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ABSTRACT

Monetary policy, when rules-based, usually follows rules regarding inflation or output, but not always quantity, endemic and financial endogenous rules that minimize the gap between optimal and current rates of inflation and output. This paper proposes a rules-based monetary policy focused on reducing differences between short-term Treasury bill and implicit pure interest rate given by gravity models. Satisfying this rule is highly explanatory for reaching potential GDP growth, and for inflation targets such as the 2%. The results are confirmed with worldwide data. Central Banks could follow this rule, or combinations with other complementary alternatives, when deciding rates and amounts.

Key words: Pure interest, Policy Rules, Financial Services, Marginal Productivity, Value added

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1. Introduction

An economy guided by a precise rule, even far from perfect, is preferable to discretionary policies. In fact, simple rules, when applied correctly, can be as accurate as those derived from optimal control theory or complex New Keynesian or Neoclassical models that use several variables (Taylor and Williams, 2010). This paper proposes a monetary policy rule, derived from a model that uses optimal methods, which follows the financial constraints based on the self-working and behavior of financial services. Recently, when most developed Central Banks fail to apply low or even zero interest rates,[1] mostly discretional monetary policy rules apply, or at least, Friedman's k-rules of near constant (and low) interest rates apply. In this case, it seems that monetary policy is useless, and therefore, Economics as a science would not be necessary for setting up policies that are day-to-day more, and more short-run-driven, and even not driven by economic objectives, but political or ideological. However, this is not correct because *Economics matters* and *rules-based policies matter*. Even applying constant zero official interest rates or k-ruled based policies, monetary amounts are also relevant although not only for (trying to) stimulate the economy, but also these non-rules-based quantity policies are relevant because they can also lead to a crash through, for example, overinflate non-real prices like the prices of the government bonds. To avoid the possible crushing of public bond prices due to the expansion of this bubble, this paper proposes two rules of monetary policy based on the self-mechanism of the financial system. Based on the works of Lopez-Laborda and Peña (2018) and Peña (2019) concerning the banking intermediation mechanisms, it is proposed, first, that the rates of public bonds should follow a gravity equation between lending and deposit interest rates as Spain and United Kingdom during at least 1980-1998, as these authors show. Second, a mixed rule is also suggested between the well-known Taylor rule and the contribution of this paper, which smooths the Taylor's proposal.

An economic policy is called "optimal" when it is a non-distorting policy that does not alter investment, allowing a neutral behavior in the economy, especially if the market interest rate or the intertemporal discount factor are not altered, which determinate the level of investment, and therefore, of consumption. According to Poddar and English (1997), the short-term Treasury bill rate is close to this "pure interest"—i.e. interest without bank fees and risk—, and in addition, the Central Banks or Federal Reserves can alter the Treasury bill rate by shifting the official or nominal interest rate set by them. Thus, given this fact, this paper proposes a monetary policy rule that consists of reducing the gap between the short-term Treasury bill rate and the implicit

[1] This low-interest policy also affects regular bank intermediation activity (Brei et al., 2020)

pure interest. Nonetheless, which is the implicit pure interest? How can we obtain it? In a recent paper, Lopez-Laborda and Peña (2018) propose an explicit specification that is found endogenously as a function of interest receipts and payments, expressed as a gravity equation. This expression is used in this paper as pure interest, and allows us to calculate the gap between public interest rates and this gravity equation, also used in the empirical section to check the strength and explanatory power of the indicator. Moreover, given the current environment of low or zero nominal interest rates in many developed countries, with unexpected real or financial inflation, deviation from this gravity equation could be a reliable indicator of excess of inflation or deflation of goods and financial assets. Consequently, Central Banks should analyze not only real inflation, but also financial inflation to avoid asset bubbles and crises for instance of bonds.

On the other hand, there are currently other policy rules for Central Banks, although they are not always followed today, mainly based on real and prices variables, not focused on quantities and capital flows like this paper. Friedman (1969) proposed a constant growth of the money supply equal to the growth of the US production, and also proposed a zero nominal rate to avoid the inflation tax, which is the current monetary policy in most countries. These policies are mainly in force by any Central Bank since the liquid tramp of Japan that began at the end of the previous century. McCallum (1988) proposes a monetary policy rule that follows the nominal output and the velocity of money. Taylor (1993) proposes a new rule that could be considered integrated according to the previous one, where it relates nominal interest rates to inflation and excess GDP from an optimum. Another version of this rule only relates to GDP or inflation, but can be considered less accurate. Ball (1999) defines an efficient rule as one that achieves the minimum weighted sum of the variances of GDP and inflation, which can be expressed as a "Taylor rule" that relates inflation and output. Nevertheless, as far I know, none of them explicitly focus on quantity and financial or capital variables, as this paper proposes.

Finally, with regard to the relationship between financial VAT and money rules, Correia and Teles (1996) suggest that, when money is not an intermediate good, the optimal inflation tax is zero, as proposed by Friedman (1969), who proposed a rule of constant growth of money allowing GDP expansion and a nominal interest rate of zero for allowing no inflation taxation. Nonetheless, they affirm that, when money is an intermediate good and the technology function is one of the type constant returns to scale (CRS), the inflation tax has also to be zero, because these goods should not be taxed in a second-best environment, according to Diamond and Mirrlees (1971). Despite, nothing is said about when money and, as an extension, when financial services can be considered as final goods, as Lopez-Laborda and Peña (2018) and Peña (2019) suggest.

The gravity equation has been known in economics since Isard (1954). In general, this equation was used the first time for trade, including financial services, but only for trading financial services or international financial flows (Kimura and Todo, 2010). Consequently, it was considered a commercial rather than a financial variable. However, it is not unreasonable to also take into account financial variables, especially considering equivalences on the amount between financial and commercial variables in the payments account. Lopez-Laborda and Peña (2018) developed and empirically corroborated the existence of a gravity equation for financial services that was based on the relationship between interest payments and receipts that leads to an "implicit rate" that could be considered pure interest, because the expression is close to the short-term public bond rates. According to these authors and some data from developed countries (using an approximation based on short-term government bond rates), pure interest is mainly equal to two times the product of interest payments and receipts and divided by the sum of interest payments and receipts. They obtain this equation by considering the same deposit and loan capital.

These authors also develop in their paper a method to tax the value added of financial services with VAT through the taxation of explicit fees and the implicit margin. The method applies a "mobile-ratio" to each transaction, that is, the difference between interest payments and receipts and is divided by the sum of both to reflect margin per transaction unit. This ratio represents the value added per transaction without explicit fees and commissions, which is taxed with the VAT rate and could be considered an approximation to the marginal productivity of financial services, where it is observed that its use as an input on real output is observed to be constant (Odedokun, 1998).

The paper is divided as follows. First, Section 2 explains other rules for monetary policy, comparing them with the proposal. Section 3 will relax the assumption of equality of capital amounts in the gravity equation made when it was proposed. The differences in financial volumes will be considered, concretely, the case in which the capital that generates interest payments and receipts differs. The result will be the same gravity equation as with the assumption of equal amounts of capital if interest rates are considered. Finally, the monetary policy proposal will be formally provided. Section 4 provides a general equilibrium theoretical framework for the proposal of monetary policy. The empirical analysis is carried out in Section 5, analyzing the data and applying Ordinary Least Squares (OLS) techniques and descriptive analysis. In Section 5 the results are discussed and finally in Section 6 the conclusions are provided.

