PANOECONOMICUS, 2025, Vol. 72, Issue 2, pp. 165-182
Received: 23 April 2021; Accepted: 23 May 2024.

UDC 332.1:330.34(100)OECD "1985/2015"
https://doi.org/10.2298/PAN210423014A
Original scientific paper

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CEF.up is financed by Portuguese public funds through FCT - Fundação para a Ciência e a Tecnologia, I.P., in the framework of the project with references UIDB/04105/2020 and UIDP/04105/2020.

The Impact of Fiscal Policy on the Economic Growth of OECD Members between 1985 and 2015

Summary: We aim to evaluate the impact of fiscal policy on the OECD countries' economies between 1985 and 2015. We estimate the impact of fiscal policy using econometric estimation based on panel data. We conclude that government spending on primary expenses and government spending on military are fiscal policies that negatively impact economic growth. In turn, government spending on education and tax revenue have a positive effect on economic growth.

Keywords: Fiscal policy, OECD, Economic growth.

JEL: C23, E62, F43.

Government intervention in economic activity was limited before the Great Depression of the 1930s. However, in the following decades, governments took a more active role through fiscal policy by adjusting expenditure and taxes to achieve macroeconomic objectives (Oliver Blanchard et al. 2009). In developing countries, government involvement in the economy has increased to promote economic growth and correct market imperfections.

The relationship between economic growth and fiscal policy has been widely discussed in recent decades. Economists have developed theories and presented evidence linking both variables, considering different countries, periods, and models. We contribute to the discussion by measuring the impact of fiscal policy on economic growth in OECD countries from 1985 to 2015, assessing the effects of government spending, education spending, military spending, and tax revenue.

The primary objective is to evaluate and quantify the impact of various fiscal policy components on OECD countries' economic growth. Diverse results in the literature, due to differing methodologies, periods, and country characteristics, highlight

the need for further examination. Our detailed analysis aims to provide a clearer understanding of the relationship between fiscal policy and economic growth.

Our study addresses several gaps in the existing literature. It includes all OECD countries except Colombia and examines a comprehensive set of fiscal policy variables. Using panel data methodology, we offer a nuanced understanding of the relationship over a substantial period. Additionally, we explore the impact of government effectiveness on fiscal policy outcomes, an often-overlooked aspect. This research provides valuable insights into the complexities of fiscal policy's effects on economic growth.

Following this introduction, we present the literature review (Section 1), relevant variables (Section 2), methodology, data analysis, and interpretation (Section 3), and conclusions with suggestions for future research (Section 4).

1. Literature Survey

Empirical studies of the relationship between fiscal policy and economic growth are focused primarily on providing evidence on the impact of the government spending and tax level on growth, and second, on the impact of the tax structure on growth. A number of studies (Tamoya Christie 2012; Norman Gemmell, Richard Kneller, and Ismael Sanz 2016; Tuan Chu, Jens Hölscher, and Dermot McCarthy 2018; Mutiu A. Oyinlola et al. 2020) have investigated the link between the overall level of public spending or total tax burden and economic growth using cross-country growth regression models covering different periods and various samples of countries. From these works, no clear consensus about the nature and significance of such a relationship has emerged since the overall size of the public sector has two opposite effects. Higher taxes cause potentially higher distortions and impact negatively on economic activity and growth, and higher taxes suppose higher levels of public expenditure, some of which may foster economic growth.

For the Eurozone countries, the analysis of the fiscal policy is even more important to understand due to the monetary policy constraints, which need to follow the guidelines established by the European Central Bank (ECB) – e.g., Paul De Grauwe (2005). Due to the limitations on monetary policy, it is crucial to understand if fiscal policy is enough to recover some countries' situation when they are in recession or to enhance growth if the countries are already on a positive trajectory. *Ceteris paribus*, if the Eurozone countries cannot rely on their fiscal policy, they are dependent on the monetary policy conducted by the European Central Bank (ECB) or the global status of the economy (e.g., Richard Baldwin and Charles Wyplosz 2006). Having these constraints in mind, each national government establishes a set of fiscal policies to implement during its governmental period to promote growth even in the face of existing restrictions (Rui Alves and Oscar Afonso 2007). Within that set, expenses regarding education are included (European Council 2005) since they are crucial for economic growth (e.g., Ross Milbourne, Glen Otto, and Graham Voss 2003).

Although there are many studies regarding the impact of fiscal policy on economic growth, there is no consistent conclusion as to the sign of the relationship. Most of the studies evidenced a negative effect, but some show a positive relationship or even an insignificant one as well – see, e.g., Stefan Fölster and Magnus Henrekson

(2006), Nikos Benos (2009), Leonel Muinelo-Gallo and Oriol Roca-Sagalés (2011), Dimitrios Paparas, Christian Richter, and Alexandros Paparas (2015). These contradictory conclusions may arise from the countries selected, the variables studied, the databases chosen, or even the methodology adopted.

There is a lengthy discussion regarding this topic. Nevertheless, there are few studies including all OECD countries. We have included all of them, except Colombia[1]. Indeed, most studies select a smaller sample. Choosing a larger sample than usual and including some critical variables of fiscal policy are the main contributions of our work. Our results, which have been obtained through a panel data methodology, are still in line with those in most of the bibliographical references that address the issue, especially if we consider the type of countries in our sample.

