Universitat Autònoma de Barcelona

# THREE EMPIRICAL STUDIES ON FISCAL POLICY

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Ph.D. Dissertation

Barcelona, 2021

**A Valentina, Blanca y Mirley**

# Acknowledgements

First and foremost, I would like to express my sincere gratitude to my advisors, Oriol Roca-Sagalés and Leonel Muinelo-Gallo, for their invaluable support, scientific guidance, and encouragement. I am extremely grateful for the time and effort they have dedicated to this work. I am grateful to Leonel, who introduced me to Oriol and encouraged me to study at Universitat Autònoma de Barcelona.

I am also grateful to the professors, doctoral students, and administrative stuff of the Department of Applied Economics, especially to professors Emilio Padilla and Rosella Nicolini for having trusted in me to be part of the Ph.D. programme. Gratitude is also extended to my colleagues of the Institute of Economics for their supportive attitude.

I gratefully acknowledge financial support from the Institute of Economics of Universidad de la República (Uruguay) and Agencia Nacional de Investigación e Innovación (ANII) of Uruguay (POS_EXT_2018_1_153809).

Finally, I must acknowledge people that have always been by my side, inspiring me to follow my dreams.

Barcelona, November 2021
Ronald Miranda.

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# Chapter 1

# Introduction

Over the last decades, the importance of governments and their participation in the economy has increased relatively rapidly around the world. The size of government, measured as the public spending as a share of gross domestic product (GDP), has increased from about 25 percent in the early 2000s to about 29 percent in 2019 (IMF 2020).

This is not just a consequence of government' choices to boost economic development. In recent times, there has been a strong interest among citizens to demand more and better services, the efficient use of the public resource and the quality of fiscal policies from their governments (Afonso et al. 2010; Christl et al. 2020). Certainly, election gives citizens some control over politicians, such as punish them at re-election, and thus it may be expected that policymakers pursue policies that most improve their quality of life and well-being (Persson and Tabellini 1994).

However, the level and growth of government spending provide little information about which expenditures are prioritised in the public budget, or the quality of public services delivered, or how they are combined to achieve efficiency (e.g., better public outcomes with the same fiscal resources) and promoting equity (e.g., improving income redistribution and human development as well as reducing poverty) objectives (Sen 1999; Izquierdo et al. 2018). In this sense, the public expenditure composition (by government functions and economic characteristics) and organizational aspects (e.g., the extent to which it is decentralized) can shed light on citizens' preferences for public spending, the size of government and the fiscal resources allocation (at central and subnational level) (Shelton 2007). Moreover, the fiscal policy design of the types of public spending over the business cycle could also affect government spending policies. In particular, there are social and political pressures that may lead governments to spend too much in good times, even supporting expansions of structural spending (e.g., redistributive spending) to be paid for by temporary additional revenues (Akitoby et al. 2006). Consequently, policymakers' need to adjust or even cut spending in bad times to achieve fiscal

sustainability, provoking adverse economic conditions for the most vulnerable groups of society (Gasparini and Lustig 2011; Caminada et al. 2019).

This dissertation analyses different aspects of the fiscal policies through three independent empirical chapters that follow different methodological approaches using updated data from different countries. This section introduces a summary of the three central chapters of the thesis. Chapter 2 examines the cyclical movements of public social cash transfers for the Uruguayan economy. Chapter 3 analyses the redistributive efficiency of fiscal policy -cash transfers and direct taxes at central and subnational level- across countries and time, and how the level of political decentralization affects redistribution efficiency objectives. Chapter 4 employs cross-country evidence to analyse to what extent public health and education expenditure, at central and subnational level, affect the human development index (HDI) and its three dimensions (health, education, and income). Finally, the Chapter 5 summarises the main concluding remarks.

*Chapter 2. The behaviour of social transfers over the business cycle: Empirical evidence of Uruguay*[1]

One important topic in fiscal literature is cyclical aspects of fiscal policy. According to the basic Keynesian perspective, the government spending should be moved in a countercyclical direction, as a macroeconomic stabilising force, that involves increase spending in good times and cut it in bad times (Gavin et al. 1996; Lane 2003). Thus, when analysing the cyclical performance of the fiscal policy, government spending has a crucial role, reducing the duration and intensity of economic cycles (Gavin et al. 1996; Avellan and Vuletin 2015). Whilst some empirical studies show that some developing countries experienced important fiscal policy changes in the 2000s and have been able to shift from procyclical to countercyclical fiscal spending policy, it is also true that about two-thirds of them have not been able to escape the procyclical "trap", therefore, they still show procyclicality in their fiscal policy (Frankel et al. 2013; Vegh et al. 2017).

A vast literature has analysed the cyclicality of aggregate measures of public expenditure over the business cycle (Talvi and Végh 2005; Klemm 2014); however, just a few studies examined the cyclical movements of the public social spending and its components (Busch et al. 2018; Michaud and Rothert 2018).

[1] This chapter has been published in: Hacienda Pública Española (2020), vol. 233(2), 25-54.

This chapter analyses the cyclical fluctuations of public social cash transfers and its components in Uruguay over 1988/Q1 to 2016/Q3. Using time series analysis tool to do so. First, it is detected seasonality in unadjusted macroeconomic time series due to quarterly data being used. Thus, it is used a seasonal adjustment method (TRAMO-SEAT) to identify and subtract the seasonal components (fluctuations and intra-year effects) and the irregular components of the unadjusted time series. As a result, the seasonally adjusted series obtained is comprised of the trend and the cycle components. Then, the unobservable cyclical components are extracted from the economic time series using different detrending methods (Linear trend, Beveridge-Nelson filter, Hodrick-Prescott, and Hamilton filter); and finally, it is revised the most relevant cycle properties of the public social cash transfers' components (volatility, persistence, co-movements, and phases changes) and explore the nonlinear causal relationships between series.

The results show that components of public social cash transfers are procyclical and lag the macroeconomics fluctuations. This enables us to say that instead of these cash transfers contributing to stabilising the Uruguayan economy they have thereby aggravated the business cycle, and through various expenditure items expose the vulnerable groups of society to more adverse economic conditions.

The chapter makes two main contributions to the available literature. On one hand, it complements previous related empirical works, addressing the cyclicality of disaggregated measures of public social cash transfers. To the best of our knowledge none of the previous studies have decomposed public social cash transfers, both contributory and non-contributory, and used higher frequency data to investigate the cyclicality of fiscal policy. On the other hand, there is not much more information and analysis to extract from off-the-shelf data sources to help to analyse the pro-cyclicality of public social cash transfers in the developing world, and this chapter focuses on a specific developing country, the Uruguayan economy by using a novel dataset.

*Chapter 3. Redistributive efficiency of fiscal policy: The role of decentralization*

The analysis of income redistribution, commonly define as the difference between market income inequality (i.e., pre cash transfers and direct taxes) and inequality of disposable income (i.e., post cash transfers and direct taxes), constitutes one of the most important topics in economic literature (Alvaredo et al. 2018). In fact, one of the main driving forces behind the differences in inequality reduction across countries is attributed to

asymmetries in the role played by the design and effects of fiscal policies (Brandolini and Smeeding 2007; Wang et al. 2014). While developed economies have shown a strong fiscal redistributive impact through transfers and taxes, in developing countries this is very limited since they tend to have fewer fiscal resources available to affect redistribution (Goñi et al. 2011; Villela et al. 2007). Meanwhile, scholars emphasise the fact that income redistribution has weakened or stagnated in many economies over the last twenty-five years (Gasparini and Lustig 2011; Caminada et al. 2019). Moreover, the empirical evidence indicates that the size of fiscal resources as well as their degree of decentralization is also relevant in affecting income redistribution (Sepulveda and Martinez-Vazquez 2011).

Considering this context, this chapter empirically analyses the redistributive efficiency of fiscal policy considering both its main cash redistributive instruments and its degree of decentralization for a sample of 35 developed and developing countries over the 2000-2016 period. To do this, it follows a two-stage procedure (Simar and Wilson, 2007, 2011) where in the first stage employs a bootstrap Data Envelopment Analysis (DEA) method to estimate the redistributive efficiency of cash transfers and direct taxes at central and subnational level. By employing this methodology, a redistributive efficiency score is obtained for each country and time period (and also a country efficiency ranking), which arises from comparing the individual redistributive performance of each country with respect to the best possible redistributive performance in the sample of countries. In the second stage, a bootstrap truncated regression analysis is used to identify the explanatory or contextual factors that might explain redistribution efficiency scores variation across countries and time, and which do not respond to discretionary fiscal policy decisions, at least in the short term; specifically, it analyses the role played by the level of political decentralization.

It obtains evidence that redistributive efficiency varies across countries and -on average- has diminished after the Great Recession (2007-2008) and is lower in the Southern European countries, and higher in almost the rest of Europe and developing countries. Additionally, the results show empirical evidence that redistributive efficiency is directly associated with low political decentralization. And only in case of countries that enjoy a high level of government quality, politically decentralized systems are more redistributive efficient.

This chapter contributes to the existing empirical literature in two ways. First, it provides novel empirical evidence on the redistributive efficiency of cash transfers and

direct taxes instruments at central and decentralised level for an extended panel of developed and developing countries. Secondly, it explores in depth the underlying determinants of redistributive efficiency differences across countries and over time. This article naturally complements previous work in the redistribution literature covering different explanatory factors.

*Chapter 4. Human development and decentralization: The importance of public health expenditure*

Public spending has traditionally been considered an important instrument to improve economic and human development of a society, being an essential support of modern welfare states (Musgrave 1959). But not less relevant aspect for affecting economic and human development is the allocation of public spending resources, this is the extent to which is decentralized (Oates 1972, 1999). Indeed, over the last decades, there has been a global trend across developed and developing economies towards fiscal decentralization with the aim to improve citizen welfare and economic development (Martinez-Vazquez et al. 2017).

The empirical literature to date, have studied to what extent fiscal decentralization affects GDP per capita growth, governance, and education and health outcomes. However, there is a dearth of empirical evidence of it impact on variables reflecting human welfare (e.g., poverty, per capita PPP income, and the human development index) (Canare 2021).

This chapter empirically analyse the impact of central and subnational government spending on human development in a sample of 57 developed and developing countries over the period 2000-2018. Specifically, it focuses on the effects of health and education public expenditure on the Human Development Index (HDI) and its dimensions (life expectancy, education, and income).

Applying panel regression analysis with OLS based on panel-corrected standard errors, using annual and five-years means data, the empirical evidence shows the importance of central and subnational government health expenditure positively impacting on HDI and each one of its components, while in the case of the education expenditure, this positive effect is only confirmed on the educational dimension of HDI. These results remain basically unchanged by using a Two-Stage Least Square instrumental variables techniques, and by introducing a different lagged structure of the

government expenditures variables. Thus, this study outlines that governments may stimulate human development, improving the well-being of the citizens, allocating more resources to healthcare through the different administrative levels.

This chapter contributes to two strands of the available empirical literature. Firstly, to the best of our knowledge, it does the first attempt to examine the relationship between decentralized health and education expenditure and human development using updated data of an extended sample of developed and developing countries. Secondly, it explores in-depth the underlying determinant of the HDI, and in each of their dimensions, considering a cross-country perspective.

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# Chapter 2

# The behavior of social transfers over the business cycle: Empirical evidence of Uruguay

## 2.1 Introduction

The cyclicality of fiscal policy has received considerable attention in the public finance literature. Scholars have claimed counter-cyclical fiscal policies to be important (Lane 2003). Counter-cyclical policies involve spending less in good times in order to cool off the economy and allow the government to increase its savings, and spending more in bad times to mitigate recession and speed up recovery. This can be contrasted with pro-cyclical spending policies, which increase spending in good times and cut it in bad times. This tends to amplify output fluctuations and create large social costs, particularly affecting the most vulnerable segments of the population (Vegh and Vuletin 2014).

Specifically, the empirical literature describes that fiscal spending policy in developed countries have been characterised by behaving a-cyclical or counter-cyclical, while in developing countries it has historically been pro-cyclical, particularly in Latin American and the Caribbean (LAC) countries (Gavin and Perotti 1997; Klemm 2014; Talvi and Végh 2005). Thus, the government spending in the developing countries has been increased during the period of booms and decreased during periods of recessions (Avellan and Vuletin 2015). Consequently, this pro-cyclical behaviour of the fiscal spending policy has been provoked adverse implications for developing economies due to having intensified volatile economic cycles (Gavin et al. 1996).

This paper complements previous empirical work related to the cyclicality of aggregate measures of public expenditures.[2] In it, we address the cyclicality of disaggregated measures of public social cash transfers. The exercise reveals structural deficiencies, not only in actual spending, which in many developing countries is pro-cyclical and discretionary, but also in the design of more specific fiscal policies.

[2] See, for example, Talvi and Végh (2005) and Klemm (2014).

Our analysis focuses on the cyclicality of contributory and non-contributory public social cash transfers for two main reasons. First, these transfers are an important proportion of government expenditures. Therefore, their design is relevant for the role of fiscal policy as a stabilization tool for the business cycle. Second, they respond to very specific government policy objectives which focus on income maintenance, income and wealth inequalities reduction, and reduced poverty. As is well known, governments operate this cash transfer system as a form of insurance for their population against income losses, notably during recessions. Thus, one important goal of fiscal policy design is to understand the extent to which higher income risk in recessions is mitigated by these specific policies. In this context, well-designed management of fiscal policy during the cycle impacts sustainability, as well as distributive and re-distributive outcomes achieved, and also social tension.

Uruguay is a good case study for these issues. In a context of macroeconomic stability and rapid economic growth fostered by an increase in international demand for commodities, and via redesign of its social transfer system, this country has achieved a large reduction in poverty levels and lower inequality over the last decade (Amarante et al. 2014; Bucheli et al. 2014). In fact, the country recently reached high-income status according to the World Bank's country classification. In this context, Uruguayan citizens are demanding more and better services from their government. If the Uruguayan government cannot meet these new demands, social tensions may arise, stalling development. This challenge is presently even greater due to comparatively high world interest rates, low commodity prices and low world growth; these external factors may not favour Uruguay as they did in the early 2000s.

We explore the cyclical movements of a novel disaggregated fiscal database of different contributory and non-contributory public social cash transfers for the Uruguayan economy from 1988/Q1 to 2016/Q3. We use time series analysis tools to do so. A time series approach helps us to find the main time components of different variables (Ladiray and Quenneville 2001). First, we detected seasonality in unadjusted macroeconomic time series. Then, we estimated the unobservable cyclical components of the series using different detrending procedures. Finally, we revised the most relevant cyclical properties of components of social transfers (obtained using different detrending methods). This last point is extended further to examine the nonlinear causal relationships.

We obtain empirical evidence that social transfers are pro-cyclical and lag the business cycle in the Uruguayan economy during the sample period. In this article, we

show that among the social transfers this pattern is driven by old age benefits and survivors' pensions. Also, we found a high degree of variability and persistence of social transfers and components thereof. Our results indicate that social cash transfers exacerbated the business cycle and additionally exposed the most economically vulnerable groups of Uruguayan society to macroeconomically adverse episodes. This suggests that social demands and fiscal strengthening can be attained in Uruguay through an effective cyclical design, rather than the standard solution of spending cuts to achieve fiscal sustainability. It is important to carefully manage redistributive spending demands throughout the business cycle, including in good times, when specific interest groups and weak institutions may combine to push expenditures above trend and toward more inflexible spending (i.e., transfers) that may be difficult to sustain during the next stage of the business cycle.

The remainder of the paper proceeds as follows. Section 2 presents a detailed review of the related literature. In Section 3, the social cash transfer system in Uruguay is described. Data and variables are presented in Section 4. The empirical strategy is described in Section 5, while Section 6 presents the main empirical findings. Section 7 presents two additional empirical exercises with important policy implications. Concluding remarks and policy recommendations are in Section 8.

## 2.2 Background: Social transfers over the economic cycle

One important topic in fiscal literature is cyclical aspects of fiscal policy. Scholars have identified different patterns through which public expenditures may affect output fluctuations (Vegh et al. 2017):

- counter-cyclical: government expenditures act in the opposite direction to output fluctuations, and this tends to stabilize the business cycle;
- pro-cyclical: associated with government spending moving in the same direction as changes in output, which reinforces the business cycle;
- a-cyclical: aggregate government expenditures are constant over the output cycle; it does not stabilize or reinforce the business cycle.

Public spending policy over the business cycle essentially results from deliberate decisions of policymakers on whether to increase or cut spending (discretionary spending). Public consumption (wages and salaries; goods and services) and public investment result from deliberate spending decisions when policymakers approve the budget. A large percentage of primary spending is basically not determined by policymakers' discretionary spending decisions. Instead, much of it results from implementation of social programs and benefits that are automatic in nature.[3] Such expenses, mostly cash transfers to individuals or households, involve disbursement of public funds in accordance with laws intended to benefit people who meet certain criteria (Atkinson 2000, 2003). The specific criteria depend upon the type of social program and benefits, which are themselves shaped by countries' most pressing social challenges. The most important automatic spending categories include: (i) social security (mainly transfers to individuals of retirement age), (ii) family programs and benefits, which include conditional cash transfers mainly to the poor and the most vulnerable households and (iii) unemployment insurance (payouts to unemployed individuals).

These social transfers should not be expected to relate to business cycle output fluctuations, as the underlying criterion for their design and application is determined by demographic shifts, such as in the age structure. The same should hold true, although maybe to a lesser extent and depending on the specific program design, for family programs and benefits. In principle, these social programs aim to target structural and deep-rooted problems that are not expected to change much over time, with short-term output supports (or removal of supports). Meanwhile, the unemployment insurance mechanism is, by construction, an automatic stabilizer. During a recession, when people lose their jobs in countries with unemployment insurance mechanisms, these unemployed people receive transfers to compensate for the loss of income. Broadly speaking, countries with a correctly designed unemployment insurance program should see an automatic increase in these transfers during recessions (as unemployed people claim their benefits) and, by the same logic, a large decline in these transfers as the economy recovers and people return to work.

Change in aggregate measures of fiscal policy over the business cycle has received increasing attention in empirical literature in recent years. These studies use annual data, and indicate that fiscal policy has typically been a-cyclical or counter-cyclical in

[3] About the 40 per cent of primary spending in OECD countries is discretionary (see OECD.Stat and SOCX databases).

developed countries and pro-cyclical in developing ones, respectively stabilizing and exacerbating the business cycle. For instance, Gavin and Perotti (1997) found pro-cyclicality of total government expenditures and its components (capital, government consumption, and subsidies and transfers) for a panel of 13 Latin American countries over 1968-1995. Similarly, Talvi and Végh (2005) studied a sample of 56 countries (20 developed and 36 developing countries) from 1970 to 1994, and found pro-cyclicality of government consumption in developing countries and a-cyclicality among the developed ones. Furthermore, Klemm (2014), based on a panel of 33 advanced economies and 146 emerging and developing economies over 1980-2012, showed primary balances to have been pro-cyclical in Latin America, but counter- or a-cyclical in industrial economies.

In this context, scholars had provided three main arguments to explain why aggregate fiscal policy measures would be pro-cyclical in developing countries. On the one hand, the traditional economic literature gives two main arguments to explain why the fiscal policy would behave procyclicality. The first references the lack of access to international financial markets during bursts in developing countries, which leaves governments not in a position to run a counter-cyclical policy (Gavin and Perotti 1997; Caballero and Krishnamurthy 2004; Kaminsky et al. 2004). The second argument is associated with pressures of multiple interest groups in society to appropriate additional public spending in good times (e.g., booms in commodities prices, expanded foreign aid transfers and natural resources endowments), labelled as the "voracity effect". In such a case, there are social and political pressures that lead governments to spend too much in good times, even supporting expansion of structural expenditures to be paid for by temporary additional revenues (Tornell and Lane 1999). In this sense, Akitoby et al. (2006) provide empirical evidence for the case of 51 developing economies in the period 1970-2002 that support the "voracity effects", and also the "ratcheting effects" of the procyclicality of the public spending.[4] Moreover, Alesina et al. (2008) indicate that fiscal procyclicality emerges from political distortions due to corrupt democracies; the argument is that the corrupted context leads voters to increase the demand for government spending in order to avoid the government abuse of power, such as appropriation of excessive rents.[5] Thus, for this second argument, the procyclicality is largely explained

[4] The ratchet effect refers to a downward-rigidity in public spending once the exogenous events or changes in the public's preferences rise the public spending relative to the original situation (Hercowitz and Strawczynski 2004).

[5] For more details about this argument, see Frankel et al. (2013), Vegh and Vuletin (2014), Avellan and Vuletin (2015), and Vegh et al. (2017).

by the existence of political economy distortions and weak fiscal institutions (Avellan and Vuletin 2015; Frankel et al. 2013; Vegh and Vuletin 2014; Vegh et al. 2017). On the other hand, the global financial crisis has become an alternative interpretation of the procyclicality policy. Some scholars have become supportive of the arguments that procyclical fiscal behavior is a consequence of the over-optimism in the government's output forecasts, particularly during economic expansion rather than in normal times (Frankel and Schreger 2013; Cimadomo 2012, 2016).

Far fewer studies have examined the cyclicality of government social subsidies and transfers components of public spending. For instance, Arreaza et al. (1999) investigating a sample of the EU and OECD countries between 1971 and 1993, observe that government transfers tend to behave more counter-cyclical over the economic cycle than the other components of the public spending. Similarly, Lane (2003) found for the OECD countries that fiscal cyclicality depends on the expenditure component and the country considered; and the counter-cyclical government spending is derived from transfers and debt interest payments. Recently, Michaud and Rothert (2018) analysed government spending over the business cycle in a sample of 30 countries across 1980-2015. They found that the cyclical aspects of the government spending are explained by the cyclicality of their aggregate measure of social transfers, which is pro-cyclical in emerging economies and counter-cyclical in developed economies.

