EXAMINING THE LONG-RUN RELATIONSHIP BETWEEN MONEY OUTPUT, INFLATION, AND EXCHANGE RATES: INTERNATIONAL EVIDENCE OF THE QTM AND PPP IN EMERGING MARKET ECONOMIES

by

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Abstract

The Quantity theory of Money (QTM) and the Purchasing Power Parity theory (PPP) have been long tested in the literature. This paper aims to contribute by analyzing QTM and PPP main propositions regarding the long-run relation of money, prices, output, and exchange rates from a combined framework. The empirical analysis is performed over a dataset of 22 countries considered to be emerging market economies by the IMF. The implications of this paper are of importance for these types of countries because as open-economies, careful attention should be paid to the relation among the variables in this study. Results support the propositions of QTM when tested individually, but the same is not true for PPP. Evidence supports the idea of some studies that PPP does not hold in the long-run. In the combined framework, mixed results are found.

Introduction

A central implication of *the Quantity Theory of Money* (QTM) tells as that in the long-run a given change in the rate of growth of the quantity of money (M) induces an equal change in the rate of growth of price inflation (Lucas 1980)[1]. Another very important implication of QTM is that there is not long-run correlation between either money growth or inflation and the growth rate of output.[2]The latter is not as robust as the former; McCandless and Weber (1995) found a positive correlation between real growth and money growth, but not inflation. Kormend and Meguire (1984) and Geweke (1986) argued that the data reveal no long-run effect of money growth on real output. Barro (1995) reported a negative correlation between inflation and growth in a cross-country sample. On the other hand, *the Purchasing Power Parity* (PPP) tells us that the difference in the growth rate of prices in two different economies, namely the difference in the inflation rates, is equal to the percentage depreciation or appreciation of the exchange rate. Moreover, according to PPP exchange rates move in the same proportion to prices in the long-run. Recent work on PPP among high-income countries has found evidence in favor of the hypothesis that real exchange rates converge to their PPP level in the long run. Other studies using long data series find evidence in favor of long-run PPP (by rejecting either the null hypothesis of unit roots in real exchange rates or the null of no cointegration between nominal exchange rates and relative prices (Engel 2000)[3]. Ng and Perron (2002) support Engle's idea that in the long-run PPP does not hold. Implication of the above two theories have been tested extensively using different data sets, different time

[1] Berentsen, Menzio, and Wright (2008) replicated Lucas's paper using data from 1955 to 2005 and found similar results.
[2] McCandless and Weber (1995) provide a summary of long-run monetary relationships examining data covering 30 years from 110 countries using different definitions of money.
[3] T Frankel (1986), Edison (1987)) reached the conclusion that real exchange rates do not have unit root.

periods, and different empirical approaches. But there are few studies that have analyzed for PPP and QTM propositions jointly. This paper tries to do exactly that under the idea that combining QTM and PPP into one theory, one can derive the proposition that money, exchange rates, and prices should all move proportionally in the long run (De Grauwe and Grimaldi 2001)[4]. In this paper, I want to test the propositions presented above by QTM and PPP; following De Grauwe and Grimaldi 2001 paper. In their paper, De Grauwe and Grimaldi tested the validity of these propositions in the long run using a cross-section of approximately 100 countries over a thirty-year period. They found the PPP and QTM propositions to hold quite well for the sample as whole. However, when distinguishing between high and low inflation countries the results were different. In low inflation countries an increase in the growth rate of money stock does not have a long run proportional effect on inflation. All this contrasts with the results of the high inflation countries where the proportionality propositions hold very tightly both in the context of the QTM and of PPP. Although the present paper follows De Grauwe and Grimaldi 2001 ideas closely, it differs from the latter in some important aspects: (a) this paper uses data from 22 countries considered Emerging Market Economies (EME); (b) this paper does not make a distinction between high and low inflation countries, but the distinction is made on the basis of the monetary policy tool used by the countries in the sample, namely Inflation Targeting (IT) or other (non-Inflation targeting); (c) I used panel data regressions instead of cross-section; and (d) the estimation time-period is from 1971 to 2010 (40 years). I think the following analysis is especially important, from an emerging market country perspective, given that as open-economies countries, exchange rate

