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Research article

Interest rates affect public expenditure growth

Guillermo Peña*

Departamento de Análisis Económico and IEDIS, Universidad de Zaragoza, Spain

* **Correspondence:** Email: gpena@unizar.es; Tel: +34976762408; Fax: +34976762408.

Abstract: The aim of this paper is to analyze interest rates and public spending to provide policy implications. Concretely, it explores the influence of these rates on public expenditure growth as opposite to the traditional direction view, dealing with 216 countries for the 1972–2021 period and estimating system GMM models. A balanced subsample is used for assessing Granger causality through a recent panel technique. The results are robust for the used dependent and target variables and also the methodology. They show that decreasing interest rates are associated with—and in some cases also lead to—lower per capita public expenditure growth. These results can be interpreted as a twofold effect of shifts in relative prices—through fiscal illusion—and of crowding out of private investment with respect to the public sector.

Keywords: public budgeting; interest rates; tax prices; household perceptions; fiscal illusion

JEL Codes: H61, H62, G21, H25

Graphical abstract:

$$\uparrow \text{Interest rates} \begin{cases} \text{Crowding out effect} \\ \text{Fiscal illusion} \end{cases} \rightarrow \uparrow \text{Public Spending}$$

Highlights:

- Interest rates positively affect public expenditure through a double transmission channel.
- The mechanism consists of crowding out and fiscal illusion.
- The theoretical expectations are empirically confirmed.

Abbreviations: GMM: generalized method of moments; SGMM: system GMM; FE: fixed effects; OLS: ordinary least squares; GDP: gross domestic product; GFC: Global Financial Crisis; G: public expenditure; D: demand; S: supply; GC: Granger cause; T-bills: Treasury bills; VAT: value added tax

1. Introduction

According to Blanchard (2023), the historical net debt ratios for the major countries are in most cases above 100%. With few exceptions, these debts are significantly higher than they were in 2007, before the beginning of the Global Financial Crisis (GFC). Additionally, reference interest rates have been extremely low in the last years. Traditionally, when the economic growth rate is higher than the neutral interest rate for that period, it is assumed that policies fighting income inequality must be applied in order to reduce the deviation between neutral interest rates and economic growth rate, thereby diminishing inequality. This transmission channel assumes an unequivocal direction of the effect from public spending to interest rates. The effect of public spending on economic growth (Matei, 2020) is also well known. Nonetheless, interest rates can have an impact on public expenditures if we consider the latter as endogenous. So, according to this reasoning, the question would be what interest rate we need, for instance, to fight income inequality through public expenses—i.e., the main target of the present paper is to find what type of shift of interest rates leads to an increase in public spending. For instance, inflation and interest rates are currently rising, and authors as Heinemann (2001) consider that when there is bracket creeping, which is provoked by inflation, the mix of fiscal and monetary illusion allows for real budget expansions. Recently, Murphy and Walsh (2022) have found that, contrary to the theoretical expectation that an increase in public spending will raise interest rates, the effect is negative. Going forward, we can be concerned even about the direction of influence, where the opposite direction of the relationship is relatively less studied. In fact, this topic is even more relevant nowadays with rising interest rates and high debt levels.

In order to answer these questions, both theoretical and empirical literature is provided on fiscal illusion and concerning the relationship between fiscal policy and interest rates, in addition to showing the main determinants of public expenditure through fiscal illusion and other mechanisms. The empirical estimates analyze the effects of different kinds and specifications of interest rates and also of public expenditure, both for general and for goods and services expenses—respectively, with and without including the financing costs. The full sample database used consists of one of the largest available datasets, covering 216 countries during the 1972–2021 period. The methodology consists of two-step system GMM models, a recent test of Granger causality for panel data and a pairwise Granger causality method for a robustness check. The first methodology is chosen due to its benefits in addressing endogeneity—since two-step system GMM "relies on internal instruments (lagged values, internal transformation) to address the different sources of endogeneity" (Ullah et al., 2018). Causality with panel data and country by country methods are used to check the direction of the influence.

Murphy and Walsh (2022) suggested the existence of a demand channel that offsets the traditional positive effect of public expenditure on interest rates, where an increase in the spending is associated with an increase in the demand and, thus, higher credit and lower interest rates. The present paper proposes two novel mechanisms for this relationship, which are opposite to the most common direction of influence addressed by the literature. Specifically, when reference rates rise, investment decreases, and—due to the trade-off between public and private investment (Yakita and Yakita, 2017)—public expenditure increases. The second transmission channel is based on fiscal illusion. The public expenditure increases since a rise in interest rates may be perceived by consumers as a higher price for

the services supplied by the private sector, mostly determined by the reference rates. Therefore, consumers perceive a decrease in the relative prices of the public sector services—mostly determined by tax rates—*ceteris paribus*. Additionally, rising interest rates can be perceived by society as a signal of improving economic context, which is associated with higher demand and also with higher tax collection due to automatic stabilizers. Further, new explanations take into account the isolated effect of interest rates without these proposed channels. In particular, raising interest rates leads to higher funding costs. Therefore, policy makers must reduce other public expenditures in order to maintain the initial amount, *ceteris paribus*, expecting an isolated negative influence.

The previous theoretical expectations are empirically confirmed, showing the need to reduce the importance of the previous transmission channels if lower indebtedness is desired in a context of rising rates. One of the first possible policy implications includes further improvements in the efficiency of the private sector to balance the shift in relative prices, as well as the trade-off of the investment by economic agents between the public and private sectors. A second possible policy measure would be raising tax rates to compensate the fiscal illusion by the government. An additional achievement of the present study—apart from the large sample, the novel direct/indirect effects and transmission channels, as well as the direction of influence—is the fact of differentiating between public expenditures with and without financing costs. The main limitation of this paper is the lack of a vast literature on this specific direction of causality by other authors. Another limitation is the diverse country sample used—a twofold (dis)advantage.

The results show a statistically significant and robust positive effect of interest rates on public spending, also confirmed by a robustness check using different methodologies and diverse dependent and independent variables. One of the main reasons the present paper provides for this fact is that a raise in interest rates is associated with higher relative prices and lower demand in the private sector. The demand then shifts towards the goods and services of the public sector due to a crowding out effect, mainly in investment, thus increasing public expenditure. Regarding the fiscal illusion explanation, by raising the interest rates and maintaining the prices of public services—i.e., taxes—consumers perceive a decrease in the relative tax prices of the public sector vs. the private one. Therefore, there is a misperception of the costs of public goods and services, leading to buying or demanding them more and more often than otherwise.

This paper is divided as follows. After this introduction, Section 2 provides the literature review. Section 3 explains the theory and development of hypotheses, and Section 4 presents the data and methodology. Section 5 shows the results, while Section 6 discusses them and provides a robustness check. Finally, Section 7 provides concluding remarks.

2. Literature review

This section initially deals with the introduction of the concept and main determinants of fiscal illusion due to its possible relevance to the study of the theoretical effects of interest rates on public spending. Second, it analyzes the literature regarding the influence of budget surplus, government debt and public spending on interest rates. Next, it presents the closest papers to the present one, to the author's knowledge. Based on the previous information, the work will propose a theoretical view for the expectations of the effects of monetary policy on public expenditure.

Onal (2021) recently highlighted that the topic of the size of government is one with a long trajectory, developed in the 1960s thanks to the "public choice" school, which faces so-called "Keynesian biases." From this topic, a related concept emerged: fiscal illusion. Amilcare Puviani (1903)

was the first one to provide a theory of this concept. Hotak and Kaneko (2022) referred to fiscal illusion as "taxpayers' perceptions of the gap between their burden and their expectations regarding the provision of public services." Oates (1988) considered this misperception to be fiscal illusion when it is "systematic." Furthermore, there is an incorrect perception of public good costs, considering the tax price lower than the real one (Brennan & Buchanan, 1980; Buchanan, 1967). Jimenez and Afonso (2021) suggested that governments can manipulate citizens through fiscal illusion in order to increase the public sector size.