Concerning the variables government spending on primary expenses and government spending on military, most studies, such as ours, point to a negative estimated value of both variables on economic growth (e.g., Shahid Ali, Naved Ahmad, and Mahmood Khalid 2010, for government spending on primary expenses, and Suleiman Abu-Bader and Aamer Abu-Qarn 2003, for government spending on military). However, even concerning these variables, the literature is not in agreement; indeed, Emile Benoit (1978) observed that defense spending stimulates economic growth using cross-sectional data from 44 least developed countries during 1950-1960. Moreover, Ching-Chong Lai, Jhy-Yuan Shieh, and Wen-Ya Chang (2002) refer to military spending's relevance from both the demand and supply effect perspectives. These authors provide a theoretical explanation for the empirical results of Benoit (1978). The countries' sample can explain the contradictory results – OECD developed countries in our case and less-developed in Benoit (1978) – and by the differences in the considered time period. Indeed, Aart Kraay and Luis Severn (2008) conclude that the impact of expansionary fiscal policy on economic growth is much smaller in developing countries than in developed countries.

Although government spending on education is often mentioned as having a positive impact, few confirm the positive effect's statistical significance. Our estimates regarding government spending on education guarantee the expected outcome of a positive effect, which is also statistically significant. Sefa Awaworyi, Siew Ling Yew, and Mehmet Ugur (2015) considered 29 papers that specifically look at the impact of government education expenditures on economic growth in a recent meta-analysis. Of these 29 studies, 14 report a positive and statistically significant effect of government expenditure on growth, 12 report a negative effect, and three report no statistically significant effect.

Few studies include a variable that captures the quality of government decisions. To this end, we include the effect of government effectiveness. This variable assesses, for example, the degree of independence between the government and public and civil services and their quality. Our results are in line with Md Rafayet Alam, Erick Kitenge, and Bizuayehu Bedane (2017), which finds a significant positive effect of government effectiveness on economic growth.

[1] Colombia was officially admitted as an OECD member in April 2020. Due to the recent admission, we did not include Colombia.

Concerning the literature in general, the only contradictory result regarding fiscal policy was the impact of tax revenues; it was expected to harm growth, but we estimated a positive effect as with the notable exception of Hsiao Chink Tang, Philip Liu, and Eddie C. Cheung (2013) for the ASEAN countries[2]. Moreover, the impact of other control variables is also assessed: (i) on the one hand, the degree of openness (e.g., Yaya Keho and Miao Grace Wang 2017), initial GDP (e.g., Robert J. Barro 2003), and gross fixed capital formation (e.g., Barro 2003) with a statistically significant and positive impact on growth; on the other hand, inflation (e.g., Barro 2003) and interest rate (e.g., Robert King and Ross Levine 1993) with a statistically significant and negative effect on growth.

2. Data and Variables' Definition

To analyze and evaluate the relationship between fiscal policy and economic growth, we collected data for the 36 OECD countries (excluding Colombia due to its recent admission as an OECD member) on the World Bank, Penn World Table, and OECD databases from 1985 until 2015.

2.1 Economic Growth and Fiscal Policy Variables

Considering previous studies, the most common *proxies* for economic growth are the GDP per capita (GDPpc) or GDP growth rate. In this case, the dependent variable will be the GDP per capita, which may be interpreted as the economic production value attributed to each citizen. If this value in one country increases, we may conclude that the economy as a whole for that country is growing.

To represent the fiscal policy, government spending on education, tax revenue, on the military, expenditures, and spending on infrastructure is usually used. Regarding fiscal policy variables, the chosen variables were government spending on education (GSEdu), government spending on "primary" expenses (GS), government spending on military (GSMil), and tax revenues (TAX). The proxies used were the respective total divided by the GDP, which means that the variables are GDP related ratios. Table 1A, in the appendix, presents a brief description of each of these variables.

Government spending on infrastructures was not used in our study, but a variable related to capital was selected as a control variable, as shown in Subsection 2.2. Hence, the importance of capital accumulation and investment are reflected in that variable.

2.2 Control Variables

As referred before, fiscal policy alone may not be enough to enhance economic growth. Its impact on the economy will be strongly dependent on each country's specificities. Thus, to get a complete analysis, the inclusion of control variables is essential. These control variables are commonly mentioned and used as determinants of economic growth in previous studies.

[2] Furthermore, positive tax multipliers are obtained by Jean-Louis Combes et al. (2014).

The first neoclassical theories introduced technological advances, innovations, and capital accumulation as they are considered important factors to enhance economic growth. Hence, a proxy that is typically used and that we will use is the Gross Fixed Capital Formation (GFCF), that is represented by the capital stock at constant 2011 national prices (in a million 2011 USD).

A few years later, Robert Lucas Jr. (1990) introduced the variable of human capital as also important to a country's growth. Thus, all studies that want to evaluate economic growth must have at least one variable of this kind in their estimations. It is assumed that human capital has a positive impact on economic growth as verified in some studies (Fölster and Henrekson 2006; Muinelo-Gallo and Roca-Sagalés 2011), but surprisingly in other studies, the results are negative (Benos 2009; Paparas, Richter, and Paparas 2015). We will not use any control variable because there might be some conflict with one of the Fiscal Policy explanatory variables that we want to study (Government Spending on Education).