[4] De Grauwe and Grimaldi 2001 presented their paper On April 19 – 20, 2001 the Oesterreichische National bank sponsored a Workshop organized by Richard Clarida (Columbia University), Helmut Frisch (TU Wien) and Eduard Hochreiter (OeNB) on „Exchange Rate and Monetary Policy Issues".

movements play an important role in the transmission process that links monetary disturbances to output and inflation movements (Walsh 2006, 3rd Edition). Moreover, it is important because having a better understanding of the long-run relationship among economic variables is crucial to implement effective policies that can contribute to further economic stability and growth. The rest of the paper is organized as follows. In section 2 a simple model that is introduced to combine the QTM and PPP in the same context. In Section 3 the empirical analysis is presented along with the data information and variables description. Section 4 presents the testing of the long-run convergence of exchange rates towards its PPP values. Section 5 tests the long-run neutrality of money. Section 6 concludes.

A simple theory

The Quantity Theory of Money and *the Purchasing Power Parity Theory* provoked an extensive number of studies that tries to explain the long-run behavior of the growth rates of money (m), output(y), inflation (p), and the rate of depreciation of the currency. The QTM can be represented by the following equation:

$$p = m + v - y \qquad (1)$$

where p is the percent change in the domestic price level (inflation), m is the percent change in money supply, v is the percent change in velocity, y is the growth rate of output. In the case of a foreign country, we have the following:

$$p^* = m^* + v^* - y^* \quad (2)$$

where the variables with * relate to the foreign country. The QTM formulates two important propositions: (a) in the long-run money (m) is *neutral*; this means that changes in money do not affect output changes when a sufficiently long period of time is allowed for; and (b) in the long-run changes in money and prices are *proportional*, this means that an percentage increase in the money stock leads to an equal percentage change in the price level. In the other hand, PPP can be represented with the following equation:

$$e = p - p^* + k \qquad (3)$$

where e is the nominal rate of depreciation of the domestic currency relative to the foreign currency, k is the real rate of depreciation of the domestic currency. The PPP theory implies that there is proportionality between the rate of depreciation of the domestic currency and the rate of change in domestic prices. After substituting (1) and (2) into (3), the new equation allows us to combine QTM and PPP, and is defined as:

$$e = (m - m^*) + (v - v^*) - (y - y^*) + k \qquad (4)$$

Equation (4) implies that there is a proportional relation between the changes in money, the exchange rate and the price level. The validity of (4) and its propositions are the main focus of this paper. By further analyzing (1), (2), and (4), we can test additional propositions of the QTM and PPP theory concerning the long run effect of the output changes. It follows that (a) a higher rate of domestic output growth (for a given foreign growth rate) leads to lower inflation, given the money growth; and (b) a higher rate of domestic output growth (for a given foreign growth rate) leads to an appreciation of the domestic currency, given the money growth. An important issue regarding this theory is that the propositions mentioned above are assumed to hold for all countries irrespective of the institutional differences between them. This issue will be taken into consideration by analyzing the individual country random effects in the empirical section below. At this point is worth mention, that there may be many sources of institutional differences between countries; one important one is the difference between monetary policy regimes that countries adopt (issue analyze in this paper). Some countries use Inflation Targeting (IT), others use a type of interest rates, and others use exchange rates. These differences affect institutions within each country, and are worthy to analyze if they affect the validity of the QTM and PPP in the long-run.

Empirical Analysis

In order to provide a different approach to De Grauwe and Grimaldi 2001 this paper uses panel data analysis. De Grauwe and Grimaldi 2001 use information for 20 years from 100 countries in their estimations. They calculate yearly averages over the period 1970-99 (therefore the data refer to averages of almost 30 years). The authors assume that such a period can be considered as representing the long run. Under their approach, each variable has roughly 100 observations. If one wants to focus on EME, the number of countries will be significantly reduced given the availability of data. In my dataset information for 22 countries is included; therefore following De Grauwe and Grimaldi 2001 yearly average approach means that each variable will only have 22 observations. After performing the analysis with only 22 observations per variable, results (which are not provided in this paper) were not very significant and provide so many mixed conclusions. Therefore, I opted to perform a panel data analysis that will make use of around 880 observations per variable. Another important reason for use panel data is that the analysis allows you to control for variables you cannot observe or measure like cultural factors or difference in monetary policy regimes across countries; or variables that change over time but not across entities (i.e. national policies, federal regulations, international agreements, etc.). On the latter, for example, open economies face the possibility of economic disturbances that originate in other countries, and this raises questions of monetary policy design that are absent in a closed-economy environment[5]. The