A brief literature review on the topic can be found in Facchini (2018). Regarding the first analytical models explaining fiscal illusion, Wagner (1976) developed a model in which this effect leads citizens to underestimate the real costs of public goods —that is, the fiscal price—provoking their overweighted production. One of the most relevant empirical papers in the previous decade is the estimation by Dell'Anno and Mourao (2012) of a fiscal illusion indicator (Mourao 2008, 2011) based on 50 countries for the period between 2000 and 2008. For the regression, they used self-employed workers, tax revenues over GDP, the maximum marginal tax rates in income tax and social security and institutional, political and educational explanatory variables.

Dollery and Worthington (1996) carried out a literature review of the main articles on fiscal illusion up to the 1990s, studying public expenditure, public consumption or per capita public expenditure as main explanatory variables. They included the following as main explanatory variables, in addition to more recent inclusions: wages (Clotfelter, 1976; Wagner, 1976; Di Lorenzo, 1982a; Marshall, 1991; Dell'Anno and Dollery, 2014), poverty or inequality (Wagner, 1976; Beck, 1984), population (Oates 1975; Clotfelter, 1976; Pommerehne and Schneider, 1978; Di Lorenzo, 1982b; Marshall, 1989, 1991; Heyndels and Smolders, 1994; Dollery and Worthington, 1995), GDP or GDP per capita (Wagner, 1976; Pommerehne and Schneider, 1978; Di Lorenzo, 1982a; Marshall 1991), education or secondary education (Brazer and McCarty, 1987) and trade openness, with a positive correlation (Sáenz et al., 2013).

Regarding fiscal variables, it is worth highlighting the indicator of tax simplicity (Wagner, 1976; Pommerehne and Schneider, 1978; Munley and Greene, 1978; Heyndels and Smolders, 1994; Worthington, 1994; Dollery and Worthington, 1995; Dell'Anno and Dollery, 2014) and the ratio of indirect taxes over direct taxes (Clotfelter, 1976; Henrekson, 1988; Dollery and Worthington, 1995). All these variables are considered as potential influences on fiscal illusion. As previously seen, none of them includes the interest rate. In the present paper, this topic is empirically dealt with.

In relation to the literature about the linkages between fiscal and monetary policies, it is worth highlighting that most, if not all, of the literature studies the effects of fiscal policy on the interest rates but not the opposite direction of the relationship. The issue regarding the possible influences comes from some papers questioning whether the interest rates are exogenous (Wray, 2006), whether the public expenditure is productive (Aschauer, 1989) and whether it stimulates the economy (Aschauer, 1990). The positive effect of fiscal policy on the economy is a way to confirm that such policy matters (Blinder and Solow, 1973).

Frenkel and Razin (1984) developed an analytical model in which a budget deficit raises world interest rates, negatively transmitting this deficit to the rest of the world through the world capital market. They distinguished between two different effects of a rise in government spending. If the effect is transitory, it always provokes an increase in interest rates, but if the effect is permanent, it will depend on whether the national economy is a net saver or dissaver with respect to the rest of the world economies. In this case, if there is a surplus in the current account, then there will be a rise of the world

rates of interest, while if there is a deficit in the current account of the home economy, it would be associated with a decrease in the interest rates. Authors such as Evans (1985, 1987) and Cebula (1988) empirically checked whether large deficits lead to higher interest rates.

More recently and regarding the effects of public debt on interest rates, Engen and Hubbard (2004) highlighted that, while these effects have been analyzed for decades, they are still under debate, since there is no consensus on their empirical effects yet. This debate still continues nowadays. As Blanchard (2019) recently suggested, low interest rates—since the economic growth rate is higher than the natural interest rate— are an encouragement to increase debt. Brumm et al. (2022) corrected the previous author's statement that "deficits are free" for ex-ante utility, leading to even more room to obtain Pareto improvements from budget deficits.

Finally, and specifically focusing on public spending, Choi and Devereux (2006) empirically explored possible asymmetric effects of government spending on economic activity depending on different values of real interest rates, finding that expansionary public spending is more predisposed to short-run growth when the real interest rates of the country are low. Table 1 provides a summary of the studies of the next authors.

As previously expressed, most studies focus on the effects of public spending on interest rates. Blanchard (2023) highlighted that, when monetary policy is not available for raising output toward its maximum potential since the reference interest rates are so close to the zero bound rate (ZBR), fiscal policy has to intervene by expansionary public policies, so there is a need for raising public expenditures. According to this author (pp. 6–7), the "future path of interest rates is not exogenous and depends very much on fiscal policy itself." Nonetheless, this paper is focused on the opposite direction of the effect.

An additional topic worth mentioning is the financial sustainability issue, which is key in the recent economic literature and policy debate. The sustainability of public finances must ultimately eliminate government bankruptcy. Brady and Magazzino (2018a) used data from 19 European Monetary Union (EMU) countries for the 1970–2016 period and found that the solvency condition may be considered to be satisfied for these countries. Austerity policies would improve the conditions of the public accounts in the more indebted countries. This would restore the credibility of the institutions of these countries and reduce the spreads. Their results also showed that the co-movement of public debt ratios shows a counter-cyclical response to the common business cycle. Furthermore, they also found an unobserved factor driving such co-movement. Brady and Magazzino (2018b) applied causality tests to the 28 European Union member states for the 1980–2015 period, and they suggested the presence of the fulfillment of the neutrality hypothesis, that "government revenues do not cause the expenditures, and vice versa" (p. 1). Finally, Magazzino et al. (2019) found that G7 countries have to pay attention to the equilibrium between government expenditure and revenues, which they considered as a possible source of fiscal insolvency. They also observed bi-directional causality flows that emerge both between public revenues and expenditures and between government primary deficit and public debt.

Table 1. Summary of some literature on the topic.

Source	Econometric approach	Main variables used	Time span	Number of countries	Main results	Target factor/ topic
Mauro (1998)	OLS and OLS robust	Corruption and GDP per capita	1982–1995	106	Corruption reduces Public Expenditure	Politicians
Delavallade (2006)	Three-stage least squares method	Corruption, GDP, Total and Urban Population, Dependency Ratio, Young People, Military personnel, social contributions, lack of global freedom	1996–2001	64	Corruption distorts Public Expenditure by reducing the social portion	
Magazzino et al. (2015)	Unit root tests, cointegration and GC tests	General Government Expenditure, GDP, Investment/GDP	1980–2013	EU	An increase in GDP tends to raise the government expenditure/GDP share	Wagner's law
Azolibe et al. (2020)	Modified and Fully Modified ordinary least squares (OLS)	Population age structure, self–employment, GDP per capita, inflation, control of corruption, foreign aid and unemployment	1989–2018	10	Population age structure influences the growth of public expenditure in Africa, Self–employment, GDP per capita, inflation and control of corruption (–) and foreign aid and unemployment (+) influence	Population age structure
D'Alessandro et al. (2019)	Vector Auto-Regressive	Federal Funds and Government Expenditures	1953–2007	US	Significant reduction in interest rate after a raise in Public Expenditure	Interest rates
Murphy and Walsh (2022)	Structural Vector Auto-Regressive	Treasury Bill rates and Government Expenditures	1983Q1 – 2007Q4	US	The increased demand for credit associated with government spending is offset by an increase in the supply of credit due to higher aggregate income (p.1)	

The main aim of this paper is to observe the influence of reference rates on public spending. In the case of the opposite direction, it is remarkable that "most macroeconomic models imply that increases in government spending cause interest rates to rise, but empirical evidence from the U.S. generally fails to support this prediction" (Murphy and Walsh, 2022). These authors found that the positive effect of

public spending rates through credit demand is compensated by a rise in credit supply through an increase in income. Other authors, such as D'Alessandro et al. (2019), also found a negative effect.

