Handbook on Economics, Finance and Management Outlooks
ISBN: 978-969-9952-03-6
homepage: http://pakinsight.com/?ic=book_detail&id=11
Conference venue : Lebua Hotels and Resorts, 1055 Silom Road, Bangrak, Bangkok 10500 Thailand

Vol.3 , 2015
(27-28 July)

Paper ID : 679/15/3rdICEFMO

The Impact of Money Supply on Economic Growth: Theory, Experience, Modelling

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Abstract

The slowdown of the economy and even the continuation of the economic downturn in many countries are enhanced by a number of reasons. The deep and durable recession is typical for the undermonetized economies. This study proves non-linear relationships between money supply and GDP volume by the curves of macroeconomic equilibrium in the money market and the market of real goods. The paper contributes the logical analysis influenced of monetary deficit, especially as a consequence of high cost of money, for impossibility to allocate resources for the real sector arising. This study is one of very few studies which show a positive long-term effect of increasing the coefficient of monetization on economic growth by the empirical examples of different countries. We have considered the BRICS countries among them, as well as rapidly growing Asian countries. At the same time, there is a threshold level of monetization in which monetary growth is fraught with increasing inflation and other negative consequences that have been already felt by the PIIGS countries. This paper permits to determine some reasons for the lack of monetary volume and conclusions for monetary policy aimed at overcoming the crisis and transition to sustainable economic growth.

Keywords: Monetization of the economy, Money market, Economic growth, Non-linear dynamics, Econometric modelling, Monetary policy.
JEL Classification: C22; O42; E31; E52.

1. Introduction

Monetary policy of the most states focuses primarily on holding steadily low inflation (inflation of costs), the arising of which is often associated with an increase of money supply. The viewpoint of management of the central banks, as well as representatives of international financial organizations, that policy permits to keep control for the financial markets, avoiding significant fluctuations on them. The real (but unmentioned) problem is that money is also a commodity, the turnover of which has recently accelerated. Deficiency of money leads to an increase the price of not only for money, but also for all other goods, for which money is the equivalent. Thus, the compression of money supply also leads to inflation, but now it is demand inflation.

Similar delusions are related with a fatal error of some economic schools about the linear character of the links between numerous economic indicators. Those views are firmly entrenched in the 'Economics' textbooks and are reflected in many scientific works of modern neoclassical synthesis. If we look at the majority of the formulas given by them, we see nothing more than a direct or feedback links of two or more variables. The proof of such theories are often found in some empirical studies conducted in different countries and times (Ihsan and Anjum, 2013); (Nouri and Samimi Ahmad, 2011) etc. The reason is, dynamics of relations between the two indicators may indeed appear linearly in certain short-run periods, just as any smooth curve may be approximated by a straight line at each of its small neighborhoods. However, monetary policy is known to have long-term consequences, and shifts towards longer horizons evoke the fact that connection between the same indicators obviously loses its linearity (Goridko and Nizhegorodtsev, 2013).

2. Principles

From the standpoint of economic theory, the change in the relation of money supply (M2) with a gross output (Y) can be substantiated by different approaches. If you use the resource approach and consider the money as a production resource, it can be assumed that the function describing the relationship between M2 and Y monotonically increases for a certain period, and each subsequent unit of

money invested in production, brings the gross output increasing until the limit value of the resource ($M2_{lim}$) has reached. That interval is marked by points1 and 2 in Figure 1.

For the value $M2_{lim}$ when the money supply is optimal, the maximum possible volume of gross output at the current stage of macrosystem is reached. A further increase in the money supply leads to it downfall, marked by points 3 and 4 in Figure 1.

Figure 2 considers in details a direct link between those indicators, illustrated by the curves of money demand and supply (MD and MS), as well as the curves IS-LM, representing the balance of money and commodity markets. Initially the macrosystem is at position 1.