In conclusion, to the best of our knowledge none of these studies have decomposed public social cash transfers and used higher frequency data (quarterly instead of annual data to capture cyclical movements) to investigate the cyclicality of fiscal policy. The empirical literature involves studies of panels of countries which use aggregate measures of expenditures (either total or social expenditures). Only recent work (Busch et al. 2018), based on annual longitudinal micro-data, adopts a similar methodological approach as proposed in our research. Specifically, they examine the cyclicality of gross household earnings to post-government household earnings over 1976-2010. However, these authors work with three developed countries (Germany, Sweden, and the United States) and with aggregated measures of public spending.[6] We can observe that there is not much more information and analysis to extract from off-the-shelf data sources to help to analyse the pro-cyclicality of public policy in the developing world. Our work is a start to filling this gap, by using a novel dataset for Uruguay with quarterly frequency and focusing on the

[6] The three aggregate categories analysed by these authors are: labour-market-related policies, aid to low-income families and pension payments.

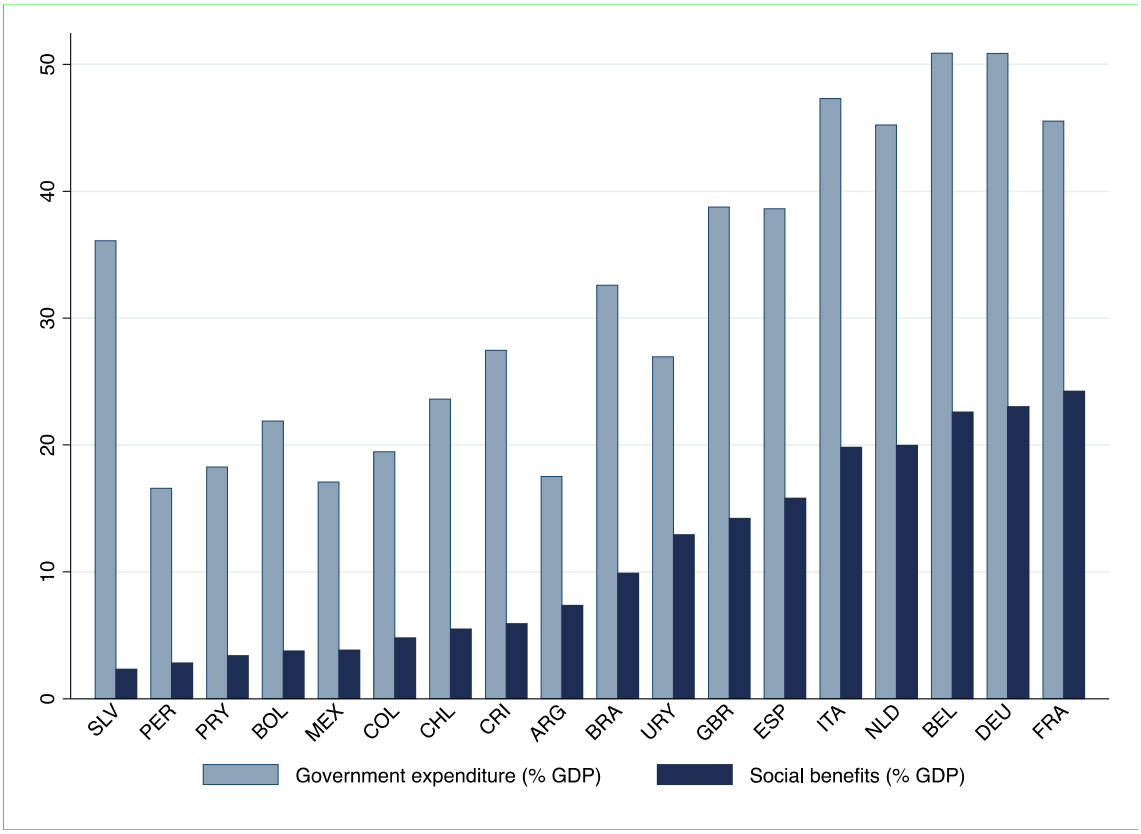
most important social cash transfer and benefits programs (covering the 100 per cent of social cash transfers).

### 2.3 The social transfer system in Uruguay

In Figure 1 we illustrate simple averages of general government spending and public social transfers (or social benefits) for a selected group of countries in LAC and Europe, over the whole 1988-2016 period. This figure provides comparative information on Uruguay with respect to the LAC region and Europe. The first point that arises from the figure is the large difference between government expenditures and social benefits as shares of GDP in LAC countries and the European economies. While the average government expenditures over the whole period in the LAC country sample is about 23% of GDP, in the European country sample is close to 45%; and the average social benefits spending is only 5.7% in LAC economies and 20% in European economies in terms of GDP. To sum, social fiscal transfers programs in LAC are substantially smaller than European countries.[7] So, if most of these programs respond as automatic stabilizers, may not have the counter-cyclical or a-cyclical fiscal policy effect over government expenditures as it may happen in the European countries (Michaud and Rothert 2018). And from an income redistribution perspective, given that these programs involve essentially the workers in the formal labour market, and LAC presents a high informal sector, particularly composed by poor people, they are excluded from most of the social transfers schemes (Lindert et al. 2006). On the other hand, among the sample of LAC countries El Salvador, Brazil and Costa Rica show the highest government spending, followed by Uruguay. In terms of public social transfers, Uruguay leads the social benefits spending, above 10% of the GDP on average, and 50% in terms of government expenditures.

[7] Huber et al (2008) examined the determinants of social spending in 18 Latin American countries for the period 1970-2000 and they emphasize the important role play by the level of democracy on the amount that governments spend on social transfers.

**Figure 1 – Government expenditure and social benefits for a selected group of countries (mean period 1988-2016, percentage of GDP)**




*Note:* Expenditure is measure at the General Government level. Values represents the averages of annual data in the period 1988-2016. Country abbreviation: SLV: El Salvador; PER: Peru; PRY: Paraguay; BOL: Bolivia; MEX: Mexico; COL: Colombia; CHL: Chile; CRI: Costa Rica; ARG: Argentina; BRA: Brazil; URY: Uruguay; GBR: Great Britain; ESP: Spain; ITA: Italy; NLD: Netherlands; BEL: Belgium; DEU: Germany; FRA: France.
*Source:* Own elaboration based on data from IMF.

*A briefly description of the social transfer system in Uruguay*

The Uruguayan social transfer system consists of a set of benefits that meet the needs of differentiated population groups in terms of demographics, economic activity status and income levels. This country has been characterized by having developed a social security system that, regionally speaking, has achieved an acceptable level of coverage, in terms of population covered and risks considered in legislation.

Over time, this country has had important developments in its social security system. The first social insurance was created at the end of the 19th century, and extended in the first half of the 20th century to cover the different sectors of activity and various short- and long-term risks. In general, this process was cumulative and decentralized (organized/operated independently by different collectivity's). However, in 1967 the Banco de Previsión Social (BPS) was created, with constitutional authority as an

independent institution. This centralized different retirement and pension funds throughout the century, granting the institution the role of coordinating governmental social welfare services and organizing the country's social security.

It is since the democratic restoration of 1985 that an organic structure of the social security system has been consolidated in this country, characterized by an important degree of centralisation in the BPS. The BPS, in addition to coordinating and executing the disability, old age and survivorship programs, also began to administer benefits for economically active persons. The individuals receiving this set of benefits include public employees as a whole, and private sector worker, whether employees or employers, and from almost all sectors of activity: rural, domestic service, industry, commerce, and services.

The main benefits currently in force are:

- benefits to individuals who are not active in economic activity (defined as benefits for those who are outside of economic activity): pensions, survivors' pensions, old age and disability pensions
- benefits to individuals who are active in the labour market (active benefits): unemployment insurance, and maternity and family allowances (*Asignaciones Familiares,* AFAM).

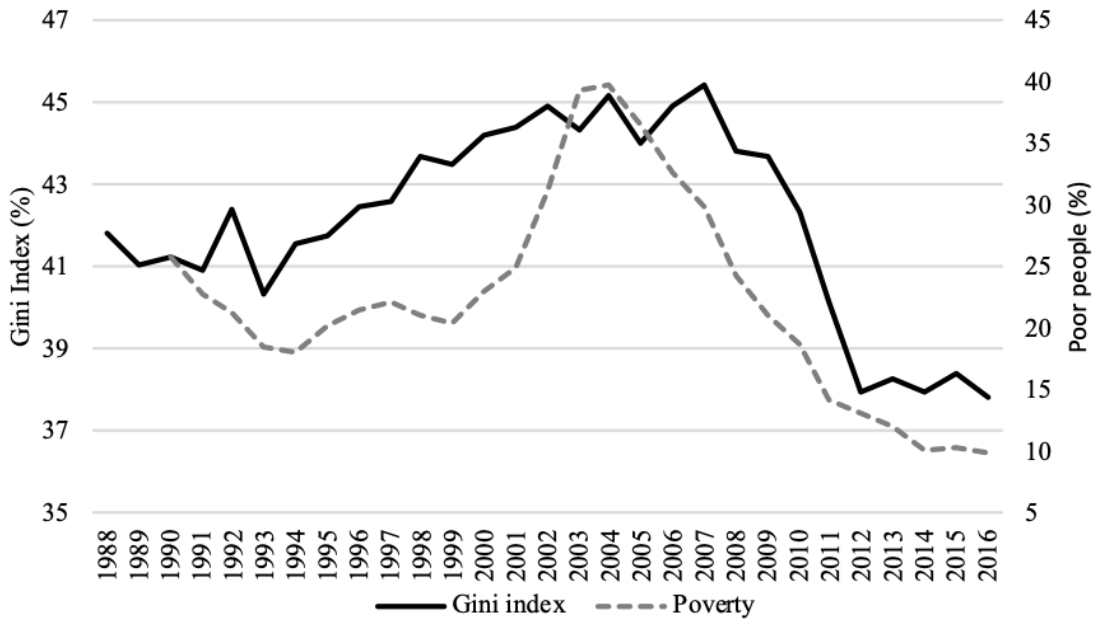
In the early days, the different benefits programmes were strongly linked to the contributory situation of the beneficiaries or their families. This type of survivors' pensions and disability benefits became widespread around 1950, unemployment insurance was created in 1958, AFAMs linked to private contributory workers were established by the law creating the Wage Councils in 1943, and old-age pensions emerged in 1919. Initially, these benefits packages were not conditional on the financial situation of households, with the exception of old-age pensions, the early emergence of which was linked to the poor coverage of the pension system. In 1995, however, AFAMs became a means-tested benefit.

At the beginning of the 21st century, a redesign of the benefits which were not linked to the contributory situation of the beneficiaries was introduced for low-income segments of the population.[8] These initiatives include the expansion, in 1999 and 2004, of the AFAM scheme for low-income households, the monetary benefit of the National Social Emergency Attention Plan (*Plan de Asistencia Nacional a la Emergencia Social*,

[8] See Amarante et al. (2014).

PANES) which covered a broad spectrum of non-contributory interventions, and the reformulation of the AFAMs within the framework of the Equity Plan launched in 2008. This second generation of benefits is subject to verification of means and conditionality to receive them. The verification of means is according to two main modalities: declaration of income below a certain threshold in the AFAM system that was in force until 2007, and deprivation indices based on household characteristics in the case of the Citizen Income (*Ingreso Ciudadano*) and the new AFAM system. In both cases, deprivation indices are combined with income thresholds. This new group of social cash benefits were principally aimed at reducing inequality and alleviating poverty in the context of economic growth. These policies have achieved considerable reductions in extreme poverty and drops in inequality levels (see Bucheli et al. 2014). In Figure 2 we detail the changes in inequality and poverty measures.

**Figure 2 – Evolution of poverty and inequality in Uruguay (1988-2016)**




*Source:* Own elaboration based on data from Instituto Nacional de Estadísticas (Uruguay).

A visual inspection of Figure 2 shows major decreases in these indicators, in the poverty case from 2004, and in the case of inequality from 2008. But, despite this notable progress, Uruguay still lags significantly behind OECD countries in terms of redistribution achieved through social spending tools (Lustig and Pereira 2016). In this sense, it is natural to ask about the fiscal sustainability of these policies. We believe that

the correct anti-cyclical design of the current system of non-contributory and contributory social cash transfers in Uruguay is an important part of the answer.

## 2.4 Data

Our analysis focuses on the case of Uruguay for which we have a novel complete and disaggregated database of contributory and non-contributory public social cash transfers for a sufficiently long period. The sample used consists of quarterly data on these transfers and economic variables of the Uruguayan economy for 1988/Q1 to 2016/Q3.[9]

Gross domestic product (GDP) comes from the Uruguayan Central Bank. Quarterly information on GDP is available from 1988/Q1 on, which determines the starting quarter of our period of analysis. Meanwhile, we cover 100 per cent of the contributory and non-contributory public social cash transfers implemented in Uruguay. All fiscal data is administrative information obtained from the BPS expressed in millions of Uruguayan pesos, which we convert into constant prices using the Consumer Prices Index (CPI) (base 2010=100) from the Instituto Nacional de Estadística (INE-Uruguay).

We define social cash transfers as the cash amount of public social benefits from the government to the population that is associated with social and economic risks. This is the sum of passive and active benefits.[10] The first category, passive benefits, includes old age pensions, survivors' pensions, temporary subsidies, and pensions for old age and disability, the last being the only non-contributory program. Old age refers to cash transfers to formal sector workers that have reached the retirement age; survivors' pensions are cash transfers to widows of formal workers and family members who meet specific requirements (such as physical disability); pensions for old age are cash transfers to people 65 and older with insufficient income; and temporary subsidies are associated with cash transfers related to specific injuries of workers.

The active benefits include illness subsidies, employment injury, unemployment subsidies, and maternity and family allowances, all of which contributory programs. Illness subsidies refers to cash transfers to formal workers with temporary illness; employment injury benefits are cash transfers to formal workers with total and permanent

[9] The definitions and sources of all variables are presented in Table A.1 and descriptive statistics in Table A.2, both in the Appendix A.
[10] Due to the availability of data, real GDP and passive benefits cover 1988/Q1-2016/Q3, while active benefits cover 1988/Q1-2015/Q4.

incapacity; unemployment subsidies are cash transfers to unemployed workers; maternity allowances refer to maternity and parental leave allowances and care for the parent; and, family allowances (AFAM) are cash benefits to the family based on the income level and also includes medical care for children and mothers.[11]

Table 1 provides a statistical overview of public spending and social cash transfers in Uruguay.

**Table 1 – Government spending and social cash transfers in Uruguay (averages, percentage of GDP)**

| | *1988/ 1989* | *1990/ 1994* | *1995/ 1999* | *2000/ 2004* | *2005/ 2009* | *2010/ 2014* | *2015* | *2016* |
|---|---|---|---|---|---|---|---|---|
| **Expense of Central Government** | **17.80** | **22.82** | **25.80** | **25.94** | **25.42** | **28.08** | **28.79** | **28.59** |
| **Current expenditure** | **15.48** | **20.49** | **23.04** | **23.27** | **22.51** | **24.94** | **26.48** | **26.07** |
| Compensation of employees | 3.10 | 4.06 | 4.61 | 4.75 | 4.67 | 4.93 | 4.99 | 4.75 |
| Non-personal expenditure | 2.32 | 3.05 | 3.50 | 3.53 | 3.97 | 3.59 | 3.75 | 3.70 |
| Social passive benefits | 6.96 | 9.31 | 10.39 | 10.52 | 8.71 | 8.88 | 9.38 | 9.71 |
| Transfers (*) | 3.10 | 4.06 | 4.54 | 4.47 | 5.16 | 7.54 | 8.35 | 8.19 |
| **Investment** | **2.32** | **2.49** | **2.77** | **2.67** | **2.91** | **3.13** | **2.31** | **2.24** |
| | ***Social cash transfers*** | | | | | | | |
| **A) Social Cash Transfers** | **7.67** | **9.91** | **11.02** | **11.28** | **9.43** | **9.90** | **10.64** | **9.71** |
| **A.1) *Passive benefits*** | **6.96** | **9.31** | **10.39** | **10.52** | **8.71** | **8.88** | **9.38** | **9.71** |
| *Contributive* | | | | | | | | |
| a. Old-age pensions | 5.31 | 7.18 | 7.86 | 7.70 | 6.14 | 6.25 | 6.68 | 6.93 |
| b. Survivor pensions (**) | 1.23 | 1.62 | 1.99 | 2.27 | 2.05 | 2.04 | 2.09 | 2.16 |
| *No contributive* | | | | | | | | |
| c. Pensions to old age and disability | 0.42 | 0.51 | 0.54 | 0.55 | 0.52 | 0.58 | 0.61 | 0.63 |
| **A.2) *Active benefits*** | **0.71** | **0.60** | **0.64** | **0.76** | **0.72** | **1.02** | **1.25** | ----- |
| *Contributive* | | | | | | | | |
| d. Illness subsidies | 0.11 | 0.10 | 0.08 | 0.08 | 0.09 | 0.20 | 0.27 | ----- |
| e. Unemployment | 0.14 | 0.20 | 0.26 | 0.34 | 0.20 | 0.33 | 0.49 | ----- |
| f. Maternity allowances | 0.05 | 0.04 | 0.05 | 0.05 | 0.05 | 0.07 | 0.13 | ----- |
| *No contributive* | | | | | | | | |
| g. Family allowances (***) | 0.40 | 0.25 | 0.24 | 0.29 | 0.38 | 0.42 | 0.37 | ----- |

*Notes:* (*) Include: active benefits, transfers to public entities, debt services, and affected rents. (**) Include: transitory subsidies. (***) Include: AFAM, PANES and *Plan de Equidad*.
*Source:* Own elaboration based on data from Ministerio de Economía y Finanzas and Banco de Previsión Social.

While the size of government was below 23% of GDP over 1988-1994, it reached 28% by the end of the sample period. The amount of contributory and non-contributory

[11] Family allowances were initially a contributory program, and then benefits were extended somewhat in the subsequent periods. Now, the main part of this program is the *Plan de Equidad*, a non-contributory program created in 2008 (Amarante et al. 2008).

cash transfers currently represents about 40% of total public expenditures, the passive benefits being the largest share of social transfers over the period.

Table 1 also shows the composition of the passive and active benefits by subcategory. Old age benefits were the largest item among passive social benefits (6% of GDP), followed by survivors' pensions (2% of GDP). In terms of active social benefits, family allowances and unemployment subsidies are the most important components of the active social benefits. However, their sum is less than 1% of GDP. Specifically, we find a key difference relative to developed countries in the size of unemployment insurance spending and family allowances. In Table 2 we compare the main cash transfer programs of Uruguay with the USA and other OECD countries.

**Table 2 – Public social cash transfers**
**(mean period 1988-2016, percentage of GDP)**

| | *Uruguay* | *United States* | *OECD** |
|---|---|---|---|
| *a. Old-age benefits* | 6.8 | 5.4 | 6.3 |
| *b. Unemployment subsidies* | 0.3 | 0.4 | 0.9 |
| *c. Family allowances* | 0.4 | 0.7 | 1.8 |

*Notes:* SOCX database provided annual data of the USA and OECD countries over 1988-2016 period.
(*) not included the United States.
*Source:* Own elaboration based on data from Ministerio de Economía y Finanzas, Banco de Previsión Social (Uruguay), and SOCX database.

We observe active social benefits to be very small as a share of GDP. Specifically, we find a key difference relative to OECD countries in the size of family allowances and unemployment insurance spending. For example, while unemployment insurance represents about 0.9 per cent of GDP in the OECD sample, it is barely 0.3 per cent in Uruguay. This asymmetry could reflect low unemployment insurance coverage in Uruguay.

## 2.5 Empirical strategy

The formal statistical treatment of our database, through time series analysis tools, allows us to obtain adequate information on the cyclicality of these variables, which may inform policy implications for the Uruguayan economy.[12] This section explains the procedure

[12] See, for example, Hamilton (2017).

we use to analyse the cyclical fluctuations of the social transfers and its components over the business cycle. First, we revise the seasonal adjustment techniques of the time series due to quarterly data being used. Second, we describe the detrending procedures we use to extract the unobservable cyclical component of the observable economic time series. Finally, we explain the properties of the cyclical fluctuations, and explore the nonlinear causal relationships between series.

The procedure allows us to decompose the observed series $Y_t$ into four unobservable components (Espasa and Cancelo 1993):

- $T_t$ is the trend, representing the long-term evolution of $Y_t$.
- $C_t$ is the cycle, corresponding to the systematic deviations of $Y_t$ with respect to the trend, displaying successive phases of expansion and recession.
- $S_t$ is the seasonal movement, including the regular and systematic intra-year oscillations of $Y_t$, such as quarterly, that repeats year by year.
- $I_t$ is an irregular component, referring to non-systematic oscillations or idiosyncratic shock.

A well-known decomposition of the observable time series $Y_t$ is:

$$Y_t = T_t . C_t . S_t . I_t \qquad t = 1, \dots, T \tag{1}$$

Let the natural logarithm of the previous expression (the observable time series $Y_t$) be denoted by $y_t$, and the unobservable components $\{T_t, C_t, S_t, I_t\}$ by $\{t_t, c_t, s_t, e_t\}$:

$$y_t = \tau_t + c_t + s_t + e_t \qquad t = 1, \dots, T \tag{2}$$

Removing the seasonal and irregular components from the series could make it possible to obtain the relevant features of the trend component of the cycle. The discussion in the literature is centred on two issues: the "seasonal adjustment," and that seasonal adjustment does not distinguish between trend and cycle, and the other deals with "cycle extraction" techniques (Canova 1998).

### *2.5.1 Seasonal adjustment*

The main objective of the seasonal adjustment process is to identify and subtract the seasonal components (fluctuations and intra-year effects) of the unadjusted time series, which can impede a clear interpretation of the time series movements. As a result, the seasonally adjusted series obtained is comprised of the trend, the cycle, and irregular components.

We examine signal extraction in a univariate time series context of an ARIMA data generating process. More specifically, we use both parametric and non-parametric methods. The parametric method decomposes the observable time series, assuming that each unobservable component follows a theoretical econometric model; in this case, the reference procedure is TRAMO-SEATS (Gómez and Maravall 1996). The non-parametric method analyses the real series decomposition but does not explicitly refer to any type of theoretical model of data generation. In this case, the most recent implemented method is X-13ARIMA-SEATS (US Census Bureau 2017).