3. Theory and development of hypotheses

The possible effects of monetary policy on fiscal sustainability regarding public expenditure are presented. Two different potential effects with opposite sign are assessed. Finally, a discussion is provided afterwards to determine which sign is more feasible.

The first effect considers interest rates as the fiscal price of money. The reason for considering the interest rate as a fiscal price is that money can be considered a kind of public good since it generates public positive externalities—its intrinsic price is almost null, but its benefits are very high—and the supervision of money for the whole country would be very costly for the private sector. Nonetheless, a higher interest rate would lead to a lower provision of money, and this would impede the public sector in monetizing its debt, constraining future public spending. Additionally, the public sector will pay higher interest rates for the debt, with direct negative repercussions on the public budget and thus on public expenditure.

The second effect considers that, knowing that taxes impact in a direction opposite to the price of the good they are levying, as well as taking into account that taxes on financial services such as financial VAT have a negative effect on public expenditure, the expected sign for the effect of interest rates—price of money—would be the opposite, i.e., positive. The reason is that, taking into account the crowding out effect between the public and private sectors, if the price of financial services is raised by the central banks through a raise in the reference interest rates, then the public services would be expected to be cheaper with respect to financial services, raising the demand of public goods and therefore increasing public expenditure. Additionally, if the interest rates of the Treasury bills (T-bills) are higher, then the price of the bonds would decrease, leading to higher demand of public debt. It would then be possible to expand the quantity of debt, leading to possibly higher availability for public expenses.

Regarding the first couple of opposite effects, it is worth highlighting that, even considering money as a convention or even a public good, the interest rate is always the reference for most of the investments made by the private sector. Therefore, raising it may lead to higher returns to the private sector and higher costs—apart from those of the debt—for the public sector. The reason is that the balance of the public and private sectors regarding the relative price in their trade-off tends toward the private sector, benefiting it, provided that reference interest rates have risen. Regarding the second couple of effects with opposite sign, the mere raise of T-bill rates could be considered as a higher public expense. Thus, it would be necessary to additionally consider not only public expenditure in the broad sense but also without including the financing costs in the expenditure, which is a robustness check that will be provided in the empirical section.

Therefore, a positive effect of interest rates on public expenditure is expected. In addition to the previous final effect of the variable, the direct and indirect influences and transmission channels are about to be analyzed. First of all, a well-known equation explaining public expenditure (G) is presented:

$$GS_t = T_t + M_t + E_t + rD_t \tag{1}$$

which can be considered the supply (S) side (Facchini, 2018). The time is t, T is the tax revenue, M is the money creation (inflation tax of Friedman), E is the income from state properties, D is public debt, and r is interest rate. According to this, *ceteris paribus*, if interest rates rise, then the rest of the public

expenditure has to reduce to keep the same amount. This is considered here the negative, direct effect. Additionally, the direct/indirect effects and transmission channels appear on the demand (D) side:

$$GD_t = A[GS_t(r) - T(r)] + BI(r) \quad (2)$$

where A and B are parameters of negative sign, reflecting, respectively, the reluctance of the government to raise deficits due to the need to increase taxes or the inflation tax for financing it, and the trade-off between private investment (I) and public expenditure. In (2), the isolated direct negative effect of interest rates on G and the two indirect positive ones appear. The effect related to tax revenue comes from the higher tax collection associated with good economic times. This is influenced by the signal of raising reference interest rates and the lower relative prices of services provided by the public sector keeping the same tax rates, *ceteris paribus*, while the prices of the goods and services obtained from the private sector—shown on the interest rate—are higher, increasing the demand of public services—and so, of G—through fiscal illusion. The other channel is the transmission through the trade-off between investment and public expenditure (Yakita and Yakita, 2017), leading to a crowding out effect. Therefore, a rise in reference rates usually leads to lower investment, and, according to this channel, G would rise.

4. Data and methodology

The database used in this paper is formed by unbalanced panel data of the 216 countries shown in Table 2 for the 1972–2021 period. The main variables used in the present paper are the target ones, which are the different specifications of interest rates, the explained variables regarding public expenditure and the control variables taken from the literature as the main determinants of fiscal illusion and public spending. The descriptive analysis of those variables is collected in Table 3. The data used are collected in the Harvard Dataverse in order to guarantee reproducibility.

The empirical strategy first applies fixed effects panel data models and then it follows the GMM econometric techniques for dynamic panel data models with robust variance estimators developed by Arellano and Bond (1991), Arellano and Bover (1995) and Blundell and Bond (1998). Specifically, the system GMM methods are estimated, following the analytical formulation

$$y_{it} = \gamma\, y_{it-1} + T_{it}\beta_T + X_{it}\,\beta + \varepsilon_{it} \quad (3)$$

where y_{it} is the variable that represents the per capita public expenditure —either total or only for goods and services— growth rate for country i and year t, y_{it-1} is the first delay of the explained variable, and γ is its coefficient. T_{it} is the regression matrix of interest variables—different expressions and specifications of interest rates. X_{it} is the regression matrix of control variables, β_T and β are the vectors of coefficients for the, respectively, interest and control variables, and ε_{it} is the perturbation. The software used was Stata 17.

Table 2. Data sample.

216 countries for the 1972–2021 period								
Aruba	Bermuda	Czech Republic	Gambia, The	Jordan	Monaco	Norway	Senegal	Timor-Leste
Afghanistan	Bolivia	Germany	Guinea-B.	Japan	Moldova	Nepal	Singapore	Tonga
Angola	Brazil	Djibouti	Equatorial Guinea	Kazakhstan	Madagascar	Nauru	Solomon Islands	Trinidad & Tobago
Albania	Barbados	Dominica	Greece	Kenya	Maldives	New Zea.	Sierra Leone	Tunisia
Andorra	Brunei Darussalam	Denmark	Grenada	Kyrgyz Republic	Mexico	Oman	El Salvador	Turkiye
United Arab Emirates	Bhutan	Dominican Republic	Greenland	Cambodia	Marshall Islands	Pakistan	San Marino	Tuvalu
Argentina	Botswana	Algeria	Guatemala	Kiribati	N. Macedonia	Panama	Somalia	Tanzania
Armenia	Canada	Ecuador	Guam	St. Kitts and Nevis	Mali	Peru	Serbia	Uganda
American Samoa	Switzerland	Egypt, Arab Rep.	Guyana	Korea, Rep.	Malta	Philippines	South Sudan	Ukraine
Antigua and Barbuda	Channel Islands	Eritrea	Hong Kong SAR, C.	Kuwait	Myanmar	Palau	Sao Tome and Principe	Uruguay
Australia	Chile	Spain	Honduras	Lao PDR	Montenegro	Papua New Guinea	Suriname	United States
Austria	China	Estonia	Croatia	Lebanon	Mongolia	Poland	Slovak Republic	Uzbekistan
Azerbaijan	Cote d'Ivoire	Ethiopia	Haiti	Liberia	Northern Mariana Islands	Puerto Rico	Slovenia	St. Vincent & the Grenadines
Burundi	Cameroon	Finland	Hungary	Libya	Mozambique	Korea, Dem. People's Rep.	Sweden	Venezuela, RB
Belgium	Congo, Dem. Rep.	Fiji	Indonesia	St. Lucia	Mauritania	Portugal	Eswatini	British Virgin Islands
Benin	Congo, Rep.	France	Isle of Man	Liechtenstein	Mauritius	Paraguay	Sint Maarten (Dutch part)	Virgin Islands (U.S.)
Burkina Faso	Colombia	Faroe Islands	India	Sri Lanka	Malawi	West Bank and Gaza	Seychelles	Vietnam
Bangladesh	Comoros	Micronesia, Fed. Sts.	Ireland	Lesotho	Malaysia	French Polynesia	Syrian Arab Republic	Vanuatu
Bulgaria	Cabo Verde	Gabon	Iran, Islamic Rep.	Lithuania	Namibia	Qatar	Turks and Caicos Islands	Samoa
Bahrain	Costa Rica	United Kingdom	Iraq	Luxembourg	New Caledonia	Romania	Chad	Kosovo

