistic	Prob.
m1	1.907105	0.098695	19.32319	0.0000
Adjusted R-squared	0.665442	Akaike info criterion		11.12132
Durbin-Watson stat	2.393552	Log likelihood		-888.7053

Table A.3: Additional cross-section regressions for M2

All countries, no constant

Variable	Coefficient	Std. Error	t-Statistic	Prob.
m2	1.770511	0.099108	17.86450	0.0000
Adjusted R-squared	0.633613	Akaike info criterion		11.28090
Log likelihood	-856.3484	Durbin-Watson stat		2.017938

Outliers removed

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-23.52294	6.387124	-3.682869	0.0003
m2	2.022677	0.115450	17.51990	0.0000
Adjusted R-squared	0.675459	Akaike info criterion		11.17045
Durbin-Watson stat	2.250960	Prob(F-statistic)		0.000000

Outliers removed, no constant

Variable	Coefficient	Std. Error	t-Statistic	Prob.
m2	1.781907	0.099140	17.97371	0.0000
Adjusted R-squared	0.647721	Akaike info criterion		11.24577
Log likelihood	-831.1870	Durbin-Watson stat		2.047797

Table A.4: Results of ADF tests (intercept, no trend) of the time series of M1 and M2 growth and inflation rate. No entry denotes nonstationarity, 1, 5, 10 denote rejection of H_0 at respectively 1%, 5% and 10% level.

Inflation		M1		M2	
Country	Test result	Country	Test result	Country	Test result
ALBANIA		ALBANIA		ALGERIA	10
ALGERIA		ALGERIA		ANGOLA	
ANGOLA		ANGOLA		ANTIGUA AND BARBUDA	5
ANTIGUA AND BARBUDA		ANTIGUA AND BARBUDA	1	ARGENTINA	5
ARGENTINA	1	ARGENTINA	5	ARMENIA	
ARMENIA		ARMENIA		ARUBA	
ARUBA		ARUBA		AUSTRALIA	5
AUSTRALIA		AUSTRALIA	1	AZERBAIJAN	
AUSTRIA		AUSTRIA	5	BAHAMAS	1
AZERBAIJAN		AZERBAIJAN		BAHRAIN	5
BAHAMAS	10	BAHAMAS	1	BANGLADESH	10
BAHRAIN		BAHRAIN	5	BARBADOS	5
BANGLADESH	10	BANGLADESH	5	BELARUS	
BARBADOS		BARBADOS	5	BELIZE	1
BELARUS		BELARUS		BENIN	5
BELGIUM		BELGIUM	10	BHUTAN	
BELIZE	5	BELIZE	1	BOLIVIA	5
BENIN	1	BENIN	5	BOTSWANA	
BHUTAN	10	BHUTAN	10	BOTSWANA	10
BOLIVIA		BOLIVIA	5	BRAZIL	
BOTSWANA		BOTSWANA		BULGARIA	
BRAZIL		BRAZIL	10	BURKINA FASO	
BULGARIA		BULGARIA		BURUNDI	5
BURKINA FASO		BURKINA FASO	5	CAMBODIA	
BURUNDI	10	BURUNDI	10	CAMEROON	
CAMBODIA		CAMBODIA		CANADA	
CAMEROON	5	CAMEROON	10	CAPE VERDE	
CANADA		CANADA	5	CENTRAL AFRICAN REP.	5
CAPE VERDE		CAPE VERDE	5	CHAD	1
CENTRAL AFRICAN REP.	10	CENTRAL AFRICAN REP.	10	CHILE	
CHAD	10	CHAD	1	CHINA: MAINLAND	10
CHILE	5	CHILE		CHINA:HONG KONG	
CHINA: MAINLAND	10	CHINA: MAINLAND	1	COLOMBIA	1
CHINA:HONG KONG		CHINA:HONG KONG		CONGO, DEM. REP. OF	
COLOMBIA	5	COLOMBIA		CONGO, REPUBLIC OF	
CONGO, DEM. REP. OF	10	CONGO, DEM. REP. OF		COSTA RICA	5
CONGO, REPUBLIC OF	1	CONGO, REPUBLIC OF	10	COTE D IVOIRE	10
COSTA RICA	5	COSTA RICA	1	CROATIA	
COTE D IVOIRE	10	COTE D IVOIRE	5	CYPRUS	10
CROATIA		CROATIA		CZECH REPUBLIC	
CYPRUS		CYPRUS		DENMARK	
CZECH REPUBLIC		CZECH REPUBLIC		DJIBOUTI	
DENMARK		DENMARK	5	DOMINICA	1