2. Existing monetary policy rules

Throughout history, many prestigious economists have provided simple rules or have attempted to provide guidelines for monetary policy. Taylor and Williams (2010) provide some historical background. Even Adam Smith highlighted the importance of a "well-regulated paper-economy", after which economists as Fisher and Wicksell proposed monetary policy guidelines. Later, Friedman proposed the constant growth rate rule. More recently, Taylor (1993) proposed the most widespread modern monetary policy rule, created to avoid the effects of the Great Inflation between the late 1960s and 1970s. After him, several variants and modifications of his rule have emerged, but none as his original rule for the good performance of the economy. Compliance with accurate and simple rules led to the Great Moderation (1980s and 90s), where monetary and fiscal policy were less interventionist, more predictable and systematic, using the "automatic stabilizers" for the fiscal policy (Taylor, 2011). This led to less uncertainty, greater economic stability and less impact of economic crises, if any, in a period of sustainable economic growth. In contrast, current discretionary policies as those of the 1960s and 1970s and those of the early mid-2000s, now in force, are characterized by being less predictable, more interventionist and focusing on the short-term rather than in the long run. Fiscal policy makes tax rebates and shifts to produce a short-term stimulus. These policies can be effective, because simple rules are only a guideline, but "those more effective interventions would have not been necessary had the earlier interventions been avoided" (Taylor, 2011). So, economic history of the last 60 years suggests a correlation between good economic performance and rules-based policies.

The monetary policy rule proposed by Taylor (1993) is as follows:

$$i_t = r^* + \pi_t + 0.5\left(\pi_t - \pi^*\right) + 0.5\left(y_t - y^*\right) \quad . \qquad (1)$$

Where i_t is the interest rate, r^* is the optimal real interest rate, estimated in 2%, π_t is the inflation and π^* is the optimal or target inflation, estimated in 2%, y_t is the real output growth and y^* the potential one. Some other rules consider financial assets, price levels, lags or leads or other combinations and formulations, only inflation or only output, sometimes measured by the unemployment rate as it is related by the Okun's law.

More recently, the Federal Reserve (Fed) has laid out some money rules, which have been analyzed by Cochrane et al. (2019). For instance, a "balanced-approach rule" like the following:

$$i_t^{BA} = r^* + \pi_t + 0.5\left(\pi_t - \pi^*\right) + 2\left(u^* - u_t\right) \quad , \qquad (2)$$

where u_t is the unemployment rate and u^* is the natural or Non-Accelerating Inflation Rate of Unemplyment (NAIRU) rate of unemployment. In addition, we also show the "first difference rule":

$$i_t^{BA} = r^* + \pi_t + 0.5\left(\pi_t - \pi^*\right) + \left(u^* - u_t\right) - \left(u_{t-4}{}^* - u_{t-4}\right). \quad (3)$$

This expression is similar to the previous one but weighting the current unemployment deviation by 1 instead of 2 and adding the differences between the real and natural unemployment rates lagged four years.

3. Exogenous models based on accounting identities

Lopez-Laborda and Peña (2018) consider the assumption that receipts and payments of capital or principal amounts were equal, but this assumption is not entirely true since capital amounts are not equal in most cases. For instance, the capital amount of loans is usually higher than that of deposits in banking institutions or in economies by an aggregate way. Therefore, this section tries to relax the assumption made in the previous section about the equality of the capitals that generate interest payments and receipts.

These authors consider the following equations to obtain the gravity equation that leads to the pure interest:

$$\begin{matrix} \rho \cdot IR = IR - \varepsilon \\ \rho \cdot IP = \varepsilon - IP \end{matrix} \Rightarrow \rho = \frac{IR - IP}{IR + IP} \quad , \quad (4)$$

Where the value added per transaction is given by the mobile-ratio ρ, interest receipts are IR, and interest payments are IP. Finally, ε is the pure interest, given by the formula:

$$\varepsilon = \frac{2 \cdot IR \cdot IP}{IR + IP} \quad . \quad (5)$$

It can be seen that interest receipts and payments have the capital included inside, which is the same for both. This formula can be expressed in terms of interest rates and capital for receipts and payments, r_0 and R_0 respectively, with ε_0 as the pure interest rate. The case of the original proposal of the gravity equation for financial services would take place when amounts of capital are equal, but the following formula is more general. Consequently, from equation (5) in which $C = D$, both two capitals with differing amounts are now considered, where C is the capital generator of interest receipts and D is the capital generator of interest payments.

$$\begin{aligned} \rho \cdot r_0 \cdot C &= r_0 \cdot C - \varepsilon_0 \cdot C \\ \rho \cdot R_0 \cdot D &= \varepsilon_0 \cdot D - R_0 \cdot D \end{aligned} \quad . \tag{6}$$

In the following section an alternative formulation will be provided in which there is a product between the pure interest and the amount of bonds, instead of principals of credits and deposits as the previous expression. Solving for the marginal productivity of financial services:

$$\rho = \frac{r_0 \cdot C - R_0 \cdot D - \varepsilon_0 \left(C - D\right)}{r_0 \cdot C + R_0 \cdot D} \quad . \tag{7}$$

The pure interest ε_0 must be solved, resulting in the same expression (5) for the same principal amounts for interest payments and receipts, but in rates rather than amounts:

$$\varepsilon_0 = \frac{2 \cdot r_0 \cdot R_0}{r_0 + R_0} \quad . \tag{8}$$

This expression is similar to the gravity equation for trade proposed by Feenstra (2015). Therefore, since the gravity equation does not change even when the initial assumption of the same amounts of capital for financial products is relaxed, the expression proposed as a policy rule does not change when the capital amounts fluctuate. Consequently, it could be a reliable indicator of price distortions.

Next, an alternative formulation of the marginal productivity is considered taking into account the amounts to be more realistic: the pure interest rate of equation (6) is multiplied by the bond amounts (B), instead of the credit and deposit, leading to the next expression:

$$\begin{aligned} \rho \cdot r_0 \cdot C &= r_0 \cdot C - \varepsilon_0 \cdot B \\ \rho \cdot R_0 \cdot D &= \varepsilon_0 \cdot B - R_0 \cdot D \end{aligned} \quad . \tag{6'}$$

So, solving these two equations for the two rules with quantities, leads us to similar as (4) and (5):

$$\rho = \frac{r_0 \cdot C - R_0 \cdot D - \varepsilon_0 \left(B - B\right)}{r_0 \cdot C + R_0 \cdot D} = \frac{r_0 \cdot C - R_0 \cdot D}{r_0 \cdot C + R_0 \cdot D}, \tag{4'}$$

$$\varepsilon_0 B = \frac{2 \cdot r_0 \cdot C \cdot R_0 \cdot D}{r_0 \cdot C + R_0 \cdot D} \quad . \tag{5'}$$

In this general case, the capital amount of payments and receipts are not the same, but the amount of the pure interest is the bond principal, so the gravity equation for quantities changes, as well as the optimal marginal productivity of financial services. These two rules on quantity amounts, (4') and (5'), should apply for all financial entities, both institutions and authorities. Nonetheless, this paper is going to be focused in the second one[2]. The rest of the results of the paper remain similar by applying this change ($r_0 \cdot C$ and $R_0 \cdot D$ instead of IR and IP).

