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Is monetary policy really neutral in the long-run? Evidence for some emerging and developed economies

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Abstract

The traditional economic theory suggests that changes in the money supply or in the interest rates can influence the business cycle, but not the long-run potential output. In other words, monetary policy is neutral over the long-run. In this paper we use some new developments in econometrics to test for the existence of a long-run relationship between the monetary policy instrument used by most Central Banks - short-term interest rates - and real output. Using annual data for 14 emerging and developed countries our results offer overall support for the traditional economic theory.

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1. Introduction

The traditional economic theory suggests that monetary policy can influence the business cycle, but not the long-run potential output. In other words, monetary policy is neutral over the long-run. Evidence on this matter can be found in several studies, such as Olekalns (1996), Sarletis and Koustas (1998), Bernanke and Mihov (1998), Bullard (1999) and Bae, Jensen and Murdock (2005). However, this literature faces two central challenges. Firstly, most studies have only analyzed developed countries[1]. This evidence may not be relevant for emerging countries, since nominal and real interest rates in developed countries are generally much lower and less volatile than in the emerging world (see for e.g. Calvo and Reinhart, 2002; Ferreira and León-Ledesma, 2007). Secondly, much of the empirical investigation has focused on the neutrality of monetary aggregates, whereas Central Banks have been widely employing short-term interest rates as their main policy instrument[2]. Therefore, this evidence can be seen more as favoring aggregates neutrality than monetary policy neutrality. An important exception is Aksoy and León-Ledesma (2005), who check the long-run neutrality of short-term interest rates using data for the U.S and the U.K.

In this sense, in this paper we ask whether the monetary policy, through the setting of short-term nominal interest rates, affects long-run output in a sample of 14 developed and emerging countries. As in Aksoy and León-Ledesma (2005), we apply the cointegration test developed by Pesaran, Shin and Smith (2001) in order to overcome the problem of different orders of integration of the variables. Our results provide overall support for the traditional economic theory, as we were able to reject the null hypothesis of no long-run relationship between real output and nominal interest rates for only one out of the 14 countries analyzed.

The rest of the paper is as follows: section 2 presents the data and applies some unit root tests; section 3 investigates the existence of long-run relationships; section 4 concludes.

2. Data and unit root tests

We collected annual data on real output and short-term nominal interest rates for a sample of 14 emerging and developed countries. Data on Brazil's real output was obtained from IPEA (http://www.ipeadata.gov.br); all the other data was obtained from the IMF's IFS database.

Table 1: Sample periods and data definitions

Country	Sample Period	Interest rate	Real output
U.S.	1948-2007	Treasury bill rate	GDP vol. (2000=100)
U.K.	1948-2007	Treasury bill rate	GDP vol. (2000=100)
Sweden	1950-2007	Bank rate	GDP vol. (2000=100)
Switzerland	1948-2007	Discount rate	GDP vol. (2000=100)
Canada	1948-2007	Treasury bill rate	GDP vol. (2000=100)
Japan	1955-2007	Discount rate	GDP vol. (2000=100)
New Zealand	1954-2007	Discount rate	GDP vol. (2000=100)
Brazil	1948-2007	Money market rate	GDP (2007 prices)
Colombia	1968-2007	Discount rate	GDP vol. (2000=100)
Peru	1950-2007	Discount rate	GDP vol. (2000=100)
India	1963-2007	Bank rate	GDP vol. (2000=100)
South Korea	1953-2007	Discount rate	GDP vol. (2000=100)
Venezuela	1957-2007	Discount rate	GDP vol. (2000=100)
South Africa	1950-2006	Treasury bill rate	GDP vol. (2000=100)

[1] Relevant exceptions include Moosa (1997), Bae and Ratti (2000), and Starr (2005).

[2] Both monetary aggregates and interest rates are expected to have useful information to explain business cycles. However, several studies have argued that since the end of the 1970s the relationship between aggregates and fundamentals collapsed (see Clarida, Gali and Gertler, 2000). A common response to this information loss by many of the countries considered in this paper have been the adoption of explicit or implicit inflation goals, with the utilization of short-term interest rates as operating targets, normally through the use of Taylor-type rules.

We applied some ADF and DF-GLS unit root tests on the data collected. The results are reported in Tables 2 and 3. If a series is I(0) the tests should reject the null of a unit root. Taken as a whole, the results support the hypothesis of non-stationarity in real output, but provide mixed evidence regarding interest rates (in fact, we can reject the null for only 5 countries). This finding brings a disturbing issue at the theoretical point of view, which is a possible unit root in interest rates. The reason for that, as discussed by Aksoy and León-Ledesma (2005), is that according to the traditional economic theory interest rates should be stationary for a dynamic general equilibrium to exist[3].