David Ricardo (1817) presented the comparative advantage theory, stating that a country should specialize in its production and minimize the consumption of a good for which they have a comparative advantage. A country has a comparative advantage when producing a good at a lower relative marginal cost before the trade. Suppose two countries can produce two goods. In that case, each country should produce the most efficient goods, exporting it and importing the good on which each country is less efficient. Therefore, since Ricardo international trade is considered beneficial for countries, and this effect is present in most, if not all studies regarding economic growth. The Degree of Openness is one of the most used variables to represent this effect.

Government effectiveness plays a crucial role because a government that gives precise and reliable information to its firms and people develops a trustworthy relationship with them, which leads to better decisions by these agents regarding their financial and economic choices and investments. An estimate between -2.5 (low government effectiveness) and 2.5 (high government effectiveness) was used to capture perceptions of the quality of public and civil services 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.

It is necessary to include some macroeconomic variables like inflation and long-run interest rates. This is expected to have a negative impact on each country's economic growth because inflation reduces the competitiveness of international trade and, consequently, exportation.

It is important to have a GDP reference, such as the initial GDP or the GDP logarithm to catch the influence of the previous years' GDP level. Economic growth in the poorer countries is faster than in the richer ones. Therefore, the logarithm of the GDP is also included in order to control convergence.

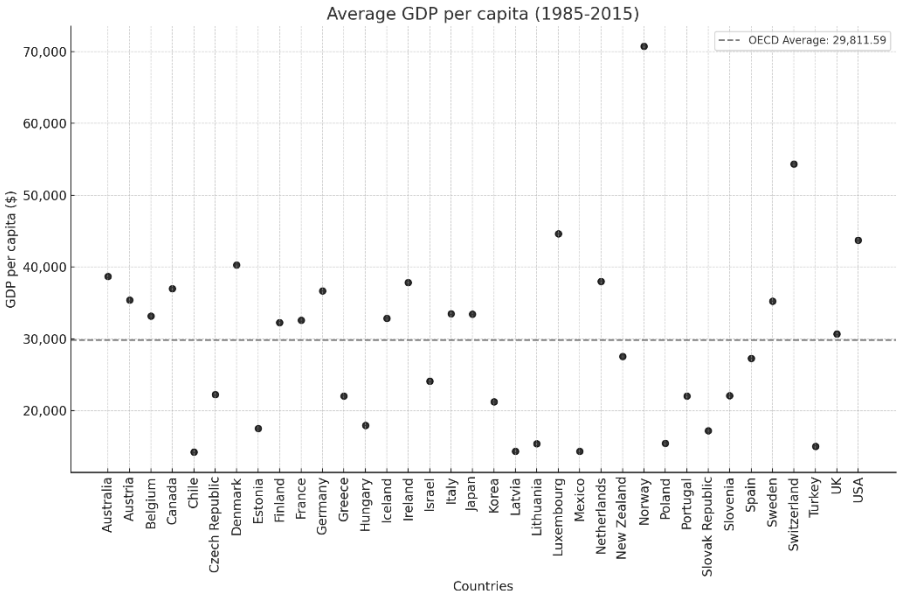
2.3 Descriptive Statistics

Once all relevant variables have been defined within this investigation's scope, the respective data is organized and summarized by calculating the means and measures of variability, namely the standard deviation, maximum and minimum values. The

following sections present these parameters' values for both dependent and independent variables from 1985 to 2015.

2.3.1 Descriptive Statistics of Dependent Variable

The Table with the average per capita GDP for each country during the studied period was built with information gathered from Penn World Table – Table 2A, in the Appendix. GDP per capita is expressed in 2011 USD. Figure 1 also provides a better comparison of all studied countries' averages and comparison with the OECD average.



Source: Penn World Table version 9.1.

Figure 1 Average GDP per capita 1985-2015

By analyzing Table 2A, as expected, the less developed countries of the OECD (Chile, Estonia, Hungary, Latvia, Lithuania, Mexico, Slovak Republic, and Turkey) are the ones that present a lower GPD per capita across the years, on average. The vast majority of these countries were the last countries to be admitted as OECD members, except Turkey. Although Turkey was one of the founding members, it is one of the countries with lower GDP per capita, averaging just 14,996.35 USD (prices of 2011 as a base term). Hence, Turkey presents a steady growth of its GDP per capita, passing from 9,681.58 USD in 1985 to 23,806.05 USD in 2015.

On the other hand, both being admitted as a member of the OECD in 2010, Slovenia and Israel present a GDP per capita average higher than Greece, Korea, and Portugal. The average, alone, may conceal some important evolutions over time. Korea is one of these cases; in 1985, it presented a level of just 7,574.80 USD, which over the years sustained a considerable increase, and in 2015 the GDP per capita level was 35,145.32 USD.

Over the years, OECD countries presented a positive GDP per capita growth countries even though they all suffered one or another setback, some more than others. As mentioned before, there was at least one period where all OECD countries suffered these setbacks, it was at the end of the first decade of this century, during the European debt crisis.