### *2.5.2 Cycle extraction*

In the economic literature, there is controversy about which procedures to adopt to extract the cyclical component of the times series, so some researchers decided to implement alternative methods. In this vein, Canova (1998) removed the trend using different detrending techniques, and found that their results are sensitive to the selection of the procedure. In light of the aforementioned, and as robustness checks of our results, we apply four different trend-removing methods: Linear Trend (LT), Beveridge-Nelson filter (BN), Hodrick-Prescott (HP), and a Hamilton filter (Hf).

The LT method assumes that the trend component is a deterministic process, which is uncorrelated with the cyclical component, which can be represented with a first-degree polynomial function of time (Canova 1998). The BN, HP and Hf methods assume that the trend component is a stochastic process. Beveridge and Nelson's (1981) decomposition assumes that the trend component behaves as a unit root with drift and the cyclical component follows a stationary process, and both unobservable components are perfectly correlated. However, Kamber et al. (2017) show that it does not produce a reasonably accurate cycle component due to overestimation of parameters' contribution to the underlying trend in the variance decomposition. Therefore, they introduce a modified version of the decomposition that improves the detrending procedure, called a

BN filter, that uses a Bayesian framework (preceded by a "Minnesota" shrinkage). As for Hodrick and Prescott (1997), they assume that the trend is a smoothly stochastic process over the time, uncorrelated with the cyclical component. Finally, Hamilton (2017) proposes a linear regression of a non-stationary process based on the future value of the time series and the four most recent lags. Here, the estimated residual is the cyclical component that follows a stationary process, and is uncorrelated with the trend component.[13]

### *2.5.3 Cycle properties*

Once the cyclical component for each series is obtained, we first proceed with analysing the cyclical fluctuations of the series ($c_{it}$) itself and its relationship with the benchmark cycle series ($c_t^*$), in our case the GDP, through three kinds of analysis. First, we examine the standard deviation and the first order autocorrelation coefficient of each series $c_{it}$. The standard deviation is a measure of the absolute volatility (amplitude) of the cycle of each series relative to the trend. In addition, we consider the standard deviation of the cyclical component of one series divided by the standard deviation of a benchmark series, ($\sigma_{c_{it}} / \sigma_{c_{it}^*}$), which is a measure of relative volatility (deviation from the reference cycle).

Meanwhile, the first order autocorrelation coefficient of $c_{it}$ measures the persistence of the cyclical deviations from the trend. Secondly, we estimate the co-movements through the cross-correlation coefficients, $\rho_i(k)$, between the cyclical fluctuation of one series $c_{it}$ and the cyclical benchmark series $c_t^*$ at $t$. On the one hand, the value of $\rho_i(k)$ for $k=0$ shows the contemporaneous degree of co-movements of $c_{it}$ and $c_t^*$. A positive (negative) value of $\rho_i(0)$ indicates that $c_{it}$ is pro-cyclical (counter-cyclical). A value of $\rho_i(0)$ close to zero indicates a-cyclicality (non-correlation) between the two series. We follow Fiorito and Kollintzas (1994) who classify and denote the degree of contemporaneous co-movements as: "strong," for $0.5 \le |\rho_i(0)| < 1$; "weak" for $0.2 \le |\rho_i(0)| < 0.5$ and

[13] In Appendix B we describe the different alternatives detrending methods used to extract the trend and cycle from the observable time series – once the data has previously been seasonally adjusted and the irregular fluctuations are not substantial.

"uncorrelated" for $0 \leq |\rho_i(0)| < 0.2$. On the other hand, the values of $\rho_i(k)$ for $k \neq 0$ depict the phase changes of the cycles of $c_{it}$ and $c_t^*$. We say that $c_{it}$ is leading (or lagging) the $c_t^*$ if $\rho_i(k)$ reaches its maximum value when $k < 0$ ($k > 0$). If the maximum value of $\rho_i(k)$ is reached when $k = 0$, the two series synchronize. Finally, the existence of the correlation between variables does not necessarily imply causality. For this reason, we also analyse the temporal dependence between variables (effects of lagged variables on another variable). Several studies analyse the linear dependence relations between time series based on the Granger (1969) causality test. However, the Granger test is not useful to detect nonlinear causal relations which are common among economic variables. Therefore, we use a modified version of a nonlinear Granger causality test developed by Diks and Panchenko (2006).

## 2.6 Results[14]

First, we present the results of the seasonal adjustment, and then, the detrending methods used to extract the cyclical components of the economic time series. Second, we report the main effects of the cyclical properties on the social cash transfers and its components. Finally, nonlinear causality tests are developed.

### *2.6.1 Seasonal adjustment*

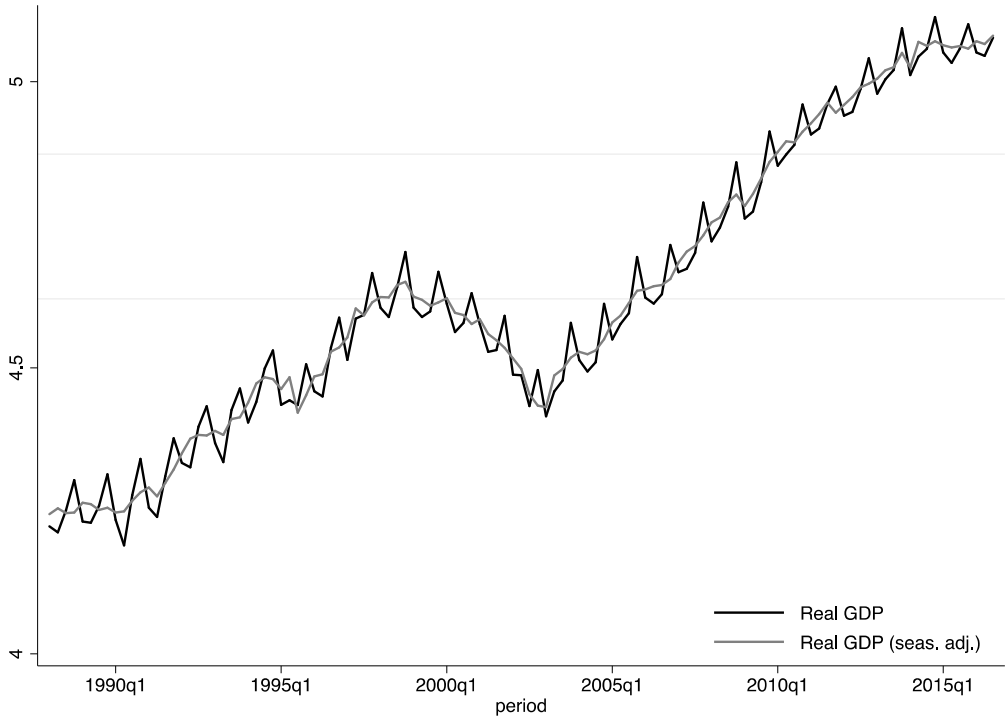
We use the TRAMO-SEATS method for the seasonal and calendar adjustment of official statistics. Formal diagnostics of seasonality suggest that there is seasonality of the social transfers variables (see Table C.1 in the Appendix C).[15] For this reason, we used the seasonal adjustment time series of the social transfers variables.

In general terms, a visual inspection of Figure 3 shows that both the natural logarithm of real GDP (panel a) and the social public cash transfers (panel b) series have systematic intra-year oscillations, i.e., seasonality, which are even more regular and pronounced in the case of real GDP. However, when the seasonal adjustment is performed over the entire observed series, the estimated series does not indicate seasonality.

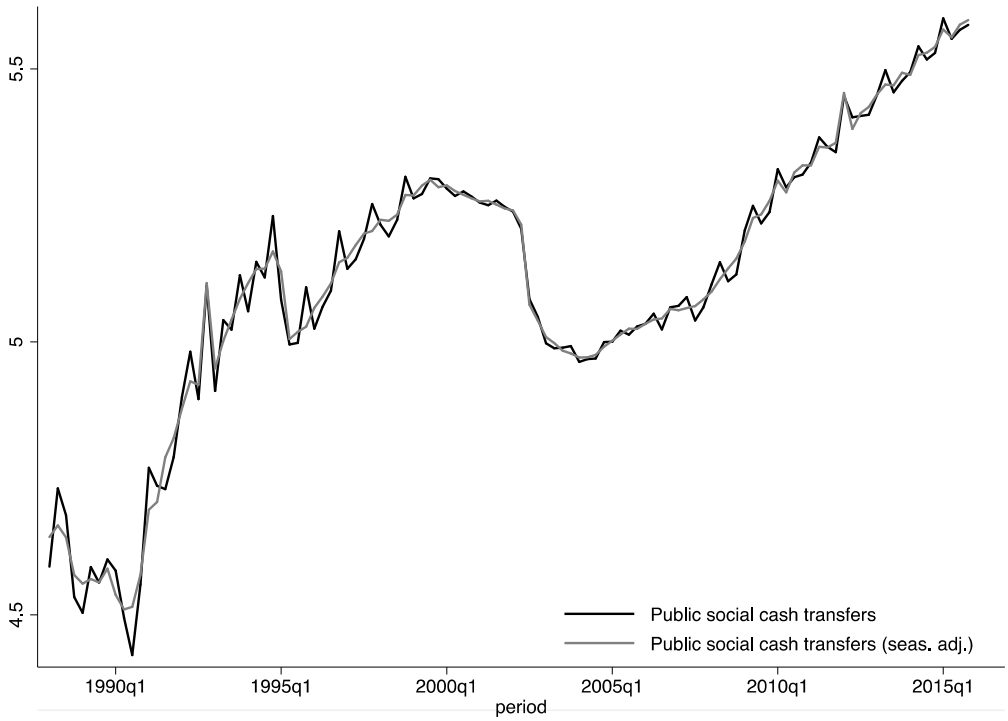
[14] Descriptive statistics of all variables are presented in Table A.2 of the Appendix A.
[15] Similar results are obtained using the X-13ARIMA-SEATS method, see Table C.2 of the Appendix C.

**Figure 3 – Real GDP and public social cash transfers seasonal adjustment (in logarithm)**

***Panel (a) Real GDP***




***Panel (b) Public social cash transfers***

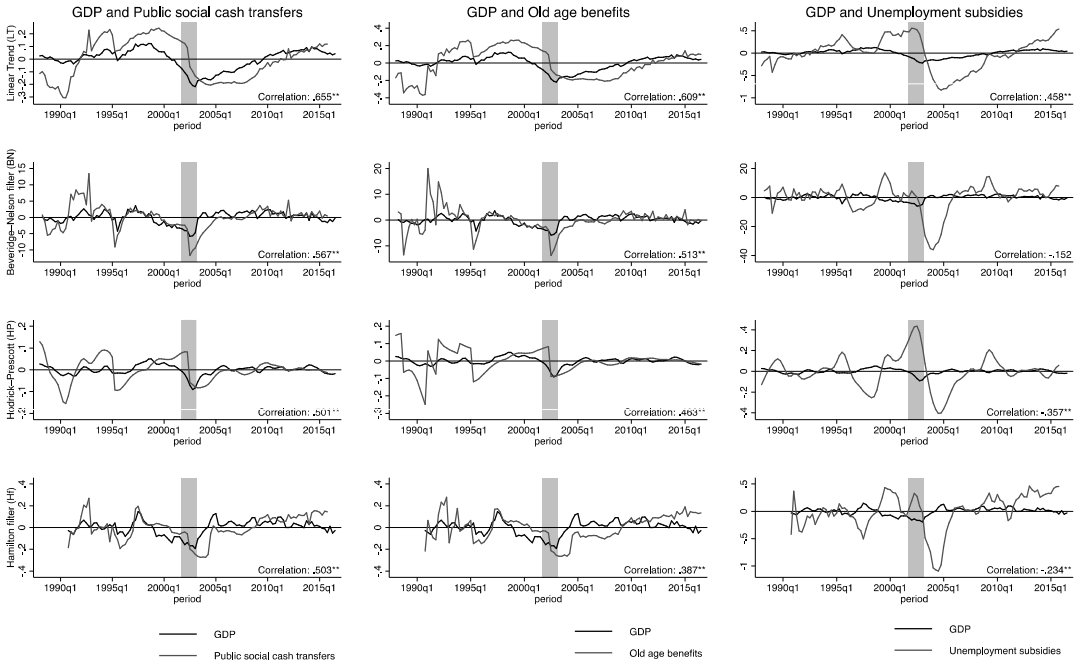



*Note:* Seasonal adjustment with TRAMO–SEATS.
*Source:* Own estimations based on data from Central Bank and Banco de Previsión Social (Uruguay).

### *2.6.2 Detrending methods*

Figure 4 displays the plots of the estimates of the cyclical components of real GDP, social transfers, old-age benefits, and unemployment subsidies, using the four different detrending methods. The plot representation allows to observe the co-movements of social transfers, old age benefits and unemployment subsidies with real GDP. The y-axis value equal to zero represents the trend, therefore, we see the fluctuations of the cyclical components around it. When the cycle takes a value above zero this indicates an expansion, whereas a value below zero indicates a recession.[16]

**Figure 4 – Cyclical components**




*Note:* Shaded area in the time series plots cover the year 2002, it illustrates the most important financial crisis in the Uruguayan economy. Real GDP (black line) and passive benefits (and its components) were estimated in the sample period 1988/Q1-2016/Q3; public social cash transfers and active benefits (and its components) were estimated in the sample period 1988/Q1-2015/Q4. The selected public social cash transfers categories are represented by column (grey line). Significance level: ** $\rho < 0.05$.
*Source:* Own estimations.

[16] The cyclical components of the other social cash transfers are illustrated in Figures C.1 and C.2 of Appendix C.

A visual inspection of Figure 4 allows to see that the patterns of the cyclical component of the series in terms of volatility (e.g., amplitude of the cycle peak from the trend), persistence (e.g., time between beginning of below-trend growth and recovery) and co-movements (e.g., dissimilarity in the number of lag periods). First, all the detrending methods adequately identify the crisis episode of 2002 with the real GDP cycle below its trend; the cyclical components are below zero. Secondly, independently of the trend-removing procedures, social fiscal cash transfers and its components are in sync with or lag the business cycle. Finally, the cyclical components' patterns do not indicate a path with low smoothness, as the HP filter shows.

### *2.6.3 Cycle properties*

#### *2.6.3.1 Volatility and persistence*

We focus on the properties of the cyclical components of the social cash transfers variables, first analysing the volatility and persistence of each series itself, and then the correlation with real GDP. Table 3 illustrates the results for absolute and relative volatility, and the persistence of the real GDP and the social cash transfers components considered.

## Table 3 – Volatility and persistence of public social cash transfers and real GDP cycles in Uruguay

| ***Property\Variable*** | ***GDP*** | ***Public social cash transfers*** | ***Passive benefits*** | *Old age* | *Survivors pensions* | *Pension to old age and disability* | ***Active benefits*** | *Illness subsidies* | *Unemployment subsidies* | *Maternity allowances* | *Family allowances* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | *(1)* | *(2)* | *(3)* | *(4)* | *(5)* | *(6)* | *(7)* | *(8)* | *(9)* | *(10)* | *(11)* |
| *Method: Linear Trend (LT)* | | | | | | | | | | | |
| *Absolute volatility* | 0.080 | 0.160 | 0.167 | 0.176 | 0.152 | 0.149 | 0.221 | 0.415 | 0.349 | 0.297 | 0.250 |
| *Relative volatility* | --- | 2.000 | 2.088 | 2.200 | 1.900 | 1.863 | 2.763 | 5.188 | 4.363 | 3.713 | 3.125 |
| *Persistence* | 0.973 | 0.964 | 0.938 | 0.944 | 0.946 | 0.944 | 0.950 | 0.976 | 0.959 | 0.888 | 0.871 |
| *Method: Beveridge-Nelson filter (BN)* | | | | | | | | | | | |
| *Absolute volatility* | 1.829 | 3.687 | 4.483 | 4.502 | 4.203 | 4.108 | 5.627 | 6.319 | 9.939 | 8.416 | 8.179 |
| *Relative volatility* | --- | 2.016 | 2.451 | 2.461 | 2.298 | 2.246 | 3.077 | 3.455 | 5.434 | 4.601 | 4.472 |
| *Persistence* | 0.815 | 0.747 | 0.551 | 0.568 | 0.672 | 0.623 | 0.865 | 0.913 | 0.908 | 0.291 | 0.539 |
| *Method: Hodrick-Prescott (HP)* | | | | | | | | | | | |
| *Absolute volatility* | 0.023 | 0.054 | 0.052 | 0.066 | 0.052 | 0.048 | 0.076 | 0.091 | 0.156 | 0.108 | 0.099 |
| *Relative volatility* | --- | 2.362 | 2.262 | 2.86 | 2.271 | 2.109 | 3.297 | 3.987 | 6.808 | 4.696 | 4.336 |
| *Persistence* | 0.919 | 0.874 | 0.767 | 0.699 | 0.782 | 0.847 | 0.915 | 0.933 | 0.948 | 0.375 | 0.808 |
| *Method: Hamilton (Hf)* | | | | | | | | | | | |
| *Absolute volatility* | 0.068 | 0.114 | 0.118 | 0.119 | 0.107 | 0.131 | 0.201 | 0.240 | 0.336 | 0.248 | 0.225 |
| *Relative volatility* | --- | 1.689 | 1.751 | 1.764 | 1.584 | 1.944 | 2.973 | 3.550 | 4.975 | 3.677 | 3.330 |
| *Persistence* | 0.867 | 0.839 | 0.788 | 0.766 | 0.822 | 0.844 | 0.882 | 0.851 | 0.875 | 0.794 | 0.834 |

*Note:* Absolute volatility measures the cycle amplitude from the trend for each series; Relative volatility measures the cycle amplitude of the series w.r.t. the benchmark series; Persistence shows the degree of inertia of the cycle to reach the trend. Real GDP and passive benefits (and its components) were estimated in the sample period 1988/Q1-2016/Q3; public social cash transfers and active benefits (and its components) were estimated in the sample period 1988/Q1-2015/Q4.
*Source:* Own estimations.

We observe that the economic cycle (column 1) is less volatile than the social cash transfers series (column 2 to 11), both in absolute and relative terms across the trend-removal procedure. For instance, according to the Hf method, the absolute volatility of the GDP cycle component is 6.8% (column 1) and the absolute volatility of the social cash transfers cycle component is 11.4% (column 2). Meanwhile passive benefits and its categories are shown to have similarly high volatility, and active benefits has lower volatility than its components. Among social cash transfers components, the highest relative volatility among categories of passive social benefits is old age (for formal workers), while illness subsidies and unemployment subsidies have highest volatility among active social benefits categories.

In Table 3 we can also see that the majority of the components of the fiscal transfers series have high persistence. For instance, social cash transfers have a first order autocorrelation coefficient of between 0.75 and 0.96 across the trend-removing methods.

*2.6.3.2 Co-movements and phase changes*

Table 4 presents the co-movements and phases changes between the cyclical components of social cash transfers variables and the real GDP cycle (the point of comparison/reference).

The contemporaneous co-movements suggest strong pro-cyclicality of social cash transfers (column 1). Passive benefits in this case have strong pro-cyclicality ranging from 0.44 to 0.60. Similarly, old-age benefits vary from 0.39 to 0.61, survivors' pensions from 0.43 to 0.51, and pension for old age and disability by between 0.59 and 0.85.

However, the co-movements of active benefits (appear to) differ by more than passive benefits. While the BN, HP and Hf trend-removal procedures indicate a-cyclicality of social benefits to those defined as economically active, the LT method shows strong pro-cyclicality (column 6). Similarly, the co-movements of the different components of active benefits (columns 7 to 10) are sensitive to the trend-removal procedures. However, we found some facts in common. The results for illness subsidies vary from 0.51 to 0.74 and maternity allowances by between 0.29 and 0.76, both categories being pro-cyclical. In the case of unemployment subsidies, they behave weakly counter-cyclically by HP (-0.36) and Hf (-0.23) procedures and appear a-cyclical by BN (-0.15). In other words, they have limited performance as automatic stabilizers of the macroeconomic cycles.

To sum up, we have a systematic relationship between short-term fluctuations of the social cash transfers' components and the business cycle. Consequently, instead of contributing to stabilizing the Uruguayan economy, they have aggravated the business cycle. Similarly, these pro-cyclical patterns are followed by some components of active benefits, such as illness subsidies, maternity allowances, and to a lesser extent, family allowances. Moreover, the most important social transfers component to conduct a counter-cyclical fiscal policy, unemployment subsidies, has unclear results regarding cyclicality. Therefore, due to social transfers being generally associated with governmental goals of income maintenance and poverty reduction, we can infer that the design of social fiscal policy in Uruguay has not had the desired effect on the most economically vulnerable groups.

