

Implications of the financial crisis to the relevance of Taylor rule Case study: European Union

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Abstract. *The recent global economic crisis has caused huge losses not only financial but also and more important losses related to the general confidence in the ability of the science of economics to contribute to the political decision making in a manner that will ensure an economic, social and sustainable development on the long run. To this regards, the science of economics, as any other science, must constantly review all its mainstream theories, theories that in time have been implemented by most of the economic policymakers around the world. The Taylor rule is a central element in the decision making process of monetary policy rates set by most central banks, both in developed and emerging economies .*

This paper proposes an analysis of the Taylor rule efficiency in terms of achieving the objectives of the monetary policy throughout the European Union, and to briefly outline some possible adjustments taking into account the unique specificity of these economies.

Keywords: macroeconomics, economic crisis, monetary policy, financial markets, Taylor's rule.

JEL Classification: E44, Q54, E43.

REL Classification: 8J, 8N.

1. Introduction

The recent financial crisis came as a surprise to macroeconomic policy makers. The financial crisis has been felt in the U.S. at first, but has quickly spread to the European continent and the entire world due to the very strong economic ties in the global financial system, as a result of the globalization process.

Basically, by the magnitude of adverse effects and the persistence, this crisis is proving to be one of the most severe economic crisis that mankind has seen so far. Today, more than five years after its inception, the financial crisis still makes its presence felt in the everyday lives of people everywhere.

Among the most damaging and long lasting effects of this financial crisis is the remarkable loss of confidence in the ability of the most market participation to the financial system to help grow the economy through the efficient allocation of resources, in the capacity of policy makers to help ensure economic stability and in the market's ability to self-adjust in time. Finally, it is also important to mention the trust loss of politicians and opinion leaders in the science of economics ability to provide concrete solutions to the problems encountered.

In these circumstances it is of the utmost importance for the science of economics to revise the widely accepted theories and assumptions on which it is based.

Taylor rule is a central element for analysing the decision making of monetary policy rates set by most central banks in both developed economies and emerging economies.

This paper is divided into five parts. After a brief introduction, the second part proposes a brief description of the Taylor rule, a rule that expresses a mathematical relationship between the monetary policy interest rate, inflation and the output gap (the difference between actual GDP and potential GDP). The third part aims to present the main coordinates of the evolution of the financial crisis in the European Union, focusing on the reaction of central banks in the EU. In forth part we analysed the monetary policies adopted by the European Union central banks, through the relationship proposed by John B. Taylor, in the pre-crisis period and during the crisis. The last part is an attempt to explain the reasons for deviations from this rule, and to outline some possible improvements to it.

2. Short description of Taylor's monetary policy rule

Taylor monetary policy rule expresses a simple mathematical relationship linking monetary policy interest rate, which is the main tool used by central banks to implement the economic policies that are responsible for, the output gap (the difference between actual GDP and potential the GDP) and the inflation deviation from the target (Taylor, 1993: p. 202):

$$r = p + 0.5y + 0.5(p - 2) + 2,$$

where:

r – monetary policy interest rate;

p – inflation rate over the last 4 quarters;

y – GDP output gap measured by:

$$y = 100(Y - Y^*)/Y^*,$$

where:

Y real GDP;

Y* potential GDP.

The above equation is adjusted for the US economy in which the targeted level of inflation and the equilibrium long term interest rate are equal with 2%.

Long before the appearance of this rule, economists have tried to find a mathematical relationship between inflation and interest rates charged by central banks. Although many relationships were previously proposed, the Taylor equation was the rule which prevailed between the theories of mainstream economic thinking. Currently this, rule is the main instrument to assess the decision making process of monetary policy rates set by most central banks in both developed economies and emerging economies.

Over the past decades, there have had outlined several monetary policy strategies. Currently, the most commonly used are direct inflation targeting strategy, practiced primarily in the European Union, and the strategy used by FED in the United States that implies the existence of a dual mandate: the central bank has responsibility for price stability and for the level of employment rate.

Inflation targeting strategy was first adopted in March 1990 by New Zealand and followed by Canada (1991), UK (1992), Finland, Spain and Sweden (1993) and Australia (1995). Romania has adopted this strategy in August 2005.