[5] Walsh, Carl. "Monetary Theory and Policy", Chapter 9, 3rd Edition, MIT Press 2010

monetary regimes adopted by each country in the sample can affect the propositions of the model. In particular, countries that adopt IT to other type of monetary instrument may experience different transmission processes of money to prices and to exchange rates. In order to account for these cross-country differences, the regression analysis in this paper will make use of the Random Effects (RE) tools. I chose to account for random effects in my regression analysis because it will allow to correct for unique, time constant attributes of each country that are the results of random variation and do not correlate with the regressors. This model is adequate, as we want to draw inferences about the whole population, not only the examined sample. Also after running the Hausman test[6], the results verified that in this dataset random effects are the preferred method over fixed effects.

Data and variables creation

The empirical analysis is performed over a data set personally created that includes information on Gross Domestic Product (GDP); Consumer Price Index (CPI); monetary aggregates (M1, M2, and M3); and exchange rates (XR). The data was collected using different sources. One point worth mention here is the difficulty of working with EME countries data-wise. EME data sets do not have long series; in contrast to countries like the U.S. or the U.K where one can find information for hundred of years, in EME one can optimistically find data for the last 30 or 40 years. Data sources included the International Financial Statistic (IFS) from the International Monetary Fund (IMF), the World Economic Outlook (WEO) from the World Bank (WB), the Federal Reserve Economic Data (FRED) from the Federal Reserve Bank of St. Louis, the ERS/USDA dataset from the U.S. Department of Agriculture, and many of the included countries

[6] See Hausman (1978)

central banks or statistics offices. The dataset encompasses 22 EME countries. In this paper a country is classified as EME if is consider either an emerging market economy or a developing economy by the IMF. Then using the WB upper-middle income classification the 22 countries where chosen. The time period of the variables differed from one country to another; then in order to create the panel dataset, the start date of 1971 was selected (given that most of the 22 countries have complete information from this date). So the time period for the analysis is from January 1971 to December 2010. The dataset includes information of GDP, CPI, M1, M2, M3, and XR. The velocity variable was calculated using the available information on nominal GDP and monetary aggregates. Yearly growth rates of each variable across countries were calculated; this new variables are the ones used in the calculations[7]. The list of the 22 countries used in this paper is provided in the Appendix section.

Testing the proportionality of the variables

In order to test both the proportionality between money growth and inflation and between money growth and exchange rate, the following relations need to be specified:

$$p_i = a_1 + a_2 m_i + a_3 y_i + a_4 v_i + \mu_i \quad (5)$$

$$e_i = b_1 + b_2 m_i + b_3 y_i + b_4 v_i + \omega_i \quad (6)$$

where e_i is the rate of depreciation of currency i against the US dollar; p_i, m_i, y_i, and v_i are the rates of growth of prices (CPI), money, output (GDP) and velocity. As mention above, all the variables include cross-section information refer to almost 40 years (the period 1971-10). I calculated the velocity for M1 and M2. A test of proportionality consists in checking whether the estimated coefficients of money (a_2 and b_2) are equal to one. An econometric issue that arises

[7] When interpreting the regressions coefficient values, one needs to be careful in order to provide an accurate interpretation.

with the specification (5) and (6) is the potential for collinearity between the regressors (De Grauwe and Grimaldi 2001). Table 1 shows the correlation matrix of the regressors M2, GDP, and V. In contrast to De Grauwe and Garibaldi's paper, the correlation coefficients in this data set are high; especially, between M2 and its velocity. When M1 and its velocity are used, the correlation coefficient decrease but is still above 0.5, as we can see in table 2 below.

Table 1. Correlation Matrix

	M2	GDP	V
M2	1	-0.47398048	-0.70095324
GDP	-0.47398048	1	-0.013469
V	-0.70095324	-0.013469	1

Table 2. Correlation Matrix

	M1	GDP	V
M1	1	-0.35541301	-0.50445011
GDP	-0.35541301	1	-0.01973743
V	-0.50445011	-0.01973743	1

In order to reduce to some extent the collinearity problem, I will use M1 and its velocity in the subsequent calculations. Table 3 presents the regression results of estimating (5). The explanatory power of the variables is high considering panel data, but lower than previous studies. Almost 86% of cross-country difference in inflation is explained by the macroeconomic money growth, output growth, and velocity growth. The coefficient for M1, a_2, is very significant and very close to one[8]. This supports the QTM proposition of a proportional relation between exchange rate changes and money growth. The coefficient of GDP, a_3, is significantly different from zero and