Continued on next page

216 countries for the 1972–2021 period								
Bahamas, The	Cuba	Georgia	Iceland	Latvia	Niger	Russian Federation	Togo	Yemen, Rep.
Bosnia and H.	Curacao	Ghana	Israel	Macao SAR, C.	Nigeria	Rwanda	Thailand	South Africa
Belarus	Cayman Islands	Gibraltar	Italy	St. Martin (French part)	Nicaragua	Saudi Arabia	Tajikistan	Zambia
Belize	Cyprus	Guinea	Jamaica	Morocco	Netherlands	Sudan	Turkmenistan	Zimbabwe

Note: C. – China, N. – North, H. – Herzegovina, B. – Bissau, Zea. – Zealand.

Table 3. Descriptive analysis of the variables used in the estimation.

Variable Name (unit) and Short Description	Obs.	Mean	Std. dev.	Min	Max	Skewness	Kurtosis
Pepcgr (%): growth rate of Public spending pc	3,777	18.45526	155.9466	−58.03723	8774.37	48.28702	2647.87
gspepcgr (%): as pepcgr but without financing costs	3,737	15.70413	71.6467	−78.78874	2356.45	19.95582	519.712
gkf (% of GDP): gross capital formation	8,093	23.30144	8.857052	−13.4053	89.3811	0.935966	6.02619
pressure (% of GDP): tax revenue	4,124	17.08778	7.802476	0.000078	147.6613	3.151591	42.66256
openness (% of GDP): trade (exports plus imports)	8,425	78.43731	54.45225	0.020999	863.1951	2.935124	20.2202
density (people per km^2): population density	10,632	334.6091	1599.583	0.098625	21388.6	9.048465	92.01418
gdppcgr (%): growth rate of GDP pc	9,739	1.933724	6.125898	−64.99237	140.367	1.678479	51.9209
polstab (index): political stability	4,592	−0.014807	0.994145	−3.312951	1.965062	−0.595467	2.782004
eps (%): pure interest rate (2*lr*dr/(lr+dr))	3,953	40.21565	1799.814	−0.994776	113115.5	62.75774	3943.24
tbr (%): Treasury bill rate (lr−risk premium)	2,319	8.806777	9.474351	−0.541158	124.025	4.20468	32.24998
lr (%): lending interest rate	4,473	39.40397	1493.189	0.5	99764.53	66.62715	4449.955
dr (%): deposit interest rate	4,599	44.75213	1935.35	−0.41853	130592	66.79412	4503.728
mid (%): mid-price of interest rates ((lr+dr)/2)	3,953	42.72524	1832.786	0.657333	115178.3	62.73961	3941.696
eca(0−1): Europe & Central Asia m. (ECA)	10,800	0.268519	0.443205	0	1	1.044618	2.091227

Note: pc – per capita; m. – member; obs. – observations; std. dev.: standard deviation.

The variables employed in the estimations are collected in Table 3. The dependent variables are *pepcgr* and *gspepcgr*, where the former variable reflects the per capita public expenditure of a country, with public expenses understood as the cash flows from the public sector for operational activities and for the provision of goods and services, including the compensation of employees, interests and subsidies, donations, social benefits and other public spending such as income and dividends. The *gspepcgr* variable is similar to the previous one but only reflecting the payments of money due to the provision of public goods and services, so excluding financing costs. The control variables include the two previous variables, which have been multiplied by 100 from the growth rate of the original source—expense, current Local Currency Unit (LCU)—divided by the population[1] and the *gkf* variable, which is the gross capital formation divided by the GDP. Yakita (2008) and Yakita and Yakita (2017) expected a negative sign of the coefficient associated with this variable. Trade openness is given by *openness*, a variable derived from the percentage of the sum of exports and imports over GDP. The *density* variable is the population divided by the area of the country (km^2). The *pressure* variable measures the tax collection of a country divided by the GDP, and the *gdppc* variable measures the growth rate of the GDP per capita. Finally, the political stability is addressed by the *polstab* variable, as an index with −2.5 as the lowest political stability and 2.5 as the highest. As suggested by Mauro (1998) and others, a positive sign can be expected. All these variables have been taken from the World Development Indicators[2].

Regarding the interest variables, the *eps* variable includes the explicit specification of "pure" interest rate—i.e., the interest rate without fees or risk—proposed by López-Laborda and Peña (2018) and used in algorithmic trading by Peña (2020). It constitutes twice the product of lending and deposit interest rates divided by the sum of both of them. The *tbr* variable includes the interest rate of the short-term Treasury bill rates, the *lr* variable is the lending interest rate, the *dr* variable represents the deposit interest rates, and the *mid* variable reflects the mid-price, expressed as the arithmetic average of *lr* and *dr*. Before performing the causality test, an analysis of outliers and of the data sample, as well as a diagnostic test, will be conducted. Figure 1 shows the analysis of outliers for the dependent and control variables, showing outliers around 1990, especially Peru (PER) and Nicaragua (NIC). Each point has the label of the country according to the World Bank codes. Figure 2 shows the analysis of the averages of the target and dependent variables by country for each year, also reflecting the peak around 1990. Finally, Figure 3 reflects the averages of the same variables by year for each geographical region—East Asia & Pacific (EPA), ECA, Latin America (LATAM), Middle East and North Africa (MENA), South Asia (SA), North America (NA), Sub-Saharan Africa (SSA)—and for upper income (UI), lower income (LI) and upper/lower middle income (UMI/LMI) countries.

The correlation matrix appears in Table 4, in order to analyze multicollinearity. It is observed that there is not any variable with a correlation higher than 0.4, which indicates no multicollinearity.

Finally, before the results section, the degrees of causality of the target variables on the dependent variables is assessed using Granger causality techniques. Previous authors have done this regarding the issue of the causality between interest rates and economic growth (Lee and Werner, 2018), but in this case (Psaradakis et al., 2005), it is with respect to public expenditure. It is performed by applying

[1]The total population variable is also from the World Bank Indicators database. It is worth mentioning that the access was in July 2022, since the data are different for 2023. The complete databases used in this paper and its code appear in The author, 2023, "Replication Data for: Interest Rates affect Public Expenditure Growth", https://doi.org/10.7910/DVN/I4XLBM, Harvard Dataverse, V1.

[2]https://databank.worldbank.org/source/world-development-indicators.

a recent novel technique of Granger causality for panel data that solves the so-called "Neville bias." It was proposed by Juodis et al. (2021) and developed for software in the paper of Xiao et al. (2023). The main requirement of this test regarding the present paper's data is the compulsory use of a balanced panel. As the panel handled in this paper is unbalanced, a balanced sub-sample has been employed *ad hoc*. Therefore, the highest number of observations has been sought while being aware of preserving the needed balanced properties of the data. A balanced sub-sample of 14 developed and developing countries and territories has been used for the period from 2004 to 2019, and it can be seen in Table 5. To the author's knowledge, this paper uses one of the largest balanced panel sets available, with updated data compared to the rest of the literature.