Both strategies involve the public announcement of a specific quantitative target (variation margin) inflation rate, valid for one or more periods and the accountability of the central bank to achieve it.

One of the main reasons why monetary policy Taylor rule has been so quickly agreed upon is because it fits very well both in terms of central banks having the fundamental objective of price stability and in terms of central banks having a dual mandate (Asso et al., 2010: p. 12). If central banks, besides pursuing price stability, also concentrates on full employment, the rule proposes a formula that takes into account these two objectives: the output gap tends to be minimum when the potential GDP equals actual GDP and the deviation of inflation from the target

becomes a separate part of the equation. If there is a single fundamental objective of monetary policy, namely price stability, output gap becomes a simple external factor that must be estimated correctly by the central bank.

With regards to the proper use of the mathematical relationships, in his published work in 1993, Taylor stated that monetary policy makers must take into account many factors in determining the interest rates practiced and recommended adding the rule "on experimentally basis" (Taylor, 1993: p. 208).

Since its publication, Taylor rule has proven to be an effective tool in evaluating the performance of central banks. Studies on the application of the Taylor showed that during 1970, in most developed economies, interest rates charged by central banks were mostly below the level resulting from the application of this rule. From this perspective, the monetary policy of those years can be considered one of relaxation. By contrast, during the years 1980-2000, official interest rates have been consistently below the Taylor rule, the period is characterized by low inflation and an overall macroeconomic stability (Hofman, Bogdanova, 2012: p. 37).

3. Causes and manifestations of the financial crisis in European Union

There is a general consensus that the recent financial crisis has its origins in the US. In a brief analysis, the main reason for the outbreak of the financial crisis was the large volume of subprime loans that US banks have granted to individuals, based solely on real estate collateral. These credits could be granted because the US financial regulations allowed this. This is because banks which gave them could, in turn, emit a type of derivative called MBS (mortgage-backed securities), derivatives having for the underlying asset the mortgages on the financed houses. This created a vicious circle because these financial instruments fuelled the continued growth of the housing market, leading to buying houses only to access a housing loan. Eventually, after the grace period expired, the mortgage loan was refinanced by the bank through a higher amount because meanwhile the property value increased.

We can not say that the European Union commercial banks have granted too many of such loans. However the crisis has expanded rapidly in Europe due to high yields of MBS derivatives. By buying these derivatives in large quantities, the European banks also fuelled the U.S. housing market growth.

At some point, however, around 2007-2008, the housing market has reached its saturation level and the commercial banks were finding more and more difficult people with sufficient financial reliability to give them credit. The US housing market began to decline slowly and price MBSs literally collapsed.

The reasoning above seems to identify the main causes of the financial crisis in the banking regulations that allowed granting subprime loans and massive investments in financial derivatives. Another issue that stands out is the problem of corporate governance in the banking system. Basically managers of major banks on both continents showed a narrow view of the financial markets and the general course of economies, at the same time being attracted by the high profits made by the institutions they represent and by their personal financial bonuses.

For the above aspects, economic policymakers around the world seem to have put in an agreement. The most important evidence that sustains this fact is their recent adopted measures which will produce significant positive changes in corporate governance systems of the financial institutions and in the general worldwide financial regulations.

However, the causes of the financial crisis remain an extremely important and unresolved issue because the above reasoning doesn't answer an important question: how the commercial banks have had so much money in order to give the huge volumes of subprime loans? In the next chapter we show, using the a Taylor rule based model, that even before the 2008 financial crisis, there was too much liquidity in the economics systems, a fact noted by other independent studies (see OECD (2010); Taylor (2009); Hofmann, Bogdanova (2012); Belingher, Bodislav (2012) for Romania).

In terms of reaction to the financial crisis, most central banks of the world, including the European Union, responded by providing a sufficient level of liquidity in the market. It was the only thing they could do in the short term. This, however, reduced the negative effects only partially. In the short term it was not possible to address the root causes that led to this undesirable situation. When the financial system is in danger, it seems justifiable for a central bank to take action in order to increase liquidity in its financial system, even at the risk of inflation stress. Also, it's worth mentioning that during a financial crisis, in the short term, prices tend to fall.