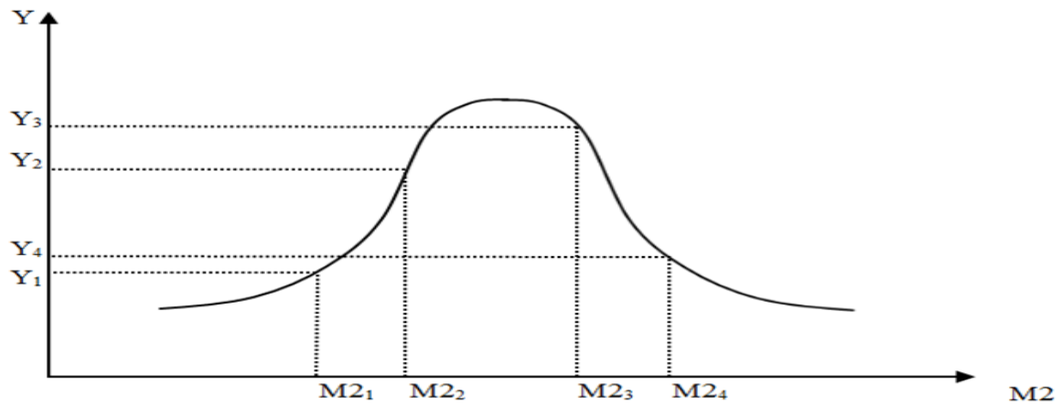


Figure-1. Dynamics of gross output for increasing the money supply

If the money supply increases from position $M2_1$ to position $M2_2$, the following occurs: 1) the money supply curve moves from location MS_1 to location MS_2 along demand curve MD, respectively, the interest rate decreases from r2 to r1; 2) reduction in the interest rate causes movement of curve liquidity-money (LM) along the curve of the investment-savings (IS), increasing gross output from Y1 to Y2. So, there was found a new balance between money and goods market in the point 2.

In other words, by analogy with Liang and Huang (2011) changing economic indicators at this phase can be expressed as:

↑ M2 (money supply) ⇒ ↓ r (interest rate) ⇒ ↑ I (investment) ⇒ ↑ Y (GDP volume).

Accordingly, by increasing the amount of money the government decides several strategic challenges, namely:

- developing the real economy, making loans more accessible, stimulating investment;
- saturating the commodity market by the products of internal production, as well as (possibly) improving the balance of trade;
- increasing the supply of the commodity market permits to reduce prices on some markets, thus reducing the level of inflation;
- increase in production evokes the unemployment reduction;
- increase well-being of the population;
- reducing social tensions, shortening the marginalized groups, and so on.

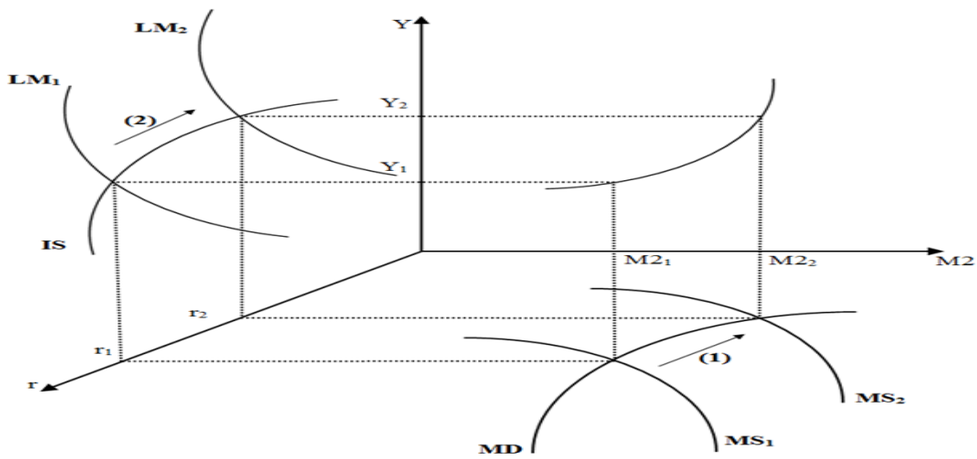


Figure-2. Direct link between the money supply and GDP volume

The efficient mode of government policy in such economic situation is the expansionary fiscal policy, and the most effective are the following instruments:

- escalating government expenditures;
- stimulating consumer demand through both mechanisms increase the price of labor, as well as social transfers;
- expansion of selective support for companies developing and introducing innovations;
- committing investments in the development of social infrastructure, including public-private partnerships in order to increase the social reliability of business;
- advancing education and science, improving the system of training for labor skills.

That mode of behavior is possible as long as there is sellers (banks, financial intermediaries, international financial institutions) in the money market, who are willing to lend money at a relatively low price. But sooner or later real resources, which involved in economic circulation, are exhausted; their volume cannot increase as fast as the money supply. This leads to a relative deficiency of resources and starts lowering the production efficiency. At that moment the money market is saturated, there comes a situation corresponding to the value of money $M2_{lim}$ and volume of gross output Y_{max}.

If the monetization of the economy is still in progress at that moment, then the following happens, like in Figure 3: 3) money demand reveals the further increase: the demand curve moves from the position MD_3 to position MD_4 along the curve of money supply MS, the supply of money in such volume is only possible by increasing interest rate r_4, which is higher than r_3; 4) money balance curve LM moves along the IS curve from location LM_3 to location LM_4, shrinking investment in production and, consequently, the GDP volume falls from Y_3 to Y_4.

There is an adverse dynamics:

↑ M2 (money supply) ⇒ ↑ r (interest rate) ⇒ ↓ I (investment) ⇒ ↓ Y (GDP volume).

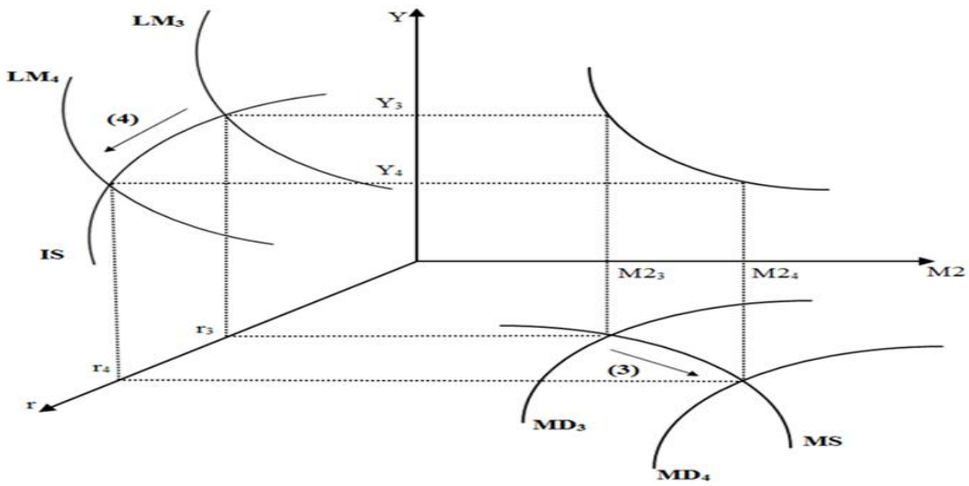


Figure-3. Feedback link between the money supply and GDP volume

Naturally, this leads to a completely opposite economic results, therefore, it is necessary to carry out a restraining economic policy. At the same time stimulating demand is devastating for the economy, it leads to overheating, resulting in flies up commercial interest rate, and reduced the refinancing rate of the central bank is unable to solve this problem. Thus, the key rate ceases to be a regulator of monetary system of the country, its value does not affect the dynamics of the commercial rate established second-tier banks.

That theoretical treatise may be quite strictly modelled by regression analysis. An example of modelling Marshall cross for the money market is given in Nizhegorodtsev and Goridko (2012) an example of modeling of curves IS-LM contained in Goridko and Nizhegorodtsev (2014).