## Table 4 – Co-movements and phases changes of public social cash transfers in Uruguay

| ***Property\Variable*** | ***Public social cash transfers*** | ***Passive benefits*** | *Old age* | *Survivors' pensions* | *Pension to old age and disability* | ***Active benefits*** | *Illness subsidies* | *Unemployment subsidies* | *Maternity allowances* | *Family allowances* |
|---|---|---|---|---|---|---|---|---|---|---|
| | *(1)* | *(2)* | *(3)* | *(4)* | *(5)* | *(6)* | *(7)* | *(8)* | *(9)* | *(10)* |
| | | | | | *Method: Linear Trend (LT)* | | | | | |
| *Co-movements (k = 0)* | 0.655** | 0.601** | 0.609** | 0.431** | 0.851** | 0.607** | 0.744** | 0.458** | 0.761** | 0.226** |
| *Lead (-)/Lags (+) (k)* | 0.724 (k = 4) | 0.659 (k = 5) | 0.676 (k = 5) | 0.485 (k = 5) | 0.876 (k = 2) | 0.768 (k = 5) | 0.754 (k = 1) | 0.870 (k = 8) | 0.845 (k = 3) | 0.267 (k = -6) |
| | | | | | *Method: Beveridge-Nelson filter (BN)* | | | | | |
| *Co-movements (k = 0)* | 0.567** | 0.514** | 0.513** | 0.506** | 0.623** | 0.059 | 0.518** | -0.152 | 0.299** | 0.077 |
| *Lead (-)/Lags (+) (k)* | 0.576 (k = 1) | 0.502 (k = 1) | 0.503 (k = 1) | 0.508 (k = 1) | 0.613 (k = 1) | 0.624 (k = 5) | 0.648 (k = 3) | 0.690 (k = 8) | 0.443 (k = 3) | 0.232 (k = -6) |
| | | | | | *Method: Hodrick-Prescott (HP)* | | | | | |
| *Co-movements (k = 0)* | 0.501** | 0.504** | 0.463** | 0.493** | 0.588** | -0.029 | 0.512** | -0.357** | 0.292** | 0.211** |
| *Lead (-)/Lags (+) (k)* | 0.528 (k =1) | 0.531 (k = 1) | 0.489 (k = 1) | 0.521 (k = 1) | 0.615 (k = 1) | 0.654 (k = 6) | 0.702 (k = 3) | 0.713 (k = 7) | 0.493 (k = 4) | 0.211 (k = 0) |
| | | | | | *Method: Hamilton (Hf)* | | | | | |
| *Co-movements (k = 0)* | 0.503** | 0.436** | 0.386** | 0.508** | 0.638** | 0.062 | 0.614** | -0.234** | 0.465** | 0.232** |
| *Lead (-)/Lags (+) (k)* | 0.564 (k = 2) | 0.519 (k = 2) | 0.469 (k = 2) | 0.578 (k = 2) | 0.671 (k = 1) | 0.662 (k = 7) | 0.671 (k = 3) | 0.663 (k = 8) | 0.673 (k = 4) | 0.298 (k = -6) |

*Note:* Real GDP benchmark series. $k$ is the cross-correlation order in quarter frequency. Co-movements $\rho_i(0)$: (+) procyclicality, (-) countercyclicality, 0 a-cyclicality. Synchronize: if the maximum value of $\rho_i(k)$: involves $k < 0$, $k = 0$, $k > 0$, the series lead, synchronize, and lags the reference series (respectively). Real GDP and passive benefits (and its components) were estimated in the sample period 1988/Q1-2016/Q3; public social cash transfers and active benefits (and its components) were estimated in the sample period 1988/Q1-2015/Q4. Significance level: ** $\rho < 0.05$.
*Source:* Own estimations.

Table 4 also documents different phases (lead/lags) of social transfers series over the business cycle, where the $k$ value represents the order of the duration of the time lags, and the respective cross-correlations between those lags and other components of the cycle. We observe that the aggregate of social transfers (column 1) lags the business cycle by between 1 to 4 quarters, depending on the trend-removal method. For example, Hf shows that real GDP at time $t$ has a positive effect on the future level of social transfers, reaching the highest point at two lags (after six months). The main sequence of events and relations within this are expressed as follows: we first have a peak (or slump) in the cyclical fluctuation of the business cycle, and then a peak (or slump) two quarters later in the cyclical movements of social cash transfers. In addition, real GDP is positively cross-correlated with passive benefits and its components, which lag the real GDP cycle by 1 to 5 quarters. Also, active benefits lag the business cycle by 5 to 7 quarters. Regarding the categories of active benefits, unemployment subsidies programs are negatively correlated with the macroeconomic cycle and lag it by 7 to 8 quarters. In this sense, we first have a slump (or peak) in the business cycle, and then 7 to 8 quarters later a peak (or slump) in the cyclical variations in unemployment subsidies.

#### *2.6.3.3 Causality*

The results of the nonlinear Granger causality test are shown in Table 5. Given that social transfers and its components lag the business cycle, we aim to find unidirectional causality from GDP to social transfers (or its components). If this unidirectional causality is demonstrated, this would reject the null hypothesis that GDP does not nonlinearly Granger-cause social transfers (or its components) and fail to reject the null hypothesis that social transfers (or its components) do not nonlinearly Granger-cause GDP.

## Table 5 – Results of nonlinear Granger causality test

| *Null hypothesis* | *LT* | *BN* | *HP* | *Hf* |
|---|---|---|---|---|
| *GDP does not cause public social cash transfers* | 1.060 [0.1446] | 1.929 [0.0268] | 0.894 [0.1856] | 1.305 [0.0960] |
| *Public social cash transfers do not cause GDP* | 1.056 [0.1453] | 0.157 [0.4377] | 1.679 [0.0465] | 0.680 [0.2483] |
| *GDP does not cause passive benefits* | 0.633 [0.2634] | 2.253 [0.0121] | 1.678 [0.0466] | 0.162 [0.5641] |
| *Passive benefits do not cause GDP* | 1.499 [0.0669] | 0.919 [0.1790] | 1.084 [0.1391] | 0.565 [0.2859] |
| *GDP does not cause old age benefits* | 1.028 [0.1520] | 1.816 [0.0346] | 1.173 [0.1203] | 0.156 [0.4379] |
| *Old age benefits do not cause GDP* | 1.245 [0.1066] | 0.940 [0.1735] | 1.025 [0.1526] | 1.325 [0.0926] |
| *GDP does not cause survivors´ pensions* | 1.039 [0.8506] | 2.031 [0.0211] | 0.618 [0.2682] | 0.800 [0.2117] |
| *Survivors´ pensions do not cause GDP* | 2.028 [0.0212] | 1.067 [0.1429] | 1.574 [0.0577] | 1.355 [0.0877] |
| *GDP does not cause pensions to old age and disabilities* | 1.027 [0.1522] | 2.670 [0.0037] | 1.822 [0.0342] | 0.833 [0.2024] |
| *Pensions to old age and disabilities do not cause GDP* | 1.363 [0.0865] | 2.118 [0.0170] | 1.400 [0.0807] | 1.401 [0.0806] |
| *GDP does not cause active benefits* | 1.266 [0.1027] | 1.957 [0.0251] | 1.760 [0.0391] | 1.249 [0.1057] |
| *Active benefits do not cause GDP* | 0.265 [0.6044] | (0.462) [0.6779] | 1.512 [0.0652] | 0.961 [0.1684] |
| *GDP does not cause illness subsidies* | 1.291 [0.0984] | 1.770 [0.0383] | 2.045 [0.0204] | 1.975 [0.0241] |
| *Illness subsidies do not cause GDP* | 0.155 [0.5615] | 0.297 [0.3833] | 1.229 [0.1094] | 0.578 [0.2816] |
| *GDP does not cause unemployment subsidies* | 2.036 [0.0208] | 1.453 [0.0731] | 1.588 [0.0560] | 1.902 [0.0286] |
| *Unemployment subsidies do not cause GDP* | 1.707 [0.0438] | 0.577 [0.2818] | 1.833 [0.0333] | 0.845 [0.1991] |
| *GDP does not cause maternity allowances* | 2.646 [0.0040] | 2.329 [0.0099] | 0.608 [0.2714] | 1.298 [0.0971] |
| *Maternity allowances do not cause GDP* | 1.119 [0.8683] | 0.825 [0.2045] | 1.016 [0.1547] | 1.436 [0.0755] |
| *GDP does not cause family allowances* | 0.280 [0.6102] | 0.444 [0.3285] | 2.018 [0.0217] | 0.906 [0.1824] |
| *Family allowances do not cause GDP* | 1.293 [0.0979] | 0.736 [0.2307] | 0.253 [0.3999] | 0.736 [0.2307] |

*Note:* The null hypothesis is that one series does not nonlinearly Granger cause the other series. T-statistics is illustrated in absolute value and p-value is reported in brackets. Following Kollias et al. (2017), the lag length used for the nonlinear causality test and the Bandwidth are set to one. In the case of the Bandwidth, values less (more) than 1 result in larger (smaller) p-values (Bekiros and Diks 2008).
*Source:* Own estimations.

Briefly summarizing the main findings, we obtained evidence of unidirectional nonlinear causality from real GDP to social transfers by {BN}, from real GDP to passive benefits by {BN, HP}, from real GDP to old-age benefits by {BN}, from real GDP to active benefits by {BN, HP}, from real GDP to unemployment subsidies by {Hf}, from real GDP to maternity allowances by {LT, BN}, among other causality relationships. I.e., we have detected an impact of the macroeconomic cycle on social transfers and its components. This allows us to state that there are certain fiscal policy responses involving social transfers caused by the economic activity phases.

## 2.7 Empirical extensions

In this section we perform two important additional exercises. First, in order to analyse whether the magnitudes and signs of cyclicality found for Uruguay are relevant, we performed a comparative exercise between Uruguay and the United States. Second, we more deeply investigate the importance of the institutional settings that could influence the cyclicality of social cash transfers in Uruguay.[17]

### *2.7.1 The relevance of pro-cyclicality in Uruguay: A comparative analysis with the United States*

Table 6 shows the co-movements and phases changes of social transfers in Uruguay and the United States over 1988/Q1 to 2016/Q3. Here, our point of reference is the available social transfers categories for the United States, which includes passive social benefits, unemployment subsidies, and family allowances.[18]

[17] Also, we perform robustness checks deflating all social fiscal transfers series by the GDP price deflator instead of CPI. Very similar results to those observed in Table 4 are obtained. These results are not reported for brevity, but are available upon request.

[18] The Bureau of Economic Analysis provides data on government social benefits (quarterly data in millions of seasonally adjusted dollars). We analyse the following available categories: social security (which includes old-age, survivors', and disability insurance benefits), unemployment insurance and family assistance. Additionally, real GDP is obtained from Federal Reserve Economic Data (FRED) of St. Louis (quarterly data in millions of seasonally adjusted chained 2012 dollars). Similarly, the CPI is obtained from FRED, index 2012 = 100, quarterly data.

**Table 6 – Co-movements and phases changes of selected public social cash transfers in Uruguay and the United States**

| *Property\Variable* | *Passive benefits* | | *Unemployment subsidies* | | *Family allowances* | |
|---|---|---|---|---|---|---|
| | *Uruguay* | *United States* | *Uruguay* | *United States* | *Uruguay* | *United States* |
| *Method: Linear Trend (LT)* | | | | | | |
| *Co-movements (k = 0)* | 0.601** | -0.551** | 0.458** | -0.319** | 0.226** | -0.643** |
| *Lead (-)/Lags (+) (k)* | 0.659 (k = 5) | -0.556 (k = 1) | 0.870 (k = 8) | -0.388 (k = -4) | 0.267 (k = -6) | -0.643 (k = 1) |
| *Method: Beveridge-Nelson filter (BN)* | | | | | | |
| *Co-movements (k = 0)* | 0.514** | -0.321** | -0.153 | -0.597** | 0.077 | -0.361** |
| *Lead (-)/Lags (+) (k)* | 0.502 (k = 1) | -0.321 (k = 0) | 0.690 (k = 8) | -0.623 (k = 1) | 0.232 (k = -6) | -0.440 (k = 4) |
| *Method: Hodrick-Prescott (HP)* | | | | | | |
| *Co-movements (k = 0)* | 0.504** | -0.439** | -0.357** | -0.805** | 0.211** | -0.348** |
| *Lead (-)/Lags (+) (k)* | 0.531 (k = 1) | -0.439 (k = 0) | 0.713 (k = 7) | -0.809 (k = 1) | 0.211 (k = 0) | -0.353 (k = 1) |
| *Method: Hamilton (Hf)* | | | | | | |
| *Co-movements (k = 0)* | 0.436*** | -0.739** | -0.234** | -0.749** | 0.232** | -0.412** |
| *Lead (-)/Lags (+) (k)* | 0.519 (k = 2) | -0.757 (k = 1) | 0.663 (k = 8) | -0.749 (k = 1) | 0.298 (k = -6) | -0.455 (k = 2) |

*Note:* Real GDP benchmark series $k$ is the cross-correlation order in quarter frequency. Co-movements $\rho_i(0)$: (+) pro-cyclicality, (-) counter-cyclicality, 0 a-cyclicality. Synchronize: if the maximum value of $\rho_i(k)$: involves $k < 0$, $k = 0$, $k > 0$, the series lead, synchronize, and lags the reference series (respectively). Real GDP and passive benefits were estimated in the sample period 1988/Q1-2016/Q3; unemployment benefits and family allowances were estimated in the sample period 1988/Q1-2015/Q4. Significance level: ** $\rho < 0.05$.
*Source:* Own estimations.

A visual inspection of Table 6 allows us to observe two very important points. First, the comparison of the sign of the estimated coefficients is extremely important. In contrast with Uruguay, the United States is shown as having a clearly counter-cyclical fiscal policy design.[19] In this sense, we can see that these expenditures have a strong anti-cyclical component in this economy. Second, the magnitude of the estimated coefficients, for both countries, reveals the importance of the cyclicality of these different social transfer programs. While the coefficients on passive benefits are similar in both countries, highlighting the importance of such social transfers in both countries, the coefficients of both unemployment insurance and family allowances are significantly lower in Uruguay, which additionally highlights the suboptimal design of these policies in relation to the economic cycle in Uruguay.

### *2.7.2 Pro-cyclicality of social transfers: The importance of institutional settings*

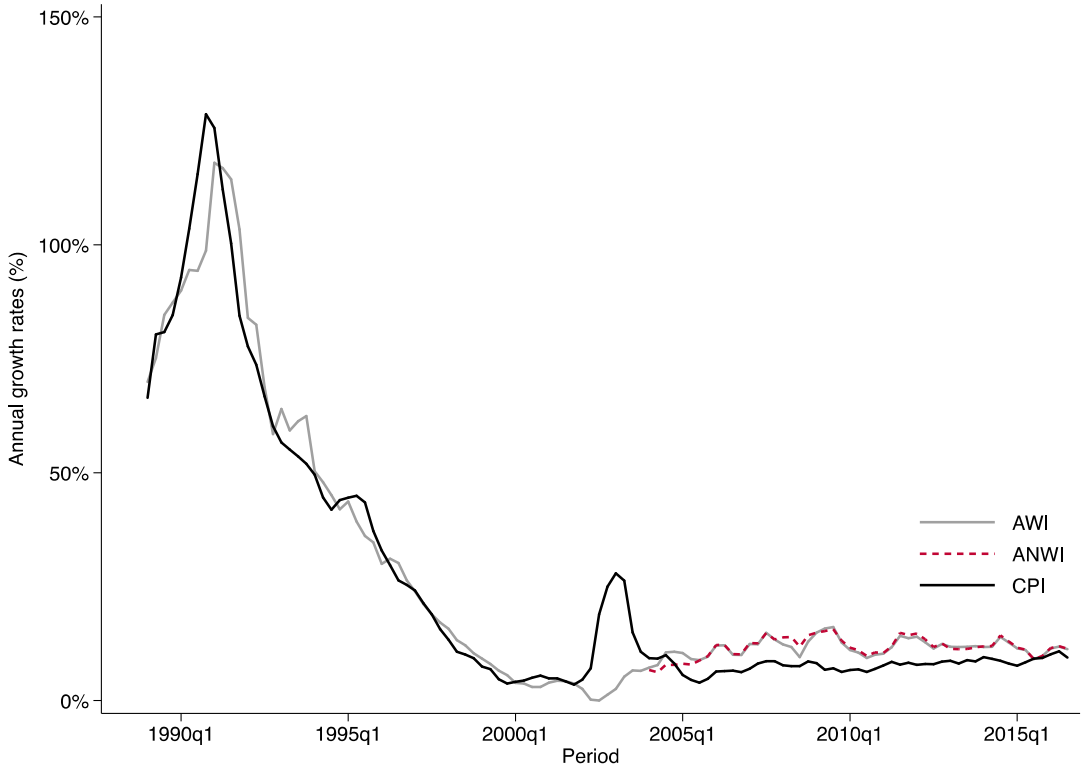
Here we analyse more deeply why social cash transfers increase in good times and fall in bad times in Uruguay. One main reason may lie in the indexing formulas of the social cash transfers. Most industrial countries have formulas that index social security benefits to nominal price inflation (measured through temporal CPI variations) -- after all, the purchasing power of retirees should ideally be preserved over time. Unfortunately, that was not the case for the prevailing social security system in Uruguay. In this country, old age and survivors' pensions were updated by the national Average Wage Index (AWI) from 1990 to 2002, and since 2003 by the Average Nominal Wage Index (ANWI), both of which are set according to regulatory laws.[20] In the case of family allowances, from 1988 to 2003 these were indexed to the minimum wage, and from 2004 to date contributory child allowances are adjusted on the basis of *Base de Prestaciones Contributivas*.[21]

[19] For similar results for the United States, and explanations of counter-cyclicality of transfer policies in this country, see Busch et al. (2018, pp. 28-30).
[20] The AWI was established by Law No. 13,728 in 1968 with the objective of estimating changes to the current income of permanent workers as reflected by dependency of the public and formal private sectors. The ANWI was established by Law No. 17,649 in 2003, its objective being to adjust pensions and retirements in accordance with the provisions of Article 67 of the Constitution of the *República Oriental del Uruguay*. The AWI and the ANWI differ in that the latter does not deduct the legal discounts charged to the worker.
[21] The *Base de Prestaciones y Contribuciones* (BPC) is an index used to adjust taxes, income, and social benefits since 2005 (Article 2 of Law No. 17,856).

Note that, typically, real wages grew faster during the economic expansions and less during the economic recessions. Thus, this indexing mechanism could introduce a substantial pro-cyclical component to old age and survivors' pensions in Uruguay. Figure 5 illustrates the evolution of the annual growth rates of the AWI, ANWI and CPI over 1988/Q1 to 2016/Q3. Some important points can be noted in observing the figure. First, no relevant difference is detected in the growth rates of the two wage indices. Second, it can be seen that the growth rates of the AWI and CPI follow a similar trajectory up to 2001, and then both indices began to experience a sharply different evolution. During the financial crisis in Uruguay over 2002-2004, the CPI growth rates are higher than the AWI and ANWI, but since 2004, wage indices clearly depict a more inflationary situation than the CPI. This last point is important due to growth rates of wage indices being applied as a reference index to update the amounts of the old age and survivors' pensions, generating an increase in their real values, and it is therefore likely that this has increased their pro-cyclicality.[22]

[22] For a good comparative analysis about these reform policies and their effects in LAC countries, see Kay (1999). This new indexing formula in Uruguay, together with the statements made by Forteza (2004) and Forteza and Ourens (2012), that one-fifth of the pensioners had not contributed to the system and added to the aging demographic structure of the country, imply imposing severe restrictions on public social spending in Uruguay. According to these authors, such expenditure increased in weight relative to GDP by 4 percentage points.

**Figure 5 – Evolution of average wage index, average nominal wage index, and consumer price index over the period 1988/Q1-2016/Q3 (annual growth rates, percentage)**




*Note:* ANWI was established in 2003.
*Source:* Own elaboration based on data from Instituto Nacional de Estadística (Uruguay).

In order to analyse this scenario, we examine the implications of updating old age benefits, survivors' pensions and family allowances by using the CPI rather than wage indices. This allows us to see if social transfers components are pro-cyclical due to the indexing formulas. To do so, we indexed the original series by dividing them by the AWI/CPI ratio, avoiding the AWI effect and substituting it with an increase equivalent to the CPI.

**Table 7 – Co-movements of a selected social transfers components in Uruguay: Comparing different indexing formulas**

| *Property\Variable* | *Old-age benefits* | | *Survival pensions* | | *Family allowances* | |
|---|---|---|---|---|---|---|
| | *Benchmark* | *AWI/CPI* | *Benchmark* | *AWI/CPI* | *Benchmark* | *AWI/CPI* |
| *Method: Linear Trend (LT)* | | | | | | |
| *Co-movements (k = 0)* | 0.609** | 0.080 | 0.431** | 0.025 | 0.266** | -0.137 |
| *Method: Beveridge-Nelson filter (BN)* | | | | | | |
| *Co-movements (k = 0)* | 0.513** | 0.188** | 0.506** | 0.175 | 0.077 | -0.104 |
| *Method: Hodrick-Prescott (HP)* | | | | | | |
| *Co-movements (k = 0)* | 0.463** | 0.221** | 0.493** | 0.244** | 0.211** | -0.124 |
| *Method: Hamilton filter (Hf)* | | | | | | |
| *Co-movements (k = 0)* | 0.386** | 0.363** | 0.508** | 0.302** | 0.232** | 0.104** |

*Note:* Co-movements $\rho_i(0)$: (+) pro-cyclicality, (-) counter-cyclicality, 0 a-cyclicality. Real GDP and passive benefits were estimated in the sample period 1988/Q1-2016/Q3; family allowances were estimated in the sample period 1988/Q1-2015/Q4
Significance level: ** $\rho < 0.05$.
*Source:* Own estimations.

Table 7 shows the co-movements of the selected social transfers series, for the case of the benchmark case (from Table 3, AWI as the indexing mechanism) and the CPI indexing mechanism. Meanwhile, the contemporaneous co-movements suggest strong pro-cyclicality of old age and survivors' pensions in the benchmark case, and the CPI indexing case shown suggests an a-cyclical or a much more moderately pro-cyclical pattern. In the case of family allowances, our results report clear evidence of a-cyclicality. In this context, we can deduce that the indexing formulas play an important role in the pro-cyclicality of the social cash transfers variables in Uruguay.

## 2.8 Conclusions

In this paper, we analyse how a significant component of the public budget, namely contributory and non-contributory social cash transfers, has been handled over the business cycle in Uruguay. We observe that social cash transfers behave pro-cyclically and lagged the business cycle, thereby exacerbating expansions and recessions of the business cycle and exposing vulnerable economic groups to more adverse conditions. In particular, we identified that the pro-cyclicality has been led by old-age benefits and survivors' pensions. Moreover, significant causality relationships were detected, such as from real GDP to old-age benefits and from real GDP to unemployment subsidies.

As we explored further, we were able to observe that the cyclicality of the major components of social cash transfers, such as old-age benefits, survivors' pensions and family allowances, is largely explained by the indexing mechanism used in Uruguay. Specifically, if these items were updated by the CPI instead of being indexed by wages, their pro-cyclicality would become much more moderate or even a-cyclical.

We therefore believe that satisfying social demands and fiscal strengthening can be attained in Uruguay through a correct cyclical design of social cash transfers rather than the standard solution of spending cuts to achieve fiscal sustainability. Large drops in public social transfers could wipe out the social gains achieved during the good years and, in some instances, rekindle widespread social tensions. In fact, it is crucial to carefully manage redistributive spending demands throughout the cycle, also during good times, when different interest groups and weak institutions may combine to push expenditures above trend and toward more inflexible spending (namely transfers) that may be difficult to sustain during the next stage of the business cycle.