4. Endogenous model of General Equilibrium

A simple and static model of three types of agents (banks, consumers and Central Bank) is considered to show the suitability of the proposed rule. To simplify the presentation and to highlight the most interesting facts for our policy, in this paper only financial sector is considered, since non-financial companies are not included.

The first agents are households or consumers, who maximize their leisure time, calculated as one minus the labor time, and subject to their budget constraint.

$$\begin{aligned} &\underset{\{l\}}{Max}\ O = 1 - l \\ &s.t.:\ wl = r_0 C - R_0 D \end{aligned} , \tag{9}$$

Where O is the leisure time, l the work time, and the whole labor income is is wasted in financial services. This income is represented by wl, where w is the wage per unit of labor.

Banks have to maximize the value added of the financial sector, subject to the behavior of financial services proposed in (6'), similar to Lopez-Laborda and Peña (2018):

$$\begin{aligned} &\underset{\{C,D\}}{Max}\ VA = r_0 C - R_0 D = wl \\ &s.t.:\ \rho r_0 C = r_0 C - \varepsilon_0 B \\ &\qquad \rho R_0 D = \varepsilon_0 B - R_0 D \end{aligned} . \tag{10}$$

Finally, the Central Bank intends to reduce the difference between the implicit interest rate, ε_0, and the Treasury Bill interest rate, i, which is guided by the reference interest rate. So, its target is to comply with the rule that is proposed in this paper:

$$\underset{\{B\}}{Min}\ \left(i - \varepsilon_0\right) B . \tag{11}$$

And finally, applying the Central Bank optimization, we have:

$$iB = \varepsilon_0 B = \frac{2 \cdot r_0 C \cdot R_0 D}{r_0 C + R_0 D} . \tag{12}$$

This is the fulfillment of the rule for the equation obtained in (5'). Therefore, the equilibrium in the economy occurs when the rates of the Treasury bills follow the gravity equation of the implicit pure interest of the financial sector.

[2] The first rule is dealt in Peña (2021), where the denominated "Financial Gravity" (FG) models are also used.

5. Empirical corroboration

This section is divided as follows. In both subsections the initial methodology and data are exposed at the beginning. First, the high correlation between the short-term bond rates and the pure interest rate defined by the gravity equation of (8) is shown. Then, the second subsection shows the empirical results that explain the inflation and GDP growth rates with the deviation of the bond rate from the proposed policy rule. Finally, the same exercise is carried out but for the deviations of inflation and output rates with respect to a given ideal datum.

5.1 Data, initial methodology and similarities between the rate of short-term Treasury bills and the pure interest estimated by the gravity equation between lending and deposit interest rates.

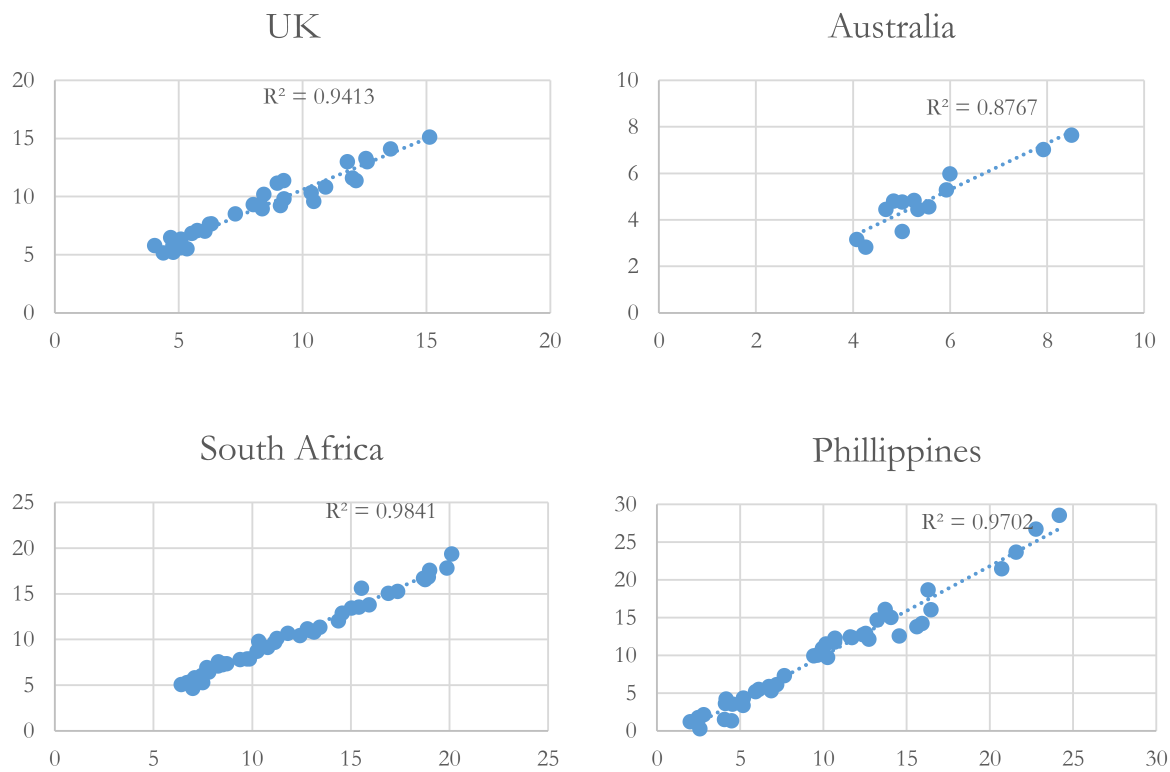
Data have been taken from the World Bank initially using the full sample and later using subsamples to obtain a balanced panel, as we will see later. The implicit pure interest rate estimated by the gravity equation of (8) has been obtained from the lending and deposit interest rates given by the database. Finally, the rates of the short-term Treasury bills have been obtained by subtracting the "risk premium" from the interest rate of the loans, both from the same database, since the risk premium is defined in the World Bank as the lending rate minus the Treasury bill rate, in percentage.

Before reducing the sample, with the complete sample of all the countries (82) and years (1960-2019) given by the World Bank that were available for the two variables obtained, the following formula has been applied, showing the first definition of deviation from the different definitions used throughout this section:

$$Deviation_1 = \frac{\varepsilon_0 - \bar{\varepsilon}_0}{\varepsilon_0 + \bar{\varepsilon}_0} \quad . \tag{13}$$

It is found a deviation average of -7.11% for the full sample, with 32 countries between -15% and 15% of deviation on average (approximately the 40% of the full sample). Among these countries, some of them are developed such as United Kingdom (UK) or Australia but also in development as South Africa or the Philippines. Next, in Figure 1, the graphs of the correlation between the implicit pure interest rate (abscises) and the short-term Treasury bill rate (ordinates) appear, both in percentages for the full sample of years of each of the four countries mentioned, reflected jointly with their corresponding trends and R^2.