[8] For the coefficient value of 0.9759. See Table 5 for t-statistic of the null that the coefficients are equal to one

by the negative sign we can see how a higher output growth leads to a lower inflation, for any given level of (m). By the magnitude of a_3, we can infer that a 1 percent change in output growth will result in a 4.3 percent decrease of inflation. Similarly, the coefficient of velocity is significant and has the expected positive sign; which means that an increase in velocity leads to an increase in inflation. On the other hand, the proportionality proposition between money growth and exchange rate is not supported. These results are presented in table 4. In contrast to De Grauwe and Grimaldi (2001), the explanatory power of the variables is much lower at around 7.3% compared to their 98.5%. But the most dramatic difference is that one of the M1, b_2, coefficient.

Table 3. Panel EGLS (Cross-section random effects)

Dependent Variable: **GCPI**
Sample: 1971 2010
Periods included: 40
Cross-sections included: 22
Total panel (unbalanced) observations: 797
Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	17.20283	7.339647	2.343823	0.0193
GM1	0.975948	0.014898	65.50725	0.0000
GGDP	-4.288590	1.046115	-4.099541	0.0000
GV2	1.736726	0.233020	7.453120	0.0000

Effects Specification

	S.D.	Rho
Cross-section random	13.54491	0.0102
Idiosyncratic random	133.1615	0.9898

Weighted Statistics

R-squared	0.852130	Mean dependent var	51.33182
Adjusted R-squared	0.851570	S.D. dependent var	345.8011
S.E. of regression	133.2275	Sum squared resid	14075406
F-statistic	1523.271	Durbin-Watson stat	1.909963
Prob(F-statistic)	0.000000		

Unweighted Statistics

R-squared	0.854098	Mean dependent var	60.57034
Sum squared resid	14177116	Durbin-Watson stat	1.896261

Even though b_2 is statistically different than zero, we can see that the magnitude of 0.005056 is far from the expected value of one[9]. This means that in the long-run money growth has little effect on the depreciation of the currency. By its small value, I can assume that in the long run money is very close to be neutral with respect to exchange rate growth rates. Table 4 results also differ from De Grauwe and Grimaldi (2001) in the sense that the coefficient of the growth rate of GDP, b_3, is significant. The negative sign goes along with the expected assumptions of the model that a higher output growth leads to an appreciation of the currency, for any given level of money growth. The effect that a change in output growth has over the currency appreciation is less than its effect on inflation, as can be observed by the magnitude of b_3. The coefficient for the velocity is not significant and has a negative sign; which means that an increase in velocity leads to depreciation in the currency.

Table 4. Panel EGLS (Cross-section random effects)

Dependent Variable: **GXR**
Sample: 1971 2010
Periods included: 40
Cross-sections included: 22
Total panel (unbalanced) observations: 797
Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	8.550707	1.665368	5.134426	0.0000
GM1	0.004706	0.002509	1.875702	0.0611
GGDP	-1.317803	0.179978	-7.322033	0.0000
GV2	-0.013764	0.038775	-0.354978	0.7227

Effects Specification	S.D.	Rho
Cross-section random	5.685107	0.0621
Idiosyncratic random	22.08857	0.9379

[9] See Table 5 for t-statistic of the null that the coefficients are equal to one

Weighted Statistics			
R-squared	0.073204	Mean dependent var	1.617328
Adjusted R-squared	0.069698	S.D. dependent var	22.98924
S.E. of regression	22.16770	Sum squared resid	389685.7
F-statistic	20.87877	Durbin-Watson stat	1.659694
Prob(F-statistic)	0.000000		

Unweighted Statistics			
R-squared	0.063581	Mean dependent var	2.902323
Sum squared resid	414695.6	Durbin-Watson stat	1.559599

Table 5 present the t-statistic for the null hypothesis that a_2 and b_2 are equal to one.

