

The Determinants of Long-term Interest Rates in Eurozone: Taylor Rule and Governance Indicators

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Abstract

This study aims to search for the determinants of long-term interest rates in the Eurozone. Panel data analysis is employed for 14 Eurozone countries for the period of 2002-2014 to analyze the determinants of long-term interest rates. This study is carried out to find out whether the Worldwide Governance Indicators (WGI), Taylor (1993) rule and also the Eurozone crisis, as a control variable, have an impact on long-term interest rates. As WGI, Voice and Accountability, Political Stability and Absence of Violence/Terrorism, Government Effectiveness, Regulatory Quality, Rule of Law and Control of Corruption are used. The first finding of the empirical study is that inflation gap has an impact on long-term interest rates. Another finding of the study is that Political Stability and Absence of Violence/Terrorism, Government Effectiveness and Regulatory Quality effects long-term interest rates in 14 panel cross-sections. Besides, the analysis shows that the financial crisis in Eurozone as control variable affected long-term interest rates, as would be expected.

Keywords: government bond yields, governance indicators, panel analysis, Taylor rule

1. Introduction

Europe experienced a sovereign debt crisis, which first started in Greece in 2009 and spread to many of the Economic and Monetary Union (EMU) countries. The GIIPS countries, which represent Greece, Ireland, Italy, Portugal and Spain, are affected the most from the Eurozone crisis. The long-term interest rates during the financial crisis have soared to the levels of 20% in Greece and 10% in Portugal. The economic crisis still continues but the financial crisis in the Euro area ended in 2012 with the ECB's announcement of the OMT (Outright Monetary Transaction) program. The long-term interest rates have come down to much lower levels after this announcement. As of 2016 some Eurozone countries have negative interest rates on long-term government bonds. Figure 1 shows the long-term interest rate behavior of Eurozone countries.

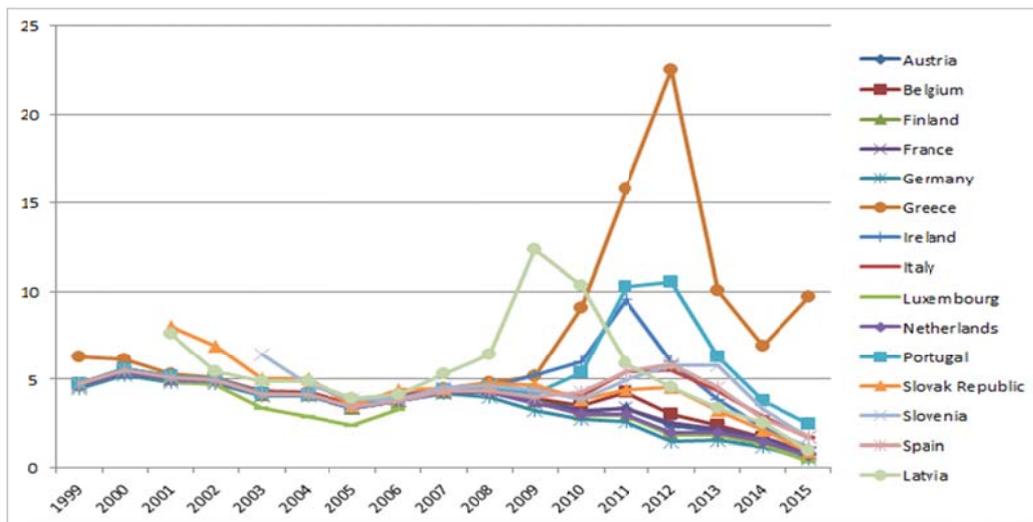


Figure 1. Long-term interest rate behavior of Eurozone countries

Various factors have been put forward to explain the determinants of long-term interest rates however there is no

consensus on the responsible factors for the changing behavior of long-term interest rates. In our study, we try to find out whether the Worldwide Governance Indicators (WGI) and Taylor (1993) rule have an impact on long-term interest rates. Long-term interest rates are the 10-year government bonds of the 14 Eurozone countries. Although the concept of governance is widely discussed among policymakers and scholars, there is no consensus around a single definition of governance. World Bank (2002) World Development Report "Building Institutions for Markets" defined governance as "rules, enforcement mechanisms, and organizations". In addition, World Bank (1992) defined governance as "the manner in which power is exercised in the management of a country's economic and social resources for development".