Table 2: Unit root tests on log of real output

	Lags	ADF	ADF +	DF-GLS	DF-GLS +
U.S.	0	-1.398	-2.271	3.608	-1.894
U.K.	2	-0.193	-2.169	1.616	-2.033
Sweden	2	-2.078	-2.089	0.673	-1.281
Switzerland	2	-2.799*	-1.776	0.859	-0.911
Canada	2	-1.969	-1.852	1.532	-0.999
Japan	0	-6.489**	-1.302	1.327	-0.086
New Zealand	0	-1.033	-2.142	3.224	-1.654
Brazil	2	-1.913	-1.234	0.380	-1.211
Colombia	1	-0.872	-2.766	0.885	-2.128
Peru	2	-1.348	-2.051	1.186	-1.401
India	4	4.517	0.347	0.883	-0.222
South Korea	0	-0.378	-1.119	3.595	-1.091
Venezuela	1	-1.736	-2.550	0.665	-1.828
South Africa	1	-1.923	-1.792	0.903	-1.153

Notes: The numbers are the test statistics of the ADF and DF-GLS unit root tests under the null hypothesis of non-stationarity. Number of lags determined using Akaike Info Criteria. + indicates a trend was included in the test's equation. * indicates rejection of the null at the 10% significance level. ** indicates rejection of the null at the 5% significance level.

Table 3: Unit root tests on nominal interest rates

	Lags	ADF	ADF +	DF-GLS	DF-GLS +
U.S.	2	-2.051	-1.834	-1.442	-1.724
U.K.	2	-2.107	-1.659	-1.125	-1.417
Sweden	0	-2.148	-2.090	-1.876*	-2.005
Switzerland	0	-2.250	-2.502	-2.345**	-2.478
Canada	0	-2.079	-1.858	-1.501	-1.781
Japan	1	-1.567	-4.075**	-1.160	-3.965**
New Zealand	0	-2.341	-2.250	-1.895	-2.152
Brazil	0	-4.933**	-5.011**	-4.900**	-5.091**
Colombia	0	-1.632	-1.384	-1.317	-1.316
Peru	3	-3.199**	-3.228*	-3.121**	-3.297**
India	2	-1.445	-1.035	-1.143	-1.202
South Korea	0	-1.535	-2.261	-1.536	-1.902
Venezuela	0	-1.656	-2.299	-1.375	-2.358
South Africa	4	-1.454	-0.548	-0.674	-1.178

Notes: The numbers are the test statistics of the ADF and DF-GLS unit root tests under the null hypothesis of non-stationarity. Number of lags determined using Akaike Info Criteria. + indicates a trend in the test's equation. * indicates rejection of the null at the 10% significance level. ** indicates rejection of the null at the 5% significance level.

[3] Other studies have also raised the issue of non-stationarity in interest rates (see for e.g. Rapach and Weber, 2001). This result may be due to the well-known low power of unit root tests (for a discussion, see Ferreira and León-Ledesma, 2007).

The results of our unit root tests bring some complications to our investigation. Traditionally, studies on the long-run monetary policy neutrality are based on coitegration tests. When the hypotheses of non-stationarity of all the variables are not rejected it is easy to justify the use of conventional cointegration tests, such as those proposed by Johansen. However, our unit root tests show that if on the one hand there is strong evidence favoring non-stationarity in real output, we are not sure about the integration order of nominal interest rates. For some countries it seems to be I(1), and for others it seems to be I(0). Furthermore, as discussed before an additional complication is that economic theory predicts that interest rates should be stationary. In this sense, we follow Aksoy and León-Ledesma (2005) and apply the cointegration test developed by Pesaran, Shin and Smith (2001), which does not require any a priori conclusion with respect to the integration order of the variables. In our case, the importance of this test is that by applying it we are not required to make any assumption regarding the stationarity of interest rates. Since our results for this variable provided mixed evidence, it is reassuring to know that our results are not dependent on ad hoc assumptions. Moreover, we can stick with the traditional economic theory, that states that interest rates should be stationary, but at the same time test for long-run relations with sound econometrics.

3. Testing for long-run level relationships

Pesaran, Shin and Smith's (2001) approach, as described by Aksoy and Leon-Ledesma (2005), is based on the estimation of an unconstrained dynamic error correction representation for the difference of the variables involved, and testing whether the lagged levels of the variables are significant[4]. In other words the test consists of estimating the following autoregressive distributed-lag (ARDL) model:

$$\Delta y_t = \beta_o + \beta_1 y_{t-1} + \beta_2 i_{t-1} + \sum_{k=1}^{m} \varphi_k \Delta y_{t-k} + \sum_{k=1}^{m} \phi_k \Delta i_{t-k} + \vartheta \Delta i_t + \eta_t \qquad (1)$$

Where Δy represents the first difference of the log of real output, and Δi the first difference of nominal interest rates. Unlike Aksoy and León-Ledesma (2005) we use the first difference of interest rates in equation (1), whereas they use the percentage change of interest rates. Although it is mainly a matter of how to interpret the coefficients, under different transformations, our approach is more commonly used in the literature.