4. Deviations from the Taylor equation

We tried to test the Taylor relationship for a number of major economies in the European Union: Euro Area 17, Great Britain, Poland, Hungary, Czech Republic and Romania. We chose these countries/economic zones to cover all types of EU monetary systems which are characterized by a very high diversity. The period analysed is 2000-2012 and the frequency of data is annual.

Euro Area 17 represents an economic zone that includes most of the developed European states who chose to submit to on a common monetary policy but kept their own fiscal policies and regulations of the financial system. Although the European treaties guaranteeing the implementation of strict fiscal principles (public debt 60% of GDP and a maximum budget deficit to 3% of GDP), fiscal policy in these countries has proved to be very different. Basically, only a few European countries have followed these principles. In these circumstances, it is difficult to adopt a common monetary policy that is suitable for all countries in the Eurozone.

Britain is one of the most advanced economies in the European Union and in the world with an important international currency and a highly developed financial system that has attracted many MBS financial derivative, later called toxic assets.

Czech Republic and Poland are two countries of the emerging economies EU group, characterized by sustainable growth rates in the long term without too many structural problems. It is important to note about these countries have been able to attract significant EU funds, funds that allowed a strong economic development, without increasing too much the level of dependence on external financial markets.

Romania and Hungary are two emerging countries very different from those above, that experienced in the pre-crisis period growth rates which were mostly based on the attraction foreign private capital. However, due to serious structural problems, these countries have not succeeded in attracting many European funds, and a large part of the capital inflows financed only imports for consumption.

The model used in this paper is based on Taylor's 1993 equation, in its general form:

$$i_t = r^* + \pi + \alpha(\pi - \pi^*) + \beta^*y,$$

where:

i_t – Taylor monetary policy rate;

r^* – real long term equilibrium interest rate;

π – annual inflation rate Dec./Dec. calculated based on the Harmonised Index of Consumer Prices (HICP);

α, β – model parameters for output gap and inflation gap.

π^* – inflation target;

y – output gap measured by:

$$y = 100(Y - Y^*)/y^*,$$

where:

Y actual GDP;

Y^* potential GDP.

For simplicity, in this article, we used parameters values $\alpha = \beta = 0.5$ for each economic area, according to the original equation proposed by Taylor in 1993. The values of these parameters depends on the country and are mainly linked to the specific economic and monetary policy that the central bank adopts.

Regarding the source of the data, we note that the data on the reference interest rates for monetary policy were collected from the websites of the relevant central banks. Most of the economies currently analysed are using inflation targeting as a monetary policy strategy. Regarding the analysed period (2000-2012), Hungary has adopted this strategy since 2001 and Romania since 2005. The remaining states had since 2000 as inflation targeting monetary policy strategy. This is relevant because such a strategy involves publishing central banks inflation target. Regarding Romania's Central Bank should be recalled that the state law for the period 2000 - 2004, price stability was the main objective pursued. In the annual reports of every year we can find the relevant inflation target level.

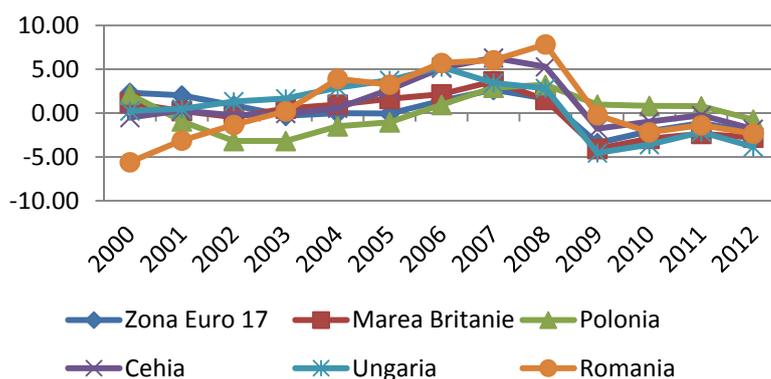
The annual inflation rate was collected from the Eurostat website based on the HICP (Harmonised Index of Consumer Prices).