Considering this scenario, three important policy recommendations emerge from our analysis. First, social security indexing formulas should be changed in Uruguay. Using the CPI, as is done in advanced economies, is the best way to protect the purchasing power of the beneficiaries of these programs with no major effect on the sustainability of these cash transfers given the present structure of the economy. Second, due to the low expenditures on unemployment pay-outs and family allowances observed in Uruguay, it is very important to increase such insurance coverage in this country. For example, given large output fluctuations, it may be worth exploring protection programs for those who become unemployed during downturns. Finally, given that updating pensions through the CPI allows to mitigate, but not prevent, their pro-cyclicality, we also recommend the establishment of national fiscal rules (e.g., structural goals of budget balance, revenues, expenditures, and debt rules) in order to stabilize the economy throughout the macroeconomic cycle and avoid pressure from different interest groups to increase the real value of their revenues.

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## Appendix A. Definition of variables and sources and descriptive statistics

### Table A.1 – Definition of variables and sources

| *Variable* | *Definition* | *Source* |
|---|---|---|
| Gross Domestic Product (GDP) | Gross Domestic Product at constant prices (volume index 2005=100). | Central Bank of Uruguay. Data period covers 1988/Q1-2016/Q3. |
| Social cash transfers | Sum of passive social benefits and active social benefits. | Banco de Previsión Social (BPS-Uruguay). Data period covers 1988/Q1-2015/Q4. |
| Passive benefits | Sum of old age plus survivors' pensions plus pension to old age and disability plus temporary subsidies. | BPS. Data period covers 1988/Q1-2016/Q3. |
| Old-age pensions | Monthly cash transfer to formal workers that have reached the retirement age. | BPS. Data period covers 1988/Q1-2016/Q3. |
| Survivors' pensions | Monthly cash transfer to widows of formal workers and family members meeting specific requirements (incapacity, etc.). | BPS. Data period covers 1988/Q1-2016/Q3. |
| Pensions to old age and disability | Monthly cash transfer to people 70 and older with insufficient income or people with disability. | BPS. Data period covers 1988/Q1-2016/Q3. |
| Temporary Subsidies | Disability subsidy. | BPS. Data period covers 1997/Q2-2016/Q3. |
| Active benefits | Sum of illness subsidies plus employment injury plus unemployment subsidies plus maternity allowance and family allowance. | BPS. Data period covers 1988/Q1-2015/Q4. |
| Illness subsidies | Monthly cash transfer to formal workers with transitorial illness. | BPS. Data period covers 1988/Q1-2015/Q4. |
| Employment injury | Monthly cash transfer to formal workers with total and permanent incapacity. | BPS. Data period covers 1988/Q1-2015/Q4. |
| Unemployment subsidies | Monthly cash transfer to unemployed workers. | BPS. Data period covers 1988/Q1-2015/Q4. |
| Maternity allowances | Maternity leave and parental leave allowance and care for the parent. | BPS. Data period covers 1988/Q1-2015/Q4. |
| Family allowances | Bi-monthly payment to the family based on the level of income and includes medical care for children and mother. | BPS. Data period covers 1988/Q1-2015/Q4. |

*Source:* Own elaboration.

## Table A.2 – Descriptive statistics

| *Variable* | *Obs.* | *Mean* | *Std. Dev.* | *Min* | *Max* |
|---|---|---|---|---|---|
| *GDP* | 115 | 105.705 | 27.923 | 65.998 | 166.143 |
| *GDP (tc)* | 115 | 105.983 | 27.687 | 69.806 | 160.441 |
| *GDP (sa)* | 115 | 105.752 | 27.723 | 69.709 | 160.854 |
| *Social cash transfers* | 115 | 173.535 | 43.555 | 83.616 | 268.464 |
| *Social cash transfers (tc)* | 115 | 172.998 | 42.891 | 91.716 | 264.983 |
| *Social cash transfers (sa)* | 115 | 173.522 | 43.320 | 90.919 | 271.827 |
| *Passive benefits* | 112 | 171.905 | 42.955 | 83.616 | 268.464 |
| *Passive benefits (tc)* | 112 | 171.541 | 42.642 | 91.709 | 267.575 |
| *Passive benefits (sa)* | 112 | 171.925 | 42.775 | 90.914 | 267.562 |
| *Old-age pensions* | 115 | 117.156 | 26.677 | 59.038 | 170.730 |
| *Old-age pensions (tc)* | 115 | 117.112 | 26.305 | 61.691 | 168.999 |
| *Old-age pensions (sa)* | 115 | 117.182 | 26.479 | 61.451 | 170.456 |
| *Survivors' pensions* | 115 | 33.550 | 10.114 | 12.674 | 52.544 |
| *Survivors' pensions (tc)* | 115 | 33.572 | 9.826 | 14.772 | 51.289 |
| *Survivors' pensions (sa)* | 115 | 33.555 | 10.075 | 12.622 | 53.007 |
| *Pension to old age and disability* | 115 | 9.328 | 2.874 | 4.489 | 15.661 |
| *Pension to old age and disability (tc)* | 115 | 9.328 | 2.800 | 5.286 | 15.349 |
| *Pension to old age and disability (sa)* | 115 | 9.329 | 2.864 | 4.479 | 15.816 |
| *Active benefits* | 112 | 13.529 | 6.514 | 6.358 | 33.128 |
| *Active benefits (tc)* | 112 | 13.461 | 6.533 | 7.499 | 32.212 |
| *Active benefits (sa)* | 112 | 13.522 | 6.500 | 7.369 | 32.098 |
| *Illness subsidies* | 112 | 2.151 | 1.660 | 0.781 | 7.091 |
| *Illness subsidies (tc)* | 112 | 2.149 | 1.645 | 0.834 | 6.811 |
| *Illness subsidies (sa)* | 112 | 2.149 | 1.646 | 0.827 | 6.933 |
| *Unemployment subsidies* | 112 | 4.721 | 2.555 | 1.586 | 13.718 |
| *Unemployment subsidies (tc)* | 112 | 4.745 | 2.501 | 1.696 | 13.297 |
| *Unemployment subsidies (sa)* | 112 | 4.722 | 2.534 | 1.516 | 13.235 |
| *Maternity allowances* | 112 | 0.992 | 0.604 | 0.349 | 3.269 |
| *Family allowances* | 112 | 5.650 | 2.384 | 2.429 | 9.922 |
| *Family allowances (tc)* | 112 | 5.639 | 2.393 | 2.417 | 9.751 |
| *Family allowances (sa)* | 112 | 5.565 | 2.376 | 2.404 | 9.755 |

*Note:* Trend-Cycle component (tc), seasonal adjustment series (sa).
*Source:* Own elaboration.

## Appendix B. Detrending methods

Our conceptual framework assumes a decomposition from the observable economic time series $y_t$ as the sum of a trend component $\tau_t$ and a cyclical component $c_t$,

$$y_t = \tau_t + c_t \qquad t = 1, \dots, T \tag{B.1}$$

We are following some basic references of detrending methods in the time domain findings in Beveridge and Nelson (1981), Canova (1994, 1998), Hamilton (2017), Hodrick and Prescott (1980, 1997), Kamber et al. (2017), and Mills (2003), among other authors. Theses draw the following descriptions.

*Linear Trend (LT)*

The linear detrending method assume that the trend component $(\tau_t)$ is a deterministic process that can be represented with a first-degree polynomial function of time, $d = 1$, which is uncorrelated with the cyclical component $(c_t)$ of the series. The model for $\tau_t$ can be specified by the following expression:

$$\tau_t = \propto_0 + \sum_{j=1}^{d} \beta_j t^j \qquad t = 1, \dots, T \tag{B.2}$$

*Beveridge-Nelson filter (BN)*

Beveridge and Nelson's (1981) decomposition illustrates a general detrending method for non-stationary economic time series $y_t$. The main assumptions are that the trend component behave as a unit root with drift and the cyclical component follow a stationary process, and both unobservable components are perfectly correlated. The observable time series $y_t$ is represented by a stationary ARIMA process of order $p$ and $q$, with mean $\mu'$.

Therefore, $y_t$ can be represented in the following form:

$$\phi(L)y_t = \theta(L)\varepsilon_t + \mu' \qquad \varepsilon_t \sim i.i.d.(0, \sigma^2) \tag{B.3}$$

and defined the first differences of $y_t$ as $w_t = y_t - y_{t-1} = (1 - L)y_t$:

$$\phi(L)(1-L)y_t = \theta(L)\varepsilon_t + \mu' \tag{B.4}$$

$$(1-L)y_t = \frac{\theta(L)\varepsilon_t + \mu'}{\phi(L)} \tag{B.5}$$

$$w_t = \frac{\theta(L)\varepsilon_t}{\phi(L)} + \mu \tag{B.6}$$

$$w_t = \lambda_i \varepsilon_t + \mu \tag{B.7}$$

where $L$ represents the lag operator, $\lambda_i = \frac{\theta(L)}{\phi(L)} = \frac{(1-\theta_1 L - \ldots - \theta_q L^q)}{(1-\phi_1 L - \ldots - \phi_p L^p)}$ with the roots of the $\phi(L) = 0$ lies outside the unit circle, so that $w_t = y_t - y_{t-1}$ is a stationary process that fluctuate around the long run mean or drift, $\mu = \mu'/\phi(L)$. Beveridge-Nelson assume that the detrending procedure is based on the relation of the observed value of $y$ at time $t$ and the conditional expectation of the observations $y's$ by forecasting the specified model.

An estimate of the trend component is given as follows:

$$\hat{\tau}_t = y_t + [\textstyle\sum_h \widehat{w}_t(h) - h\mu] \tag{B.8}$$

where $\widehat{w}_t(h) = E[w_{t+h}/y_t, y_{t-1}, \ldots]$, and $h$ is the forecast horizon (the authors recommend $h = 100$). The trend component is denoting as the sum of the value of $y$ at time $t$ plus the sum of the long-horizon conditional expectation (or forecasted future change) of $w_t$ removing any future deterministic drift. Meanwhile, the cyclical component is obtained as $\hat{c}_t = y_t - \hat{\tau}_t$,

$$c_t = [\textstyle\sum_h \widehat{w}_t(h) - h\mu] = \left(\sum_1^h \lambda_i\right)\varepsilon_t + \left(\sum_2^h \lambda_i\right)\varepsilon_{t-1} + \ \ldots, \tag{B.9}$$

Although this procedure has the advantage that involves only past values of the observed series to obtain the cyclical component, which avoids two-sided filters problems, its underlying critics related with the ARIMA models. Alternatives specifications it could be well fitted the Beveridge-Nelson procedure, consequently, it could be obtained different trend and cycle components (Canova 1998).

Recently, Kamber et al. (2017) show that Beveridge and Nelson's decomposition based on autoregressive models does not produce a reasonable accurate cycle component (small amplitude and low persistence) due to parameters estimated underlying an overrate of the trend contribution in the variance decomposition (high signal-to-noise ratio). Therefore, the authors introduce a modified version of the Beveridge and Nelson's decomposition that improve the detrending procedure, called Beveridge-Nelson filter, that involve a low signal-to-noise ratio of a univariate AR model estimation using a Bayesian framework (assume a "Minnesota" shrinkage prior).[23] We thus follow this approach in the empirical study.

*Hodrick-Prescott (HP)*

Hodrick and Prescott (1980, 1997) document a detrending procedure, HP filter, for the observable economic time series into the trend component and the cyclical component, $y_t = \tau_t + c_t$. The main theoretical assumptions that support the decomposition procedure of the time series are the trend is smoothly stochastic process over the time, and it was uncorrelated with the cyclical component.

To identify the two components of the time series, HP try to find the trend component that solve the following minimization programming problem:

$$\min_{[\tau_t]_{t=-1}^{T}} \{ \sum_{t=1}^{T} (y_t - \tau_t)^2 + \lambda \sum_{t=1}^{T} [(\tau_t - \tau_{t-1}) - (\tau_{t-1} - \tau_{t-2}) ]^2 \} \quad \text{(B.10)}$$

$$\min_{[\tau_t]_{t=-1}^{T}} \{ \sum_{t=1}^{T} (c_t)^2 + \lambda \sum_{t=1}^{T} [(\tau_t - \tau_{t-1}) - (\tau_{t-1} - \tau_{t-2}) ]^2 \} \quad \text{(B.11)}$$

The first term is the sum squared of the cyclical deviation, and it is a measure of fitting from $\tau_t$ to $y_t$, where $y_t$ involves the trend–cycle. It represents the deviations from the trend, $y_t - \tau_t$, their average is close to zero. The second term describes the assumption of smoothly varying trend component, measuring by the sum of the squares of the second difference of the trend component. Additionally, $\lambda$ is the smoothness penalty, a positive parameter penalty the variation in the trend component. For large value of $\lambda$, the trend path become smoother over the time.

[23] The procedure details are exposed in Kamber et al. (2017).

Furthermore, it is noteworthy that under perfect smoothing, $\lambda \to \infty$, there is imposed an entirely penalize in the variability of the trend. The solution of the minimization problem is reduced to fit a linear time trend function by least square, such as $\tau_t \cong \tau_0 + \beta t$ (the second difference is 0). In contrast, when $\lambda \to 0$, we have a perfect fit, $\tau_t = y_t$, and the cycle component is equal to zero. In this case, the optimal value of the smoothness parameter is $\lambda = (\sigma_c^2/\sigma_\tau^2)$, where $\sigma_c$ and $\sigma_\tau$ are the standard error deviations of the cyclical component and of the trend component of $y_t$, respectively. Hodrick and Prescott assume a value of $\lambda$ equal to 1,600 for quarterly data, considering that the standard error of the cycle (5%) is 40 times larger than the standard error of the trend (1/8%), that means cycle during around 4 – 6 years. Finally, the cyclical component estimation can be obtained as $\hat{c}_t = y_t - \hat{\tau}_t$ (Canova 1998; Canova and Dellas 1993; Hodrick and Prescott 1980, 1997).

Besides, the effectiveness of this trend–cycle decomposition procedure has been widely questioned. Cogley and Nason (1995) indicates that HP filter can generate spurious cycles when it is applied to integrates process, such as unit root or persistent time series, although the cycle dynamics does not really exist in the underlying data. However, most of the discussion is regarding with what value we should use for the specification of the smoothing parameter. Ravn and Uhlig (2002) argument, as well several researchers, are agreeing to apply the HP filter in the empirical practice in the case of quarterly economic time series, in which the smoothing parameter magnitude is 1600; the drawback is concerning to using other data frequency, but not with the HP method. For instance, Backus and Kehoe (1992) setting a value of lambda equal to 100 for annual data, whereas Correia et al. (1992) used a lambda value of 400 for the same data frequency. Ravn and Uhlig (2002) propose adjust the HP filter to annual data frequency to estimate the identical trend component as quarterly frequency. They obtained a smoothing parameter $\lambda$ equal to 6.26 for annual data (also used in Alesina et al. 2008 and Vegh et al. 2017). Baxter and King (1999) indicates that HP filter results are close to band-pass filter (proposed by them when the value of lambda is 10).

Recently, Hamilton (2017) shows that HP filter no reflect the true cycle dynamic that underlying from the original time series generating process. This occurs particularly at the middle and at the end of the sample, in the simple case of a random walk economic time series. Given that HP consider past and future observation to obtain the cycle component at date $t$ (two-sided or symmetric filter), that produce a bias at the end of the

sample. Hamilton also criticizes the ad-hoc assumption regarding how is chosen the smoothing parameter of the HP filter ($\lambda$). Therefore, propose an alternative filter, which will be illustrated later.

Although a series of studies points out HP filter drawbacks, this paper provides an empirical examination of the cyclical components of the time series obtained by the HP filter because continues today to be one of the most influential and used technique in the empirical economic literature (Fiorito and Kollintzas 1994; Frankel et al. 2013; Kydland and Prescott 1982; Ravn and Uhlig 2002; Vegh et al. 2017).

*Hamilton filter (Hf)*

Hamilton (2017) developed an alternative detrending method as respond of the HP filter drawbacks when it is used to detrend a typical random walk economic time series (i.e., difference stationary process). Hamilton filter propose a linear regression (OLS) of a non-stationary time series, $y_t$, at date $t+h$ based on a constant and the most recent four lags ($p=4$) values of the series as of date $t$.

$$y_{t+h} = \beta_0 + \beta_1 y_t + \beta_2 y_{t-1} + \beta_3 y_{t-2} + \beta_4 y_{t-3} + v_{t+h}, \tag{B.12}$$

where $v$ is the residuals and $h$ is the horizon period, $h \geq 1$. The residuals estimated represent the cyclical component at date $t+h$:

$$\hat{c}_{t+h} = \hat{v}_{t+h} = y_{t+h} - \hat{\beta}_0 - \hat{\beta}_1 y_t - \hat{\beta}_2 y_{t-1} - \hat{\beta}_3 y_{t-2} - \hat{\beta}_4 y_{t-3}, \tag{B.13}$$

Alternative, the cyclical component at date $t$:

$$\hat{c}_t = \hat{v}_t = y_t - \widehat{\propto}_0 - \widehat{\propto}_1 y_{t-h} - \widehat{\propto}_2 y_{t-h-1} - \widehat{\propto}_3 y_{t-h-2} - \widehat{\propto}_4 y_{t-h-3}, \tag{B.14}$$

The regression filter is expressed as a difference filter, whose forecast error $\hat{v}_{t+h}$ is stationary for the fourth differences of nonstationary time series processes (i.e., $(1-L)^d y_t$ is stationary for $d \leq 4$). That implies that is not necessary to know the data generating process. Hamilton recommends using a horizon $h = 8$ for quarter data (two-year), according with the business cycle literature. The Hamilton filter is an asymmetric

filter that consider the entire sample to estimate the coefficients of the regression filter, therefore, not induces spurious cycles than the HP filter bias produced at the end of the sample for obtain the cyclical component. So it is more robust to estimate the cycle of a time series than HP filter (Hamilton 2017; Schüler 2018).

When applied to a random walk time series process in a large sample, $y_t = y_{t-1} + \varepsilon_t$. We have that $d = 1$ and $v_{t+h} = \varepsilon_{t+h} + \varepsilon_{t+h-1} + \ldots + \varepsilon_{t+1}$. An OLS estimation of (B.13) converge to $\beta_1 = 1$ and $\beta_j = 0$, consequently Hamilton filter reduced to a difference filter that could be represents as follows:

$$\tilde{c}_{t+h} = \tilde{v}_{t+h} = y_{t+h} - y_t \tag{B.15}$$

or alternative,

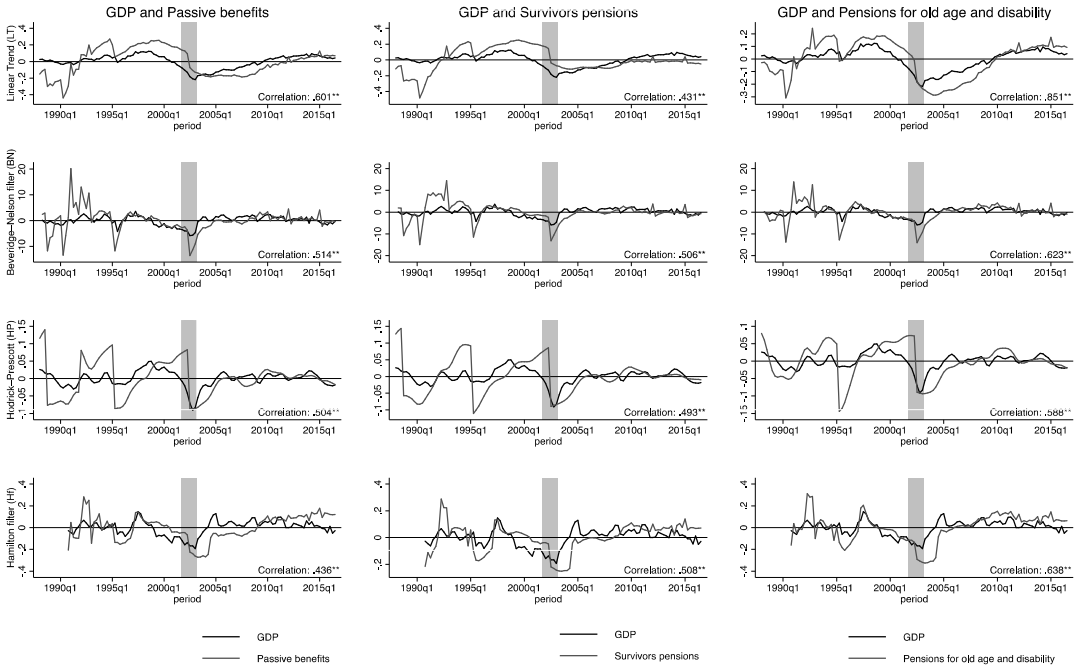
$$\tilde{c}_t = \tilde{v}_t = y_t - y_{t-h} \tag{B.16}$$

For a 8–quarter horizon Hamilton filter eliminate the trend and seasonal components, the cyclical component it could be expressed as $c_t = y_t - y_{t-8}$ (Hamilton 2017).

Schüler (2018) analysed the cyclical properties (distortions and implications) of Hamilton regression filter, and indicates that the Hamilton filter depends on an ad–hoc assumption of the horizon, 8-quarter or two-year (as well HP ad–hoc assumption of the smooth parameter). This could change the characteristics of the detrended component of the economic time series. For instance, in the case of a random walk economic time series, Hamilton filter cancel and emphasized certain cycle phases in a specific horizon, however, does not capture quick or prolonged expansion-recession phases that succeed out of the regular business cycle.