Table 5. T-statistic for the null that M1 coefficients are equal to one (t alpha= 2.33 at 1% level)		
Eq. 5		-1.718
Eq. 6		-392.63

As we can see in (5) we can not reject the null that the coefficient of the money growth is statistically equal to one; while in (6) there is a strong rejection of the null that the coefficient of M1 is equal to one. Until this point, results support that the QTM and the PPP theory seem to hold very well for the inflation in the panel data setup of 22 countries over 40 years of data (1971-2010); while the contrary is true for the exchange rate. In the appendix section, the tables A1 and A2 show the results for regressions of (5) and (6) using M2 and its velocity respectively. In table A1, we can see similar results when using M2 instead of M1 as the monetary aggregate. Table A2 results are similar to table 4, but with an even more dramatic contradiction of De Grauwe and Grimaldi (2001) conclusions on the long-run relation between the exchange rate and money growth.

Testing the quantitative importance of the variables

Next I proceed to analyze the quantitative importance of the different regressors in explaining cross-country differences in inflation over the time period. First, by omitting velocity from the regression analysis, I want to find the effect of this action on the regression results. Table 6 shows that the exclusion of velocity from the model has no perceptible effects on the explanatory power of the equation. The R^2s are practically unaffected, in both cases, changing only by decimal points. The coefficients of money and output continue to be significant and change slightly. It is important to mention that a_2 and b_2 are still very close to one. I also note that the results of estimating the equations with M2 leads to very similar results; with the difference that in (6) the coefficient is not longer significant (results not shown).

Table 6. Panel EGLS (Cross-section random effects)				
Panel A: Dependent Variable: **GCPI**				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	21.12122	7.294656	2.895417	0.000390
GM1	0.974729	0.015366	63.44587	0.000000
GGDP	-4.738813	1.072720	-4.426907	0.000000
R-squared	**0.842482**			
Panel B: Dependent Variable: **GXR**				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	8.497624	1.7047518	4.983606	0.000000
GM1	0.004751	0.002532	1.893657	0.058600
GGDP	-1.313005	0.179659	-7.307673	0.000000
R-squared	**0.072887**			

Now, if the output growth is omitted from the equation, one can evaluate the additional explanatory power of output in explaining inflation and exchange rates differentials across-countries. Table 7 shows the results of the estimations when output growth is omitted. Results suggest that in the long run, inflation changes are dominated by money growth (84% of the long-run variation of inflation is explained by money growth). This is supported by the fact that the R^2 varies slightly when output growth is omitted. On the other hand, as expected from previous estimations above, the long-run variation of the exchange rates is not affected by money growth.

Table 7. Panel EGLS (Cross-section random effects)				
Panel A: Dependent Variable: **GCPI**				
Variable				
	Coefficient	Std. Error	t-Statistic	Prob.
C				
GM1	-0.145165	5.463192	-0.026571	0.978800
	0.986208	0.015313	64.40385	0.000000
R-squared	0.838842			
Panel B: Dependent Variable: **GXR**				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.675458	1.486258	1.800130	0.072200
GM1	0.007612	0.002558	2.975376	0.003000
R-squared	0.010949			
Panel C: Dependent Variable: **GXR**				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	8.878451	1.662695	5.339796	0.000000
GGDP	-1.348816	0.177459	-7.600735	0.000000
R-squared	0.067145			

The explanatory power of the model is highly reduced (from 7.2% to 1%) when output growth is omitted. Moreover, in panel C of table 7, one can see that the long-run variation of the exchange rates is somewhat explained by output growth (around 7%). From table 7, one can also conclude that, even when, output growth has a statistically significant effect on inflation, it is not quantitatively important in explaining cross-country differences in inflation changes. The contrary is true for the effects of output growth on exchange rate changes in the long-run (it is quantitatively and statistically significant).

4. Testing the long-run convergence of exchange rates towards its PPP values

In this section I turn the focus towards directly estimating PPP (notice that in previous sections PPP has been estimated indirectly). Then one can specify the following equation:

$$e_i = c_1 + c_2 p_i + z_1 \qquad (7)$$

Where p_i represents the yearly inflation rate of country i during the sample period, and z_1 is the error term. It is assume that exchange rate changes and inflation are endogenous variables. Then, a simultaneity problem arises in estimating (7). Following De Grauwe and Grimaldi (2001) to correct for this issue, I used the two stages least squares (2SLS) method to estimate (7). Money growth will be used as the instrumental variable for inflation. Since the exchange rate changes and the inflation rates are endogenous variables, equation (7) is affected by simultaneity. Therefore we used a 2SLS procedure and we used the money growth as instrument for inflation[10]. The results are presented in the Table 8. Here it is worth mention that when using 2SLS R^2 lacks its conventional interpretation[11]. As a matter of fact, the R^2obtained in the regression is very small and negative (actual value not shown).