2.3.2 Descriptive Statistics of Independent Variables

Table 1 shows, by country, the mean values for each explanatory variable analyzed and the mean values of each variable for all studied countries as a whole. We verify the following:

(i) Control variables

The OECD's largest economies in nominal terms (Canada, France, Germany, Italy, Japan, the UK, and the USA) are the countries that present an average GDP higher than the average of the OECD. However, over the years, some countries show signs that they are willing to fight for a place among the "greatest". There are at least three obvious cases, Australia, Korea, and Spain. Among these three, Spain showed a very promising and steady growth until the end of 2008, having reached its peak so far, 1,625,225 million USD. Since then, Spain has had some ups and downs but stagnated and could not keep up with the other two countries mentioned before because for these two, the effects of the European Crisis were not so serious.

The two countries with higher average GDP have a lower degree of openness on average, which shows that larger economies tend to produce more for internal markets. On the opposite side, Luxembourg has a high degree of openness; its average over the 31 years studied is more than twice the average of 31 out of 36 countries. Hence, for Luxembourg, as the degree of openness is large, trade reveals a considerable influence on domestic activities.

As expected, on average, larger economies also have higher capital stocks. Giving a quick and very general look, when the capital stock decreases, the GDP also decreases, so a relationship appears to exist between these two variables.

Countries with an independent and better quality of public and civil services and policy formulation and implementation and a government committed to following and conducting those policies are more trustworthy. In general, they are more stable and have steady growth. On the one hand, we have the Nordic countries of Europe and Switzerland as the best examples for countries that tend to be more trustworthy. On the other hand, we may find Turkey and Mexico as the two most unreliable countries of the OECD regarding having independent public and civil services that have high corruption levels when compared with other OECD members.

About one-third of the countries had problems controlling inflation; some reached high levels. The most critical were Slovenia, Lithuania, Latvia, Poland, and Turkey. They presented a rise in prices of more than 40% over the 31 years studied. The first four had at least one year above 500%, and if we go even deeper, Slovenia and Lithuania reached more than 1000% in one year each. This happened around the

time of the Persian Gulf War. Of the countries that could control inflation, the country that did a better job is Japan, never letting inflation go over 3.5% or below -1.5%.

Japan's stable approach is also reflected in long term interest rates, averaging 2.36% over 31 years. In comparison, Iceland averaged 8.06%, which, among other reasons, explains why Iceland also had the lowest capital stock over 31 years.

(ii) Fiscal policy variables

Japan and Korea are the countries that have a lower ratio of GS on GDP, both having an average below 17%, which is quite far from the 45% and 44.61% ratio that Hungary and France, respectively, spend on primary expenses.

Regarding the Government spending on education ratio on GDP, Turkey and Greece seem to have been the countries that gave less importance to education over the years even though they are giving more importance in recent years[3]. Investing more in education started to be a trend in the last decade of the 20th century for countries with low investments in education. They are following the example of the Nordic countries of Europe since they were the countries with higher averages of GSEdu, especially Denmark, which averaged 7.57%.

Regarding Government spending on the military, Iceland spends such a residual amount that it is not even considered on the World Bank database. At the other end, Israel spent, on average, 9.69% of its GDP on the military and similar over 31 years. This is due to the conflicts that are continually taking place in the Middle East.

Finally, concerning the percentage of Tax Revenues on GDP, Switzerland is the only country with levels below 10%. To be precise, Switzerland exhibited an average of just 8.92% while Denmark was the only country over 30%, averaging 32.01%. Hence, the importance given to each policy varies from one country to another.

Table 1 Independent Variables' Averages for the Period 1985-2015

Country	Control variables (CV)						Fiscal policy variables (FPV)			
	GDP	OPEN	GFCF	GOVEFF	INF	INT	GS	GSEdu	GSMil	TAX
Australia	635,370	38.48	2,396,777.88	1.74	3.55	7.47	25.05	5.04	1.97	22.52
Austria	262,657	83.20	1,419,335.45	1.76	2.16	4.79	43.43	5.42	1.01	23.58
Belgium	317,210	133.86	1,983,442.21	1.67	2.10	5.68	43.39	5.43	1.58	25.67
Canada	962,467	64.37	4,477,954.02	1.83	2.41	5.96	19.81	5.79	1.43	13.32
Chile	111,250	62.08	607,840.39	1.20	8.76	5.75	18.90	3.51	2.95	16.59
Czech Republic	119,708	107.09	1,663,446.78	0.89	4.91	3.73	35.46	4.11	1.58	14.88
Denmark	213,865	81.35	1,101,214.52	2.08	2.36	5.56	38.41	7.57	1.59	32.01
Estonia	13,668	141.12	124,085.46	0.94	11.68	*	33.38	5.47	1.57	18.75
Finland	168,613	66.10	817,916.67	2.10	2.34	5.85	35.85	6.17	1.51	22.10
France	1,802,388	50.15	9,585,866.73	1.52	1.96	5.65	44.61	5.09	2.77	21.30
Germany	2,482,179	60.83	12,910,149.71	1.63	1.80	4.86	29.65	4.62	1.72	11.02
Greece	176,639	48.31	1,430,276.73	0.60	7.55	7.55	43.85	2.75	3.23	19.68
Hungary	88,444	122.20	892,858.20	0.77	11.40	7.09	45.00	5.03	1.77	22.24
Iceland	10,649	76.03	38,674.59	1.78	7.93	8.06	30.63	6.62	**	22.97
Ireland	136,642	148.00	592,571.09	1.56	2.49	6.56	36.38	4.88	0.83	25.11
Israel	139,536	68.07	545,523.87	1.21	17.90	5.46	41.65	5.91	9.69	26.03

[3] For both countries, there was no information for some years. We relied on the available data.