Figure 1: *Representation of the correlation between pure interest, estimated by the gravity equation, and the short-term Treasury bill rate*



For the empirical estimation of the results, we only have to keep the maximum number of countries and years in which all countries and years have non-empty data for both variables in order to obtain a balanced panel data as mentioned before. The OLS applied to the data to estimate has been:

$$TBR = \beta\varepsilon_0 + u_{i,t} \quad , \qquad (14)$$

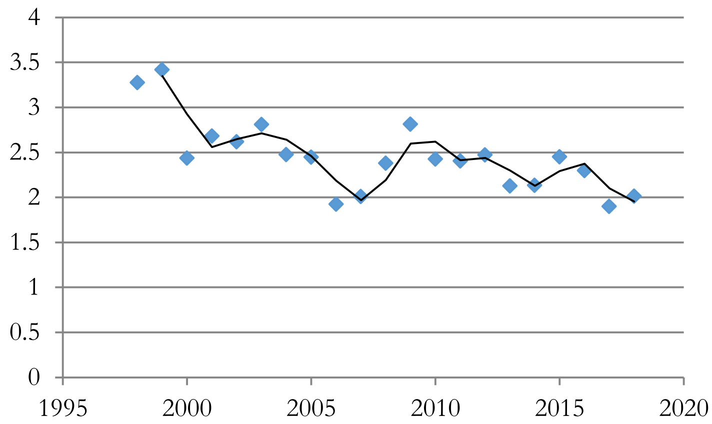
Where $u_{i,t}$ is the error term. It is obtained $\beta = 0.9552$, very close to 1 but not statistically 1, with an R^2 of 88.49% for the reduced sample. Here are the (31, almost all developing) countries and years (20) used for the full sample:

Table 1: *Countries, territories and years of the reduced balanced sample*

Years:	Countries and territories:
1998-2018	Antigua and Barbuda, Bahamas, Belize, Brazil, Barbados, Dominica, Algeria, Egypt, Arab Rep., Fiji, Guyana, Hong Kong SAR, Hungary, Israel, Jamaica, Kenya, Kyrgyz, Republic Lesotho, Moldova, Mexico, Namibia, Nigeria, Philippines, Papua New Guinea, Sierra Leone, Eswatini, Seychelles, Trinidad and Tobago, Tanzania, Uganda, South Africa, Zambia

For inflation and for Section 5.3, the same panel is used with the exceptions of Antigua and Barbuda, Belize, Arab Rep., Republic Lesotho, Namibia and Sierra Leone, in order to apply a balanced panel. There are also some additional descriptive analyses. The second deviation formula used in this paper is the one that considers the absolute value of the difference between the implicit pure interest rate and the short-term Treasury bill rate.

Figure 2: *Average deviation from the proposed rule in absolute value and in percentage for the sub-sample countries over the time.*



Note: a trend, using two-year mobile-averages, has been presented.

It can be observed how the overall trend of the deviation during these years is decreasing year by year. Therefore, the trend is diluting the differences between the proposed monetary rule and monetary praxis. Nevertheless, this paper formalizes the behavior as a proposal to be taken into account for future monetary policies.

5.2 Impact of the proposed monetary policy in economic variables and sensibility analyses

The data used to test the impact of the proposed monetary policy rule on economic variables also comes from the World Bank database, using inflation measured by the annual "consumer price index" in percentage and the economic growth rate measured by the "annual percentage growth rate of GDP at market prices based on constant local currency". The data used for the following estimations are also for the 31 countries and 20 years and appears in Table 1, but for the estimations with inflation only 26 countries were able to use, the 31 same countries with the exceptions of Antigua and Barbuda, Belize, Lesotho, Namibia and Sierra Leone as previously said in order to obtain a balanced panel of data.

To estimate compliance with the proposed rule, the folowing indicator of closeness to a datum or variable is provided, which is also useful to check the satisfaction of the non-deviation of the economic variables from a given optimal value:

$$F = \frac{1}{1+|x-x_0|} \quad , \tag{15}$$

Where x is the value of the variable that is being tested (the Treasury bill rate, the inflation or the output rate) and x_0 is the datum or expression from which we are expressing its deviation (the implicit pure interest rate expressed by a gravity equation, or the optimal inflation and GDP growth rates, respectively). So, this indicator is always between 0 and 1, with 1 being the closest situation (non-deviation) and 0 is the farthest case (complete deviation).

The econometric specification used for these estimations is the same OLS model as in (14), but with other variables:

$$y = \beta x + u_{i,t} \quad . \tag{16}$$

Where y according to the case may be the output or inflation rates, or their respective closeness from the given optimum following definition (15), and x is the deviation in absolute value or the closeness given by equation (15) of the Treasury bill rate from the pure interest explicitly given by the gravity equation.

The results are given in Table 2, which shows the impact of the indicators of closeness combined with distance or absolute deviation to the gravity equation on some representative economic variables. For instance, there is a positive and significative impact of the variables on the GDP growth and on inflation. Applying the closeness indicator to the gravity models, it is shown that this indicator has great impact on GDP growth, reaching a maximum of 6 and 10 per cent of impact on the dependent variable.

Table 1 shows the impact of the proposed indicator of closeness (15) from the Treasury bond to the implicit rate on the application of the same indicator but for studying the closeness of other economic variables to their potential optima. These results are obtained by performing a sensibility analysis and checking for what optimum of the variables the policy obtains the highest explanatory power.

Table 2: *Explanatory power of the proposed rule for reaching equilibria*

Optimum datum GDP growth	3	3.5	**4**	4.5
Coefficient	0.697	0.712	**0.722**	0.707
R2	0.591	0.599	**0.606**	0.598
Optimum datum inflation	2	2.5	**3**	3.5
Coefficient	0.584	0.607	**0.622**	0.634
R2	0.590	0.590	**0.590**	0.5866

It is found that the policy rule works better when the optimum datum of GDP growth is the 4% (R^2 of 60%), and when the explanatory power is the same for 2-3% of optimal inflation rate (R^2 of 59%). Furthermore, as the coefficient is positive, the proposed rule is efficient for reaching potential equilibria.

5.3 Empirical models, comparison with other rules and Granger Causality

This section will show the empirical models explanatory of the compliance of the rule, the pure interest expressed by a gravity model and explanatory of the comparison with other policy rules, where the power of the proposal will be seen, and the Granger causality among some of the key variables.

The descriptive analysis of the variables that are going to be used in the next section, and some of them already used at the end of this section, is shown in Table 3.

Table 3: *Descriptive analysis of the main variables*

Variable	Nº of observations	Mean	Standard Desviation	Minimum	Maximum
eps	546	8.253483	6.434868	0.0199601	43.79089
gdpgr	546	3.421117	3.219175	-6.799428	15.32916
infl	546	6.205523	6.015041	-30.24316	47.77596
bcrisis	546	0.0457875	0.2092157	0	1
tbr	546	7.94798	6.716011	0.0083333	47.18667

The main variables are the pure interest defined by the gravity model, *eps*, the GDP growth, *gdpgr*, obtained as the "annual percentage growth rate of GDP at market prices based on constant local currency", the inflation rate, *infl*, measured by the consumer price index, which "reflects the annual percentage change in the cost to the average consumer of acquiring a basket of goods and services", the presence of banking crisis, *bcrisis*, which takes 1 if there is a systemic banking crises and 0 otherwise, obtained from the World Bank until 2017 and the rest completed with the Annex II of Laeven and Valencia (2020). Finally, the treasury bill rate is *tbr*.