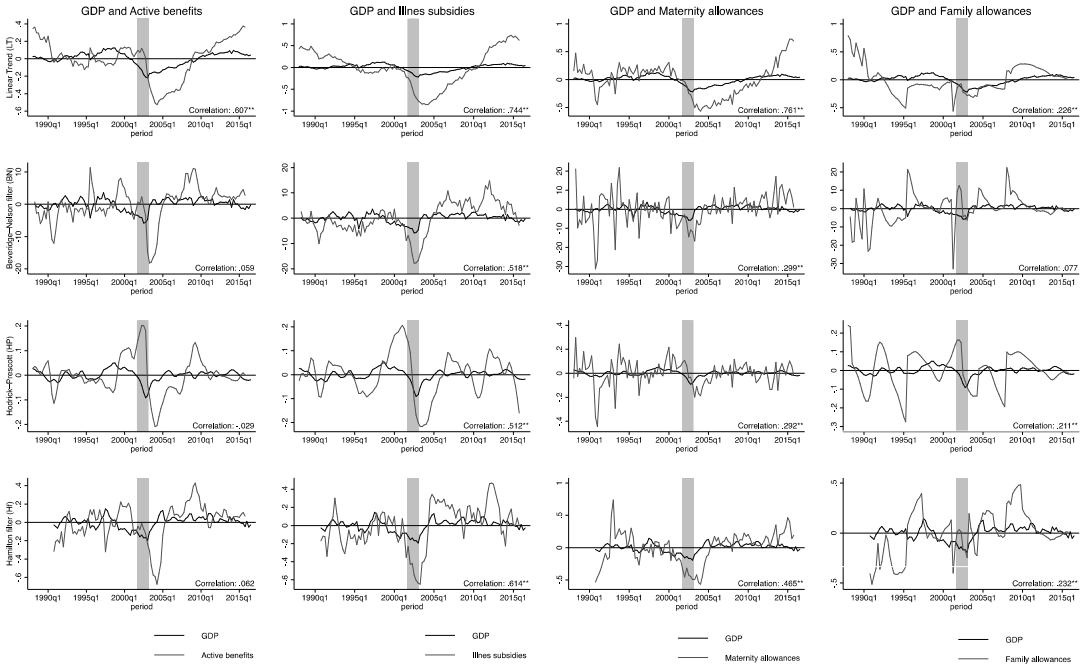
## Appendix C. Additional results and robustness checks

### Figure C.1 – Cyclical components
### (Passive benefits)




*Note:* Shaded area in the time series plots cover the year 2002, it illustrates the most important financial crisis in the Uruguayan economy. Real GDP (black line) and passive benefits (and its components) were estimated in the sample period 1988/Q1-2016/Q3. The selected public social cash transfers categories are represented by column (grey line). Significance level: ** $\rho < 0.05$.
*Source:* Own estimations.

## Figure C.2 – Cyclical components
## (Active benefits)




*Note:* Shaded area in the time series plots cover the year 2002, it illustrates the most important financial crisis in the Uruguayan economy. Real GDP (black line) and active benefits (and its components) were estimated in the sample period 1988/Q1-2015/Q4. The selected public social cash transfers categories are represented by column (grey line). Significance level: ** $\rho < 0.05$.
*Source:* Own estimations.

## Table C.1 – Results from seasonal adjustment TRAMO-SEAT

| | ***GDP*** | ***Public social cash transfers*** *(1)* | ***Passive benefits*** *(2)* | *Old age pensions* *(3)* | *Survivors' pensions* *(4)* | *Pension to old age and disability* *(5)* | ***Active benefits*** *(6)* | *Illness subsidies* *(7)* | *Unemploy-ment subsidies* *(8)* | *Maternity allowances* *(9)* | *Family allowan-ces* *(10)* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *Observation* | 115 | 112 | 115 | 115 | 115 | 115 | 112 | 112 | 112 | 112 | 112 |
| *Seasonal* | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| *Log transformations* | None | None | None | None | None | None | None | Yes | Yes | Yes | None |
| *Mean correction* | None | None | None | None | Yes | None | None | None | None | Yes | Yes |
| *ARIMA model (P,D,Q)* | (0 1 0) | (0 1 0) | (0 1 2) | (0 1 2) | (0 1 1) | (0 1 1) | (0 1 0) | (2 1 0) | (0 1 0) | (1 1 0) | (1 0 0) |
| *Seasonal (BP,BD,BQ)* | (0 1 1) | (1 0 0) | (0 1 1) | (0 1 1) | (1 0 0) | (1 0 0) | (0 1 1) | (0 1 1) | (1 0 0) | (1 0 0) | (1 0 0) |
| *BIC* | 1.681 | 4.018 | 3.510 | 3.128 | 0.428 | -1.961 | -0.656 | -5.650 | -4.072 | -4.712 | -2.634 |
| *SE (res)* | 2.168 | 6.750 | 4.666 | 4.048 | 1.053 | 0.324 | 0.684 | 0.055 | 0.126 | 0.084 | 0.216 |
| *Q-val* | 5.199 | 20.773 | 10.889 | 10.515 | 11.971 | 13.371 | 11.382 | 8.296 | 16.215 | 16.826 | 23.722 |
| *Easter corrections* | Yes | None | None | None | None | None | None | Yes | None | Yes | None |
| *Outlier corrections* | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| | | | | | *Diagnostic* | | | | | | |
| *Basic checks definition* | Good | Good | Good | Good | Good | Good | Good | Good | Good | Good | Good |
| *Residual seasonality:* | | | | | | | | | | | |
| *- test qs test on sa* | Good | Good | Good | Good | Good | Good | Good | Good | Good | Bad | Good |
| *- test qs test on i* | Good | Good | Good | Good | Good | Good | Good | Good | Good | Bad | Good |
| *Residual trading days tests f-test on sa* | Good | Good | Good | Good | Good | Good | Good | Good | Good | Good | Good |

*Note:* Significant at 5% (Good), significant at 10% (Uncertain), not significant (Bad).
*Source:* Own estimations.

## Table C.2 – Results from seasonal adjustment X-13ARIMA-SEAT

| | ***GDP*** | ***Public social cash transfers*** *(1)* | ***Passive benefits*** *(2)* | *Old age pensions* *(3)* | *Survivors' pensions* *(4)* | *Pension to old age and disability* *(5)* | ***Active benefits*** *(6)* | *Illness subsidies* *(7)* | *Unemploy-ment subsidies* *(8)* | *Maternity allowances* *(9)* | *Family allowan-ces* *(10)* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *Observation* | 111 | 108 | 111 | 111 | 111 | 111 | 108 | 108 | 108 | 108 | 108 |
| *Seasonal* | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| *Log transformations* | None | None | None | None | None | None | None | Yes | None | Yes | None |
| *ARIMA model (P,D,Q)* | (0 1 0) | (0 1 1) | (2 1 0) | (2 1 0) | (2 1 0) | (0 1 1) | (0 1 1) | (2 1 0) | (0 1 0) | (1 1 0) | (1 0 1) |
| *Seasonal (BP,BD,BQ)* | (0 1 1) | (0 1 1) | (1 0 0) | (1 0 0) | (1 0 0) | (1 0 0) | (0 1 1) | (0 1 1) | (1 0 1) | (1 0 0) | (1 0 0) |
| *AICc* | 488.25 | 668.11 | 709.69 | 643.44 | 362.4 | 117.19 | 222.63 | -172.94 | 163.69 | -225.85 | 19.672 |
| *BIC* | 496.01 | 689.88 | 732.19 | 665.95 | 384.9 | 134.99 | 235.18 | -158.01 | 176.46 | -213.08 | 52.706 |
| *QS* | 0 | 0 | 4.059 | 4.535 | 2.306 | 0.361 | 0 | 0 | 1.463 | 6.066** | 3.669 |
| *Box-Ljung* | 18.72 | 21.48 | 16.67 | 17.43 | 13.79 | 14.88 | 19.81 | 12.96 | 21.53 | 19.3 | 25.45 |
| *Shapiro* | 0.966*** | 0.977* | 0.969** | 0.966*** | 0.987 | 0.978 | 0.990 | 0.984 | 0.989 | 0.988 | 0.974** |
| *Easter corrections* | Yes | None | None | None | Yes | Yes | Yes | Yes | None | None | Yes |
| *Outlier corrections* | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |

*Note:* QS; H0: no seasonal in final series. Box-Ljung; H0: no residual autocorrelation. Shapiro; H0: normal distribution of residual. Level of significance: 10% (*), 5% (**) and 1% (***).
*Source:* Own estimations.

# Chapter 3

# Redistributive efficiency of fiscal policy: The role of decentralization

## 3.1 Introduction

Income distribution has become one of the most relevant topics in economic literature.[24] Indeed, scholars' attention has been focussed on the shaping inequality as a consequence of the expansion of finances -including wealth-, globalisation and skill-biased technological change (Franzini and Pianta 2015). This is important because the increase in income inequality could be a substantial obstacle to achieve a stable path of economic growth and development through several economic and political channels. For instance, the increase in income inequality can reduce economic growth by reducing the investment in human capital (Galor and Zeira 1993), increasing the fertility rate of poor people and reducing human capital accumulation (de la Croix and Doepke 2003), engaging socio-political instability which discourage private investment (Alesina and Perotti 1996) and increasing ethnic tensions and social polarization that reduce the security of property and contract rights (Keefer and Knack 2002).

While market income inequality (i.e., before cash transfers and direct taxes) sharply increased during the 1980s and most of the 1990s, a downward trend has been observed since the early 2000s. The latter is due to a inequality gap reduction between developed countries and the rest of the world; in particular, as a consequence of the decrease of inequality in China and India (e.g., due to a declines in geographical and inter-sectoral income gaps), and the moderate increase of market income inequality in many advanced economies (see OECD 2015 and IMF 2017). Additionally, the data also show that inequality in disposable income (i.e., after cash transfers and direct taxes) has increased in many economies over the last twenty-five years (Caminada et al. 2019). Specifically, scholars emphasise the fact that income redistribution has weakened or stagnated in the

[24] See, for example, Piketty and Saez (2006), Gasparini and Lustig (2011), Piketty (2014), and Alvaredo et al. (2018).

aftermath of the Great Recession 2008/2009 because governments have been focused on restoring public finances; and, adjustment programs frequently hurt the most vulnerable groups in society (see, for example, Gasparini and Lustig 2011).

One of the main driving forces behind the differences in inequality reduction across countries groups is attributed to asymmetries in the role played by the design and effects of fiscal policies (Brandolini and Smeeding 2007; Wang et al. 2014). While developed economies have shown a strong fiscal redistributive impact through transfers and taxes, in developing countries this is very limited since they tend to have fewer fiscal resources available to affect redistribution (Goñi et al. 2011; Villela et al. 2007). Moreover, the specialized literature indicates that the size of fiscal resources as well as their degree of decentralization is also relevant in affecting income redistribution (see, for example, Sepulveda and Martinez-Vazquez 2011).

Considering this context, our purpose is to empirically analyse the redistributive efficiency of fiscal policy taking into account the degree of decentralization for a sample of 35 developed and developing countries over the 2000-2016 period. The study focuses on fiscal policies that have a direct impact on disposable income, which are cash transfers and direct taxes at both, central and subnational level. In this context, redistributive efficiency refers to the achievement of more redistribution at given tax and spending levels. Scholars have demonstrated that both have a relevant redistributive impact; in particular, cash transfers are relevant for the most income vulnerable groups in a society and direct taxes are mainly paid by the wealth people (Wang et al. 2012; Caminada et al. 2019). Furthermore, given that we consider a cross-country perspective, naturally we also expect to find that redistribution efficiency performance may differs across countries due to several "contextual" factors, such as economic, institutional, political, and demographic issues (Mahler and Jesuit 2006). Thus, an additional relevant question we want to deal with is which are the forces that underlie achieving redistribution efficiency objectives. In particular, our interest centres on knowing the influence of political decentralization on redistributive efficiency within and between countries.

Prior objectives will be tackled by using a two-stage approach. In the first stage, we use a Data Envelopment Analysis (DEA) bootstrapping technique to empirically evaluate the redistributive efficiency of central and subnational cash transfers and direct taxes. By employing this methodology, a redistributive efficiency score is obtained for each country and time period (and also a country efficiency ranking), which arises from comparing the individual redistributive performance of each country with respect to the best possible

redistributive performance in the sample of countries. In the second stage, we examine the potential non-discretional (or contextual) determinants of the country redistribution efficiency scores previously estimated by applying bootstrap truncated panel regression analysis, and we specifically analyse the role played by the level of political decentralization assuming that it can not be discretionary modified by the public sector at least at the short term.

Our paper contributes to specialised literature in two ways. First, we provide novel empirical evidence on the redistributive efficiency of cash transfers and direct taxes instruments at central and decentralised level for an extended panel of developed and developing countries. Secondly, we explore in depth the underlying determinants of redistributive efficiency differences across countries and over time. Our article naturally complements previous work in the redistribution literature covering different explanatory factors.

We obtain empirical evidence that redistributive efficiency varies across countries and -on average- has diminished over the analysed period, showing an important reduction after the Great Recession (2007-2008). In particular, we find that fiscal decentralization might play an important role in achieving redistributive efficiency. Moreover, our result show that redistributive efficiency is straightforwardly associated with having low political decentralization. And only in case of countries that enjoy a high level of government effectiveness, politically decentralized systems are more redistributive efficient. Furthermore, redistributive efficiency is directly associated with high government effectiveness, low education inequality, high democratic accountability as well as the existence of debt fiscal rules.

The remainder of this paper is structured as follows. Section 2 provides a briefly overview about the redistributive role of fiscal policy. Section 3 reviews the empirical literature on the efficiency of fiscal policy. The data used are detailed in Section 4. Section 5 presents some stylised facts, while the empirical strategy is presented in Section 6. Section 7 presents the empirical results and Section 8 presents the sensitivity analysis. Section 9 concludes.

## 3.2 The redistributive role of fiscal policy: A briefly overview

Fiscal policy has traditionally been considered an effective instrument for affecting aggregate demand, the distribution of income and wealth, and the economy's capacity to produce goods and services (Musgrave 1959). Therefore, the correct selection of the composition and combination of these policies has become of crucial importance for the purpose of achieving a broad-based stable path of economic growth across countries. In fact, the reduction of economic disparities has emerged as one of the most challenging public policy topics in macroeconomic literature. Specifically, government intervention can be motivated by the increase of inequality of income, opportunity, and wealth. In such circumstances government policies could be designed to alleviate these inequalities.[25] In such a context, public policies designed to reduce income inequality have become a predominant phenomenon in modern economies. In particular, the distributive items of government expenditures (like transfers and subsidies) have been the most rapidly growing component of government spending in the post-war period.[26]

The fiscal policy design could have an important redistributive effect reducing income inequality by three main channels (IMF 2017): First, via cash transfers and progressive direct taxes; second, through subsidies and indirect taxes (or consumption taxes); and third, through in-kind transfers (e.g., education and health). Our proposed analysis is concerned with the first channel, which directly affects disposable income. In this context, the redistributive effects of the fiscal policy instruments may depend on the size of cash transfers and the tax burden, also on the composition of the cash transfers and on the characteristics of the direct tax system (Korpi and Palme 1998; Mahler and Jesuit 2006), as well as their decentralization (Sepulveda and Martinez-Vazquez 2011).

*The effect of decentralization on income redistribution*

The seminal literature of decentralization (Tiebout 1956; Musgrave 1959; Oates 1972) underlies on the "decentralization theorem" of Oates (1972) who identifies under which conditions local governments are more efficient in the provision of public goods and

[25] See Bénabou (2002) and Seshadri and Yuki (2004).

[26] For example, the studies of Tanzi and Davoodi (1998) and Tanzi and Schuknench (1995) found that governments' transfers and subsidies were almost non-existent at the mid-twentieth century in the seventeen industrialized countries analysed, while in recent times they represent nearly the 31% of their GDP.

services than central government. Assuming the government as a benevolent agent, Oates argued that subnational governments are in better position to adapt public policies to specific local preferences and needs of citizens – given the information advantages, resulting in an improvement of government performance and well-being of society. However, the author also indicates that certain functions, such as income redistribution, should be under the central government provision (Oates 1999). A basic reason indicates that a strong redistributive policy to support low-income groups (i.e., implementing pro-poor policies) adopted by a specific sub-central jurisdiction may induce an influx of the poor from other jurisdictions -the costs of redistributive programs tend to increase- and encourage an exodus of taxpayers (high-income) groups to other jurisdictions -the tax base of the jurisdiction tend to erode-, making the implementation of redistributive policy ineffective (Oates 1999). The central government is likely to follow an equalising role through redistribution across citizens over the national territory, but the subnational governments' policies do not always align with central government's income redistribution programs (i.e., follows their own equity targets) and thus fiscal decentralization may harm the overall redistribution withing the country (see also Musgrave 1959).

Recent literature indicates that the presence of externalities or spillovers, such as imperfect information, economies of scale and selfish officials (e.g., political rent-seeking), has undermined the normative "decentralization theorem". In this sense, centralisation can lead a superior coordination of policies by internalising the externalities (Oates 2005). Additionally, it may also reduce the elite groups' influence on local governments (Bardhan 2002; Cai and Treisman 2004) and the citizen's difficulties to discern who level of the government is responsible for good and bad policy – political institutions via clarity of responsibilities reduce corruption (Tavits 2007). In this sense, decentralization may shift the control of resources from central government to subnational governments leading to reduce the capacity of central government to address redistribution.

However, several scholars point to a positive effect of decentralization on the efficiency of public policies (Christl et al. 2020; Besley and Smart 2007; Martinez-Vazquez et al. 2017). Some authors have indicated that a certain degree of decentralization increases efficiency by greater electoral control and yardstick competition among competing jurisdictions (Adam et al. 2014). In this same vein, Christl et al. (2020) has argued that revenue decentralization increases information about the

preferences and needs of the communities as well as accountability thus reducing incentives for overspending of subnational governments and therefore improving public sector efficiency. Besley and Smart (2007) also argue that decentralization enhances the public interest to compare the public services and taxes across their jurisdictions contributing to a reduction in the "bad" use of the resources by politicians. Additionally, inter-jurisdictional competition might be observed in terms of the provision of public goods and taxation to keep their tax bases or attract new taxpayers from other jurisdictions (Sepulveda and Martinez-Vazquez 2011). In contrast to the idea that the most equitable distribution of income should remain as central government's domain, Pauly (1973) argued that under limited or costly interjurisdictional mobility, the implementation of redistributive policies by subnational governments is superior to centralised government – because it does not lead to the relocation of potential recipients and taxpayers that permits an effective within-jurisdictions redistribution.

Besides, Sepulveda and Martinez-Vazquez (2011) have shown that fiscal decentralization reduces income inequality only if the size of the public sector in the overall economy is relatively large (twenty percent or more). They argue that, for affecting income distribution, the type of redistributive programs that could be implemented at the subnational government level, and the size of public resources available for redistributive aims from central government to subnational governments, both are relevant. Indeed, distribution of income might be altered by expenditure and revenue decentralization because it could affect the composition of public spending modifying income inequality (e.g., direct income transfers to individuals as part of the redistributive policy objectives) and it could impact the progressivity of the income tax schedule (e.g., implement a progressive or regressive tax system). Also, Goerl and Seiferling (2014) indicate that decentralization can help achieve more redistribution when subnational government spending rely mainly on their own revenue sources (i.e., lowly dependent on transfers). In this sense, a fiscal disequilibrium may constraint the capacity of the central government to implement national redistributive policies. Moreover, Neyapti (2006) finds that fiscal decentralization has distributive consequences, and that a greater degree of revenue decentralization may lead to increase inequality. The author claims that the existence of income inequalities across the jurisdictions of a country involves differences in the revenue collection capacities of them and political interest groups activities -can better influence the subnational authorities than central authority-

that worsen income redistribution. But the author claims that in cases of good governance it could reduce income inequality, for instance, by checks and balances in fiscal activities.

To sum, there has been an inconclusive conclusion in relation to the relationship between decentralization and income redistribution and thus that needs to be examined further; our work aims to address this issue.

### 3.3 Efficiency of fiscal policy: Empirical background

In recent times, there has been a strong interest among citizens about the efficient use of public resources (Afonso et al. 2010a; Christl et al. 2020). In this sense, several scholars have studied public sector efficiency and its determinants using a composite indicator of different outcomes of public policy, and find significant inefficiency in many countries. Thus, Afonso et al. (2005), using a Free Disposal Hull (FDH) analysis, find for a sample of 23 OECD economies that, on average, countries with a "small" public sector (ratio of public expenditure-to-GDP) report the highest public sector efficiency. Afonso et al. (2010b), employing a two-stage approach, using a DEA method and Tobit regression analysis, obtain for "new" European Union member states and some emerging markets that public expenditure efficiency is rather diverse across them. They also find that higher income, a competent civil service, high education levels and the security of property rights tend to prevent inefficiencies in the public sector. Afonso et al. (2013), using again a DEA and Tobit regression methods, examine 23 Latin American countries covering the period 2001-2010, and find that government size is inversely correlated with public sector efficiency while transparency, regulatory quality and control of corruption are directly correlated with it. Recently, Christl et al. (2020), using FDH and order-m efficiency techniques, study 23 European countries during 1995-2015, and find that decentralization positively affects public sector efficiency while fiscal rules do not affect it. In general, these studies refer to an overall efficiency of the public sector, involving areas such as administration, education, health, economic performance, security, infrastructure, and so on.

The vast majority of the public sector efficiency literature has focussed on analysing sectoral policies (education and health services) across countries – most of them using DEA and regression analysis techniques. For both services, the most resounding conclusion is that high government spending in terms of GDP tends to be associated with

low efficiency. This is found, for instance, by the following authors: Gupta and Verhoeven (2001) for 37 countries in Africa from 1894 to 1995; Afonso and Aubyn (2005) in OECD countries for 2000; Afonso and Aubyn (2011) in OECD countries for 2000-2003 period; Hauner and Kyobe (2010) for a large panel of economies from 1980 to 2004; Adam et al. (2014) for 21 OECD countries during 1970-2000.

Another strand of literature analyses income distribution across countries, examining the effects of transfers and direct taxes systems on income distribution and their effectiveness on inequality reduction (Korpi and Palme 1998; Brandolini and Smeeding 2007). Regarding this, the evidence from OECD countries shows that the bulk of the fiscal redistributive impact is due to the effect of public transfers (Wang et al. 2014; Jesuit and Mahler 2017). However, Adema et al. (2014) point out that similar levels of government spending in OECD countries have not affected redistribution to the same extent. In relation to developing countries, Villela et al. (2007) and Goñi et al. (2011) attribute poor redistributive performance of fiscal policy in Latin American countries to lower tax revenue capacity, which limited the available resource to increase the size of transfers.