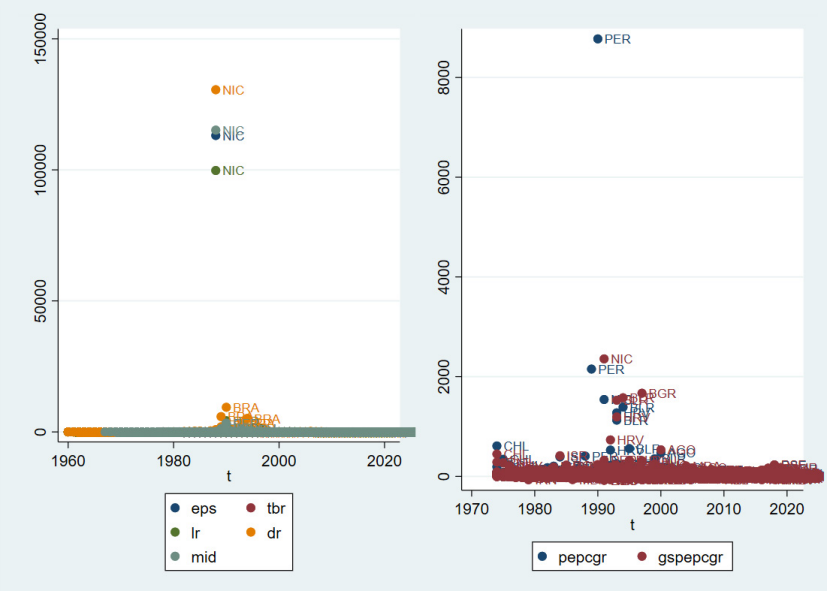

Figure 1. Analysis of outliers.

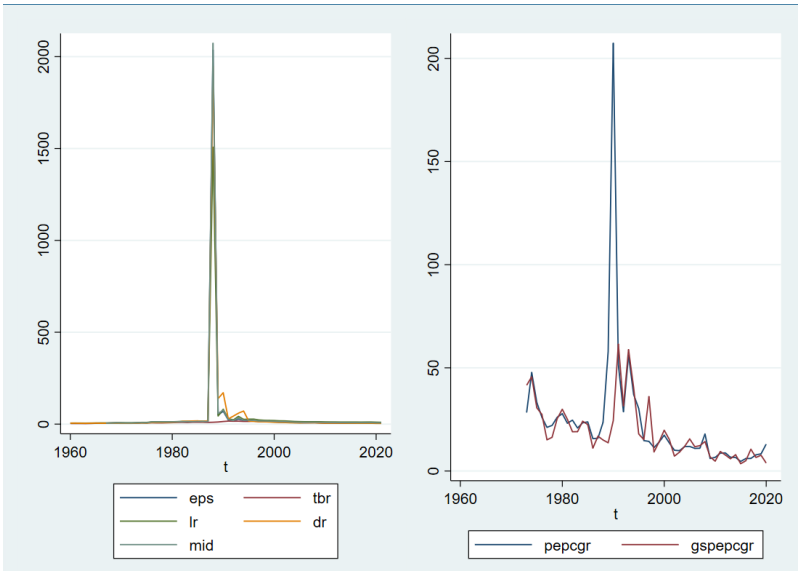

Figure 2. Time series analysis of the country averages of the target and dependent variables.

Once the panel set is chosen, the next decision is what variables are taken for the panel data Granger causality test. The results are shown in Table 6.

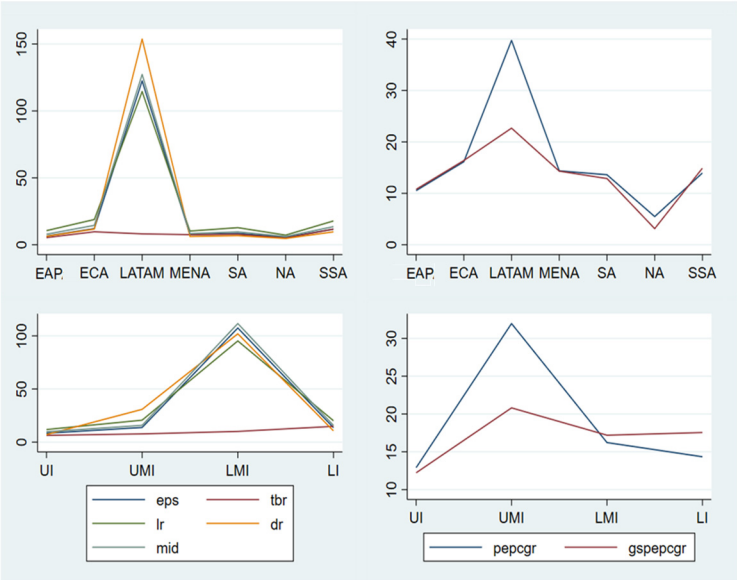

Figure 3. Cross-country section analysis of the time averages of the target and dependent variables.

Table 4. Correlation matrix.

	gkf	pressure	openness	density	gdppcgr	polstab	eps	eca
gkf	1							
pressure	0.1059	1						
openness	0.1115	0.1625	1					
density	−0.085	0.1045	0.3177	1				
gdppcgr	0.2059	−0.0149	0.0385	−0.0161	1			
polstab	0.1303	0.2791	0.3408	0.177	−0.0493	1		
eps	−0.0396	−0.1236	−0.2014	−0.1556	−0.0051	−0.2003	1	
eca	−0.0039	0.0631	0.1245	−0.1013	0.1017	0.0699	0.015	1

Table 5. Data sub-sample for the panel data Granger causality test.

14 countries and territories for the 2004–2019 period (224 observations per variable)						
Armenia	Bahamas, The	Hungary	Lebanon	Sri Lanka	Lesotho	Moldova
Mauritius	Namibia	Philippines	Thailand	Uruguay	South Africa	Zambia

The basic variables are the two dependent and the target ones, but two additional variables are also used. Nonetheless, the variables in levels are also used to check the most used ones in other papers. They will be indicated by deleting the "gr" that denotes the growth rate in each of them. Therefore, as the paper considers 4 dependent variables and 5 independent ones, 40 (=4×5×2) tests will be conducted. The result is multiplied by two since the causality can take two possible directions. The Granger causality test for panel data assesses whether one variable does not Granger cause (GC) another as the null hypothesis, with Granger causality as the alternative hypothesis. A unique significant direction shows in the results that interest rates GC per capita public expenditure growth, so the next analysis will be performed only with growth variables.

Table 6. Granger causality tests.