In order to test for the existence of a long-run relationship between real output and nominal interest rates, we apply an F-test of joint significance of the lagged levels of the variables. If the F-statistic for the joint null of zero coefficients shows to be insignificant, then it cannot be reject the null hypothesis that the variables are not related in the long-run. The procedure is based on a bounds test, in which the lower-bound represents the critical value if all the variables were I(0), and the upper-bound represents the critical value if all the variables were I(1)[5].

We follow the procedure suggested by Pesaran, Shin and Smith (2001), and do not reject the null if the F-statistic is lower than lower-bound of the critical value. On the other hand, the null hypothesis is rejected in favor of the alternative if the F-statistic exceeds the upper-bound of the critical value. When the F-statistic lies between the bounds, then the result is inconclusive.

[4] For a technical discussion on the test, the reader is referred to Pesaran, Shin and Smith (2001). Interesting applications of this methodology can be seen in Vita and Abbot (2002), Atkins and Coe (2002) and Narayan and Narayan (2005).

[5] The critical values for different specifications can be found in Pesaran, Shin and Smith (2001). We use two specifications, which represent cases III and IV in Pesaran, Shin and Smith (2001). In the first one only a constant is included in equation (1), whereas in the second one a constant and a trend are included.

3.1 Results

The results are reported in Table 4[6]. We considered two possibilities for the long-run level relationship between the variables: one with an unrestricted constant (case III in Pesaran, Shin and Smith, 2001), and another with an unrestricted constant and an unrestricted trend (case IV in Pesaran, Shin and Smith, 2001).

Table 4: Bounds testing for long-run level relationships

	F-stat	Lower Bound	Upper Bound	F-stat +	Lower Bound	Upper Bound
U.S.	2.884	4.490	5.730	5.520	6.560	7.300
U.K.	1.705	4.490	5.730	2.542	6.560	7.300
Sweden	2.853	4.490	5.730	2.831	6.560	7.300
Switzerland	**8.504**	4.490	5.730	3.814	6.560	7.300
Canada	5.407	4.490	5.730	3.733	6.560	7.300
Japan	**9.517**	4.490	5.730	1.087	6.560	7.300
New Zealand	0.986	4.490	5.730	3.336	6.560	7.300
Brazil	4.169	4.490	5.730	1.961	6.560	7.300
Brazil*	1.558	4.490	5.730	0.778	6.560	7.300
Colombia	2.069	4.490	5.730	4.432	6.560	7.300
Peru	**7.299**	4.490	5.730	**8.743**	6.560	7.300
India	4.937	4.490	5.730	1.312	6.560	7.300
South Korea	1.933	4.490	5.730	2.343	6.560	7.300
Venezuela	1.424	4.490	5.730	3.038	6.560	7.300
South Africa	**6.424**	4.490	5.730	5.511	6.560	7.300

Notes: Bold numbers indicate rejection of the null of no long-run relations. + indicates the inclusion of an unrestricted trend in the test's equation; otherwise only a constant was included. Brazil* refers to the results obtained excluding the hyperinflation period (1988-1994). Critical values were obtained from Pesaran, Shin and Smith (2001) in tables Ciii and Civ.

First of all, the results found reinforce Aksoy and León-Ledesma's (2005) findings, as we too were able to reject a long-run relationship between the variables for the U.K. and the U.S. Furthermore, this result seems to apply also for other developed countries and, most importantly, for our sample of emerging countries as well. Only for Peru the null of no long-run relationship was rejected in both specifications, whereas in the cases of Swtizerland, Japan and South Africa the second specification, which includes an unrestricted trend in the equation, does provide support of long-run monetary policy neutrality. For Canada and India the results are inconclusive in the first specification, as the F-statistic lies between the bounds, but clearly favor long-run monetary neutrality in the second specification. Finally, in the case of Brazil the results do not seem to depend on the inclusion of the hyperinflation data (1988-1994), supporting long-run monetary neutrality with both specifications for both samples.

In summary, the results found provide overall support to the traditional economic theory, suggesting that monetary policy and real output do not have a long-run level relationship, i.e. are not cointegrated.

4. Conclusion

The traditional economic theory suggests that monetary policy can influence the business cycle, but not the long-run potential output. In this paper we have investigated this hypothesis for a sample of 14 emerging and developed countries, checking whether there is a long-run

[6] For Brazil we also applied tests for a sample that excludes the hyperinflation period (1988-1994), which is characterized by very high and volatile nominal interest rates.

relationship between real output and the monetary policy instrument used by most Central Banks - short-term nominal interest rates.

Given differences in integration orders of the variables, we followed Aksoy and León-Ledesma (2005) and applied the bounds testing approach to coitegration, developed by Pesaran, Shin and Smith (2001). This procedure allows investigating the existence of long-run relationships irrespective of the integration order of the variables.

In general, the results give support to the traditional economic theory, as we were able to reject the null of no long-run relationships only for one out of 14 countries. In other words, monetary policy does not seem to affect output in the long run.

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