A relevant issue in the estimation has been finding that when economic variables perform well, then the rule is more fulfilled. Table 3 shows the estimation results of explaining the dependent variable *close*, which is the indicator of equation (15) applied to the difference between *tbr* and *eps*. The explanatory variables are the above mentioned economic ones but also the application of the difference between them and the optimum of the highest predictability of Table 4 in bold, for *cgdpgr*, *cinfl*, the 4% considered as the usual neutral nominal interest rate for *ctbr*, or the 1.9% as many Central Banks as the European Central Bank indicate to achieve an inflation close, but below 2% for *c19infl*.

Results show that the models with *cgdpgr*, *c19infl* and *ctbr* are the most explanatory (R^2= 0.7398).

Table 3: *Explanation of the fulfillment of the policy rule by economic variables*

Model. Dependent variable: *close*	**M1**	**M2**	**M3**	**M4**
cinfl	0.525***	0.286***		
	0	0		
cgdpgr	0.427***	0.424***	0.423***	
	0	0	0	
tbr	0.005***			0.011***
	0			0
ctbr		0.453***	0.435***	
		0	0	
c19infl			0.334***	
			0	
infl				0.008***
				0.007
gdpgr				0.043***
				0
R2	0.7006	0.7353	0.7398	0.4783
F (p-value)	0	0	0	0

Next Table 4 shows the Granger causality for the variables of Table 3, and shows that only for Model 4, where the economic variables are not related with any optimum, the null hypothesis that all the explanatory variables Grangr Cause (GC) the indicator *close* is rejected with a p-value of 0.08.

Table 4: *Granger Causality for the fulfillment of the policy rule and economic variables*

M1	***cgdpgr* GC *close***	***cinfl* GC *close***	***tbr* GC *close***	***all* GC *close***	**% Countries where rejected previous column**
Average	0.229	0.306	0.224	0.129	0.654
M2	***cgdpgr* GC *close***	***cinfl* GC *close***	***ctbr* GC *close***	***all* GC *close***	**% Countries where rejected previous column**
Average	0.268	0.229	0.256	0.105	0.692
M3	***cgdpgr* GC *close***	***c19infl* GC *close***	***ctbr* GC *close***	***all* GC *close***	**% Countries where rejected previous column**
Average	0.276	0.270	0.276	0.140	0.692
M4	***gdpgr* GC *close***	***infl* GC *close***	***tbr* GC *close***	***all* GC *close***	**% Countries where rejected previous column**
Average	0.293	0.226	0.201	**0.088**	0.692

Table 5 shows the correlation between interests and also the correlation of the pure interest with economic variables, for both pool OLS and OLS with fix effects models for balanced panel data. The highest explanatory power is obtained in M1, with a 90% of R^2.

Table 5: Estimations for explaining the pure interest

Model. Dependent variable: *eps*	**M1: pool**	**M2: fix effects**	**M3: pool**	**M4: fix effects**
tbr	0.9***	0.789***	0.953***	0.785***
	0	0	0	0
gdpgr	0.2***	0.053***		
	0	0.103		
infl	0.001***	0.001***		
	0.962	0.974		
constant		1.798***		2.01***
		0		0
R2	0.903	0.7832	0.898	0.782

Finally, Table 6 shows the Granger causality between the Treasury bill rate and the pure interests, as the proposed value for the former, for the full sample and divided on the Great Moderation period (including from 1998 to 2005, the minimum allowed for the estimation), and the laxity period for the rest of the sub-sample. The same exercise has been made for the Taylor (1993) rule (TR) shown in (1), but as the rest of the results were not significant, only the sub-sample of the Great Moderation has been shown. The full data is included in Appendix III.

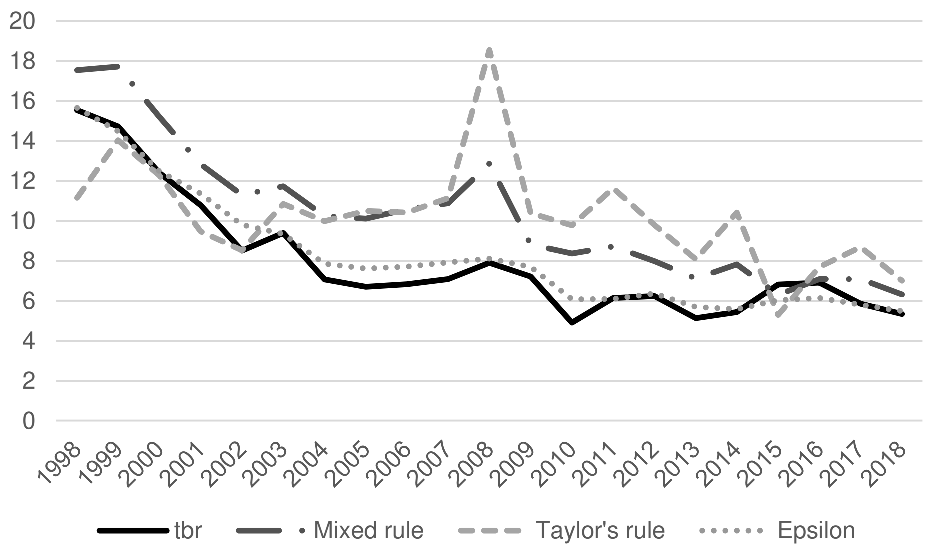
Table 6: *Granger Causality between tbr and eps*

Model	***tbr* GC *eps* *(p-value)***	**% Countries where rejected in previous column**	***eps* GC *tbr* *(p-value)***	**% Countries where rejected in previous column**	**Interferences? Lowest p-value**	**% Countries with interferences**
1998-2018	0.275	0.385	0.150	0.654	**0.100**	0.731
1998-2005	0.117	0.760	**0.077**	0.760	**0.018**	0.920
2006-2018	0.130	0.680	0.185	0.560	**0.080**	0.760
1998-2005 TR	0.128	0.692	**0.063**	0.808	**0.038**	0.962

In order to compare with other models, we have applied Probit and OLS models in which the *bcrisis* was the dependent variable and the absolute value of the difference between the *tbr* variable and the rules that appear in this paper were estimated, achieving a higher value for the proposed rule, and finding that the risk of banking crises rises as the deviation increases. Additionally, we have estimated the correlation between the *tbr* variable and other rules, obtaining the highest explanatory power for the Taylor rule of (1) when considering that the potential output is 0%, and achieving an explanatory power of almost 70%, in contrast to the 89.76% of R^2 reached with the proposal of this paper.

So, and in order to achieve a consensus between both monetary policy rules, here it is proposed a mixed policy rule in which the optimal or natural real interest rate and the inflation rate are both substituted by the proposed pure interest by the gravity model, and maintaining the rest of indicators of deviation of inflation and GDP. This rule is denominated "mixed rule". The three policy rules, considering in this case a stable potential output growth rate of the 3.5%, are shown in the Figure 3.

Figure 3: *The two proposed rules and the Taylor's rule performance compared with the tbr variable*



In the figure it can be seen that the Taylor rule is better for showing the normative guideline of how to perform, and the proposed gravity rule is higher explanatory, so it is more a "positive" rule. Indeed, this is one of the first simple rules obtained from an optimization method. The proposed "mixed rule" would be similar to (1):

$$i_t = \varepsilon_{0t} + 0.5\left(\pi_t - \pi^*\right) + 0.5\left(y_t - y^*\right) \quad , \tag{17}$$

but with the gravity formulation rather than the optimal or neutral real interest rate and the inflation.