Null hypothesis: The variable on the left does not GC the one on the right.											
Variables		*p-value*	*Variable*		*p-value*	*Variables*		*p-value*	*Variable*		*p-value*
eps	*pepc*	0.293	*pepc*	*eps*	0.375	*eps*	*pepcgr*	0.293	*pepcgr*	*eps*	0.844
tbr	*pepc*	0.66	*pepc*	*tbr*	0.621	*tbr*	*pepcgr*	0.779	*pepcgr*	*tbr*	0.701
lr	***pepc***	***0.087***	*pepc*	*lr*	0.704	*lr*	*pepcgr*	0.127	*pepcgr*	*lr*	0.35
dr	*pepc*	0.454	*pepc*	*dr*	0.263	*dr*	*pepcgr*	0.48	*pepcgr*	*dr*	0.953
mid	*pepc*	0.187	*pepc*	*mid*	0.503	*mid*	*pepcgr*	0.204	*pepcgr*	*mid*	0.517
eps	*gspepc*	0.77	***gspepc***	***eps***	***0.039***	*eps*	*gspepcgr*	0.158	*gspepcgr*	*eps*	0.939
tbr	*gspepc*	0.904	***gspepc***	***tbr***	***0.041***	*tbr*	*gspepcgr*	0.71	*gspepcgr*	*tbr*	0.102
lr	*gspepc*	0.267	***gspepc***	***lr***	***0.019***	***lr***	***gspepcgr***	***0.062***	*gspepcgr*	*lr*	0.556
dr	*gspepc*	0.526	*gspepc*	*dr*	0.122	*dr*	*gspepcgr*	0.109	*gspepcgr*	*dr*	0.65
mid	*gspepc*	0.675	***gspepc***	***mid***	***0.034***	***mid***	***gspepcgr***	***0.077***	*gspepcgr*	*mid*	0.758

Note: p-values lower than 0.1 are in ***italic bold.***

5. Results

Tables 7 and 8 show the results of this paper. Table 7 collects the fixed-effects models (1–10a), where the dependent variable is *pepcgr* for the odd models and *gspepcgr* for the even models. On the other hand, Table 8 shows the system GMM models for the *pepcgr* and *gspepcgr* variables, respectively. For the control variables, most models show positive and statistically significant effects of the *gdppcgr* variable, according to Magazzino et al. (2015). With respect to the coefficient of the lagged dependent variables, when it is statistically significant in the dynamic models, the sign is negative. This is relevant for the further interpretation of the results. The effect of the target or interest variables is the same in all cases: a positive, statistically significant relationship between the different specifications of interest rate variables and public expenditure growth for the different methods and models.

The Windmeijer bias-corrected (WC)-robust estimators of Windmeijer (2005) were applied. Some tests were performed in order to check the econometrical correctness of the applied methodologies and estimated results. Specifically, the Sargan test checks the validity of the instruments—null hypothesis—and is used in the dynamic models before applying variance-covariance matrix of the estimators (VCE) robustness. The result obtained shows that the instruments are valid with acceptable p-values in most models. In addition, the Arellano and Bond (AB) test of 2nd order was performed, checking the serial autocorrelation of the residuals of order 2 (null hypothesis). The rejection of this hypothesis indicates that the residuals are Autoregressive (AR) of second order (AR2). As there was a p-value higher than 0.1 in all models, they are considered to have good econometric properties.

The results follow Yakita (2008) and Yakita and Yakita (2017), as well as Magazzino et al. (2015), since, respectively, the trade-off of investment and public expenditure and Wagner's law are confirmed in most cases of Table 8 due to the negative and positive significant signs of the coefficients of the *gkf* and *gdppcgr* variables, respectively. Additionally, other demand factors such as the *gdppcgr* variable include the positive and significant sign of the coefficients of the *pressure* and *openness* variables. Regarding the target variables, the usual positive association with public expenditure of traditional macroeconomic models (Murphy and Walsh, 2022) is found, in contrast to the negative effect obtained by authors such as Murphy and Walsh (2022) and D'Alessandro et al. (2019). Concerning the economic interpretation of the results, as the target variables of monetary policy measured by interest rates have

a positive and statistically significant effect on the public expenditure, the coefficient of the lag of the dependent variable is in most cases negative and significant—which indicates a decrease of the variable over time. It is known that reference interest rates have also decreased over time in most countries, and the positive sign of the relationship is confirmed. Additionally, the end of Section 3 shows that, in some cases, the hypothesis that interest rates do not Granger cause (GC) per capita public expenditure growth is rejected, but it cannot be rejected in the opposite direction of causality.

Table 7. Results from the fixed effects models.

	(1)a	(2)a	(3)a	(4)a	(5)a	(6)a	(7)a	(8)a	(9)a	(10)a
VARIABLES	pepcgr	gspepcgr	pepcgr	gspepcgr	pepcgr	gspepcgr	pepcgr	gspepcgr	pepcgr	gspepcgr
gkf	0.173	0.246	0.202*	−0.0753	0.495	0.196	0.245	0.124	0.282	0.250
	(0.448)	(0.639)	(0.112)	(0.183)	(0.386)	(0.640)	(0.491)	(0.482)	(0.423)	(0.642)
pressure	1.526	1.530	0.343**	0.604**	1.272	1.555	1.499	1.418	1.499	1.539
	(1.324)	(1.418)	(0.131)	(0.234)	(1.007)	(1.232)	(1.259)	(1.252)	(1.289)	(1.407)
openness	0.293**	0.350*	0.0258	0.152***	0.255**	0.289	0.255**	0.263*	0.270**	0.312
	(0.123)	(0.203)	(0.0225)	(0.0472)	(0.117)	(0.177)	(0.109)	(0.158)	(0.125)	(0.192)
density	0.00313	0.00113	−0.000100	−0.000562	0.000757	−0.00276	0.00472	0.000351	0.00188	−0.000306
	(0.00375)	(0.00293)	(0.000688)	(0.00148)	(0.00319)	(0.00333)	(0.00351)	(0.00215)	(0.00342)	(0.00265)
gdppcgr	−0.501	−1.058	0.413***	0.881***	−0.987	−1.946	0.0704	−0.789	−0.682	−1.186
	(1.259)	(1.292)	(0.146)	(0.288)	(1.092)	(1.516)	(1.200)	(1.169)	(1.214)	(1.394)
eps	2.691***	2.077**								
	(0.0204)	(0.956)								
tbr			0.867***	1.091**						
			(0.154)	(0.416)						
lendrate					2.005***	1.293**				
					(0.00937)	(0.581)				
deprate							3.260***	1.709**		
							(0.0795)	(0.714)		
midprice									2.515***	1.605**
									(0.0161)	(0.748)
Constant	−70.56**	−67.69	−11.68***	−24.86***	−70.32**	−55.09	−70.94***	−47.82	−71.94**	−61.12
	(29.07)	(49.62)	(3.725)	(9.180)	(27.07)	(44.63)	(25.36)	(38.60)	(29.19)	(47.60)
Observations	1,691	1,665	1,008	985	1,926	1,890	1,925	1,900	1,691	1,665
R−squared	0.920	0.101	0.265	0.117	0.924	0.107	0.891	0.084	0.922	0.090
Number of countries	96	95	57	56	102	101	106	105	96	95

Note: * , **, *** indicate p-values, respectively, lower than 0.1,0.05 and 0.01. Robust standard errors are in parenthesis.

All this means that a decrease in the interest rates leads to a reduction in public expenses, as previously expected in Section 3. Thus, the results can be interpreted as follows: Lower financial costs for the public sector, caused by lower payments of public debt, due in turn to lower reference interest rates, lead to lower public expenses, as the effect on the *pepcgr* variable reflects. However, they also lead to a lower provision of public goods and services as a global effect—i.e., without direct and

indirect effects. This is shown by the influence on the *gspepcgr* variable, so it is not the only factor. Decreasing the interest rates can be considered a reduction in the private prices that encourages demand in the private sector or market of goods and services, raising private consumption. Meanwhile, the relative prices in the public sector are considered to be higher with respect to the private sector, reducing the public demand of goods and services and thus also reducing public consumption.

Table 8. Results from the system GMM models for the *pepcgr* and *gspepcgr* variables (var).