As WGI, we have used all six of the indicators, which are Voice and Accountability, Political Stability and Absence of Violence/Terrorism, Government Effectiveness, Regulatory Quality, Rule of Law and Control of Corruption. On the other hand, original Taylor (1993) rule determinants of interest rates are, output gap and inflation gap.

The WGI dataset that we used in our investigation are as follows,

Voice and Accountability is defined as "capturing perceptions of the extent to which a country's citizens are able to participate in selecting their government, as well as freedom of expression, freedom of association, and a free media" (Kaufmann, Kraay & Mastruzzi, 2010).

Political Stability and Absence of Violence/Terrorism is defined as "capturing perceptions of the likelihood that the government will be destabilized or overthrown by unconstitutional or violent means, including politically - motivated violence and terrorism" (Kaufmann et al, 2010).

Government Effectiveness is defined as "capturing perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies" (Kaufmann et al, 2010).

Regulatory Quality is defined as "capturing perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development. The respect of citizens and the state for the institutions that govern economic and social interactions among them" (Kaufmann et al, 2010).

Rule of Law is defined as "capturing perceptions of the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence" (Kaufmann et al, 2010).

Control of Corruption is defined as "capturing perceptions of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as "capture" of the state by elites and private interests" (Kaufmann et al, 2010).

In this article we try to find the determinants of long-term interest rates and see if WGI, the Eurozone crisis and Taylor (1993) rule have an impact on long-term interest rates. The determinants of long-term interest rates have so far been analysed empirically but to the best knowledge of the authors there is not any article, which analyses the Taylor (1993) rule, the Eurozone crisis and the effects of WGI on long-term interest rates for Eurozone countries.

The structure of the paper is organized as follows: Section 2 reviews the literature. Section 3 describes the data and the methodology of the empirical analyses. Section 4 presents and discusses the empirical results. Section 5 as final section discusses policy implications and concludes.

2. Literature Review

The mainstream literature offers that overnight interest rates are the main determinants of long-term interest rates (Adrian & Shin, 2009). However, Chionis, Pragidis and Schizas (2014) found budget deficit, inflation and unemployment as the major determinants of 10-year Greek Government bonds in the period between 2001 and 2012. Particularly they found strong impact of inflation on the long-term interest rates in the crisis period. In addition, Konadu-Adjei, Mayer and Chien (2012) found that GDP, inflation, budget deficit, and net capital inflows are the main components of long-term interest rates for the period of January 1999 to December 2009. In addition, the long-term interest rates of the Euro area are highly influenced by the US market according to Idier, Jardet and de Loubens (2007). On the other hand, inflation and debt to GDP ratios are also affecting long-term interest rates but GDP growth rate is not always significant. Furthermore, Makin (2005) suggested that the determinants of 10-year government bond interest rates could be largely explained by the sum of the real interest rate and expected inflation over the life of the bond.

Eichler (2014) in his study, researched about the political determinants of bond yield spreads. He used panel data from 1996 to 2009 and found strong evidence that those countries which are ruled by parliamentary systems but which have low quality of governance confront with high sovereign yields. Furthermore, he found that in countries where the political stability is high, sovereign yields spreads are low. Additionally, Rühl (2014) in his article made a comparison about the interest rate setting behavior of Bundesbank and European Central Bank (ECB) by using Taylor (1993) rule.

In his study, where he used monthly data and GMM framework, he concluded that ECB is not reacting to inflation as strongly as Bundesbank and violates the Taylor (1993) rule. In addition, he suggested that output gap is highly related with the ECB decisions of interest rate setting.