A priori, we could use various combinations of instruments of fiscal policy to generate the same redistributive level. However, the distributional impacts of fiscal policy may vary depending on the expenditure structure and specific taxes across countries. With regard to this, several empirical studies (see, for example, Wang et al. 2012, Joumard et al. 2013, Caminada et al. 2017, Causa and Hermansen 2017, and Caminada et al. 2019) indicate a greater redistributive impact of transfers than taxes.[27] From these studies, we observe that the fiscal redistributive impact is between 25% and 35% on reducing income inequality; and while social transfers account for 67%-84% of total redistribution, taxes only account for 16%-34%. However, other studies (Guillaud et al. 2019; Avram et al. 2014) for developed countries show that if pensions are classified as market income rather than transfers, redistribution from taxes is greater than that from transfers.

Most of the aforementioned studies have concluded that the redistributive impact of fiscal policies is strongly associated with budget size and less so with the extent to

[27] These studies are based on the micro-household income data from Luxembourg Income Study (LIS), which is a harmonised version of national household income surveys – using a budget incidence approach; excluding Joumard et al. (2013) that use the OECD Income Distribution and Poverty Database. LIS data set is very useful to explain the variation in levels of redistribution in a cross-country comparison; however, many times restrict the exploration of the determinants of redistribution in a temporal dimension because data are collected at irregular time points (in waves) and vary across countries (Solt 2015).

which they are targeted to low-income groups, e.g., the efficiency of the tax system progressivity (see, for instance, Korpi and Palme 1998 and Mahler and Jesuit 2006). Indeed, these results do not exclusively concern developed countries; similar conclusions are reported for Latin American countries (Goñi et al. 2011).

In this vein, other scholars have investigated the determinants of the redistributive fiscal policy across countries and over time – most of them show a weak performance and heterogeneity of expenditures and taxes to affect redistribution (Afonso et al. 2010b; Kyriacou et al. 2018). For instance, Afonso et al. (2010b) focus on the efficiency of fiscal policy with respect to income distribution for OECD countries in the 1995-2000 period using a DEA and a Tobit regression method. Kyriacou et al. (2018) study the impact of fiscal policy on redistributive efficiency for OECD countries from 1995 to 2010 using a DEA and a bootstrap truncated regression. Both analyses do not consider decentralization and provide evidence that high quality of institutions is associated with more redistributive efficiency. Apart from that, many studies (e.g., Bradley et al. 2003; Kenworthy and Pontusson 2005; Huber and Stephens 2014) report that the most important determinant of redistribution is welfare state generosity.

In sum, our starting point is that the size, characteristics, and level of fiscal decentralisation may affect their efficiency. And in this context our objective is to analyse the redistributive efficiency of the cash transfers and direct taxes, at central and subnational level, since these are the fiscal policies that have a direct impact on disposable income. To our knowledge, such an analysis has not been applied before by considering decentralization to compute redistributive efficiency. Our work aims to fill this gap by analysing a broad sample of countries with different levels of development and decentralization.

## 3.4 Data

To analyse the redistributive efficiency of fiscal policy instruments and their degree of decentralization, we have constructed a panel of 35 countries and four sub-periods of analysis during the 2000-2016 period. The panel is composed of 31 developed and 4 developing economies, covering 6 different regions namely Southern Europe, Eastern Europe, Western Europe, Northern Europe, other developed countries and developing countries (see Table D.1 of Appendix D). We have taken five year means for the periods

2000-04, 2005-09, 2010-14, and two years mean for the last period with data available for all variables included in the analysis (2015-2016); this is due to redistribution moves very slowly over time and we are interested in capture long-term trends and structural changes, i.e., we neutralise the business cycle effect (see, for instance, Afonso et al. 2005 and Sepulveda and Martinez-Vazquez 2011).

Our main variables of interest are absolute and relative redistribution, obtained from The Standardized World Income Inequality Database (SWIID) developed by Solt (2020), which provides information on the Gini indices and is available for 196 countries from 1960 to the present, annual data frequency.[28] The absolute redistribution is obtained as the difference between the Gini market index (before cash transfers and direct taxes) and the Gini net index (after cash transfers and direct taxes). The relative redistribution is calculated as the difference between the Gini market index and Gini net index divided by the Gini market index.[29] It is important to note that the absolute redistribution measure does not consider the relative effort made by the fiscal systems of the different countries through cash transfers and direct taxes. Consequently, a fiscal policy that achieves a similar reduction in inequality in market income (i.e., absolute redistribution) in two countries does not mean that they are equally effective, it going to be more effective in a country that presents lower initial inequality. In this sense, the main value added of considering a relative redistribution measure is that it allows to take into account cross-country differences in the initial level of inequality in market income.

Specifically, we analyse the redistributive efficiency of cash transfers and direct taxes, both at the central government (CG) level and at the subnational government (SNG) level. These are precisely the variables that Solt (2020) uses to explain the difference between the Gini market and the Gini net income inequality measures. In other words, cash transfers and direct taxes are the fiscal policies that are responsible of the magnitude of the absolute and relative redistribution variables we use. The cash transfers variable includes social security benefits, welfare benefits and social benefits related to employment (for example, the unemployment insurance); and is obtained from International Financial Statistics of the International Monetary Fund database (IFS-IMF) and Social Expenditure Database (SOCX) from OECD statistics. The direct taxes variable includes taxes on income and profits, social security contributions, payroll taxes and

[28] See Solt (2020) for a complete description of the SWIID; we employ version 8.3 (update in May 2020).
[29] These measure are extensively used by several authors (Korpi and Palme 1998; Bradley et al. 2003; Mahler and Jesuit 2006; Huber and Stephens 2014; Kyriacou et al. 2018).

property taxes, and is obtained from the revenues statistics database of OCDE. Cash transfers and direct taxes data are obtained from these sources at general government (GG) level and as percentage of GDP, annual data frequency.

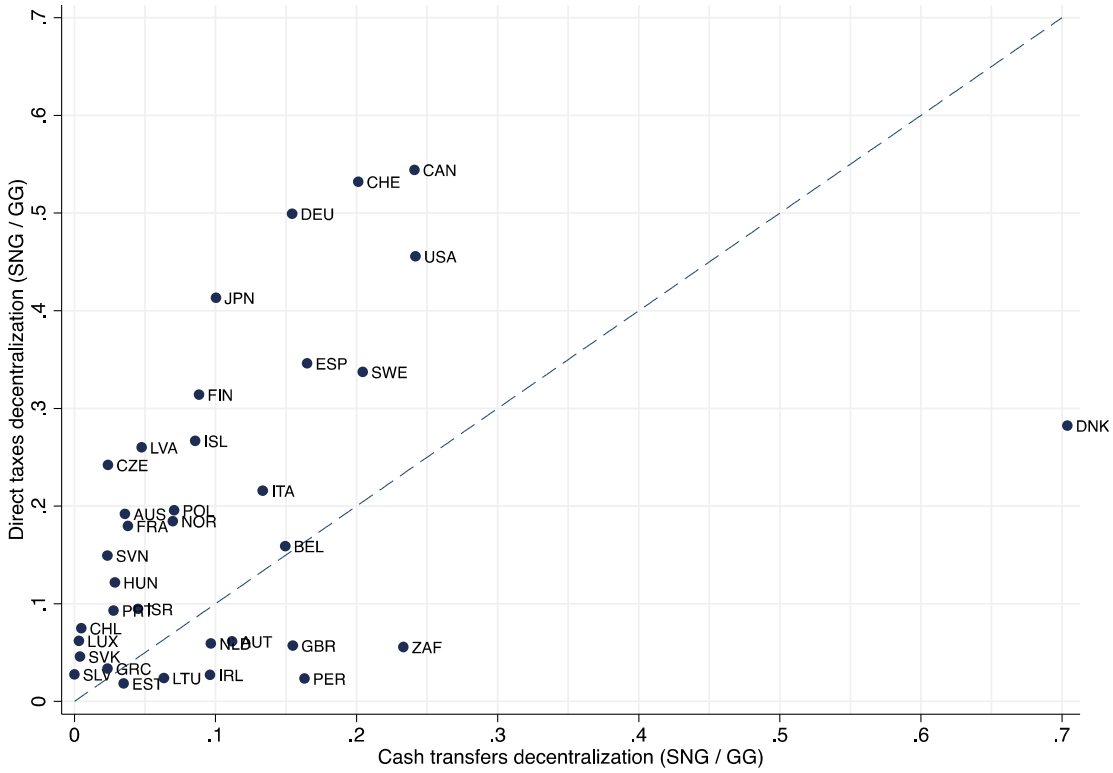
In the empirical literature, fiscal decentralization has traditionally been measured as the share of revenues and expenditures of SNGs over total revenues and expenditures of the GG and computed with data from the Government Financial Statistics of the IMF (see, for example, Adam et al. 2014, Canavire-Bacarreza et al. 2016, and Martinez-Vazquez et al. 2017). Since 2018, the decentralization data is summarised in the Fiscal Decentralization dataset from the IMF, which covers 75 countries and the period 1972-2018. Specifically, this dataset provides annual data on cash transfers and direct taxes from the SNGs (state, provincial, regional, and local governments, including districts and municipalities) expressed as a ratio of the GG level (Lledó et al. 2018). Thus, we employ this information to obtain cash transfers and direct taxes at CG and SNG levels as percentage of GDP.[30]

In Figure 1, we illustrate the degree of fiscal decentralization for our sample of countries over 2000-2016 period. The variable-axis represents the fiscal decentralization variable, measuring the share of the variable of the SNG as proportion of total variable of the GG. The figure clearly shows that countries are characterised as having more decentralised direct taxes than cash transfers (most of the dot labels for the countries appear above the 45-degree line), taking in mean values about 20% and 10% respectively. A clear exception is Denmark -DNK- that displays the highest degree of cash transfers decentralization, taking a value of 70%. In particular, we observe high fiscal decentralization in countries such as Canada, the United States, Switzerland, Sweden, Germany, Spain, and Denmark, while in countries such as Slovenia, Estonia, Slovak Republic, Greece and so on, decentralization is relatively low. It is also important to note that fiscal decentralization does not necessarily reflect the fiscal autonomy that SNGs have to collect the revenues or to decide on how to spend, but it may indicate the potential fiscal resources available at this government tier.

[30] Some authors (e.g., Adam et al. 2014 and Stegarescu 2005) used an alternatives revenue fiscal decentralization database from OECD (1999), which is for a limited number of OECD countries.

**Figure 1 – Fiscal decentralization**

**(mean period 2000-2016)**




*Note:* The country code and description are detailed in Table D.1 of Appendix D.
*Source:* Own elaboration based on data from IMF Fiscal Decentralization dataset.

## 3.5 Income redistribution and fiscal policy: A first approximation

In this section we present a first approximation of some empirical correlations between our main variables. We first focus on the inequality data (see Figure 2) and present the evolution of market and net Gini by regions for the sample of countries considered in this study from 2000 to 2016. In Figure 2, one of the most prominent features of all regions of countries is their high and persistent levels of income inequality, describing by the Gini market index, showing that developing countries are the region with the most unequal income distribution.[31] As Figure 2 also illustrates, from the Gini market index (left bar) to the Gini net index (right bar), the redistributive effect of cash transfers and direct taxes differ considerably across regions and over time – the regions are listed considering their order of absolute redistribution level from largest to smallest. They play a major role in

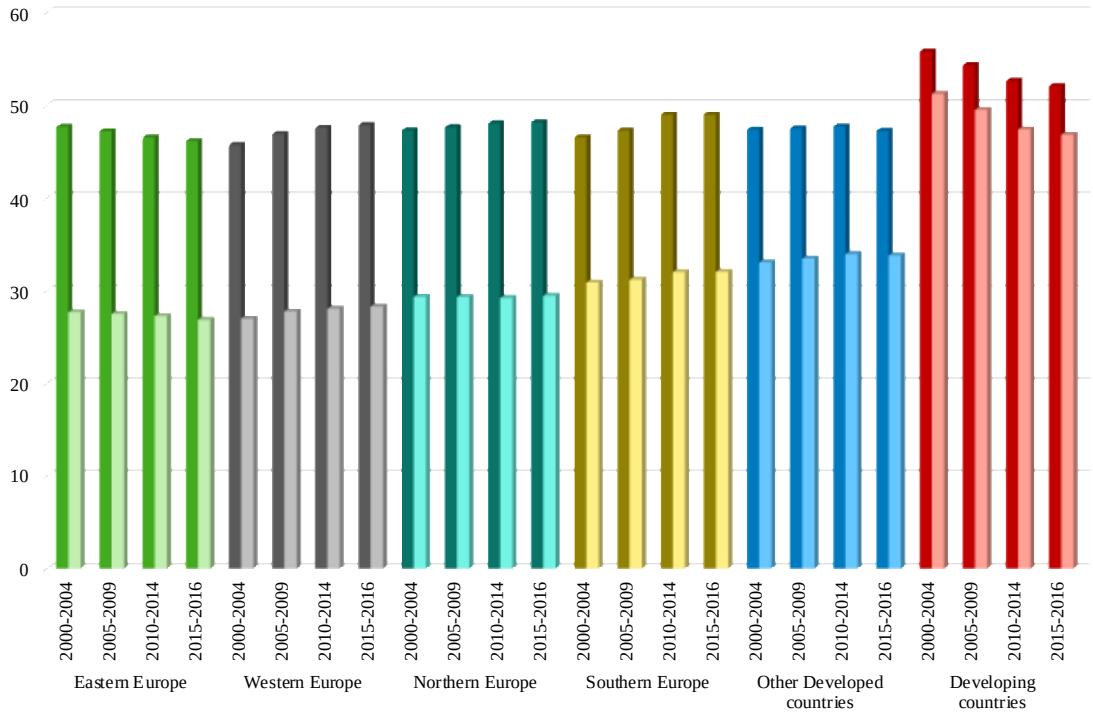
[31] For evidence in the same sense, see, for instance, Gasparini and Lustig (2011).

the reduction of inequality in market income in European countries and other developed countries – these groups show the highest level of absolute redistribution.

While the policy of cash transfers and direct taxes in Eastern Europe (e.g., Hungary and the Czech Republic, and so on), Western Europe (e.g., Belgium, Germany, and so on) and North Europe (e.g., Sweden, Denmark, and so on) economies seem to be more effective in reducing market income disparities -the absolute redistribution of these regions is 19.6, 19.2 and 18.5 points, respectively-, in Southern Europe (e.g., Italy, Spain, and so on) -the absolute redistribution in the region is 16.4 points- and other developed countries (e.g., the United States, Israel, and so on) -absolute redistribution is 13.9 points- are shown less effective. The policy appears irrelevant to reduce income inequality disparities in developing countries (e.g., South Africa, Chile, and so on) -the absolute redistribution is 5 points.

Besides, it is noteworthy that, firstly, the trend of inequality in both income Gini indicator is upward in advanced economies (excluding the Eastern Europe region) while in developing countries it declines; and secondly, fiscal redistribution to reduce inequality has remained relatively steady over time, regardless of the region.

**Figure 2 – Market and net income Gini indices by regions (over 2000-2016 period)**



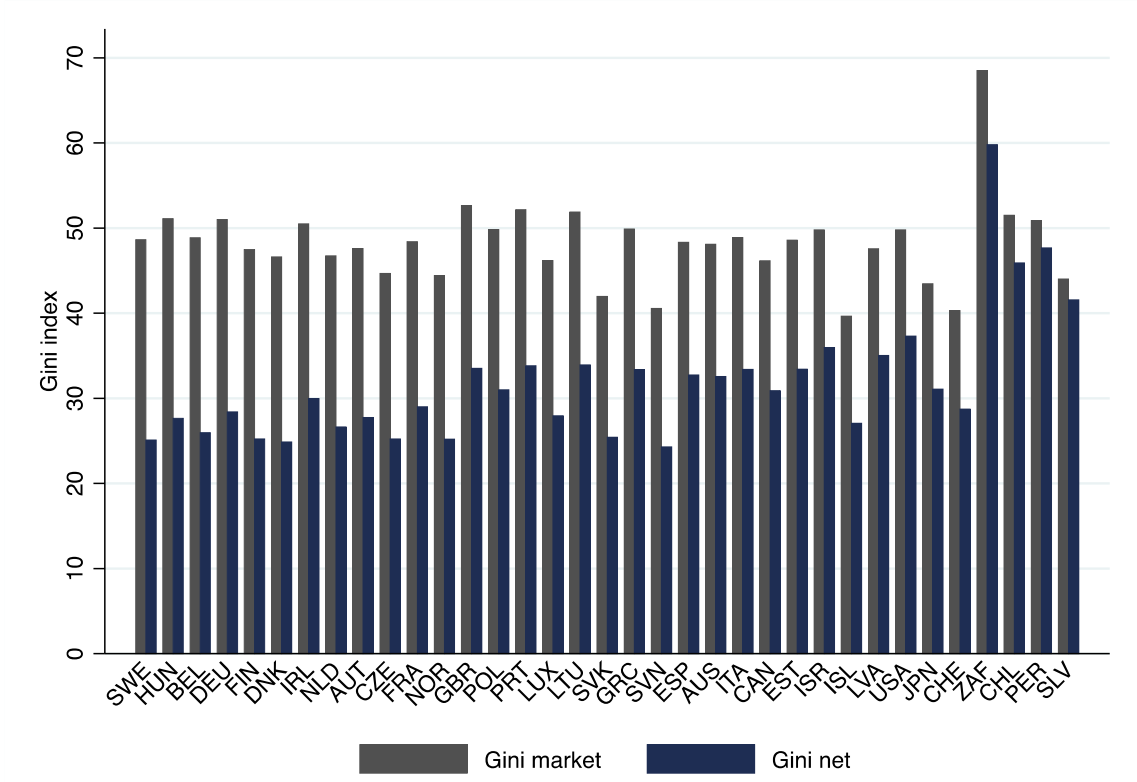

*Note:* The left bar represents the Gini market index (dark colour) and the right bar represents the Gini net index (light colour). Gini market index is computing on market income and Gini net index is compute on disposable income (disposable income = market income + cash transfers – direct taxes). Regions are listed in order of their -mean- absolute redistribution level from largest to smallest. For a complete description of the regions, see Table D.1 of Appendix D.
*Source:* Own elaboration base on Standardized World Income Inequality Database (SWIID).

Figure 3 compares the market and net incomes Gini indices by countries for our sample of thirty-five countries over the period 2000 to 2016; the countries are listed considering their order of absolute redistribution level from largest to smallest. The plot shows important differences between developed countries for the two types of Gini indices and between them and developing countries. In particular, the policy of cash transfers and direct taxes in Sweden, Hungary, Belgium, Germany, Finland, Denmark, and so on, display a greater reduction in market income disparities than Italy, Spain, Israel, the United States, Japan, Switzerland, and so on; and also, both describe a higher reduction in income inequality disparities than South Africa, Chile, Peru and El Salvador.

Moreover, the absolute redistribution measure does not differentiate the initial market income disparities between countries. For instance, the Gini market of Island, Slovenia, Slovakia and Switzerland is about 40 points, more below than other developed and developing economies in the sample; therefore, they are initially more equal societies. Consequently, a policy that achieves a similar reduction on inequality in market income

in two countries (e.g., Iceland and the United States), does not mean that they are equally redistributive effective, it going to be more effective in the country that presents the less initial inequality. To sum, our aim is to identify where the redistributive performance comes from and the methodology proposed in this study allows us to advance in this direction (see Section 6).

**Figure 3 – Market and net income Gini indices in the sample of countries (mean period 2000-2016)**



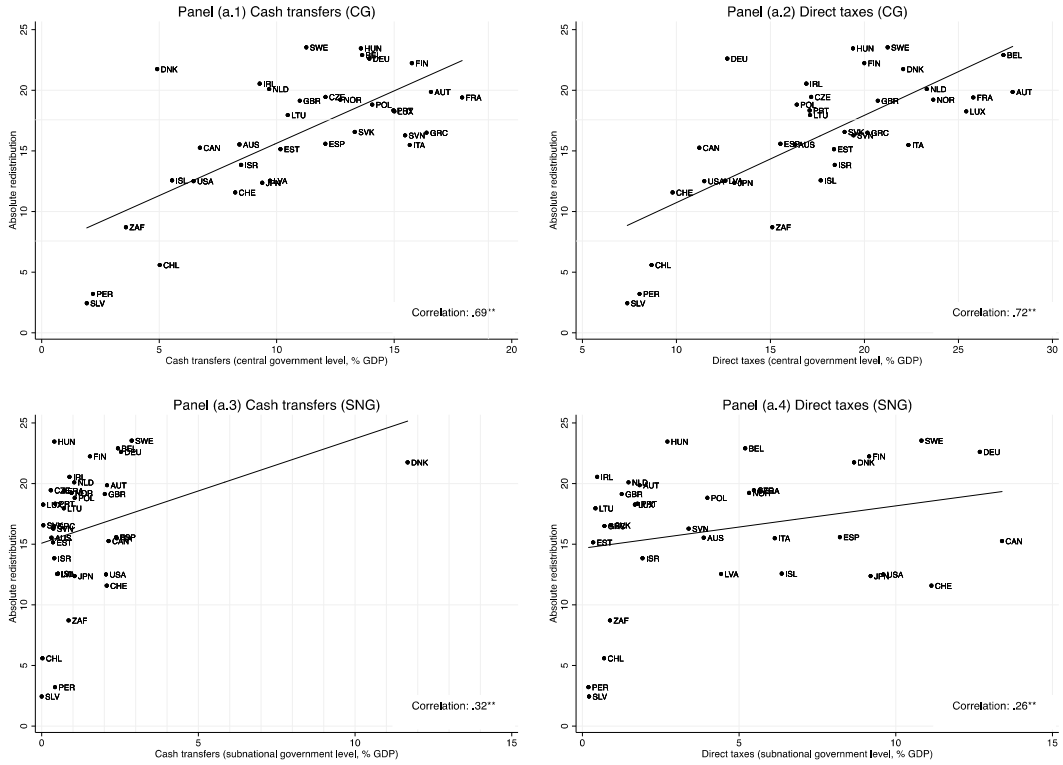

*Note:* Gini market index is computing on market income and Gini net index is compute on disposable income (disposable income = market income + cash transfers – direct taxes). Countries are listed in order of their absolute redistribution level from largest to smallest.
*Source:* Own elaboration base on SWIID.