DJIBOUTI	
DOMINICA	
DOMINICAN REPUBLIC	10
ECUADOR	
EGYPT	
EL SALVADOR	
EQUATORIAL GUINEA	5
ESTONIA	
ETHIOPIA	5
FIJI	
FINLAND	
GABON	5
GAMBIA	
GEORGIA	
GERMANY	
GHANA	
GREECE	
GRENADA	
GUATEMALA	5
GUINEA-BISSAU	
GUYANA	
HAITI	
HONDURAS	10
HUNGARY	
ICELAND	
INDIA	1
INDONESIA	
IRAN	5
IRELAND	
ISRAEL	10
ITALY	
JAMAICA	5
JAPAN	
JORDAN	5
KAZAKHSTAN	
KENYA	5
KOREA	10
KUWAIT	10
KYRGYZ REPUBLIC	
LAOS	
LATVIA	
LEBANON	10
LESOTHO	10
LIBERIA	5
LIBYA	
LITHUANIA	
LUXEMBOURG	
MACEDONIA	
MADAGASCAR	5
MALAWI	10
MALAYSIA	5
MALDIVES	
MALI	

DJIBOUTI	
DOMINICA	5
DOMINICAN REPUBLIC	
ECUADOR	10
EGYPT	
EL SALVADOR	5
EQUATORIAL GUINEA	
ESTONIA	
ETHIOPIA	5
FIJI	1
FINLAND	1
GABON	10
GAMBIA, THE	1
GEORGIA	
GERMANY	1
GHANA	1
GREECE	1
GRENADA	5
GUATEMALA	1
GUINEA-BISSAU	
GUYANA	
HAITI	1
HONDURAS	10
HUNGARY	
ICELAND	
INDIA	1
INDONESIA	10
IRAN	5
IRELAND	1
ISRAEL	
ITALY	
JAMAICA	5
JAPAN	
JORDAN	
KAZAKHSTAN	
KENYA	5
KOREA	5
KUWAIT	10
KYRGYZ REPUBLIC	
LAOS	
LATVIA	
LEBANON	
LESOTHO	1
LIBERIA	
LIBYA	
LITHUANIA	
LUXEMBOURG	
MACEDONIA	
MADAGASCAR	5
MALAWI	5
MALAYSIA	5
MALDIVES	1
MALI	5

DOMINICAN REPUBLIC	
ECUADOR	
EGYPT	
EL SALVADOR	
EQUATORIAL GUINEA	
ESTONIA	
ETHIOPIA	
FIJI	
GABON	10
GAMBIA, THE	1
GEORGIA	
GERMANY	5
GHANA	1
GREECE	
GRENADA	1
GUATEMALA	1
GUINEA-BISSAU	
GUYANA	
HAITI	10
HONDURAS	
HUNGARY	
ICELAND	
INDIA	1
INDONESIA	10
IRAN	
ISRAEL	10
ITALY	
JAMAICA	
JAPAN	10
JORDAN	
KAZAKHSTAN	
KENYA	10
KOREA	
KUWAIT	
KYRGYZ REPUBLIC	
LAOS	
LATVIA	
LEBANON	5
LESOTHO	1
LIBERIA	
LIBYA	
LITHUANIA	
LUXEMBOURG	
MACEDONIA	
MADAGASCAR	5
MALAWI	5
MALAYSIA	10
MALDIVES	1
MALI	5
MALTA	5
MAURITANIA	
MAURITIUS	5
MEXICO	5