Italy	1,486,955	45.86	10,368,924.87	0.53	3.36	5.93	42.17	4.40	1.66	22.93
Japan	4,339,043	23.47	18,932,001.23	1.39	0.58	2.36	16.28	3.63	0.94	10.62
Korea	673,421	70.06	3,698,739.20	0.98	3.94	4.71	16.85	3.38	3.07	13.75
Latvia	18,328	97.96	252,717.24	0.64	50.81	5.50	43.24	5.42	1.11	20.62
Lithuania	27,099	113.06	208,439.59	0.70	67.55	5.30	35.33	5.07	0.97	18.82
Luxembourg	30,585	256.66	130,303.68	1.78	2.11	3.89	35.32	3.77	0.68	24.21
Mexico	680,886	48.76	5,118,015.88	0.22	22.21	7.66	17.79	4.24	0.52	10.37
Netherlands	542,451	118.79	2,857,872.60	1.87	1.91	5.01	41.90	5.10	1.74	21.42
New Zealand	89,531	57.56	302,074.04	1.78	3.69	7.87	33.97	5.89	1.67	29.15
Norway	246,384	70.12	971,058.66	1.90	2.87	6.57	35.39	6.84	2.08	24.77
Poland	284,651	71.16	1,280,693.24	0.59	40.18	5.72	37.77	4.94	2.09	17.74
Portugal	146,594	65.03	1,539,953.75	1.08	5.17	5.90	38.23	4.64	2.11	19.95
Slovak Republic	53,907	133.48	407,064.03	0.77	6.24	4.39	40.59	4.09	1.68	17.64
Slovenia	31,821	118.83	255,591.03	0.97	90.95	4.44	40.54	5.36	1.41	19.49
Spain	854,340	49.59	5,981,012.03	1.29	3.69	7.29	20.28	4.18	1.77	14.77
Sweden	338,675	73.48	1,554,787.16	1.96	2.60	6.06	35.37	6.63	1.83	24.84
Switzerland	380,735	96.58	1,759,275.38	1.96	1.37	3.31	17.47	4.89	1.11	8.92
Turkey	389,048	43.00	2,881,294.74	0.17	41.89	*	23.53	2.65	3.10	15.15
The UK	1,832,137	52.48	8,043,580.60	1.71	2.98	6.23	35.80	4.72	2.72	24.57
The USA	10,502,843	23.68	41,530,117.48	1.58	2.70	5.49	21.49	4.95	4.18	10.62
OECD	899,592	81.29	4,295,694.79	1.30	12.25	5.67	33.37	5.11	2.08	19.67

Notes: (i) There were no values regarding long term interest rate either for Estonia or for Turkey (*); (ii) There were no values regarding government spending on military for Iceland, most likely because the value is very residual (**).

Source: World Bank, Penn World Table version 9.1 and OECD databases.

3. Methodology, Data Analysis, and Interpretation

3.1 Methodology

The objective of this study is to analyze the impact of fiscal policy on economic growth. In this case, we want to analyze GDP per capita (GDPpc) behavior and identify the variables that affect GDP per capita. The model was estimated using panel data methodology, contemplating time series and cross-sectional data, which allows the analysis of each variable's behavior by country and across time. The generic model is the following:

$$Y_{it} = \alpha + \beta_1 X_{1,it} + \beta_2 X_{2,it} + \cdots + \beta_k X_{k,it} + \varepsilon_{it}. \quad (1)$$

In Equation (1), Y_{it} represents a dependent variable, α is the constant, X_1, X_2, …, X_k represent the independent variables, β_1, β_2, …, β_k are the regression coefficients, and $\boldsymbol{\varepsilon}$ is a random error term[4]. When dealing with panel data, the index *i* represents each of the 36 individuals (countries) (i = 1, …, 36), and *t* represents each of the years of the studied sample (t = 1, …, 31). In this case, the panel data is unbalanced, and the total panel (unbalanced) observations are 403.

Once the generic model is described, it is essential to adapt it to the present study so that the interpretation of Equation (1) is more straightforward and more intuitive. Hence, for this specific case, the model specification takes the following form:

[4] This disturbance reflects erratic and accidental effects that, by themselves, are independent and identically distributed.

$$Y_{it} = \alpha + \beta_1 C_{1,it} + \cdots + \beta_k C_{k,it} + \delta_1 FP_{1,it} + \cdots + \delta_p FP_{p,it} + \varepsilon_{it}. \quad (2)$$

In Equation (2), Y_{it} represents the country's GDP per capita during the current period, C_1, …, C_k represent the control variables, and FP_1, …, FP_p represent the fiscal policy variables. In this case, the relevant control variables (C_m with m = 1, …, 6) of Equation (2) correspond to the following variables, lnGDP, lnOPEN, lnGFCF, lnGOVEFF, lnGOVEFF^2 and M. This M variable represents the macroeconomic variables INF and ln INT, which will be introduced separately. The ln refers to the natural logarithm, the logarithm to the base of the mathematical constant $\boldsymbol{e}$.