So, that's a question: what macrosystems experience typical situations shown in Figure 2 or 3? What are the distinctive features of those macrosystems and how to regulate their money markets to ensure stable economic growth?

3. Methodology

The information base for the study are the data of the local currency GDP volume (Y) and money and quasi money (M2) for different countries from 2000 to 2013, placed on the official website of the World Bank (World Bank, 2015). All time series were reduced to the price level of the base 2000 by deflating. Using regression analysis, we construct a function Y = f (M2), which for some countries is linear:

$$Y = a_0 + a_1 \cdot M2, \quad (1)$$

a_0 – parameter reflecting the autonomous GDP volume, independent of the money supply, a_1 – the elasticity of GDP on M2 showing how gross output changes with an increase of money and quasi money per unit. Although the graphic of function (1) is a straight line, not a curve shown in the coordinates [M2; Y] at Figure-2, it characterizes (when a_1 is positive) the undermonetized economy of a country with all the ensuing consequences for its dynamics.

The instrument adequately reflects the original data for some other countries is a quadratic function, similar to one shown at Figure-1, and it's described by the formula:

$$Y = a_0 + a_1 \cdot M2 + a_2 \cdot M2^2. \quad (2)$$

We notice that a_2 is always negative, so, it is possible to determine the function's extremum point [$M2_{lim}$; Y_{max}], indicates the level of money supply corresponding with the greatest GDP volume of that country during the period considered.

In some cases, the formula (2) needs to exclude certain parameters, which with a probability of 95% is not significant (t-Student test for the regression coefficients were smaller than the critical value for the relevant degrees of freedom). We ascertain insignificance of an absolute term (sometimes – of a linear one) in that case, and standard error of estimation generally decreased as a result of excluding.

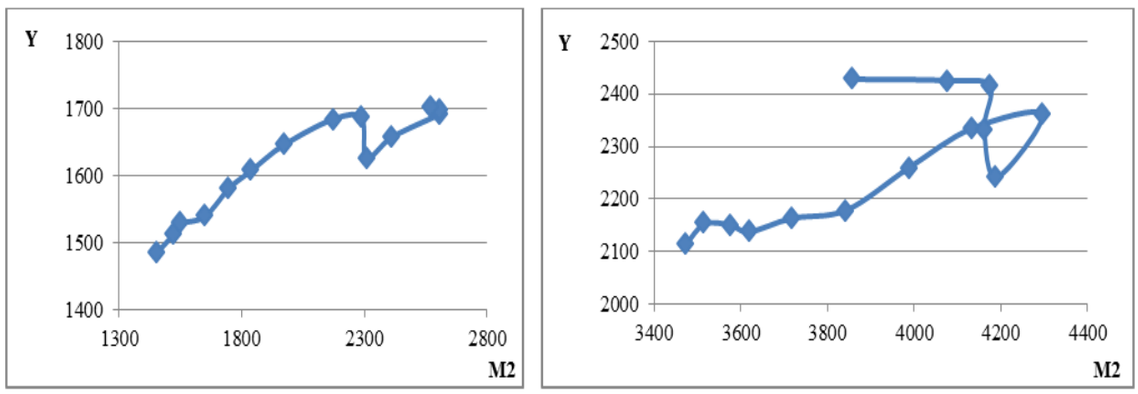
All the countries under consideration have been grouped in several pools: the first group consisted of G7 members except Italy; second – the PIIGS countries; the third – countries of Eastern Europe, recently entered in the EU; fourth – the BRICS countries; fifth – the fast-growing Asian countries. The paper presents the results of research for the most typical representatives of those groups.