Augmenting the original Taylor (1993) rule's model is often studied in the economics literature. For example, Roskelley (2016) suggested that augmenting the original Taylor (1993) rule's estimation of short-term interest rate as a monetary policy instrument with bond market information can significantly improve the model's fit. Their analysis is based on an augmented Taylor (1993) rule framework with inflation rate, output gap, and the one-year lag value of the federal funds rate. Furthermore, Seyfried (2009) researched about the dynamic version of Taylor (1993) rule as well. He analyzed the behavior of short-term and long-term government bonds in different countries. His results suggest that, ten-year government bonds are highly sensitive to inflation expectations. However, output gap has more significant impact on short-term interest rates than long-term interest rates. The reason behind this conclusion is that short-term interest rates are sensitive to economic conditions, long-term interest rates are not affected by short-term fluctuations. Another study about using the long-term interest rate as a monetary policy instrument is carried by McGough, Rudebusch and Williams (2005). They suggested that using the short-term interest rate as the monetary policy instrument can create uncertainty problems. So instead of using the short-term interest rate, using the long-term interest rate can solve this problem.

There are vast amount of studies that have been carried about the WGI. Among many others, Afonso, Gomes and Rother (2007) searched about the reasons behind the sovereign debt ratings and used all six of the WGI, which are Voice and Accountability, Political Stability and Absence of Violence/Terrorism, Government Effectiveness, Regulatory Quality, Rule of Law and Control of Corruption. According to their results, only government effectiveness has a significant and positive impact on the sovereign debt ratings.

Kaufmann and Kraay (2002) used their own study of WGI in order to find relationship between growth and governance. They used dataset of all six WGI composed of 175 countries from 2000 to 2001 and used the results to interpret this relation in the Latin American and Caribbean region. They found strong relationship between per capita income and quality of governance indicators between countries. The WGI dataset is also used to analyze the determinants of outward FDI in China between the period of 2003 to 2006 by Kolstad and Wiig (2012). The focus of this paper is particularly on institutional determinants and natural resources. They used rule of law as the institutional variable from WGI. Their analysis suggests that Chinese outward FDI is attracted to large markets, and to countries with large natural resources and poor institutions. They also tested other institutional variables (control of corruption, political stability, government effectiveness, and regulatory quality) replacing the rule of law data and found similar results. Furthermore, M'non and Sekkat (2005) tried to find the relation between the impact of corruption on growth and investment using the WGI dataset. Their dataset consist of 63 to 71 countries between the periods of 1970 to 1998. They used WGI corruption data and found a negative impact on growth and no impact of investment.

There are some studies about the determinants of long-term interest rates but the lack of empirical analysis that investigates the relationship between long-term interest rates and Taylor (1993) rule as well as WGI of the countries rendered the empirical investigation for the Euro area indispensable.

3. Data and Methodology

Our study is composed of 14 Eurozone countries (Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Latvia, Netherlands, Portugal, Slovakia, Slovenia and Spain). (Note 1) The research is conducted on annual data between the periods of 2002-2014. Our paper investigates with reference to original Taylor (1993) rule model the impact of inflation gap, output gap and also WGI on long-term interest rates in the Euro area.

Regarding the long-term interest rates, long-term (in most cases 10 year) government bond data is collected from OECD. For the inflation gap, we used Harmonized Index of Consumer Prices (HICP) data, which is extracted from EUROSTAT. ECB inflation target is subtracted from the difference of HICP data of every country. We assume that the inflation objective of the ECB in the EMU area during the period 2002-2014 was 2%. For the output gap, we used GDP constant local currency data from the World Development Indicators (WDI) databank of World Bank. In order to find the output gap, we used the logarithm of output gap and then conducted Hodrick and Prescott (1997) filter for removing the trends in the data. Finally, for governance indicators, we used WGI dataset from World Bank. The governance indicators we employed are Voice and Accountability, Political Stability and Absence of Violence/Terrorism, Government Effectiveness, Regulatory Quality, Rule of Law and Control of Corruption.

In terms of methodology, first we used panel unit root tests to control for non-stationarity. We employed Im, Pesaran and Shin (2003) test. IPS (2003) test emerges as a critique to Levin, Lin and Chu (2002) panel unit root test, which assumes homogeneous autoregressive coefficient. However, IPS test relaxes this restriction by allowing for heterogeneity in the autoregressive coefficients. The test has presence of unit root in the null hypothesis.