By its turn, Fiscal Policy variables (FP_p with p = 1, …, 4) correspond to GS, GSEdu, GSMil, and TAX. All these variables were described in Table 1A, adapting Equation (2):

$$\begin{aligned} lnY_{it} = \alpha + \beta_1 \mathrm{lnGDP}_{it} + \beta_2 \mathrm{lnOPEN}_{it} + \beta_3 \mathrm{lnGFCF}_{it} + \beta_4 \mathrm{lnGOVEFF}_{it} + \\ + \beta_5 (\mathrm{lnGOVEFF})^2_{it} + \beta_6 \mathrm{M}_{it} + \delta_1 \mathrm{GS}_{it} + \delta_2 \mathrm{GSEdu}_{it} + \delta_3 \mathrm{GSMil}_{it} + \\ + \delta_4 \mathrm{TAX}_{it} + \varepsilon_{it}. \end{aligned} \quad (3)$$

Panel data methodology permits the estimation of pooled Ordinary Least Squares (OLS), fixed effects, and random effects models. According to Tom Clark and Drew Linzer (2015), the choice between random or fixed effects consists of a trade-off between skewness and variance, respectively. With fixed effects, the estimates are highly dependent on the sample selection; there is an inherent error associated with data's randomness. In this investigation, as the sample is similar to the population, opting for fixed effects minimizes the referred error and avoids skewness problems from the random effects. All models exposed in Table 2, except the pooled OLS, were estimated by fixed effects for the OECD countries between 1985 and 2015.

Three diagnostics tests are fundamental to assess which of the previously mentioned specifications is the most adequate. The first is the fixed effects F-test that selects pooled OLS models versus fixed effects models. The second, the Hausman-test, decides between the use of fixed effects models and random-effects models. The last is the Breush-Pagan test that assesses if the fixed effects model is more appropriate than the pooled OLS. The fixed effects F-test allowed the rejection of the absence of fixed effects for countries and periods[5]. Hence, the estimation by fixed effects is the most suitable.

For the different estimated models in Table 2, we performed the Hausman-test with fixed effects for the countries or time periods. The null hypothesis was rejected for a significance level of 1%, which means that fixed effects specification was the most adequate. We also performed the Breush-Pagan-test, which corroborated the decision of estimating with fixed effects.

[5] On Table 2, for each fitted model, the fixed effects F-test was performed, and it is visible on the "Countries and periods F-test" row.

Table 2 Estimation Results for the Models

Independent variables	Pooled OLS	Fitted model A	Fitted model B	Fitted model C	Fitted model D	Fitted model E
ln GDP	0.1062 (0.025)***	0.1800 (0.033)***	0.1531 (0.032)***	0.1185 (0.033)***	0.1191 (0.033)***	0.1160 (0.033)***
ln OPEN	-0.0731 (0.055)	0.1068 (0.045)**	0.0790 (0.043)*	0.1092 (0.042)***	0.1066 (0.042)**	0.1075 (0.042)**
ln GFCF	-0.0754 (0.025)***	0.4342 (0.055)***	0.4600 (0.053)***	0.5647 (0.056)***	0.5611 (0.057)***	0.5783 (0.059)***
ln GOVEFF	0.0836 (0.048)*		0.1021 (0.025)***	0.0906 (0.024)***	0.0900 (0.024)***	0.0911 (0.024)***
(ln GOVEFF)^2	0.0708 (0.057)		0.0423 (0.013)***	0.0321 (0.013)**	0.0322 (0.013)**	0.0337 (0.013)***
GS	-0.0096 (0.003)***			-0.0040 (0.001)**	-0.0042 (0.001)***	-0.0035 (0.001)**
GSEdu	0.0555 (0.021)***			0.0170 (0.007)**	0.0167 (0.007)**	0.0151 (0.007)**
GSMil	-0.0797 (0.016)***			-0.0512 (0.014)***	-0.0505 (0.014)***	-0.0515 (0.014)***
TAX	0.0055 (0.004)			0.0091 (0.003)***	0.0092 (0.003)***	0.0088 (0.003)***
INF					-0.0010 (0.002)	
ln INT						-0.0157 (0.013)
Sample size	403	403	403	403	403	403
Adjusted R^2	0.2815	0.9797	0.9807	0.9826	0.9826	0.9827
Wald F-statistic	18.5022 (0.000)	389.8981 (0.000)	393.3588 (0.000)	407.1495 (0.000)	399.5496 (0.000)	400.8406 (0.000)
Countries and periods F-test		363.7468 (0.000)	340.1201 (0.000)	338.5477 (0.000)	315.9133 (0.000)	335.5034 (0.000)

Notes: (i) In parenthesis and under each estimate it is mentioned the corresponding robust standard errors, using the cross-section weights (Panel Corrected Standard Errors) method; (ii) The symbols ***,**,* indicate the level of significance, namely at 1%, 5% or 10%; (iii) The Wald F-statistic tests the global significance of the regression, where the value inside parenthesis gives us the p-value; (iv) In the F-test, the value in parenthesis gives us the p-value.

Source: Estimates obtained with data from World Bank, Penn World Table version 9.1 and OECD databases.

3.2 Data Analysis

Five models were estimated following the conditions mentioned in Section 3.1. The first two models (A and B) only used the control variables, except the macroeconomic variables inflation and long-term interest rate. Model C is the fitted model with all the control variables present in models A and B and the studied fiscal policy variables. Models D and E were estimated with all the model C variables adding up the macroeconomic variables not included until then. Inflation was included in model D and the long-run interest rate in model E.