4. Empirical Evidence

4.1. G7 Members

The countries of 'Big Seven' are highly developed and characterized by a relatively stable economy, with not very high, but steady pace of economic growth: the United Kingdom, Germany, Italy, Canada, USA, France and Japan. We also notice a high rate of monetization of those economies: as a rule, monetization coefficient (the ratio of money and quasi money to GDP) is 1.5 or more. Some of them are free to determine their own monetary policy, while others (except Italy) are the main policy-makers of the European Central Bank. The impact of money supply dynamics onto the volume of GDP for them is similar to the following: up to a certain point (predominantly before the economic crisis) both indicators are rising, further money supply is decline and pace of economic growth significant slowdown or even decline (with various lags in different countries).

Graphics for typical participants of this group are shown in Figure 4 (a – France; b – Germany).



a - France b - Germany

Figure-4. Relations between the money supply and the GDP volume for G7 members

As you can see, in France, as well as, for example, in Japan, with the constant growth of money supply we notice local recession in 2008-2009. According to initial data, we received two models presented in Table 1.

Both models have high explanatory characteristics; all the regression coefficients are significant. Using the quadratic model, we find the point of extremum function (1688.9, 2606.3), which corresponds to the level of 2011, i.e. at that year the level of money supply provides maximum GDP volume during the analyzed period.

Table-1. Models of relation of GDP volume with money supply in France, 2001-2013

Model type	Coefficients (t-test)			R^2	F-test	Std. error of estimate
	a_0	a_1	a_2			
linear	1275.34 (33.8)	0.17 (9.3)	-	0.88	86.13	27.54
quadratic	675.19 (3.6)	0.78 (4.1)	-0.00015 (-3.2)	0.94	81.95	20.63

As for Germany (a similar situation is observed in the UK), its money supply was compressed after the 2009 despite the fact that the gross output has been at a relatively stable level in 2012 and 2013. The dynamics of recent years has not made it possible to obtain adequate polynomial model, and the relationship of those two indicators described by a linear function:

$$Y = 1007.6 + 0.32 \cdot M2.$$
$$(3.42) \quad (4.28)$$

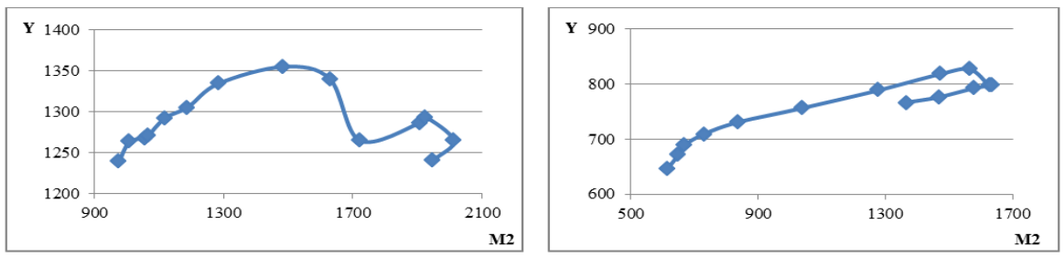
The coefficient of determination is 0.6; Fisher's test is 18.28, much higher than the table value, therefore the model, as well as its parameters, significant and adequately describes the original data.

Note that the economic dynamics of Italy is unlike other members of the 'Big Seven', it recalls the trajectory of other PIIGS countries.

4.2. PIIGS Countries

PIIGS (Portugal, Italy, Ireland, Greece, Spain) – the abbreviation composed by the first letters of the names of the European countries facing problems with the maintenance its debt obligations. Although the level of monetization of these economies is quite high – more than 1.5, it is characterized by high budget deficit relative to GDP, increasing public debt, and other symptoms of a crisis.

We notice the two different trends in the relationship of the level of GDP and the money supply, that is graphically illustrated in Figure 5.



a - Italy b - Spain

Figure-5. Relations between the money supply and the GDP volume for PIIGS countries

The trend is similar for Italy (Figure 5a) and typical for Portugal – there is a polynomial relation; point corresponding to the maximum of GDP volume falls in the period preceding the beginning of the economic crisis. Hereafter, until 2012, the money supply increased, but gross production slightly fluctuated in a narrow range; at the end of the considered period along the reducing the money supply, GDP also decreased.