MALTA		MALTA		MOLDOVA	
MAURITANIA	10	MAURITANIA		MONGOLIA	10
MAURITIUS	5	MAURITIUS		MOROCCO	
MEXICO		MEXICO		MOZAMBIQUE	
MOLDOVA		MOLDOVA		MYANMAR	
MONGOLIA		MONGOLIA		NAMIBIA	
MOROCCO		MOROCCO		NEPAL	1
MOZAMBIQUE		MOZAMBIQUE		NETHERLANDS ANTILLES	
MYANMAR		MYANMAR	10	NEW ZEALAND	
NAMIBIA		NAMIBIA	10	NICARAGUA	
NEPAL	1	NEPAL	1	NIGER	
NETHERLANDS		NETHERLANDS	5	NIGERIA	10
NETHERLANDS ANTILLES	10	NETHERLANDS ANTILLES	10	NORWAY	
NEW ZEALAND		NEW ZEALAND	5	OMAN	5
NICARAGUA		NICARAGUA		PAKISTAN	1
NIGER	5	NIGER		PANAMA	1
NIGERIA	5	NIGERIA	5	PAPUA NEW GUINEA	1
NORWAY		NORWAY	5	PARAGUAY	
OMAN		OMAN	1	PERU	5
PAKISTAN	5	PAKISTAN	1	PHILIPPINES	1
PANAMA		PANAMA	5	POLAND	
PAPUA NEW GUINEA	5	PAPUA NEW GUINEA	1	PORTUGAL	
PARAGUAY	5	PARAGUAY	10	QATAR	
PERU	5	PERU	5	ROMANIA	
PHILIPPINES	1	PHILIPPINES	1	RUSSIA	
POLAND	10	POLAND		RWANDA	5
PORTUGAL		PORTUGAL	5	SAMOA	10
QATAR	5	QATAR		SAO TOME & PRINCIPE	
ROMANIA		ROMANIA		SAUDI ARABIA	
RUSSIA		RUSSIA		SENEGAL	
RWANDA	10	RWANDA	10	SEYCHELLES	1
SAMOA		SAMOA	1	SIERRA LEONE	
SAUDI ARABIA	10	SAUDI ARABIA		SINGAPORE	5
SENEGAL	10	SENEGAL	5	SLOVAK REPUBLIC	
SEYCHELLES		SEYCHELLES	1	SLOVENIA	
SIERRA LEONE		SIERRA LEONE		SOLOMON ISLANDS	1
SINGAPORE	1	SINGAPORE	10	SOUTH AFRICA	1
SLOVAK REPUBLIC		SLOVAK REPUBLIC		SRI LANKA	
SLOVENIA		SLOVENIA		ST. KITTS AND NEVIS	
SOLOMON ISLANDS	1	SOLOMON ISLANDS	1	ST. LUCIA	
SOUTH AFRICA		SOUTH AFRICA	1	ST. VINCENT & GRENS.	10
SPAIN		SPAIN		SUDAN	
SRI LANKA	10	SRI LANKA	1	SURINAME	5
ST. KITTS AND NEVIS		ST. KITTS AND NEVIS	1	SWAZILAND	1
ST. LUCIA		ST. LUCIA		SWITZERLAND	1
ST. VINCENT & GRENS.		ST. VINCENT & GRENS.	1	SYRIA	
SUDAN		SUDAN		TANZANIA	
SURINAME	5	SURINAME	1	THAILAND	10
SWAZILAND	5	SWAZILAND	1	TOGO	5