The Wald F-statistic values reported in Table 2, for models A through E, indicate their overall significance for a level of significance of 1%.

Furthermore, to check which better model fits our data, we used inference to study the explanatory variables' possible redundancy. Let's compare models A and B, using statistic inference. We get a Wald-F statistic value of 9.4933, meaning that the

null hypothesis is rejected, for a level of significance of 1%. Therefore, we can conclude that model B, by containing GOVEFF and GOVEFF^2 variables, provides a better fit to the data than model A. There was also an improvement from model B to C, so the four fiscal policy variables are jointly significant. In this case, the Wald F-statistic value was 10.8488, with a p-value of 0.0000.

Models D and E were the models that included the macroeconomic variables, but each macroeconomic variable was not statistically significant on both models. On model D, the Wald F-statistic presented a value of 0.5957 with a p-value of 0.4407, while for model E, the Wald F-statistic value was 1.6957 with a p-value of 0.1937.

In conclusion, the most suitable fitted model for interpretation is model C.

3.3 Interpretation

Regarding the control variables, GFCF presented the highest estimates across the five fitted models, and it is significant for a level of 1%. From fitted model C, we can state that an increase of 1% on GFCF corresponds to an estimated increase of 0.56% on the GDP per capita, *ceteris paribus*[6], corresponding to an estimated elasticity of GFCF of GDP per capita of 0.56. This estimate confirms the first neoclassical theories (Robert Solow 1956) idea that capital accumulation and capital stock levels positively impact economic growth.

Contrary to the expected, the initial GDP positively impacted GDP per capita, even though its magnitude decreased as variables were added. This may indicate that if more significant variables are included, the impact may continue to fall and eventually become negative. An increase of 1% of the initial GDP implies an estimated increase of 0.12%.

As expected, the degree of openness showed a positive impact on the dependent variable; that is, an increase of 1% on the degree of openness represented an estimated impact of 0.11% on the GDP per capita. This corroborates the idea presented by David Ricardo in 1817 and in the dominant international trade literature that international trade showed a positive impact on economic growth.

Government efficiency presented a positive estimated effect of (0.0906+0.0642× ln GOVEFF)% on GDP per capita; this is the expected variation for a 1% increase in government efficiency. Hence, the estimated effect and also, the elasticity depends on the value of the GOVEFF. If we use the mean of GOVEFF that corresponds to 1.3833, the effect will be 0.11%. For the minimum value on the sample, we get -0.03%, and for maximum the value will be 0.15%. We can conclude that the estimated impact of GOVEFF is negative for values of GOVEFF smaller than 0.24 and positive for higher values.

It was essential to have macroeconomic variables on the estimation, but, unfortunately, both revealed not to be statistically significant, and thus we will not interpret their estimates.

Evaluating the fiscal policy variables' outcomes, the only variable affected contrary to the expected was TAX. It was expected to negatively impact variables GS and GSMil, but the obtained estimates were positive. In this case, a one percentage point

[6] Regarding the other interpretations, *ceteris paribus* is always assumed.

variation on TAX corresponds to an estimated change of 0.91%, on the GDP per capita. Fölster and Henrekson (2006) and Muinelo-Gallo and Roca-Sagalés (2011) estimated a negative impact between TAX and economic growth.

Government spending and Government spending on military showed harming GDP per capita. For each percentage point variation on GS and GSMil it was estimated a variation of -0.4% and -5.12 %, respectively, on the GDP per capita. These estimates support the conclusions reached by Fölster and Henrekson (2006), Muinelo-Gallo and Roca-Sagalés (2011), and Paparas, Richter, and Paparas (2015) of a negative impact of GS and GSMil on economic growth.

Finally, regarding the Fiscal Policy Variables, Government Spending on Education revealed a positive effect on the dependent variable, so for each unit percentage point variation the GSEdu, the estimated impact on the GDP per capita was a 1.7% increase. For Benos (2009) and Paparas, Richter, and Paparas (2015), GSEdu did not significantly impact economic growth. Although many studies refer that GSEdu should have a positive impact, few studies could get positive estimates on their fitted models.

3.4 Comparisons to Similar Studies

To strengthen the justification for our sample size and methodology, we draw comparisons to similar studies that have employed panel data with comparable sample sizes and yielded consistent results. Christie (2012) analyzed 22 OECD countries from 1970-2009, highlighting the heterogeneous impacts of fiscal policies. Gemmell, Kneller, and Sanz (2016) utilized data from 17 OECD countries between 1970-2005, focusing on the intricate dynamics between fiscal policy and growth. Chu, Hölscher, and McCarthy (2018) employed a dataset of 20 OECD countries from 1995-2015, emphasizing the nuanced effects of different fiscal policy measures. Oyinlola et al. (2020) investigated the fiscal policy impacts on growth in a panel of developing countries, providing insights into the varying effects in different economic contexts.

These references support our approach of using a comprehensive panel dataset covering a substantial period, ensuring robust and reliable findings. The consistency of our results with the broader literature further validates the reliability of our methodology and the chosen sample size.

4. Conclusions

With this paper, we wanted to evaluate and quantify the impact of fiscal policy on economic growth for the OECD countries between 1985 and 2015. One of the primary objectives common to all governments is to achieve sustainable economic growth, so it was important to divide other studies' conclusions into three groups: fiscal policy has (i) a negative impact on economic growth; (ii) no significant impact on economic growth or (iii) a positive impact on economic growth.