Table 8. Panel Two-Stage EGLS (Cross-section random effects)

Dependent Variable: **GXR**
Sample: 1971 2010
Periods included: 40
Cross-sections included: 22
Total panel (unbalanced) observations: 798
Swamy and Arora estimator of component variances
Instrument specification: C GM1
Constant added to instrument list

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.657222	1.471078	1.806309	0.0712
GCPI	0.007716	0.002642	2.920146	0.0036

Effects Specification		S.D.	Rho
Cross-section random		5.615210	0.0553
Idiosyncratic random		23.20545	0.9447

[10] See Wooldridge (2002), Econometric Analysis of Cross Section and Panel Data for further explanations on 2SLS and instrumental variables.

[11] See Pesaran and Smith (1994) and Pesaran (1999) and Taylor for further details.

The results of Table 8 are in line with the results in table 4 and panel B in tables 6 and 7. There is not proportional relation between inflation and exchange rate changes. The coefficient on inflation is significant but very small (the t-statistic, not presented, reject the null of equality to one). This implies that in the long run, PPP does not hold; and therefore the links between exchange rate changes and inflation rates are weak. Moreover, one can say that inflation is close to be neutral in the long-run. These results are in line with Engel (2000) that argues that the in the long PPP does not hold after all. On the other hand, these results contrast with previous time series studies on PPP that found that exchange rates converge to their PPP value over long periods of time (see Cheung and Lai 2000, Frankel 1981, Kim 1990). Table A3 in the appendix section shows OLS regression analysis of PPP instead of 2SLS. The results are very much similar to those in table 8, only that using OLS the coefficient of inflation is very small and negative; contradicting much more PPP predictions.

Testing the long-run neutrality of Money

As mentioned above, there has been a lot studies testing for one of the main propositions of the QTM, the long-run neutrality of to money. In this section, I want to analyze this proposition from a panel data of EME perspective[12]. To test this proposition, the following equation is estimated:

$$y_i = c_1 + c_2 m_i + \varepsilon_i \qquad (8)$$

[12] See Duck (1993), Nwafor et al. (2007), Wanaset (2009), Mishra et al. (2010), and Ahmed et al. (2011) for international evidence of the QTM and evidence of specific countries.

and,

$$v_i = d_1 + d_2 m_i + \vartheta_i \qquad (9)$$

where y_i is the yearly output growth of country i, v_i is the yearly growth in velocity, m_i represents the yearly money growth and ε_i and ϑ_i are the error terms. Table 9 shows the results of estimating equations (8) and (9) with OLS.

Table 9. Panel EGLS (Cross-section random effects)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Panel A: Dependent Variable: **GGDP**				
C	4.396378	0.410072	10.72099	0.000000
GM1	-0.002168	0.000484	-4.478137	0.000000
R-squared	0.024552			
Panel B: Dependent Variable: **GV2**				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.237093	0.737531	1.677344	0.093900
GM1	-1.94E-05	0.002234	-0.008673	0.993100
R-squared	0.000000			

These results support the proposition that the growth of money has no long-run effect on the output growth or velocity growth; in other words money is *neutral*. As we can see in table 9, money growth has very little explanatory power on explaining variation on either output growth or velocity growth (R^2in panel A and B are very low). The coefficient of money growth, in panel A although significant, is very close to zero. In panel B the coefficient of money growth in not only close to zero but insignificant as well. From these results, one can conclude that money is very close to be neutral in the long-run. In line with the findings of De Grauwe and Grimaldi (2001), the coefficients in the money growth are negatives. This indicates that an increase in inflation leads to a decline in output growth. These results go in line with Barros (1995) findings that show that a negative correlation exists only when high inflation countries are added to the sample.