SWEDEN		SWEDEN	5	TONGA	5
SWITZERLAND	10	SWITZERLAND	5	TRINIDAD AND TOBAGO	
SYRIA	10	SYRIA		TUNISIA	
TANZANIA		TANZANIA	5	TURKEY	
THAILAND		THAILAND	5	UGANDA	
TOGO	5	TOGO	1	UKRAINE	
TONGA		TONGA	5	UNITED STATES	
TRINIDAD AND TOBAGO	5	TRINIDAD AND TOBAGO	10	URUGUAY	
TUNISIA		TUNISIA		VANUATU	5
TURKEY		TURKEY		VENEZUELA	5
UGANDA		UGANDA		YEMEN	
UKRAINE		UKRAINE		ZAMBIA	
UNITED KINGDOM		UNITED KINGDOM	5	ZIMBABWE	10
UNITED STATES		UNITED STATES	5		
URUGUAY	10	URUGUAY	10		
VANUATU	5	VANUATU	1		
VENEZUELA		VENEZUELA	10		
YEMEN	10	YEMEN			
ZAMBIA		ZAMBIA			
ZIMBABWE		ZIMBABWE			

Figure A.1: Slope coefficient of m2 growth across time aggregation and inflation groups.

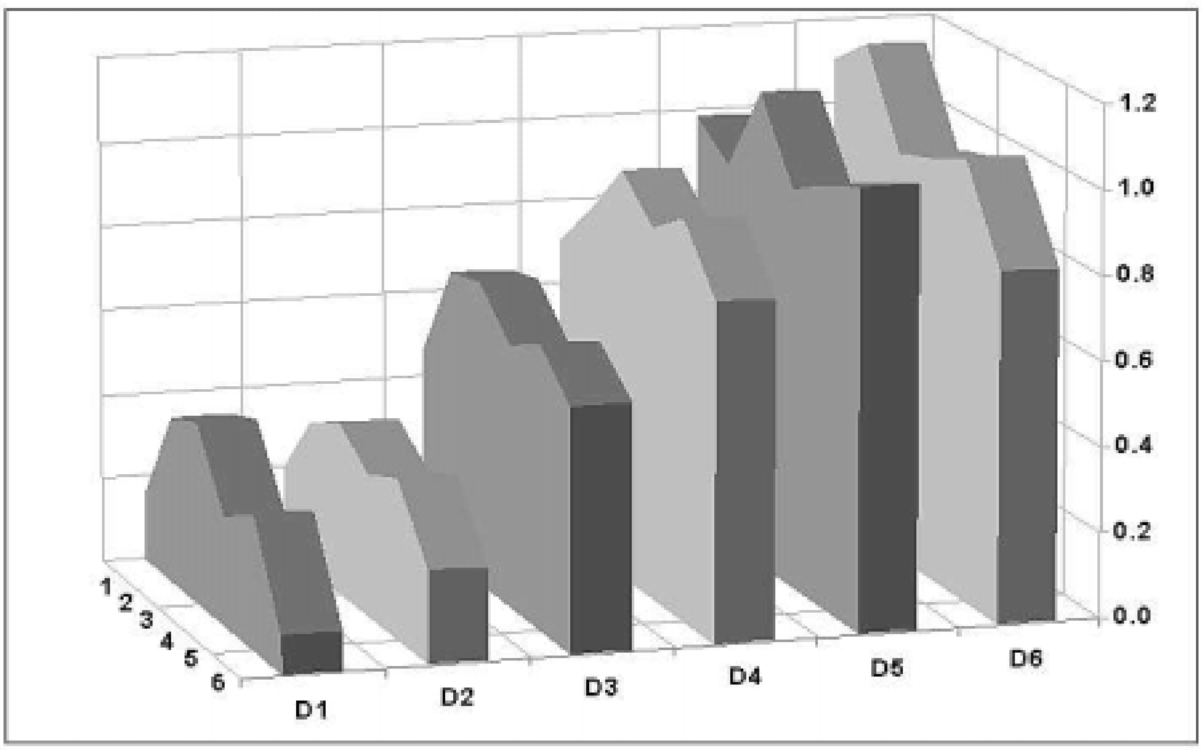


Table A.5: Estimation results for panels with inflation dummies for various levels of time aggregation (M1)