6. Discussion of the results and further considerations and research

The proposed rule is easier to calculate because it does not require obtaining the inflation expectations neither the so-difficult-to-calculate potential output for each year, only the ideal inflation and economic growth rates are needed. Another advantage is that this rule can lead the interest rates to a positive environment, avoiding the uncertainty of below-zero interest rates (Christiensen and Spiegel, 2019). The rule can serve as an indicator of good performance of economic policy, because, as we have seen, the good behavior of the most relevant economic variables leads to, and even causes, the fulfillment of the rule. In fact, the rule fits quite well to the shifts of the short-term Treasury Bill rates, and is higher explanatory than other rules. Nonetheless, a consensus rule is proposed that uses the estimated pure interest instead of the sum of the real interest rate and inflation in a Taylor rule that is smoothed by this adaptation.

While Poddar and English (1997) stated that the Treasury bill interest rate is close to the "pure" interest rate, which is the interest without bank fees or default risk, Lopez-Laborda and Peña (2018) proposed a theoretical formulation of this implicit interest that is similar to the gravity equation for commercial trade but applied to intertemporal trade through financial services. These authors confirmed their findings with data from developed countries: the short-term Treasury bill rate was close to two multiplied by the product of deposit and loan interest rates and divided by the sum of these two rates. The paper additionally explores this fact for developing countries and also proposes that expression as a rule for monetary authorities to check the possible existence of asset bubbles in the bond market or whether monetary policy is correctly applied. This considers, apart from the output, not only real inflation, as is usually the case, but also financial inflation: if the nominal interest rate or the Treasury bill rate are below pure interest, it could be indicative of excessive financial inflation and possible financial bubbles in the bond market. If, on the other hand, nominal rates are above the pure interest rate, it could be an indication of excessive spread or default risk. Therefore, pure interest indicates where the standard interest rate established by the Central Bank should be. Hayat and Mishra (2010) proposed other non-linear monetary policy rules.

The theoretical results obtained by Lopez-Laborda and Peña (2018) were based on the assumption of equality in the capital amounts of financial products that are assets and liabilities for the bank. Nevertheless, since assets are usually higher than liabilities in financial institutions and other companies, the case had to be clarified using different capital amounts. This paper shows that their gravity equation could work for financial prices, but it does not take quantities into account. The reason is these latter ones need not be taken into account for obtaining the equation, which is the same independently the capital amounts, in contrast to the marginal productivity. Finally, a more realistic expression of the gravity equation and the marginal productivity of financial services taking quantities into account into the formulation, leads to a monetary policy rule on quantities that can be used or recommended for Central Banks and their regulated banks.

Next, some considerations and policy measures are made. First, the gravity equation defining pure interest that considers an identical capital amount is the same as for different amounts. Second, a monetary policy rule is proposed using the gravity equation for financial services, which is shown for controlling financial inflation and excesses from the potential economic growth rate. Finally, a new proposal for gravity equation and mobile ratio is provided by considering financial quantities when the pure interest does not depend from capital payments or receipts but from bond amounts.

After having shown how useful is the proposal to avoid excess of output and for controlling financial inflation, it would be relevant in the current environment of low interest and inflation checking its impact not just in real inflation as is usually the case or also in asset bubbles in the bond market, but the financial inflation in the stock prices or in the Price Earning Ratio (PER). Additional studies could include the check of the Granger causality between the deviation from the proposal and inflation and output growth, or deviations of both. It will be also interesting to include additional explanatory variables apart from the deviation from the proposal, in order to obtain more explanatory and complete empirical models. There is also the possibility of studying the impact of the deviation from the proposed rule on the volatility of the indicators of output and financial and real inflation, and they could be even used models of panel data for the estimations, even considering the full, non-balanced sample, instead the used reduced, but balanced, sample. Nonetheless, all this further research overshoots the scope of this paper.

7. Concluding remarks

The widespread policy rule used by Central Banks around the world are variants of the Taylor rule, which emphasize the role of the inflation gap and the output gap in the determination of the risk-free interest rate. This paper proposes a very different approach based on financial variables and also quantities, which consists in adapting the trade gravity equation to financial services, in order to obtain a determination for the risk-free interest rate that depends on spreads (capturing the distance component of the gravity equation) and quantities (capturing the size component of the gravity equation). The idea is to use this measure to get a sense as to whether actual interest rates are optimally determined or whether they may induce bubbles or contractions in the economy or even in the price of financial instruments, as the public bonds.

Appendix I

Proof for (6)-(8)

Focusing on the first of the two equations shown in (6), ρ is replaced by (7), and rearranging:

$$\frac{r_0 \cdot C - R_0 \cdot D - \varepsilon_0 \left(C - D\right)}{r_0 \cdot C + R_0 \cdot D} \cdot r_0 \cdot C = \left(r_0 - \varepsilon_0\right) \cdot C \quad . \qquad (18)$$

Simplifying and leading ε_0 to one side and rearranging:

$$\frac{-2 \cdot R_0 \cdot D}{r_0 \cdot C + R_0 \cdot D} \cdot r_0 = \varepsilon_0 \cdot \frac{-\left(r_0 + R_0\right) \cdot D}{r_0 \cdot C + R_0 \cdot D} \quad . \qquad (19)$$

Finally, clearing ε_0 the expression (8) is obtained for rates instead of amounts.

Appendix II: Granger Causality of interests and economic variables

M1	cgdpgr GC close	cinfl GC close	tbr GC close	all GC close	% Countries where rejected previous column
Algeria	0.143	0.772	0.105	0.217	0.000
Bahamas, The	0.725	0.001	0.025	0.000	1.000
Barbados	0.376	0.903	0.499	0.747	0.000
Brazil	0.328	0.043	0.000	0.000	1.000
Dominica	0.900	0.010	0.006	0.002	1.000
Egypt, Arab Rep.	0.227	0.174	0.333	0.076	1.000
Eswatini	0.006	0.000	0.003	0.001	1.000
Fiji	0.014	0.557	0.007	0.007	1.000
Guyana	0.271	0.249	0.000	0.000	1.000
Hong Kong SAR, China	0.807	1.000	0.803	0.995	0.000
Hungary	0.000	0.037	0.001	0.000	1.000
Israel	0.216	0.025	0.001	0.000	1.000
Jamaica	0.147	0.011	0.374	0.002	1.000
Kenya	0.190	0.114	0.114	0.310	0.000
Kyrgyz Republic	0.074	0.091	0.813	0.188	0.000
Mexico	0.001	0.307	0.026	0.003	1.000
Moldova	0.025	0.012	0.287	0.017	1.000
Nigeria	0.002	0.871	0.506	0.013	1.000
Papua New Guinea	0.282	0.048	0.125	0.061	1.000
Philippines	0.090	0.030	0.253	0.114	0.000
Seychelles	0.230	0.633	0.214	0.202	0.000
South Africa	0.565	0.145	0.537	0.226	0.000
Tanzania	0.018	0.119	0.020	0.030	1.000
Trinidad and Tobago	0.150	0.650	0.139	0.033	1.000
Uganda	0.147	0.948	0.612	0.116	0.000
Zambia	0.021	0.194	0.030	0.000	1.000
Average	0.229	0.306	0.224	0.129	**0.654**