We obtained an adequate and meaningful quadratic model without a constant for Italy:

$$Y = 2.23 \cdot M2 - 0.001 \cdot M2^2.$$
$$(21.88) \qquad (-8.57)$$

Its R^2 is almost equal to 1.00, F-test is 18.29. Standard error of estimate in comparison with the original model of the form (2), in which the reliability level of the constant is not more than 50%, decreased from 19.1 to 18.5.

For countries such as Spain, Greece and Ireland, we have a different trend (see Figure 5b): the relation between the two indicators is a straight linear, but before the crisis their values were monotonically increasing, and since 2008 decreasing. Those are two different paths – ascending and descending, which reflect two opposing dynamics in the economy of these countries. Two models built for Spain have parameters shown in Table 2.

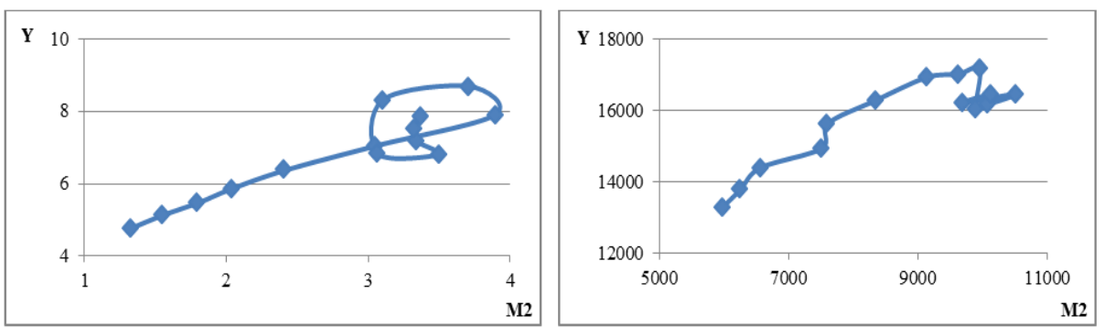
Table-2. Models of relation of GDP volume on money supply in Spain, 2001-2013

Model type	Coefficients (t-test)			R^2	F-test	Std. error of estimate
	a_0	a_1	a_2			
linear	599.66 (34.0)	0.13 (9.3)	-	0.88	85.96	20.67
quadratic	443.74 (7.3)	0.45 (3.7)	-0.00014 (-2.6)	0.92	67.54	16.92

As you can see, the null hypothesis of insignificance for model parameters must be rejected with a probability of 95%; formula adequately describes the original data and the variation of the GDP in Spain may be explained by changes of money supply at least in 88%. The quadratic model permits to determine the point of extremum (800.1, 1592.6), which falls on 2008. Since that the Spanish economy has proved to be undermonetized again.

4.3. New EU Members (Eastern Europe)

According to our division this group consists of the Baltic countries as well as Poland, Hungary and other Eastern European countries which acceded to the European Union not so long ago. They have a level of monetization of the economy about 0.4-0.8, relation among the GDP and the money supply is not uniform, and that difference was especially noticeable in the post-crisis period (Figure 6).



a - Latvia b - Hungary

Figure-6. Relations between the money supply and the GDP volume for Eastern European countries – new EU members

A kind of 'loop' (a sharp monetary volume decline with the stable GDP volume, and then a decay of GDP and a gradual increase of the money supply) is observed in all the Baltic countries. Such a trajectory is most adequately approximates by a linear model, which for Latvia (Figure 6a) has the form:

$$Y = 3.12 + 1.31 \cdot M2.$$
$$(6.42) \quad (7.89)$$

In this case, the determination coefficient is 0.84; Fisher's test is 62.2, so the model, as well as its parameters, significantly and adequately describes the original data.