	(1)b	(2)b	(3)b	(4)b	(5)b	(6)b	(7)b	(8)b	(9)b	(10)b
VARIABLES	pepcgr	gspepcgr	pepcgr	gspepcgr	pepcgr	gspepcgr	pepcgr	gspepcgr	pepcgr	gspepcgr
Dependent var t−1	−0.028***	0.145	−0.0429	−0.155**	−0.111***	0.0869	−0.00139	0.143	−0.0687***	0.144
	(0.00760)	(0.127)	(0.102)	(0.0700)	(0.0114)	(0.0692)	(0.0273)	(0.132)	(0.00941)	(0.126)
gkf	−2.740	−0.791**	−0.0640	−0.771***	−1.658	−0.809***	−2.777	−0.493	−2.495	−0.807**
	(1.970)	(0.373)	(0.132)	(0.296)	(1.145)	(0.310)	(2.643)	(0.338)	(1.692)	(0.359)
Pressure	0.943	0.275	0.465*	0.697	0.937*	0.445	0.852	0.220	0.929*	0.265
	(0.653)	(0.705)	(0.238)	(0.474)	(0.531)	(0.658)	(1.331)	(0.648)	(0.564)	(0.705)
openness	0.401	0.385*	−0.0224	0.127**	0.235	0.261	0.470	0.355*	0.373	0.375*
	(0.330)	(0.226)	(0.0375)	(0.0648)	(0.208)	(0.214)	(0.437)	(0.201)	(0.298)	(0.220)
density	0.000217	−0.0235	0.00179	−0.00365	−0.00617	−0.0212	0.00770	−0.0201	−0.00202	−0.0234
	(0.00884)	(0.0169)	(0.00266)	(0.00515)	(0.0110)	(0.0162)	(0.0139)	(0.0145)	(0.00877)	(0.0168)
gdppcgr	0.884	−0.318	0.362**	1.203***	−0.204	−2.063	1.480	−0.353	0.475	−0.315
	(1.988)	(0.737)	(0.172)	(0.428)	(1.650)	(1.950)	(2.102)	(0.622)	(1.855)	(0.729)
eps	2.767***	1.225***								
	(0.0117)	(0.372)								
tbr			1.124***	1.549***						
			(0.235)	(0.505)						
lr					2.096***	1.608***				
					(0.0352)	(0.432)				
dr							3.422***	1.163***		
							(0.123)	(0.362)		
mid									2.609***	1.205***
									(0.0108)	(0.240)
Observations	1,615	1,589	969	949	1,845	1,810	1,831	1,804	1,615	1,589
Number of Countries	95	94	57	56	101	100	104	103	95	94
Sargan p−value	0.904	0.892	0.9995	0.9998	0.682	0.833	0.799	0.767	0.924	0.887
A−B p−value	0.912	0.973	0.3299	0.967	0.584	0.620	0.344	0.761	0.398	0.950

Note: * , **, *** indicate p-values, respectively, lower than 0.1,0.05 and 0.01. WC-Robust standard errors are in parenthesis.

Therefore, this paper questions the traditional view of considering that public expenditure may affect interest rates by showing that, when public expenditure is expressed as the growth rate of public expenditure per capita, in goods and services, monetary policy in some cases also leads to an impact on fiscal policy.

6. Discussion of the results, check of the hypotheses and robustness checks

This section starts checking the Granger causality of Section 4 by using the pairwise Granger causality country by country, showing the results for *gspepcgr* and *eps* in Table 9, and achieving similar results for other specifications. The results show a lower p-value for rejecting that the *eps* variable does not GC *gspepcgr* than the opposite direction (37% vs. 36% of the countries). Furthermore, the percentage of countries where there is univocal Granger causality rather than circular Granger causality is 52.9% vs. 19.5%. Later, Table 10 will show the robustness of the dynamic panel data system GMM and static fixed effect models by including demand factors such as political stability (Facchini, 2018) and the proposed transmission channel. The results of the previous section have also been replicated, adding this variable with similar results for the target variables[3]. Furthermore, a geographic factor is considered by including the World Bank's regional classification of Europe and Central Asia (*eca* variable). The results show that, even considering circular causation or causality in an opposite direction to the one studied here, the highest number of rejections to the null hypothesis that a variable does not GC another corresponds to the influence of *eps* on *gspepcgr*. Additional results appear in Table 10, showing the transmission channel and a robustness check using the *eca* variable of countries of Europe and Central Asia and the *polstab* variables. The results show a robust and positive influence of the two transmission channels through fiscal illusion by the positive impact of the interaction of pressure and rates on the dependent variables and via investment trade-off by the interaction of investment and rates on public expenditure. Moreover, the isolated direct effect of rates when the transmission channels are considered is negative.

The results show a robust and statistically significant positive influence of interest rates on public expenses, not only due to the lower or higher need to pay the debt but also due to the need to pay public goods and services, reflecting a negative effect on public demand probably explained by the fiscal illusion or by the relative prices between the public and private sector. These results provide a new scope for further research and policy implications due to the effective impact of monetary policy on fiscal policy.

The results additionally confirm the expectances of Yakita (2008) and Yakita and Yakita (2017) for the negative relationship between public and private investment, the findings by Sáenz et al. (2013) regarding the positive correlation with trade openness and the positive relation with GDP per capita by Magazzino et al. (2015). To sum up, with these robustness checks, the main result of the positive influence of interest rates on per capita public expenditure growth—even without considering financing costs of debt—is found. They also confirm the three hypotheses stated in the theoretical section concerning the demand of public spending: The direct negative effect of interest rates on the dependent variable is corroborated when the transmission channels are considered, and the positive influences of these two channels—via both fiscal illusion and crowding out—are also confirmed.

[3]These particular results are not reported in the paper, but they are available from the author upon request.

Table 9. Robustness check of the Granger causality.

Country	eps does not GC gspepcgr?	gspepcgr does not GC eps?	Country	eps does not GC gspepcgr?	gspepcgr does not GC eps?	Country	eps does not GC gspepcgr?	gspepcgr does not GC eps?
Angola	0.008	0	Fiji	0.128	0.69	Namibia	0.926	0.925
Albania	0	0.102	Micronesia, Fed. Sts.	0.276	0.866	Nicaragua	0.688	0.913
Armenia	0.12	0.835	United Kingdom	0.371	0.809	Netherlands	0.338	0.001
Australia	0.778	0.301	Georgia	0.08	0.081	Norway	0	0
Azerbaijan	0.132	0.5	Guatemala	0.475	0.164	New Zealand	0.195	0.973
Burkina Faso	0.865	0.782	Honduras	0.12	0.573	Peru	0.007	0.03
Bangladesh	0.718	0.06	Croatia	0.806	0	Philippines	0.628	0.083
Bulgaria	0.686	0.002	Hungary	0.011	0	Papua New Guinea	0	0.688
Bahrain	0.637	0.492	Indonesia	0.018	0.093	Paraguay	0.003	0
Bahamas, The	0.007	0.267	Israel	0.113	0.002	West Bank and Gaza	0.788	0.42
Bosnia and Herzegovina	0.321	0.103	Jordan	0.479	0.119	Romania	0.227	0.541
Belarus	0.161	0	Japan	0.567	0.155	Russian Federation	0.177	0.762
Belize	0.595	0.371	St. Kitts and Nevis	0.884	0.513	Singapore	0.005	0.176
Bolivia	0.003	0.023	Korea, Rep.	0.337	0.624	Solomon Islands	0.867	0.303
Brazil	0.101	0.051	Kuwait	0.047	0.896	San Marino	0.001	0.164
Barbados	0.084	0.047	Lebanon	0.659	0.186	Sweden	0.424	0.042
Bhutan	0.342	0.408	St. Lucia	0.002	0.018	Seychelles	0.669	0.049
Botswana	0.042	0.435	Sri Lanka	0.855	0.105	Togo	0.088	0.158
Canada	0.609	0.506	Lesotho	0.025	0.627	Thailand	0.628	0.186
Switzerland	0.652	0.308	Macao SAR, China	0.216	0.197	Timor-Leste	0.243	0.324
Chile	0.003	0.021	Moldova	0.35	0.614	T. & Tobago	0.365	0
Cote d'Ivoire	0.811	0.054	Madagascar	0.024	0.199	Tanzania	0.001	0
Colombia	0.185	0.3	Maldives	0	0.419	Ukraine	0.607	0.662