2 period averages				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	2.6399	0.2246	11.7559	0.0000
m1*D1	0.2486	0.0283	8.7693	0.0000
m1*D2	0.3684	0.0167	22.0682	0.0000
m1*D3	0.7576	0.0258	29.4042	0.0000
m1*D4	1.0300	0.0416	24.7548	0.0000
m1*D5	1.0728	0.0254	42.2562	0.0000
m1*D6	1.3864	0.0176	78.8707	0.0000
Adjusted R-squared	0.818826	Durbin-Watson stat	1.361736	
Prob(F-statistic)	0			
3 period averages				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	-0.2726	0.1923	-1.4175	0.1566
m1*D1	0.5322	0.0317	16.7669	0.0000
m1*D2	0.5747	0.0171	33.6222	0.0000
m1*D3	0.7377	0.0253	29.1056	0.0000
m1*D4	1.0739	0.0460	23.3458	0.0000
m1*D5	1.0603	0.0360	29.4286	0.0000
m1*D6	1.3130	0.0234	56.0891	0.0000
Adjusted R-squared	0.886199	Durbin-Watson st	1.477593	
Prob(F-statistic)	0			
4 period averages				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	4.4592	0.3285	13.5743	0.0000
m1*D1	0.2004	0.0344	5.8271	0.0000
m1*D2	0.3440	0.0223	15.4538	0.0000
m1*D3	0.8163	0.0337	24.2541	0.0000
m1*D4	1.0583	0.0563	18.7967	0.0000
m1*D5	1.0707	0.0259	41.3538	0.0000
m1*D6	1.1136	0.0344	32.3357	0.0000
Adjusted R-squared	0.828436	Durbin-Watson st	1.451887	
Prob(F-statistic)	0			
5 period averages				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	3.7790	0.2716	13.9159	0.0000
m1*D1	0.2555	0.0364	7.0157	0.0000
m1*D2	0.3685	0.0199	18.4769	0.0000
m1*D3	0.9060	0.0172	52.7452	0.0000
m1*D4	1.0128	0.0545	18.5765	0.0000
m1*D5	1.0228	0.0466	21.9263	0.0000
m1*D6	1.0463	0.0118	88.8310	0.0000
Adjusted R-squared	0.976284	Durbin-Watson st	1.518322	
Prob(F-statistic)	0			

6 period averages				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	9.6394	0.5227	18.4427	0.0000
m1*D1	-0.3061	0.0864	-3.5418	0.0004
m1*D2	0.0007	0.0310	0.0228	0.9818
m1*D3	0.5807	0.0444	13.0899	0.0000
m1*D4	0.8550	0.0554	15.4346	0.0000
m1*D5	0.9662	0.0536	18.0229	0.0000
m1*D6	0.8265	0.0283	29.1810	0.0000
Adjusted R-squared	0.810996	Durbin-Watson st	1.084037	
Prob(F-statistic)	0			

Table A.6: Estimation results for panels with inflation dummies for various levels of time aggregation (M2)

2 period averages				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	2.0243	0.2780	7.2813	0.0000
m2*D1	0.3883	0.0367	10.5905	0.0000
m2*D2	0.3545	0.0184	19.2585	0.0000
m2*D3	0.6920	0.0249	27.8310	0.0000
m2*D4	0.8183	0.0358	22.8870	0.0000
m2*D5	0.9126	0.0688	13.2710	0.0000
m2*D6	1.1797	0.0171	68.9314	0.0000
Adjusted R-squared	0.771561	Durbin-Watson st	1.503819	
Prob(F-statistic)	0			
3 period averages				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	1.9512	0.3118	6.2583	0.0000
m2*D1	0.4276	0.0399	10.7252	0.0000
m2*D2	0.4067	0.0203	20.0530	0.0000
m2*D3	0.7156	0.0249	28.7559	0.0000
m2*D4	0.9595	0.0097	98.8007	0.0000
m2*D5	1.1264	0.0503	22.4002	0.0000
m2*D6	0.9623	0.0217	44.3719	0.0000
Adjusted R-squared	0.999993	Durbin-Watson st	1.677419	
Prob(F-statistic)	0			
4 period averages				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	3.6846	0.3984	9.2482	0.0000
m2*D1	0.2608	0.0537	4.8517	0.0000
m2*D2	0.3367	0.0251	13.4025	0.0000
m2*D3	0.6161	0.0298	20.6450	0.0000
m2*D4	0.8692	0.0461	18.8366	0.0000
m2*D5	0.9446	0.0789	11.9725	0.0000
m2*D6	0.9903	0.0186	53.2551	0.0000
Adjusted R-squared	0.802458	Durbin-Watson st	1.439118	
Prob(F-statistic)	0			