The other countries of this group are characterized by a permanent change of monetary policy. The trajectory inherent for them is multi-directional changes in money supply that impact on the change of GDP growth. Such dynamics, for example, are proved to be in the pre-crisis economy of Ukraine (Goridko, 2012). As for Hungary (Figure 6b), we obtained two models: linear and quadratic without a constant term (Table 3).

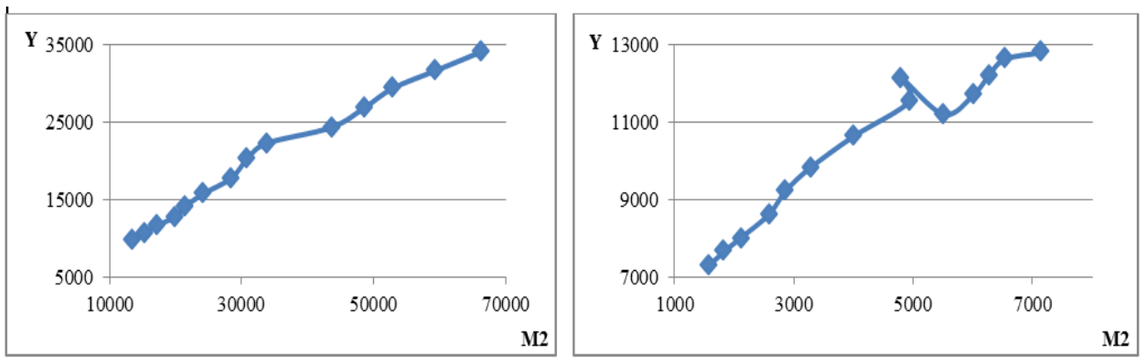
Table-3. Models of relation of GDP volume on money supply in Hungary, 2001-2013

Model type	Coefficients (t-test)			R^2	F-test	Std. error of estimate
	a_0	a_1	a_2			
linear	9868.46 (11.35)	0.68 (6.89)	-	0.80	47.52	566.58
quadratic	-	3.18 (36.86)	-0.00015 (-16.34)	1.00	10786.29	402.73

Both of models by all their parameters and explain characteristics adequately describe the original data. As before, the quadratic function permits to find a point of extremum (16612.5, 10448.9) which corresponds the most closely to about 2011 for that country.

4.4. BRICS Countries

In countries of BRICS (Brazil, Russia, India, China, South Africa) the crisis tendencies of 2008-2009 don't reflected significantly on the relation between the GDP volume and the money supply. As a rule, for the level of monetization of 0.5-0.7 (the exception is China, where the ratio of money supply to GDP is reaching towards 2), resources of money supply for growth of gross output is far from exhausting, as shown in Figure 7.



a - China b - Russia

Figure-7. Relations between the money supply and the GDP volume for BRICS countries

For all countries of this group, we successfully obtained both linear and polynomial of the second degree models (in some cases – without a constant term). Formula for China presented in Table 4, for Russia – in Table 5.

Table-4. Models of relation of GDP volume on money supply in China, 2001-2013

Model type	Coefficients (t-test)			R^2	F-test	Std. error of estimate
	a_0	a_1	a_2			
linear	4301.95 (7.22)	0.46 (29.59)	-	0.99	875.58	981.24
quadratic	-	0.74 (45.24)	-0.0000035 (-10.98)	1.00	7019.05	682.03

Table-5. Models of relation of GDP volume on money supply in Russia, 2001-2013

Model type	Coefficients (t-test)			R^2	F-test	Std. error of estimate
	a_0	a_1	a_2			
linear	6218.81 (17.83)	0.98 (13.04)	-	0.93	170.02	513.81
quadratic	4204.17 (6.69)	2.14 (6.39)	-0.00014 (-3.50)	0.97	170.62	369.35

In our opinion, linear models would be enough to describe the relation among GDP volume and money supply for the BRICS countries, but quadratic ones permit us to determine the potential GDP growth. Thus, extremum point for China (38985.9; 105,331.9), while as in 2013 indicator M2 amounted to 34058.4 and GDP volume – 66,250.9 billion yuan in the 2000 prices. As for Russia, in connection with the more convex quadratic function graph, obtained due to a sharp falling of GDP volume in 2008, an extremum point has coordinates (12653.4, 7900.8). So, GDP maximum has not been reached for Russia, and monetary volume in its economy is still insufficient.