Output gap is the percentage difference between actual GDP and potential GDP. Calculation of this variable involves estimating potential output which is a conceptual variable. In the economic literature there are several methods for estimating the output gap. Two of them are most commonly used: the estimation method using a production function - the method involves estimating GDP at full employment conditions and at using the whole capital stock – and the estimation method using the Hodrick-Prescott coefficient. The latter requires econometric analysis of time series of actual GDP and the calculation of its trend and its residual component. Potential GDP is given by the trend. In our analysis we opted for the first method because it is less mechanical and is more sensible to the variation of important economic and demographical indicators. The data used in this analysis are based on an estimate of potential output using a production function that measures the level of GDP in conditions of full employment. For consistency, the data on the output gap for each of the economies analysed were taken from the European Commission's website, which contains their latest estimates of these variables. The results are presented in tables and graphs below:

Table 1. Output gap (% of potential GDP)

	Euro Area 17	Great Britain	Poland	Czech Republic	Hungary	Romania
2000	2,32	1,16	2,15	-0,51	0,25	-5,59
2001	2,02	0,24	-0,93	0,29	0,47	-3,12
2002	0,88	-0,47	-3,18	-0,24	1,33	-1,34
2003	-0,31	0,52	-3,17	-0,04	1,66	0,21
2004	-0,01	0,98	-1,49	0,56	2,90	3,91
2005	-0,05	1,63	-1,04	2,68	3,76	3,26
2006	1,40	2,16	0,95	5,13	5,25	5,72
2007	2,66	3,64	2,90	6,30	3,44	6,04
2008	1,66	1,53	3,22	5,29	2,83	7,84
2009	-3,42	-4,08	0,97	-1,78	-4,54	-0,22
2010	-2,07	-2,92	0,82	-0,97	-3,59	-2,18
2011	-1,14	-2,35	0,79	-0,25	-2,17	-1,38
2012	-2,18	-2,79	-0,73	-1,81	-3,86	-2,34

Source: <https://circabc.europa.eu>

Graph 1 - output gap (% of potential GDP)

Source: <https://circabc.europa.eu>

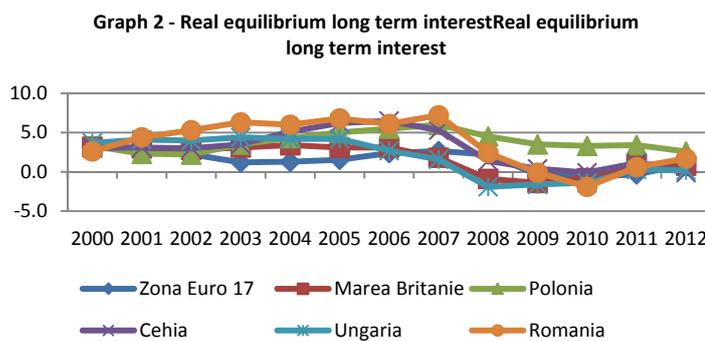
Equilibrium real interest rate is a conceptual variable representing the economic interest rate for which the money supply equals money demand. This is the interest rate that would be obtained if the prices would be stable and the output gap would be zero. There are many economic studies that support the estimation of this rate based on the potential GDP growth trend, which, in turn, depends on numerous economic factors (structural and/or institutional) such as: technical progress, population growth, changes in total productivity of the economy.

In our analysis we estimated the real equilibrium long term interest rate by calculating the trend of potential GDP estimated for the period 1996-2015 by the European Commission (1998 for Euro Area 17) via a production function, using a simple moving average of 3 periods. The results are shown in the table and graph below:

Table 2. Real equilibrium long term interest

	Euro Area 17	Great Britain	Poland	Czech Republic	Hungary	Romania
2000	3.2	3.2	3.3	3.0	3.7	2.6
2001	2.9	3.0	2.3	3.1	4.1	4.4
2002	2.2	2.8	2.2	3.0	4.0	5.3
2003	1.2	3.1	3.5	3.5	4.4	6.3
2004	1.3	3.4	4.3	5.1	4.2	6.0
2005	1.5	3.1	5.0	6.2	4.2	6.8
2006	2.4	3.1	5.5	6.5	2.7	6.1
2007	2.7	1.8	6.0	5.3	1.6	7.2
2008	2.2	-0.9	4.5	1.4	-1.9	2.4
2009	-0.3	-1.4	3.5	0.4	-1.6	-0.1
2010	-0.7	-0.8	3.3	-0.1	-1.4	-1.9
2011	-0.3	1.0	3.4	1.1	0.3	0.6
2012	0.9	0.8	2.6	-0.1	0.2	1.7

Source: own estimations based on Eurostat data.



Source: own estimations based on Eurostat data.

By applying the Taylor equation for calculating the monetary policy rate using the variables described above and comparing these results with the policy interest rates actually used by central banks economies, revealed the following:

Table 3.1. Euro Area 17

	Taylor rate	MPIR
2000	6.6	4.0
2001	6.0	3.9
2002	4.8	3.2
2003	3.1	2.3
2004	3.5	2.0
2005	3.7	2.3
2006	5.0	3.0
2007	6.5	3.9
2008	4.8	3.4
2009	-0.6	1.4
2010	0.4	1.0
2011	1.5	1.3
2012	2.0	0.8

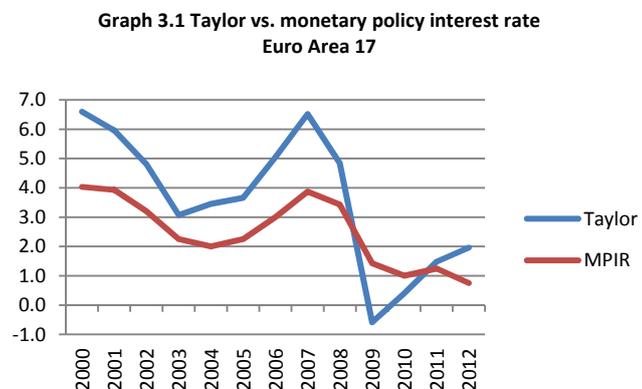
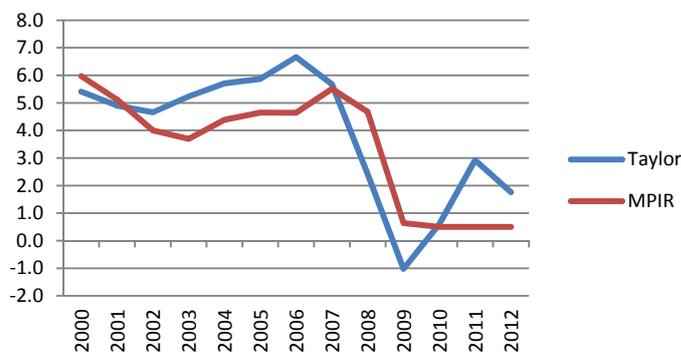
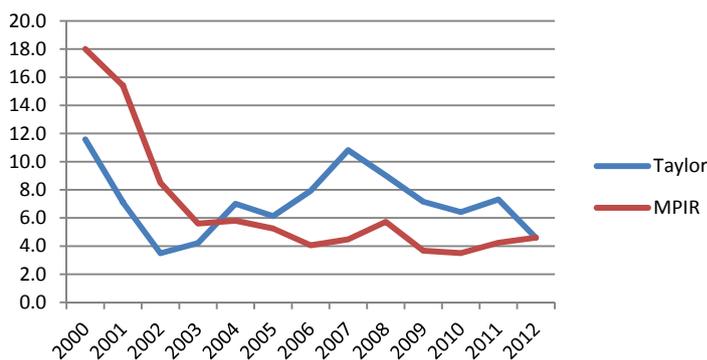


Table 3.2. Great Britain

	Taylor	MPIR
2000	5.4	6.0
2001	4.9	5.1
2002	4.7	4.0
2003	5.2	3.7
2004	5.7	4.4
2005	5.9	4.7
2006	6.7	4.6
2007	5.7	5.5
2008	2.4	4.7
2009	-1.0	0.6
2010	0.6	0.5
2011	2.9	0.5
2012	1.8	0.5