M2	**cgdpgr GC close**	**cinfl GC close**	**ctbr GC close**	**all GC close**	**% Countries where rejected previous column**
Algeria	0.057	0.484	0.027	0.075	1.000
Bahamas, The	0.361	0.000	0.016	0.000	1.000
Barbados	0.137	0.811	0.198	0.479	0.000
Brazil	0.629	0.229	0.000	0.000	1.000
Dominica	0.633	0.044	0.445	0.176	0.000
Egypt, Arab Rep.	0.190	0.240	0.048	0.009	1.000
Eswatini	0.031	0.000	0.002	0.000	1.000
Fiji	0.005	0.186	0.010	0.010	1.000
Guyana	0.283	0.027	0.092	0.101	0.000
Hong Kong SAR, China	0.465	0.950	0.042	0.353	0.000
Hungary	0.000	0.005	0.263	0.000	1.000
Israel	0.176	0.010	0.561	0.047	1.000
Jamaica	0.071	0.008	0.080	0.000	1.000
Kenya	0.613	0.259	0.489	0.696	0.000
Kyrgyz Republic	0.029	0.297	0.123	0.028	1.000
Mexico	0.042	0.330	0.156	0.027	1.000
Moldova	0.016	0.003	0.061	0.002	1.000
Nigeria	0.001	0.932	0.769	0.023	1.000
Papua New Guinea	0.544	0.182	0.143	0.069	1.000
Philippines	0.148	0.065	0.558	0.101	0.000
Seychelles	0.315	0.668	0.137	0.141	0.000
South Africa	0.754	0.117	0.895	0.340	0.000
Tanzania	0.117	0.028	0.163	0.041	1.000
Trinidad and Tobago	0.000	0.047	0.354	0.000	1.000
Uganda	0.528	0.023	0.825	0.010	1.000
Zambia	0.814	0.016	0.191	0.001	1.000
Average	0.268	0.229	0.256	**0.105**	**0.692**

M3	cgdpgr GC close	c19infl GC close	ctbr GC close	all GC close	% Countries where rejected previous column
Algeria	0.000	0.000	0.000	0.000	1.000
Bahamas, The	0.009	0.000	0.031	0.000	1.000
Barbados	0.142	0.888	0.189	0.507	0.000
Brazil	0.699	0.276	0.000	0.000	1.000
Dominica	0.553	0.442	0.784	0.699	0.000
Egypt, Arab Rep.	0.599	0.000	0.242	0.000	1.000
Eswatini	0.025	0.000	0.001	0.000	1.000
Fiji	0.052	0.700	0.160	0.050	1.000
Guyana	0.125	0.009	0.138	0.039	1.000
Hong Kong SAR, China	0.629	0.869	0.294	0.330	0.000
Hungary	0.000	0.014	0.472	0.000	1.000
Israel	0.426	0.248	0.501	0.469	0.000
Jamaica	0.017	0.000	0.005	0.000	1.000
Kenya	0.995	0.333	0.394	0.797	0.000
Kyrgyz Republic	0.018	0.069	0.020	0.005	1.000
Mexico	0.033	0.102	0.054	0.007	1.000
Moldova	0.005	0.001	0.054	0.000	1.000
Nigeria	0.001	0.957	0.758	0.024	1.000
Papua New Guinea	0.232	0.010	0.009	0.003	1.000
Philippines	0.030	0.046	0.967	0.075	1.000
Seychelles	0.301	0.670	0.314	0.142	0.000
South Africa	0.240	0.080	0.400	0.265	0.000
Tanzania	0.111	0.015	0.135	0.023	1.000
Trinidad and Tobago	0.910	0.839	0.070	0.014	1.000
Uganda	0.209	0.442	0.989	0.186	0.000
Zambia	0.806	0.014	0.184	0.001	1.000
Average	0.276	0.270	0.276	0.140	**0.692**

M4	**gdpgr GC close**	**infl GC close**	**tbr GC close**	**all GC close**	**% Countries where rejected previous column**
Algeria	0.307	0.187	0.763	0.308	0.000
Bahamas, The	0.806	0.000	0.000	0.000	1.000
Barbados	0.483	0.013	0.040	0.045	1.000
Brazil	0.000	0.164	0.000	0.000	1.000
Dominica	0.608	0.966	0.063	0.114	0.000
Egypt, Arab Rep.	0.005	0.511	0.002	0.002	1.000
Eswatini	0.018	0.083	0.030	0.001	1.000
Fiji	0.204	0.614	0.047	0.051	1.000
Guyana	0.639	0.018	0.000	0.000	1.000
Hong Kong SAR, China	0.293	0.076	0.563	0.424	0.000
Hungary	0.000	0.665	0.012	0.000	1.000
Israel	0.005	0.035	0.001	0.000	1.000
Jamaica	0.264	0.019	0.062	0.002	1.000
Kenya	0.005	0.728	0.242	0.041	1.000
Kyrgyz Republic	0.422	0.027	0.089	0.210	0.000
Mexico	0.389	0.337	0.170	0.257	0.000
Moldova	0.456	0.094	0.867	0.159	0.000
Nigeria	0.177	0.631	0.146	0.173	0.000
Papua New Guinea	0.947	0.289	0.625	0.369	0.000
Philippines	0.668	0.033	0.172	0.050	1.000
Seychelles	0.001	0.001	0.000	0.000	1.000
South Africa	0.398	0.009	0.254	0.001	1.000
Tanzania	0.267	0.023	0.423	0.066	1.000
Trinidad and Tobago	0.002	0.000	0.099	0.000	1.000
Uganda	0.015	0.006	0.431	0.000	1.000
Zambia	0.241	0.355	0.133	0.004	1.000
Average	0.293	0.226	0.201	0.088	**0.692**

Appendix III: Granger causality between interests

1998-2018	**eps GC[1] tbr**	**% Countries where rejected in previous column**	**tbr GC eps**	**% Countries where rejected in previous column**	**Interferences? Lowest p-value**	**% Countries with interferences**
Algeria	0.26	0.00	0.01	1.00	0.01	1.00
Bahamas, The	0.24	0.00	0.00	1.00	0.00	1.00
Barbados	0.62	0.00	0.00	1.00	0.00	1.00
Brazil	0.05	1.00	0.00	1.00	0.00	1.00
Dominica	0.09	1.00	0.00	1.00	0.00	1.00
Egypt, Arab Rep.	0.23	0.00	0.39	0.00	0.23	0.00
Eswatini	0.00	1.00	0.00	1.00	0.00	1.00
Fiji	0.02	1.00	0.01	1.00	0.01	1.00
Guyana	0.57	0.00	0.00	1.00	0.00	1.00
Hong Kong SAR, China	0.46	0.00	0.33	0.00	0.33	0.00
Hungary	0.63	0.00	0.49	0.00	0.49	0.00
Israel	0.03	1.00	0.00	1.00	0.00	1.00
Jamaica	0.01	1.00	0.16	0.00	0.01	1.00
Kenya	0.00	1.00	0.00	1.00	0.00	1.00
Kyrgyz Republic	0.77	0.00	0.13	0.00	0.13	0.00
Mexico	0.32	0.00	0.70	0.00	0.32	0.00
Moldova	0.40	0.00	0.00	1.00	0.00	1.00
Nigeria	0.13	0.00	0.02	1.00	0.02	1.00
Papua New Guinea	0.00	1.00	0.58	0.00	0.00	1.00
Philippines	0.21	0.00	0.08	1.00	0.08	1.00
Seychelles	0.32	0.00	0.35	0.00	0.32	0.00
South Africa	0.01	1.00	0.02	1.00	0.01	1.00
Tanzania	0.90	0.00	0.05	1.00	0.05	1.00
Trinidad and Tobago	0.00	1.00	0.00	1.00	0.00	1.00
Uganda	0.15	0.00	0.04	1.00	0.04	1.00
Zambia	0.74	0.00	0.55	0.00	0.55	0.00
Average	0.27	**0.38**	0.15	**0.65**	**0.10**	**0.73**