5 period averages				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	2.4477	0.3654	6.6982	0.0000
m2*D1	0.3174	0.0448	7.0777	0.0000
m2*D2	0.3760	0.0255	14.7545	0.0000
m2*D3	0.6715	0.0331	20.2794	0.0000
m2*D4	0.9416	0.0603	15.6122	0.0000
m2*D5	0.9960	0.0985	10.1147	0.0000
m2*D6	1.0348	0.0050	207.2429	0.0000
Adjusted R-squared	0.987306	Durbin-Watson st	1.658091	
Prob(F-statistic)	0			

6 period averages				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	5.6360	0.4197	13.4286	0.0000
m2*D1	0.0906	0.0482	1.8800	0.0608
m2*D2	0.2198	0.0269	8.1730	0.0000
m2*D3	0.5730	0.0329	17.4224	0.0000
m2*D4	0.7937	0.0585	13.5573	0.0000
m2*D5	1.0382	0.0648	16.0249	0.0000
m2*D6	0.8241	0.0297	27.7333	0.0000
Adjusted R-squared	0.776666	Durbin-Watson st	1.562859	
Prob(F-statistic)	0			

Table A.8: A smaller sample of countries used in analysis of orthogonality of the growth rates of output and money.

ANTIGUA AND BARBUDA	DENMARK	LESOTHO	RWANDA
ARGENTINA	DOMINICAN REPUBLIC	LITHUANIA	SAMOA
ARMENIA	ECUADOR	LUXEMBOURG	SAUDI ARABIA
AUSTRIA	EGYPT	MADAGASCAR	SENEGAL
BAHAMAS	EL SALVADOR	MALAWI	SEYCHELLES
BAHRAIN	ESTONIA	MALAYSIA	SIERRA LEONE
BANGLADESH	FIJI	MALDIVES	SINGAPORE
BARBADOS	FINLAND	MALTA	SLOVAK REPUBLIC
BELARUS	GHANA	MAURITIUS	SLOVENIA
BELGIUM	GREECE	MONGOLIA	SRI LANKA
BELIZE	GUATEMALA	MOROCCO	ST. KITTS AND NEVIS
BHUTAN	GUYANA	MOZAMBIQUE	ST. LUCIA
BOLIVIA	HAITI	MYANMAR	ST. VINCENT & GRENS.
BOTSWANA	HONDURAS	NAMIBIA	SURINAME
BRAZIL	HUNGARY	NEPAL	SWAZILAND
BULGARIA	ICELAND	NICARAGUA	SWEDEN
BURKINA FASO	INDIA	NIGER	SYRIA
BURUNDI	INDONESIA	NIGERIA	TANZANIA
CAMEROON	IRAN	NORWAY	THAILAND
CHILE	IRELAND	OMAN	TRINIDAD AND TOBAGO
CHINA: MAINLAND	ISRAEL	PAKISTAN	TUNISIA
CHINA:HONG KONG	JAMAICA	PANAMA	TURKEY
COLOMBIA	JORDAN	PAPUA NEW GUINEA	UGANDA
CONGO, DEM. REP. OF	KAZAKHSTAN	PARAGUAY	URUGUAY
CONGO, REPUBLIC OF	KENYA	PERU	VANUATU
COSTA RICA	KOREA	PHILIPPINES	VENEZUELA
CROATIA	KUWAIT	POLAND	YEMEN
CYPRUS	LAOS	PORTUGAL	ZAMBIA
CZECH REPUBLIC	LATVIA	ROMANIA	ZIMBABWE