In our estimation, we used panel data of 14 Eurozone states. Our dependent variable is long-term interest rates. We chose the fixed-effects method because of the fact that fixed-effects method allows different constants for each group and eliminates the heterogeneity from the model. We also employed a dummy variable, which is the crisis dummy. The crisis years in the model is; 2009, 2010, 2011 and 2012. The model equations for fixed effects method for 14 panel cross-sections are as follows:

Fixed effect (including cross country effects) model with lagged dependent variable (short run model):

$$IR_{it} = \alpha + \alpha_i + \alpha_1 \cdot IR_{it-1} + \alpha_2 \cdot \tilde{\pi}_{it} + \alpha_3 \cdot \tilde{y}_{it} + \alpha_4 \cdot gov_{it} + \alpha_5 \cdot d_t + \alpha_6 \cdot trend_t + u_{it} \quad (1)$$

where IR_{it} refers to long-term interest rates (where i is the cross-section and t is the time) in the equation. IR_{it-1} refers to lagged long-term interest rates in equation. $\tilde{\pi}_{it}$ refers to inflation gap and \tilde{y}_{it} refers to output gap that we have calculated. gov_{it} refers to six governance indicators which are Voice and Accountability, Political Stability and Absence of Violence/Terrorism, Government Effectiveness, Regulatory Quality, Rule of Law and Control of Corruption. d_t in equation refers to trend. u_{it} is the error term.

4. Findings and Discussions

We employed IPS unit root test to see whether our dataset is unit root or stationary. As can be seen from table 1, all variables are observed to be stationary except for interest rate and three governance indicators, namely Regulatory Quality, Rule of Law and Control of Corruption, which are in index form. Non-stationarity problem of interest rate is overcome by inclusion of its lagged form as an independent variable.

Table 1. IPS Unit Root Test

	INTERCEPT	INTERCEPT AND TREND
INT	-0.3943 (0.346)	0.1559 (0.562)
INFGAP	-4.3608 (0.000)	-3.4609 (0.000)
OUTGAP	-3.043 (0.001)	0.177 (0.570)
VOACC	-1.7758 (0.037)	-4.5937 (0.000)
POLSTA	-4.2725 (0.000)	-3.2984 (0.000)
GOVEFF	-3.4222 (0.000)	-1.8747 (0.030)
REGQUA	0.2233 (0.588)	-1.3042 (0.096)
RULELAW	-0.8991 (0.184)	-0.6619 (0.254)
CONCOR	-1880 (0.425)	-1.0739 (0.141)

Note. The values shown in brackets are p values.

We employed fixed effect (including cross country effects) model with lagged dependent variable.

Table 2. Fixed effect (including cross country effects) model with lagged dependent variable (short run model)

Regressors	(1)	(2)	(3)	(4)	(5)	(6)
LAGGED IR	0.623 (0.00)**	0.588 (0.000)**	0.640 (0.000)**	0.597 (0.000)**	0.631 (0.000)**	0.646 (0.000)**
INFGAP	15.197 (0.058)**	15.558 (0.048)**	13.684 (0.086)*	14.867 (0.057)**	15.035 (0.061)*	13.382 (0.099)*
OUTGAP	1.712 (0.679)	0.868 (0.830)	0.336 (0.935)	2.528 (0.526)	2.207 (0.590)	3.233 (0.433)
VOACC	-1.949 (0.250)					
POLSTAB		-2.153 (0.006)**				
GOVEFF			-2.045 (0.027)**			
REGQUA				-3.531 (0.002)**		
RULELAW					-1.772 (0.206)	
CONCOR						-1.342 (0.136)
TREND	-0.092 (0.032)**	-0.078 (0.041)**	-0.104 (0.012)**	-0.124 (0.003)**	-0.070 (0.070)*	-0.106 (0.019)**
DUMMY	1.232 (0.000)**	1.123 (0.000)**	1.208 (0.000)**	1.227 (0.000)**	1.268 (0.000)**	1.274 (0.000)**
R-squared	0.644	0.658	0.652	0.662	0.644	0.646

Note. (*) and (**) denote 10% and 5% significance level, respectively.