1. **GC means "Granger Causes"**

1998-2005	**tbr GC eps**	**% Countries where rejected in previous column**	**eps GC tbr**	**% Countries where rejected in previous column**	**Interferences? Lowest p-value**	**% Countries with interferences**
Algeria	0.05	1.00	0	1.00	0.00	1.00
Bahamas, The	0.00	1.00	0.00	1.00	0.00	1.00
Barbados	0.00	1.00	0.37	0.00	0.00	1.00
Brazil	0.00	1.00	0.00	1.00	0.00	1.00
Dominica						
Egypt, Arab Rep.	0.00	1.00	0.00	1.00	0.00	1.00
Eswatini	0.00	1.00	0.00	1.00	0.00	1.00
Fiji	0.00	1.00	0.00	1.00	0.00	1.00
Guyana	0.00	1.00	0.36	0.00	0.00	1.00
Hong Kong SAR, China	0.70	0.00	0.20	0.00	0.20	0.00
Hungary	0.05	1.00	0.23	0.00	0.05	1.00
Israel	0.00	1.00	0.00	1.00	0.00	1.00
Jamaica	0.47	0.00	0.11	0.00	0.11	0.00
Kenya	0.00	1.00	0.00	1.00	0.00	1.00
Kyrgyz Republic	0.18	0.00	0.00	1.00	0.00	1.00
Mexico	0.00	1.00	0.00	1.00	0.00	1.00
Moldova	0.00	1.00	0.59	0.00	0.00	1.00
Nigeria	0.00	1.00	0.00	1.00	0.00	1.00
Papua New Guinea	0.21	0.00	0.04	1.00	0.04	1.00
Philippines	0.00	1.00	0.00	1.00	0.00	1.00
Seychelles	0.33	0.00	0.00	1.00	0.00	1.00
South Africa	0.00	1.00	0.00	1.00	0.00	1.00
Tanzania	0.95	0.00	0.04	1.00	0.04	1.00
Trinidad and Tobago	0.00	1.00	0.00	1.00	0.00	1.00
Uganda	0.00	1.00	0.00	1.00	0.00	1.00
Zambia	0.00	1.00	0.00	1.00	0.00	1.00
Average	0.12	**0.76**	0.08	**0.76**	**0.02**	**0.92**

2006-2018	**tbr GC eps**	**% Countries where rejected in previous column**	**eps GC tbr**	**% Countries where rejected in previous column**	**Interferences? Lowest p-value**	**% Countries with interferences**
Algeria						
Bahamas, The	0.00	1.00	0.00	1.00	0.00	1.00
Barbados	0.00	1.00	0.23	0.00	0.00	1.00
Brazil	0.00	1.00	0.00	1.00	0.00	1.00
Dominica	0.00	1.00	0.00	1.00	0.00	1.00
Egypt, Arab Rep.	0.20	0.00	0.29	0.00	0.20	0.00
Eswatini	0.00	1.00	0.00	1.00	0.00	1.00
Fiji	0.00	1.00	0.00	1.00	0.00	1.00
Guyana	0.00	1.00	0.01	1.00	0.00	1.00
Hong Kong SAR, China	0.00	1.00	0.00	1.00	0.00	1.00
Hungary	0.02	1.00	0.15	0.00	0.02	1.00
Israel	0.00	1.00	0.00	1.00	0.00	1.00
Jamaica	0.00	1.00	0.00	1.00	0.00	1.00
Kenya	0.00	1.00	0.00	1.00	0.00	1.00
Kyrgyz Republic	0.24	0.00	0.24	0.00	0.24	0.00
Mexico	0.84	0.00	0.16	0.00	0.16	0.00
Moldova	0.00	1.00	0.52	0.00	0.00	1.00
Nigeria	0.12	0.00	0.00	1.00	0.00	1.00
Papua New Guinea	0.38	0.00	0.98	0.00	0.38	0.00
Philippines	0.00	1.00	0.35	0.00	0.00	1.00
Seychelles	0.69	0.00	0.79	0.00	0.69	0.00
South Africa	0.10	0.00	0.08	1.00	0.08	1.00
Tanzania	0.00	1.00	0.58	0.00	0.00	1.00
Trinidad and Tobago	0.00	1.00	0.00	1.00	0.00	1.00
Uganda	0.00	1.00	0.00	1.00	0.00	1.00
Zambia	0.65	0.00	0.24	0.00	0.24	0.00
Average	0.13	**0.68**	0.18	**0.56**	**0.08**	**0.76**

1998-2005 Taylor Rule	**tbr GC tr**	**% Countries where rejected previous column**	**tr GC tbr**	**% Countries where rejected previous column**	**Interferences? Lowest p-value**	**% Countries with interferences**
Algeria	0.00	1.00	0	1.00	0.00	1.00
Bahamas, The	0.00	1.00	0.00	1.00	0.00	1.00
Barbados	0.00	1.00	0.00	1.00	0.00	1.00
Brazil	0.16	0.00	0.01	1.00	0.00	1.00
Dominica		1.00		1.00	1.00	0.00
Egypt, Arab Rep.	0.00	1.00	0.00	1.00	0.00	1.00
Eswatini	0.94	0.00	0.17	0.00	0.00	1.00
Fiji	0.00	1.00	0.00	1.00	0.00	1.00
Guyana	0.00	1.00	0.00	1.00	0.00	1.00
Hong Kong SAR, China	0.00	1.00	0.00	1.00	0.00	1.00
Hungary	0.00	1.00	0.46	0.00	0.00	1.00
Israel	0.00	1.00	0.03	1.00	0.00	1.00
Jamaica	0.36	0.00	0.26	0.00	0.00	1.00
Kenya	0.00	1.00	0.00	1.00	0.00	1.00
Kyrgyz Republic	0.00	1.00	0.00	1.00	0.00	1.00
Mexico	0.29	0.00	0.00	1.00	0.00	1.00
Moldova	0.00	1.00	0.12	0.00	0.00	1.00
Nigeria	0.00	1.00	0.00	1.00	0.00	1.00
Papua New Guinea	0.01	1.00	0.00	1.00	0.00	1.00
Philippines	0.00	1.00	0.00	1.00	0.00	1.00
Seychelles	0.31	0.00	0.00	1.00	0.00	1.00
South Africa	0.68	0.00	0.00	1.00	0.00	1.00
Tanzania	0.00	1.00	0.00	1.00	0.00	1.00
Trinidad and Tobago	0.00	1.00	0.01	1.00	0.00	1.00
Uganda	0.24	0.00	0.52	0.00	0.00	1.00
Zambia	0.20	0.00	0.00	1.00	0.00	1.00
Average	0.13	**0.69**	0.06	**0.81**	**0.04**	**0.96**

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