4.5. Advancing Asian Countries

This pool of countries in our view may include Thailand, Malaysia, South Korea and other countries, where we investigate rapid economic growth and the level of monetization of the economy, as a

rule, is from 1 to 1.5. They are similar to the BRICS in trajectory of the studied indicators change. As an example, consider Thailand (Figure 8).

We also have two models that describe both linear and quadratic relations for it (Table 6).

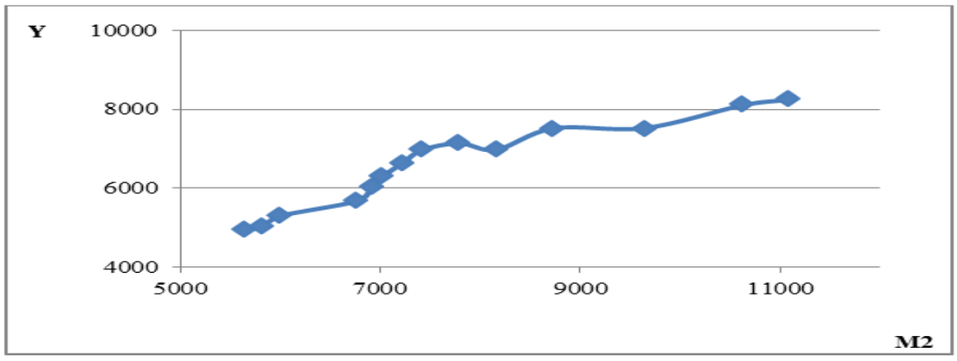


Figure-8. Relations between the money supply and the GDP volume for Thailand

Table-6. Models of relation of GDP volume on money supply in Thailand, 2001-2013

Model type	Coefficients (t-test)			R^2	F-test	Std. error of estimate
	a_0	a_1	a_2			
linear	1897,96 (4,03)	0,60 (10,21)	-	0,90	104,22	365,03
quadratic	-4948,85 (-3,24)	2,32 (6,13)	-0,0001 (-4,56)	0,96	148,39	224,32

The calculations for this country reveal that its economy is very close to its saturation limit because, as the quadratic function shows, an extremum point has coordinates (8130.5, 11529.7), while in 2013 M2 was 8246.8 and GDP volume – 11095.5 Thai baht in the prices of 2000.

5. Conclusions

The study explains the prerequisites of a nonlinear relation between money supply and GDP volume caused by rules of market economy.

In countries where the level of monetization is quite low and has not reached a critical level, such as the BRICS countries and some rapidly growing countries in Asia, the increase of money supply is necessary to stimulate economic growth. The government fiscal policy should be expansionary, and monetary policy should be aimed at eliminating the shortage of money as long as there are unoccupied resources available to be engaged in economic circulation in a short horizon.

Countries that have reached the saturation limit of a money market, risk with a further increase in the level of the economy's monetization will have the opposite effect and lead to the deployment of cost-push inflation, in accordance with the postulates of neoclassical synthesis.

We also consider the problems of monetary policy within the European Union. The interests of the EU developed countries which are the policy-makers of the European Bank, and the interests of EU underdeveloped countries are facing there. Those less developed countries are in monetary shortage, they suffocate from lack of funds, and the European Bank does not intend to provide the inflow. Debt problems in many of those countries are externally enhanced, provoked by the policy of the European Bank, aimed at pumping out of the resources of those countries and turning them into the colonial markets for products of companies from the Western Europe.

Study was supported by Russian Foundation of Humanities, project No 14-02-001100a ‘Monetary policy as an instrument of enforcement for economic growth’.

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