The results show that inflation gap significantly affects long-term interest rates in 14 Eurozone countries. Our second

finding is that political stability and absence of violence/terrorism, government effectiveness and regulatory quality affects long-term interest rates at 95% confidence level. However, long-term interest rate is not affected from voice and accountability, rule of law and control of corruption. Based on the Kaufmann et al.'s (2010) WGI definitions and our findings, destabilized political environment, violence or terrorism in the countries affects long-term interest rates. Furthermore, ineffective policies and regulations that the government formulates affect long-term interest rates as well.

Furthermore, the dummy variable shows us that the crisis in the Eurozone affected long-term interest rate at 95% confidence level. In contrast to our expectations in relation with Taylor (1993) rule we found out that output gap is not significant in affecting long-term interest rate. (Note 2)

Rühl (2014) finds out in his study about Taylor (1993) rule that output gap is significant. However, in Rühl's (2014) study he treated the Euro area as one single unity whereas our study uses dataset of individual countries. Treating the Euro area as a homogenous group can change the potential influencing factors. So this can be the explanation for the differences with our study and Rühl's (2014). In addition, our output gap findings are in the same direction with Seyfried's (2009) research about the dynamic version of Taylor (1993) rule. His results suggest that, output gap has more significant impact on short-term interest rates than long-term interest rates because short-term interest rates are sensitive to economic conditions however long-term interest rates are not affected by short-term fluctuations.

As a double check, we employed the same procedure only to GIIPS countries. The empirical analysis shows that the results are the same with our estimations except for the Regulatory Quality. (Note 3)

5. Conclusion and Policy Implications

In our study the impact of inflation gap and output gap, additionally Eurozone crisis and WGI on long-term interest rates are investigated for a panel of 14 Eurozone countries between the periods of 2002-2014. During the investigation, the years between 2009 and 2012 are used as a dummy variable for the sovereign debt crisis in the Eurozone.

Political stability and absence of violence/terrorism, government effectiveness and regulatory quality of the countries affects long-term interest rates. On the other hand, control of corruption, rule of law and voice and accountability has no significant effect on long-term interest rates. In addition, inflation gap is highly related with long-term interest rate yet output gap does not have an impact on long-term interest rate.

Since more and more studies (Note 4) suggest the use of long-term interest rates instead of short-term rates for monetary policy, the results of this empirical investigation about the determinants of long-term interest rates may also be interpreted as the determinants of monetary policy conduct.

Policy makers should take into consideration that the destabilized political environment, the quality of the regulations and effectiveness of the government are highly important whereas output gap is not effective on the formulation of long-term interest rates and/or monetary policy.

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References

- Adrian, T., & Shin, H. (2009). Prices and quantities in the monetary policy transmission mechanism. *Federal Reserve Bank of New York Staff Report No. 396*. <http://dx.doi.org/10.2139/ssrn.1483825>
- Afonso, A., Gomes, P., & Rother, P. (2007). What "hides" behind sovereign debt ratings?. *European Central Bank, Working paper series, 711*, 1-67. Retrieved from <http://www.ecb.europa.eu/pub/pdf/scpwpwps/ecbwp711.pdf>
- Chionis, D., Pragidis, I., & Schizas, P. (2014). Long-term government bond yields and macroeconomic fundamentals: Evidence for Greece during the crisis-era. *Finance Research Letters, 11*(3), 254-258. <http://dx.doi.org/10.1016/j.frl.2014.02.003>
- Eichler, S. (2014). The political determinants of sovereign bond yield spreads. *Journal of International Money and Finance, 46*, 82-103. <http://dx.doi.org/10.1016/j.jimonfin.2014.04.003>
- Eurostat. (2016). Harmonized index of consumer prices (HICP). Retrieved from <http://ec.europa.eu/eurostat/data/database>
- Hodrick, R., & Prescott, E. (1997). Postwar U.S. business cycles: An empirical investigation. *Journal of Money, Credit and Banking, 29*(1), 1. <http://dx.doi.org/10.2307/2953682>
- Idier, J., Jarret, C., & de Loubens, A. (2007). Determinants of long-term interest rates in the United States and the Euro area: A multivariate approach. *Banque de France Working Paper No. 170*. <http://dx.doi.org/10.2139/ssrn.1694505>