**Graph 3.2 - Taylor vs. monetary policy interest rate
Great Britain****Table 3.3. Poland**

	Taylor	MPIR
2000	11.6	18.0
2001	7.1	15.4
2002	3.5	8.5
2003	4.2	5.6
2004	7.0	5.8
2005	6.1	5.3
2006	7.9	4.1
2007	10.8	4.5
2008	9.0	5.7
2009	7.2	3.7
2010	6.4	3.5
2011	7.3	4.2
2012	4.6	4.6

**Graph 3.3 - Taylor vs. monetary policy interest rate
Poland****Table 3.4. Czech Republic**

	Taylor	MPIR
2000	7.0	5.3
2001	6.7	5.1
2002	4.9	3.6
2003	6.0	2.3
2004	8.1	2.2
2005	10.0	2.0
2006	11.3	2.2
2007	12.7	2.9
2008	7.2	3.4
2009	1.3	1.5
2010	1.6	0.8
2011	3.4	0.8
2012	1.2	5.9

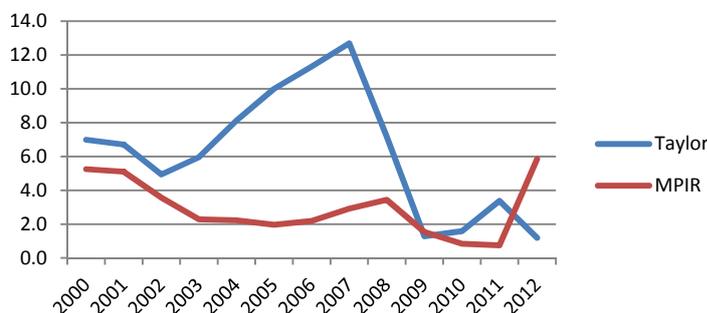
**Graph 3.4 - Taylor vs. monetary policy interest rate
Czech Republic**

Table 3.5. Hungary

	Taylor	MPIR
2000	13.3	11.5
2001	11.2	10.7
2002	9.3	9.0
2003	9.8	8.7
2004	10.2	11.0
2005	9.7	7.3
2006	10.4	7.2
2007	8.5	7.6
2008	2.7	9.7
2009	0.3	7.6
2010	0.6	5.6
2011	2.8	6.5
2012	2.3	6.3

Graph 3.5 - Taylor vs. monetary policy interest rate Hungary

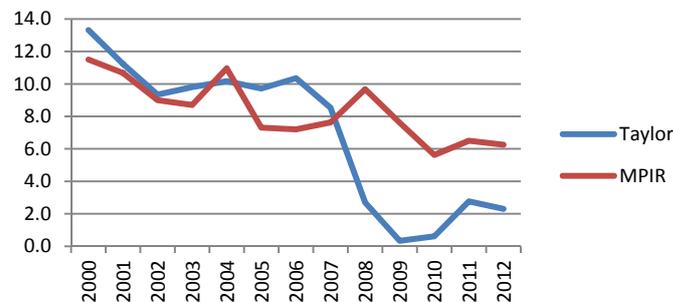
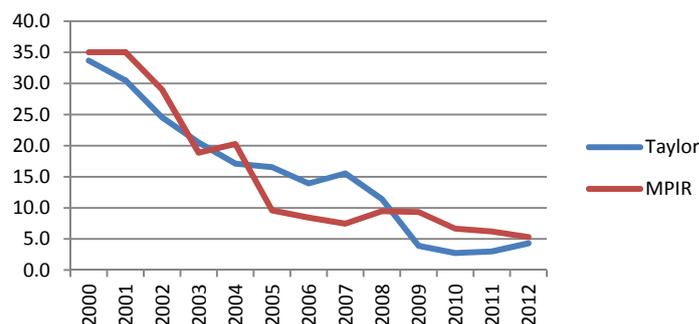