From the studies we selected, we gathered data regarding the variables that are considered as being the most important to evaluate economic growth. Initially, we performed the descriptive analysis of these established variables and the ones we proposed separately. With the collected data, we completed the estimations using panel data methodology, which is considered the most adequate. We adapted the generic model

to our specific case, and then we performed the diagnostics tests. These determined that the most suitable specification was fixed effects.

The estimates of three of the fiscal policy variables studied, government spending, government spending on military, and government spending on education, corroborate the conclusions reached by other studies. The first two harm economic growth, and the other has a positive effect on economic growth. Tax revenue was the only fiscal policy whose estimates had a contradictory impact to what was expected. In this case, its estimates were positive. Hence, two fiscal policies had a positive effect, and the other two had a negative impact. Government spending on military estimates has such a strong negative influence that government spending on education cannot counterbalance it alone.

We also confirmed that capital stock – capital accumulation – has an essential role in economic growth. Higher stock capital levels, combined with a population with high education levels, tend to generate higher levels of production. Therefore, governments should invest in infrastructures and equipment to be able to obtain higher levels of capital. At the same time, they should invest in their population, on the human capital. For example, investing in the education of the younger generations and providing training for the working population to keep up with the constant modernization and technological progress.

All in all, through this study, we determined government spending and government spending on military to be the fiscal policies with a negative impact on economic growth, while government spending on education and tax revenue have a positive effect on the economy. Simultaneously, we verified that it is crucial to have a transparent and trustworthy government as its effectiveness may lead to a positive and steady economic growth impact. In contrast, a corrupt or unreliable government may have the opposite effect.

Although this study was carried out for a considerable time period, some important data was not available; for example, there was no complete government effectiveness data. The countries' sample size may mask the real impact of fiscal policy on their economic growth for some countries, particularly for those smaller countries. This doubt arises from the fact of the studied countries not being homogeneous.

Given the results and the heterogeneity of the studied countries, we may question if there are not different limits on which the fiscal policies studied switch from positive to negative or *vice versa*. A suggestion for a future investigation would be trying to understand if it is possible for a country to have positive effects from all these fiscal policies studied at a certain point.

With the groundwork laid by our study, several avenues for further research emerge. Firstly, extending the analysis to include non-OECD countries could provide valuable insights into how fiscal policy impacts economies with different levels of development and institutional structures. Secondly, exploring the dynamics of fiscal policy in response to economic shocks or policy changes over shorter time frames could offer a more nuanced understanding of its effectiveness in varying contexts. Additionally, investigating the role of political and institutional factors in shaping the effectiveness of fiscal policy interventions could shed light on the mechanisms through which policy decisions translate into economic outcomes. Finally, employing

alternative econometric techniques or refining existing models to better capture the complex interactions between fiscal policy variables and economic growth could contribute to more robust and reliable empirical findings. These avenues represent exciting directions for future research, offering opportunities to deepen our understanding of the intricate relationship between fiscal policy and economic growth.

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Appendix

Table A1 Variables' Description and Expected Impact on GDP per capita

Variable	Description	Expected impact on GDPpc
GDPpc	GDP per capita growth rate	
OPEN	Degree of Openness as a % share on GDP of the sum of exports and imports	+
GDP	Initial GDP	–
INF	Inflation, consumer prices (annual %)	–
INT	Long term interest rate	–
GFCF	Gross fixed capital formation: Capital stock at constant 2011 national prices (in a million 2011 USD)	+
GOVEFF	Government effectiveness captures 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.	+
GS	Government spending on primary expenses: cash payments for operating activities of the government in providing goods and services. It includes compensation of employees (such as wages and salaries), interest and subsidies, grants, social benefits, and other expenses such as rent and dividends. (% of GDP)	–
GSEdu	Government expenditure on education (% of GDP)	+
TAX	Tax Revenue (% GDP)	–
GSMil)	Government expenditure on military and national defense (% of GDP)	–

Source: World Bank, Penn World table version 9.1 and OECD databases.

Table A2 Average GDP per capita for the Period 1985-2015

Country	Average GDP per capita (2011USD)	Country	Average GDP per capita (2011USD)
Australia	38,657.89	Greece	21,992.44
Austria	35,387.88	Hungary	17,909.26
Belgium	33,170.48	Iceland	32,835.20
Canada	36,981.34	Ireland	37,854.02
Chile	14,206.14	Israel	24,108.12
Czech Republic	22,232.20	Italy	33,490.53
Denmark	40,294.87	Japan	33,407.06
Estonia	17,512.41	Korea	21,211.78
Finland	32,279.07	Latvia	14,343.44
France	32,583.63	Lithuania	15,364.72
Germany	36,659.69	Luxembourg	44,605.95
Mexico	14,328.31	Slovenia	22,094.85
Netherlands	37,970.22	Spain	31,588.14
New Zealand	27,545.77	Sweden	35,250.92
Norway	70,739.68	Switzerland	54,356.41
Poland	24,852.90	Turkey	14,996.35
Portugal	22,037.53	The UK	30,664.24
Slovak Republic	17,179.43	The USA	43,701.22

Source: Penn World table version 9.1.