- Im, K., Pesaran, M., & Shin, Y. (2003). Testing for unit roots in heterogeneous panels. *Journal of Econometrics*, 115(1), 53-74. [http://dx.doi.org/10.1016/s0304-4076\(03\)00092-7](http://dx.doi.org/10.1016/s0304-4076(03)00092-7)
- Kaufmann, D., & Kraay, A. (2002). Growth without governance. *Economía*, 3(1), 169-229. <http://dx.doi.org/10.1353/eco.2002.0016>
- Kaufmann, D., Kraay, A., & Mastruzzi, M. (2010). The worldwide governance indicators: Methodology and analytical issues. *World Bank Policy Research Working Paper No. 5430*, <http://dx.doi.org/10.1596/1813-9450-5430>
- Kolstad, I., & Wiig, A. (2012). What determines Chinese outward FDI? *Journal of World Business*, 47(1), 26-34. <http://dx.doi.org/10.1016/j.jwb.2010.10.017>
- Konadu-Adjei, C., Mayer, R., & Chien, W. (2012). Determinants of long-term interest rates in the United States. *Journal of Business & Economics Research (JBER)*, 10(5), 257. <http://dx.doi.org/10.19030/jber.v10i5.6977>
- Levin, A., Lin, C., & Chu, C. J. (2002). Unit root tests in panel data: Asymptotic and finite-sample properties. *Journal of Econometrics*, 108(1), 1-24. [http://dx.doi.org/10.1016/s0304-4076\(01\)00098-7](http://dx.doi.org/10.1016/s0304-4076(01)00098-7)
- Makin, J. H. (2005). What determines interest rates? *American Enterprise Institute for Public Policy Research*, 1-4. Retrieved from https://www.aei.org/wp-content/uploads/2011/10/20041222_17755graphics.pdf
- McGough, B., Rudebusch, G., & Williams, J. (2005). Using a long-term interest rate as the monetary policy instrument. *Journal of Monetary Economics*, 52(5), 855-879. <http://dx.doi.org/10.1016/j.jmoneco.2005.07.011>
- Món, P., & Sekkat, K. (2005). Does corruption grease or sand the wheels of growth? *Public Choice*, 122(1-2), 69-97. <http://dx.doi.org/10.1007/s11127-005-3988-0>
- OECD. (2016). Long-term interest rates.
- Roskelley, K. (2016). Augmenting the Taylor rule: Monetary policy and the bond market. *Economics Letters*, 144, 64-67. <http://dx.doi.org/10.1016/j.econlet.2016.05.002>
- Rühl, T. (2014). Taylor rules revisited: ECB and Bundesbank in comparison. *Empir Econ*, 48(3), 951-967. <http://dx.doi.org/10.1007/s00181-014-0820-z>
- Seyfried, W. L. (2009). Using a dynamic Taylor-type rule to examine the behavior of bond yields: Some international evidence. *International Business & Economics Research Journal (IBER)*, 8(3), 25-32. <http://dx.doi.org/10.19030/iber.v8i3.3112>
- Taylor, J. (1993). Discretion versus policy rules in practice. *Carnegie-Rochester Conference Series on Public Policy*, 39, 195-214. [http://dx.doi.org/10.1016/0167-2231\(93\)90009-1](http://dx.doi.org/10.1016/0167-2231(93)90009-1)
- World Bank. (1992). *World development report 1992: Development and the environment*. New York: Oxford University Press. World Bank. Retrieved from <https://openknowledge.worldbank.org/handle/10986/5975>. <http://dx.doi.org/10.2307/1973669>
- World Bank. (2002). *World development report 2002: Building institutions for markets*. New York: Oxford University Press. World Bank. Retrieved from <https://openknowledge.worldbank.org/handle/10986/5984>
- World Bank. (2016). World development indicators: GDP (constant LCU). Retrieved from <http://databank.worldbank.org/data/reports.aspx?source=world-development-indicators>.
- World Bank. (2016). Worldwide governance indicators (WGI). Retrieved from <http://info.worldbank.org/governance/wgi/index.aspx#home>