Table 3.6. Romania

	Taylor	MPIR
2000	33.7	35.0
2001	30.5	35.0
2002	24.5	29.0
2003	20.5	18.8
2004	17.1	20.3
2005	16.5	9.6
2006	13.9	8.4
2007	15.6	7.5
2008	11.4	9.5
2009	3.9	9.3
2010	2.7	6.7
2011	3.0	6.2
2012	4.3	5.3

Graph 3.6 - Taylor vs. monetary policy interest rate Romania



From the above graphs and tables we can observe a significant deviation from the Taylor rule regarding the setting of monetary policy interest rates for the Euro Area 17 in the period 2000 to 2008, during which the interest rate used by the European Central Bank was under the Taylor level. In the UK there is a significant deviation in the period 2003-2006, in the same sense. In Poland and the Czech Republic similar deviations can be seen (with a higher magnitude in the Czech Republic) in the period 2003-2011 for Poland and from 2003 to 2007 for the Czech Republic. In Hungary there is a slight deviation in both directions, the central bank rate used were placed slightly bellow Taylor during 2002-2007 and above after 2007. Regarding Romania, the monetary policy rate was placed very close to Taylor in the 2001-2004 period, below this value during the period 2005-2008, above this value in 2009-2010 and very close (slightly above) after 2010.

5. Conclusions

The analysis results are consistent with several other recent studies on the subject. Basically, in the period before the financial crisis, the majority of EU monetary policies have been rather accommodative. In the situation of an economic boom, an accommodative monetary policy is of a procyclical nature. No one can ignore the fact that in the period before the financial crisis, in the banking systems around the world there has been an abundance of liquidity.

The questions arising from this conclusion are: how should have banks use this liquidity? There were other areas where banks would have been better to invest and did not?

Certainly, one reason that banks have not invested in other areas was the attractiveness of real estate investments sector. From this point of view, it is noteworthy that the U.S. housing market has also been supported by European banks, indirectly, through financial derivatives. Another possible explanation could be the quite strict regulations of the banking systems that didn't allow too much credit without the existence of collateral, in case of debtor default. This makes hard to finance those businesses that start from zero because there are not capitalized. However, some of these businesses involve real innovation, which is an essential element for sustainable growth. In our opinion, the regulations on these types of loans should be analysed in detail.

It is also important to note that most analysed central banks have successfully achieved their fundamental objectives of a low inflation (often set by state laws). From this perspective, we consider that economic science has to answer a seemingly simple question: How should inflation be measured? Inflation represents the general rise of prices. We must determine exactly what kind of prices. Real estate prices are not included in the international methodologies for calculating inflation. This happens, although the majority of our revenues are used for the purchase of houses (more or less new). One of the causes of the financial crisis is that excess liquidity has slipped somewhat unnoticed, going to real estate markets. This, in our opinion, is one of the main source of the crisis. When the banks began to face difficulties in repayment of loans and had to be assisted in providing liquidity for the daily operations, the financial crisis turned into a sovereign debt crisis and an economic crisis of great magnitude.

So far, long-term changes on the economic framework in response to the financial crisis have materialized in better regulation of financial markets and solve problems of corporate governance in financial systems. In the absence of a comprehensive analysis of all the causes that made the emergence and development of this crisis possible, the worldwide policymakers efforts to prevent future crises could be insufficient.

The crisis, however, also requires an answer to a fundamental problem of economics regarding how to set the optimal level of liquidity at a particular point in time in an economy. The model proposed by Taylor is not perfect mainly because it doesn't respond very quickly to major economic fluctuations that can not be ignored by central banks. After the occurrence of the financial crisis, central banks found themselves in a position to act to save their banking systems, and further increase the liquidity in the market. Another practical problem with the Taylor rule implementation is that this requires the use of several estimated variables (potential GDP, the long-term equilibrium interest rate, etc.). Also, the Taylor model doesn't respond to the problem of determining the inflation target. In theory, by setting a higher inflation target, a central bank policy may be procyclical but still fit into the model proposed by Taylor. In addition, we consider that it's necessary to improve the methods for calculating inflation worldwide. Currently, housing prices do not fall in the inflation index.

The above presented ideas highlights the importance of the Taylor rule in monetary policy decision making, which is an essential factor in preventing future crises.

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