Continued on next page

Country	eps does not GC gspepcgr?	gspepcgr does not GC eps?	Country	eps does not GC gspepcgr?	gspepcgr does not GC eps?	Country	eps does not GC gspepcgr?	gspepcgr does not GC eps?
Cabo Verde	0.009	0.01	Mexico	0	0.878	Uruguay	0	0.289
Costa Rica	0.113	0.626	North Macedonia	0	0.001	St. V. & the Grenadines	0.462	0.872
Czech Republic	0.131	0.118	Mali	0.444	0.241	Vanuatu	0.013	0.064
Dominican Republic	0.029	0.363	Mongolia	0.454	0.054	Samoa	0.007	0
Egypt, Arab Rep.	0.421	0.006	Mauritius	0.347	0.183	South Africa	0.36	0.765
Ethiopia	0.9	0.614	Malaysia	0.002	0.012	Zambia	0	0.701
						Average	0.30195402	0.31166667

Table 10. Robustness check of the panel data estimations.

VARIABLES	(1)c pepcgr	(2)c gspepcgr	(3)c pepcgr	(4)c gspepcgr	(5)c pepcgr	(6)c gspepcgr	(7)c pepcgr	(8)c gspepcgr	(9)c pepcgr	(10)c gspepcgr
Dependent var t−1	−0.0285	−0.112**	−0.0539	−0.124**	−0.0607	−0.123**	−0.061	−0.116**		
	(0.0644)	(0.0559)	(0.0736)	(0.0573)	(0.0696)	(0.0543)	(0.073)	(0.0576)		
gkf	−0.922**	−0.940*	−0.247	−0.189	−0.730	−0.728	−0.844**	−0.718	−0.608*	−0.753**
	(0.438)	(0.512)	(0.260)	(0.361)	(0.451)	(0.581)	(0.419)	(0.588)	(0.341)	(0.336)
pressure	1.002	0.672	−0.0217	0.0970	0.393	0.416	0.293	0.340	−0.190	−0.296
	(0.703)	(0.589)	(0.389)	(0.512)	(0.562)	(0.579)	(0.520)	(0.612)	(0.249)	(0.315)
openness	0.170	0.256*	0.172	0.231*	0.194	0.255*	0.191*	0.228	0.0879	0.200***
	(0.124)	(0.134)	(0.120)	(0.135)	(0.121)	(0.140)	(0.124)	(0.139)	(0.0535)	(0.0760)
density	−0.00752	−0.0109	−0.00772	−0.0203	−0.00746	−0.0137	−0.007	−0.00978	0.000737	0.00394
	(0.00549)	(0.0171)	(0.00780)	(0.0232)	(0.00649)	(0.0174)	(0.007)	(0.0131)	(0.00248)	(0.00272)
gdppcgr	−0.147	−0.0696	−0.0455	0.0702	−0.163	−0.0527	−0.148	−0.0328	0.0721	0.590**
	(0.169)	(0.202)	(0.158)	(0.199)	(0.153)	(0.191)	(0.152)	(0.184)	(0.173)	(0.232)
polstab	−1.204	−4.593	−3.120	−4.424	−1.721	−5.726	−2.144	−5.989	−0.938	−2.740
	(3.912)	(5.092)	(4.518)	(5.799)	(4.457)	(5.372)	(4.633)	(6.085)	(1.863)	(2.376)
eps	−0.451	−1.346	−1.635**	−1.701	−2.845***	−2.696**	−3.379**	−2.758*	−4.334**	−4.798**
	(0.998)	(0.900)	(0.811)	(1.217)	(1.033)	(1.355)	(1.499)	(1.505)	(1.974)	(2.219)
*eps*gkf*	0.0847**	0.111***			0.0743*	0.0854*	0.0908**	0.0867*	0.0878***	0.0932***
	(0.0371)	(0.0350)			(0.0413)	(0.0476)	(0.0379)	(0.0504)	(0.0317)	(0.0295)
*eps*pressure*			0.212***	0.182**	0.178**	0.125	0.187**	0.142*	0.229**	0.254**
			(0.0677)	(0.0760)	(0.0759)	(0.0780)	(0.0909)	(0.0809)	(0.103)	(0.125)

Continued on next page

VARIABLES	(1)c pepcgr	(2)c gspepcgr	(3)c pepcgr	(4)c gspepcgr	(5)c pepcgr	(6)c gspepcgr	(7)c pepcgr	(8)c gspepcgr	(9)c pepcgr	(10)c gspepcgr
eca							6.161	−9.925		
							(12.31)	(16.61)		
constant							−1.892		8.741	0.218
							(14.11)		(9.201)	(10.13)
Observations	1,259	1,246	1,259	1,246	1,259	1,246	1,259	1,246	1,312	1,296
R−squared									0.366	0.221
Number of Countries	94	93	94	93	94	93	94	93	95	94
Sargan p−value	0.037	0.366	0.0315	0.266	0.05	0.307	0.147	0.249		
A−B p−value	0.263	0.944	0.358	0.701	0.453	0.809	0.503	0.883		

Note: * , **, *** indicate p-values, respectively, lower than 0.1,0.05 and 0.01. Robust and WC-Robust standard errors are in parenthesis.

7. Concluding remarks, policy implications and further research

This paper broadens the focus on fiscal-monetary policies by considering the influence of monetary policy on public expenditure, instead of considering the effects of fiscal policy on the neutral interest rates, as most authors in the literature do. This is the main novelty of the present paper. Thus, panel data of 216 countries for the 1972–2021 period was employed by using the fixed effects and system GMM models to check the effects of different specifications of interest rates on the public expenditure in general and for goods and services in particular. A balanced sub-sample of 14 countries for the 2004–2019 period was employed to check Granger causality using a novel technique recently developed: Granger causality for panel data. The null hypothesis on whether interest rates do not Granger cause (GC) per capita public expenditure is in some cases rejected only in this direction, specifically when the dependent variable is expressed in growth rates and in terms of the spending on goods and services.

A main conclusion of this paper, in light of the theoretical and empirical exercises, is the existence of a positive influence of interest rates on public expenditure through, at least, two transmission channels: The first is fiscal illusion by increased demand of public services and then tax revenue. The second is the trade-off between public and private investment, where investment decreases with an increase in interest rates, but public expenditure increases by the crowding out effect. Once these mechanisms are considered, the direct influence of interest rates on public spending, by itself, is negative since the highest financing costs lead the government to reduce other expenditures, *ceteris paribus*. Overall, the first indirect positive effects predominate over the direct negative one. Some policy implications are derived from the results. For instance, in the current context of high indebtedness and an environment of rising interest rates, the transmission channel may be reduced or avoided. This could be done by improving the efficiency of the private sector to be more competitive or raising tax rates by the public sector to offset the reduction of the relative prices of the public and private sectors via fiscal illusion. The proposed policy measures of this paper can be useful for society in general and for policy and law makers in particular. Further research would take into account additional time series analysis, applying artificial intelligence, bootstrapping or machine learning techniques to study cointegration and Granger causality of the variables, according to the Toda-Yamamoto methodology.

Use of AI tools declaration

The author declares he has not used artificial intelligence (AI) tools for the creation of this article.

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Conflict of interest

The author declares no conflicts of interest in this paper.

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