Conclusions

Following De Grauwe and Grimaldi (2001), this paper intended to analyze the different propositions of *the Quantity Theory of Money* and *the Purchasing Power Parity theory*. This was done by combining both theories into one theoretical framework. Using a panel data set that includes 22 EME for a period of 40 years between 1971 and 2010, different regression approaches were performed. Controlling for cross-countries differences in monetary regimes using random effects panel data estimations, this paper found evidence to support the long-run proportional relation between money growth and inflation. The explanatory power of the long run variation of inflation is mainly explained by the growth rate. Moreover, the growth rate and the growth of velocity, although, significant have little quantitative effects in the long-run variation of inflation. On the other hand, no evidence of a proportional relation between money growth and exchange rates were found. The money growth does not explain any of the long-run variation of changes in exchange rates, and has not significant effect on this. Output growth somewhat explain some of this variation. There is not proportional relation between inflation and exchange rate changes. The PPP theory did not hold in the long run; and there is no evidence that the links between exchange rate changes and inflation rates are strong. Moreover, one can say that inflation is close to be neutral in the long-run. When testing for the long-run neutrality of money, strong evidence supporting this proposition was found. Coefficients of the money growth variable were very close to zero, providing evidence that in the long-run money is close to be neutral. However, the coefficients had negative signs; which indicate that in the long-run an increase in inflation leads to a decline in output growth. All the conclusions in this are somehow supported by previous literature. Future studies can look for further analyze the institutional cross-country differences.

For example, the regressions can be re-estimated with sub-samples of the data; including in each subsample countries with common monetary policy regimes. Another idea for future research would be to test for the long-run relation between money, inflation, output and exchange rates from a VAR approach.

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Appendices

A1. Dependent Variable: GCPI

Panel Least Squares
Sample: 1971 2010
Periods included: 40
Cross-sections included: 22
Total panel (unbalanced) observations: 798

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	23.64767	6.964119	3.395644	0.0007
GM2	0.979306	0.016031	61.08768	0.0000
GGDP	-4.686652	1.118792	-4.189028	0.0000
GV	5.517926	0.274479	20.10328	0.0000

Effects Specification

Cross-section fixed (dummy variables)

R-squared	0.857858	Mean dependent var	60.52371
Adjusted R-squared	0.853445	S.D. dependent var	349.1707
S.E. of regression	133.6714	Akaike info criterion	12.65947
Sum squared resid	13811991	Schwarz criterion	12.80616
Log likelihood	-5026.130	Hannan-Quinn criter.	12.71583
F-statistic	194.3844	Durbin-Watson stat	1.710130
Prob(F-statistic)	0.000000		

A2. Dependent Variable: GXR

Panel EGLS (Cross-section random effects)
Date: 01/08/12 Time: 21:26
Sample: 1971 2010
Periods included: 40
Cross-sections included: 22
Total panel (unbalanced) observations: 798
Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	9.041025	1.716649	5.266669	0.0000
GM2	-0.000239	0.002625	-0.091165	0.9274
GGDP	-1.370188	0.180563	-7.588437	0.0000
GV	-0.002747	0.045358	-0.060567	0.9517

Effects Specification

	S.D.	Rho
Cross-section random	6.002111	0.0684
Idiosyncratic random	22.14580	0.9316

Weighted Statistics

R-squared	0.068759	Mean dependent var	1.549246
Adjusted R-squared	0.065240	S.D. dependent var	22.96213
S.E. of regression	22.19458	Sum squared resid	391123.8
F-statistic	19.54182	Durbin-Watson stat	1.708030
Prob(F-statistic)	0.000000		

Unweighted Statistics

R-squared	0.060324	Mean dependent var	2.879279
Sum squared resid	416455.4	Durbin-Watson stat	1.604136

Panel EGLS (Cross-section random effects)				
Dependent Variable: GXR				
Sample: 1971 2010				
Periods included: 40				
Cross-sections included: 22				
Total panel (unbalanced) observations: 800				
Swamy and Arora estimator of component variances				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	3.231885	1.469442	2.199396	0.0281
GCPI	-0.002333	0.002387	-0.977177	0.3288
	Effects Specification			
			S.D.	Rho
Cross-section random			5.648717	0.0572
Idiosyncratic random			22.93624	0.9428
	Weighted Statistics			
R-squared	0.001190	Mean dependent var		1.629247
Adjusted R-squared	-0.000061	S.D. dependent var		22.98865
S.E. of regression	22.98318	Sum squared resid		421524.7
F-statistic	0.950979	Durbin-Watson stat		1.683011
Prob(F-statistic)	0.329766			
	Unweighted Statistics			
R-squared	0.001542	Mean dependent var		2.837609
Sum squared resid	443211.3	Durbin-Watson stat		1.600660