We now focus on the relationship between the redistribution measures (absolute and relative) and cash transfers and directs taxes at the CG and SNG levels (see Figure 4). The plots suggest that the countries with higher levels of cash transfers and direct taxes, tend to have greater income redistribution and apparently this is more clean referring to CG than to SNG. Specifically, there is a higher correlation between the redistribution measures and the level of cash transfers and direct taxes at the CG level than them at SNG level, correlation about 0.70 and 0.30 respectively. Besides, the plots

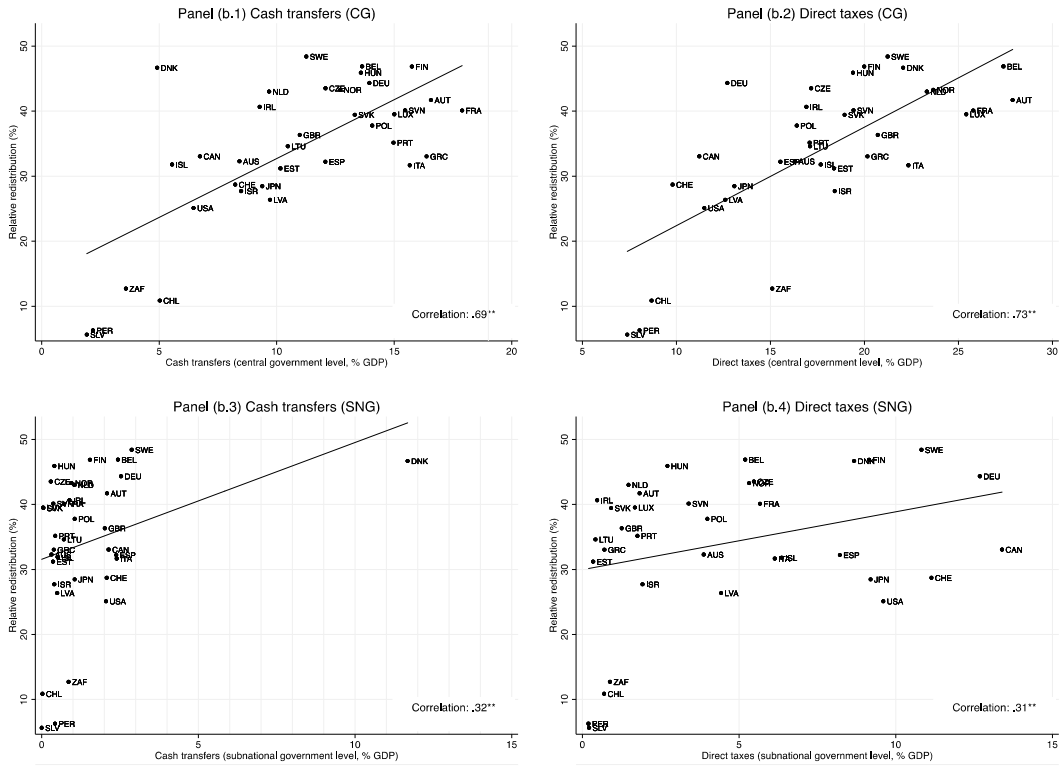
illustrate the fact that countries with diverse fiscal resources and decentralization (e.g., European countries) show different redistributive performances.

**Figure 4 – Relationship between income redistribution measures and fiscal policy (mean period 2000-2016)**

***Panel (a) Absolute redistribution***




***Panel (b) Relative redistribution***




*Note:* The country code and description are detailed in Table D.1 of Appendix D. (**) is the level of significance 5%.
*Source:* Own elaboration based on data from SWIID, IFS-IMF and OECD (SOCX) statistics.

## 3.6 Empirical strategy

The aim of this section is to present the empirical strategy used to, first measure the redistributive efficiency of cash transfers and direct taxes at central and subnational levels and, second analyse the factors that might explain how redistributive efficiency varies across countries and over time, examining specifically the role played by political decentralization. To undertake this analysis, a two-stage approach is proposed (Simar and Wilson 2007, 2011), as we detail in the next subsections.

### *3.6.1 First-stage DEA analysis*

We first consider the DEA methodology in order to obtain the countries redistributive efficiency score. DEA is a linear programming (LP) methodology for measuring efficiency by comparing each decision making unit (DMU), with an efficient production frontier (Farrell 1957; Charnes et al. 1978). In this sense, DEA uses data on input and output variables to construct a non-parametric efficiency frontier over the data points solved by the sequence of LP problem – one data point solution for each DMU. The DEA analysis methodology can be performed input-oriented or output-oriented. While the input-oriented model minimises inputs for a given amount of output, the output-oriented model maximises output for a given amount of inputs. The result of the LP problem is an efficiency score for each DMU, which makes possible to rank the efficiency of DMUs by comparing each performance with the best-practice (or performance) in the sample at period *t*. Specifically, the DEA method defines the set of observations with the best performance for the DMUs of the analysis and produces a frontier of production possibilities by linearly connecting them, under the assumption of convex technology; DMUs that are not defining the frontier are considered inefficient (Bogetoft and Otto 2011).

Analytically, suppose there are *N* inputs and *M* outputs for each of I DMUs; and for the *i-th* DMU, $\boldsymbol{x}_i$ is the column vector of the inputs and $\boldsymbol{y}_i$ is the column vector of the outputs. We can define $\boldsymbol{X}$ as the (*N* x *I*) input matrix and $\boldsymbol{Y}$ as the (*M* x *I*) output matrix. The output-oriented efficiency score for the *i-th* DMU is then estimated via the following LP problem (Coelli et al. 2005):

$$\max_{\theta,\lambda} \theta_i \tag{1}$$

subject to

$$-\theta_i \mathbf{y}_i + \mathbf{Y}\boldsymbol{\lambda} \geq 0, \tag{2}$$

$$\mathbf{x}_i - \mathbf{X}\boldsymbol{\lambda} \geq 0, \tag{3}$$

$$\mathbf{I1}'\boldsymbol{\lambda} = 1, \tag{4}$$

$$\boldsymbol{\lambda} \geq 0 \tag{5}$$

where $\theta_i$ is the output-oriented efficiency score that measures technical efficiency $(1/\theta_i)$, i.e., the optimal solution to this problem (Equation 1), $1 \leq \theta_i \leq \infty$, and $\theta_i - 1$ is the potential proportional increase in the output quantities that could be achieved without altering the input quantities by the i-th DMU. If $\theta_i > 1$, the country is within the frontier (i.e., it is inefficient), while $\theta_i = 1$ implies that the country is on the efficiency frontier (i.e., efficient). Accordingly, the lower the score of the country, the higher its level of efficiency. Equation 2 stands for the "output constraint", indicating that the weighted sum of outputs from all DMUs in the sample must be greater than or equal to the potential output for i-th DMU given the "input constraint" shown by Equation 3. The vector $\lambda$ is a (Ix1) vector of constants that measures the weights used to compute the location of an inefficient country if it became efficient. Equation 4 represents the "convexity constraint" that accounts for variable returns to scale (VRS) production function technology, where $\boldsymbol{I1}$ is an Ix1 dimensional vector of ones. Note that the convexity constraint essentially ensures that an inefficient DMU is only "benchmarked" against DMUs of a similar size. That is, the projected point (for that DMU) on the DEA frontier is a convex combination of observed DMUs. Finally, this problem has to be solved for each of the i-th DMUs to obtain the i efficiency scores.

However, DEA efficiency scores may be influenced by exogenous (or "environmental") factors that potentially downward bias efficiency. In order to correct it, at least in advance, we compute the bootstrapping DEA method (Simar and Wilson 2007, 2011; Bogetoft and Otto 2011; Du et al. 2018) that is based on the numerical simulation of the original data set calculating efficiency of the simulated sample through DEA to generate bias-corrected efficiency and confidence intervals (Efron 1979; Simar and Wilson 1998, 2000).

In this study, we take countries' as DMUs, the income redistribution (two specifications, absolute and relative) as the one output variable and cash transfers and direct taxes variables, both at CG and SNG levels, are the four input variables.[32] This is, we take into account the size and decentralization degree of cash transfers and direct taxes as inputs, which is a novelty. To our knowledge, such an analysis of redistributive efficiency of fiscal policy has not been applied before by considering decentralization to compute efficiency scores and countries' efficiency ranking. Note that fiscal decentralization is discretionary fiscal policy and thus we capture it in the first stage of the DEA analysis (as input). Moreover, we select an output-oriented model (i.e., increase the output given fixed the inputs) because the government's target we assume is redistribution. The frontier and country scores and ranking of efficiency are computed for each sub-period of analysis considered.

### *3.6.2 Second-stage regression analysis*

In the second stage, we regress the obtained efficiency scores using the DEA on a set of possible explanatory factors that might explain differences in the variation of the redistributive efficiency across countries and over time, and which do not respond to discretionary fiscal policy decisions. Thus, we regress the estimated bias-corrected efficiency scores, $\hat{\theta}_{it}$, on a set of non-discretionary (or exogenous) variables, $Z_{it}$, that potentially influence the efficiency level. Specifically, we consider the following model:

$$\hat{\theta}_{it} = \propto + Z_{it}\beta + d_t + d_j + \varepsilon_{it} \quad (6)$$

where $i = 1, 2, \ldots I$ represents the countries in the sample and $t = 1, 2, \ldots T$, refers to the time period, $\propto$ is a constant, $\beta$ a vector of parameters to be estimated that capture the effect of the explanatory variables on efficiency scores, $d_t$ represents period fixed effects, $d_j$ represents the time-invariant variables and $\varepsilon_{it}$ is statistical noise, $\varepsilon_{it} \sim N(0, \sigma_\varepsilon^2)$, with left-tail truncation given by $\varepsilon_{it} \geq 1 - \propto - Z_{it}\beta - d_t - d_j$ since DEA efficiency scores are larger than or equal to 1 in the output-orientation approach we used.

[32] See Table D.3 of Appendix D for descriptive statistics of input-output variables.

A problem arise since true DEA efficiency scores are unobserved and replaced by the previously estimated $\hat{\theta}_i$, which in turn are serially correlated to the non-discretionary explanatory variables in an unknown way (Fernandes et al. 2018). Therefore, a bootstrap procedure is implemented to overcome the correlation problem and obtain unbiased coefficients and valid confidence intervals. Thus, following Simar and Wilson (2007, 2011) and Du et al. (2018), a double bootstrap method will be used, in which DEA scores are bootstrapped in the first stage of the analysis to obtain bias-corrected efficiency scores, and then the second stage is performed, consisting of regressing the bias-corrected efficiency scores on a set of potential explanatory factors using a bootstrap truncated regression.

*Specification of the second stage empirical model*

We estimate the following empirical model:

$$\text{Efficiency score}_{it} = \beta_0 + \beta_1 \text{PD}_{it} + \beta_2 \text{X}_{it} + \beta_3 \text{W}_i + \beta_4 \text{dr}_i + \beta_5 \text{dt}_t + \varepsilon_{it} \qquad (7)$$

where i indexes the countries and t denotes the sub-period covered. "Efficiency score" is the dependent variable referring to relative redistribution or absolute redistribution outputs. X is a vector of time varying control variables, W is a vector of time-invariant control variables, and $\varepsilon$ the error term.[33] Also, we include region and period fixed effects, $dr_i$ and $dt_t$ respectively. Since we are analysing the redistributive efficiency of both, central and subnational level, we are interested in controlling the role of political decentralization (PD). Therefore, we include as explanatory variable the PD. But measuring PD may be done using different variables that measure different objects.

We examine four alternative measures of PD. First of all, we consider the role of a federal political system, as a proxy of PD, and we introduce the variable "federalism" from Gerring and Thacker (2004), that is a time-invariant variable. "Federalism" involves two components. On the one hand, territorial government, that refers to a political system where the national government is or is not sovereign relative to its territorial units, namely, unitary and federal states respectively. On the other hand, bicameralism, which

[33] The definitions and sources of all variables are presented in Table D.2 and descriptive statistics in Table D.4, both in the Appendix D.

refers to the relative power between the lower and upper houses (i.e., share of policy-making power between two chambers) at the national level. Consequently, a federal state is characterised by federal territorial government and strong bicameralism (i.e., upper house has some effective veto power); in this case, the "federalism" variable takes the highest value. In a fully federal state, territorial units have constitutional recognition of subnational authority, independently elected territorial legislature, specific policy purviews reserved to them, and revenue-raising authority.

Since autonomous or self-governing regions by constitution mandate is a feature of federal system, secondly, we also consider the variable "autonomous regions" from the Database of Political Institutions (DPI) as a proxy of PD. That is a dummy variable that takes a value of 1 in countries with autonomous regions, and a value of 0 otherwise.

Thirdly, we employ the "regional authority index" (RAI) from Hooghe et al. (2016), that is a continuous variable, as a proxy of PD. RAI is an overall indicator of "regional authority" obtained as the sum of "self-rule" (five dimensions: institutional depth, policy scope, fiscal autonomy, borrowing autonomy, representation) and "shared-rule" (five dimensions: law making, executive control, fiscal control, borrowing control and constitutional reform); and where the greater the SNG authority, the greater the RAI variable values (i.e., high PD).

Finally, we follow Schneider (2003) that indicates that the existence of elections at the municipal level or the state/provincial level is an indicator of PD because they increase the probabilities that some political functions are decentralised, such as representation that empowers local voters. We consider the variables municipal and state governments locally elected from the DPI (data are not fully available for our sample of countries) to build an aggregate variable "electoral decentralization". Both variables are recorded in the same manner, taking the value 0 if neither local executive nor local legislature are locally elected, 1 if the executive is appointed, but the legislature elected, and 2 if they are both locally elected. In particular, we consider the sum of both variables and thus our variable ranges from 0 to 4, where 4 indicates high PD.

We consider these four variables proxies of PD, because they measure different decentralization characteristics. The correlation analysis indicates a positive and significant relationship between our four variables at the 5% level. For instance, the correlation between: "federalism" and "regional authority index" variables are about 0.75; "federalism" and "autonomous regions" variables are about 0.01; "federalism" and "electoral decentralization" variables are about 0.41; "regional authority index" and

"autonomous regions" variables are about 0.20; "regional authority index" and "electoral decentralization" variables are about 0.38; "autonomous regions" and "electoral decentralization" variables are about 0.28. Therefore, we obtained that the PD variables are correlated but they are not precisely similar (i.e., low correlation).

Based on the background section, we would expect that countries with high PD are less redistributive efficient; because reduce available resources to central government and redistribution is principally a national level policy (Oates 1999, 2005), and; because the decentralised political power is more corrupt (Gerring and Thacker 2004).

We next explain the control variables included in Equation (7). To account for the possibility that wealthier economies show a more redistributive efficient fiscal policy, we control for "GDP per capita" (in logs). We would expect that economies with higher real income are more productive and developed, therefore, they may be more efficient. We also include "elderly people", the share of the population over 65 years of age, in an attempt to account for the pressure of the pension system on redistributive efficiency. Note that old-age benefits are (one of) the most important social transfers in countries and their effect on redistributive efficiency would depend on fiscal policy design and their implementation. Additionally, we consider the "unemployment rate" since it affects redistribution via the amount of government resources through unemployment subsidies (Huber and Stephens 2014). Again, we expect that the impact on redistributive efficiency will depend on the specific unemployment compensation scheme. In this sense, Mahler and Jesuit (2006) indicate a positive effect of the elderly (weak effect) and unemployment rate (strong effect) on fiscal redistribution but they do not examine efficiency.

Also we consider the role of "government effectiveness" used to proxy government quality (Kaufmann et al. 2011), which involves attributes such as quality of public and civil services, independence from political pressures, policy design and execution and government credibility. We expect that countries with high government effectiveness should be able to achieve more redistribution for a given level of government resources and consequently more efficient (see Kyriacou et al. 2018).

Moreover, we control for a time invariant variable which is "ethnic fractionalisation" in attempt to account for the possibility that high ethnic heterogeneity in the society makes it difficult to agree about what constitutes "good" fiscal policies and therefore the income redistribution needed. Our fractionalisation variable is obtained from Alesina et al. (2003) and takes higher values when there are many small groups in the society. We expect a negative effect on redistributive efficiency because ethnic

fractionalisation may lead to rent-seeking behaviour of multiple interest groups, creating an inefficient provision of public good (Easterly and Levine 1997; La Porta et al. 1999; Alesina et al. 2003).

We also control for human capital distribution by including the variable "education inequality" from Castelló-Climent and Doménech (2014). The expectation is that high education inequality leads to low societal demands for government-led redistribution (e.g., by increasing the elites influence in political systems) and therefore a less efficient redistribution (Kerr 2014).

Furthermore, we include a variable from International Country Risk Guide (ICRG) called "democratic accountability". This is an indicator of political stability of the country and is computed on the basis of the type of a country's governance, from altering democracies to autarchies governance (i.e., from high to low democratic accountability). We would expect countries with high democratic accountability, that are characterised as a government that switches (e.g., after two successive terms) and also has the presence of more than on political party, to lead to an overall effectiveness of fiscal policies and thus show more redistributive efficiency (Persson and Tabellini 2004).

In recent decades, the increase in public debt and overspending in developed countries led to introducing and strengthening the fiscal rules (such as the European Fiscal Compact after the Great Recession) with the consensus being that they foster fiscal discipline (Heinemann et al. 2018).[34] Nevertheless, the empirical literature is inconclusive about the budgetary impact of the fiscal rules on public sector efficiency. A recent work of Christl et al. (2020), indicates that fiscal rules are relevant to positively affect public sector efficiency, particularly in the presence of high fiscal imbalance of SNGs. Thus, we control for the existence of "debt fiscal rules" in an attempt to account for the possibility that the debt boundary prevents overspending and enforces government to be more efficient in using public resources.

Finally, we include "geographical region" dummy variables, which allow us to partially account for country-specific effects (Sepulveda and Martinez-Vazquez 2011). In this sense, Canavire-Bacarreza et al. (2016) claim that more geographically diverse countries present more heterogeneous population with different preferences and needs for public goods and services provision, which is positively associated with higher levels of fiscal decentralization. In addition, Ligthart and Oudheusden (2017) argue that

[34] Fiscal rules are laws designed to impose a budgetary constraint to limit countries' scope on fiscal aggregates (Lledó et al. 2017).

geographical proximity draws countries to adopt policies similar to neighbouring countries, such as the kind of decentralization. Therefore, we expect that geographical regions affect redistribution although we do not have any prior expectation about the effect on efficiency.

## 3.7 Results

### *3.7.1 First-stage result*

#### *3.7.1.1. Efficiency scores and country rankings*

Table 1 and 2 show the efficiency scores and country rankings obtained from the estimated the bootstrap-DEA output-oriented model (VRS technology) considering four inputs (cash transfers and direct taxes, both at CG and at SNG levels) and one output, absolute and relative redistributions respectively, for the four selected periods of analysis (2000-2004, 2005-2009, 2010-2014, and 2015-2016).[35] The results in Table 1 and Table 2 show that the average values of the efficiency scores in the sample of countries increase during the period of analysis, which means that the "average" country is becoming more redistributive inefficient over time (see the bottom row of Tables 1 and 2). Accordingly, countries could potentially increase their redistribution without altering the volume of cash transfers and direct taxes resources and decentralization degree; by a range of 12.5%-24.7% and 8.6%-22.2% in the cases of absolute and relative redistributions, respectively – if this is the case, countries would be deemed efficient. Note that some authors (see, for instance, Christl et al. 2020) highlight the fact that countries' public sector efficiency improved in the aftermath of the Great Recession based on the argument that budget cuts did not cause a reduction in public sector goods and services to the same extent. Nevertheless, we are providing evidence that income redistribution (i.e., distribution component of the public sector) became more inefficient in many countries after the Great Recession and this outcome may be provoked because government policies have been

[35] To obtain the DEA efficiency score, we use the "Benchmarking" package (function DEA.boot) in R software and the bootstrap truncated regression analysis was performed in STATA. All code is available from the authors upon request.

focused on restoring public finances and not to reduce increasing income inequalities (Caminada et al. 2019).

In Table 1, we present the efficiency score outcomes using the absolute redistribution measure as an output and find that Sweden (2000-2004), the Czech Republic (2005-2009), Iceland (2010-2014) and Belgium (2015-2016) are the most efficient in the sample (first rank), being located very close to the efficiency frontier (scores close to 1). In contrast, Italy (2000-2014) and Japan (2015-2016) are the least efficient. The economic interpretation is as follows: for instance, Belgium has an efficiency score of 1.066 in the 2015-2016 period, which means it could increase absolute redistribution by 6.6% without altering the cash transfers and direct taxes resources and their degree of decentralization. On the other side, the efficiency score of Japan is 1.875 in the 2015-2016 period, therefore, it could increase absolute redistribution in 87.5% without altering the cash transfers and direct taxes levels and their degree of decentralization, thus, there is an important possibility for increasing redistributive efficiency.

**Table 1 – Absolute redistribution: Efficiency scores and country rankings**

| *Country* | *2000-2004* | | *2005-2009* | | *2010-2014* | | *2015-2016* | |
|---|---|---|---|---|---|---|---|---|
| | *Efficiency score* | *Ranking* | *Efficiency score* | *Ranking* | *Efficiency score* | *Ranking* | *Efficiency score* | *Ranking* |
| *Australia* | 1.037 | 3 | 1.062 | 9 | 1.059 | 3 | 1.369 | 29 |
| *Austria* | 1.130 | 26 | 1.159 | 26 | 1.192 | 28 | 1.193 | 19 |
| *Belgium* | 1.054 | 8 | 1.049 | 4 | 1.068 | 6 | 1.066 | 1 |
| *Canada* | 1.049 | 6 | 1.063 | 10 | 1.082 | 13 | 1.105 | 5 |
| *Chile* | 1.074 | 18 | 1.066 | 11 | 1.079 | 11 | 1.134 | 17 |
| *Czech Republic* | 1.049 | 5 | 1.037 | 1 | 1.064 | 4 | 1.129 | 10 |
| *Denmark* | 1.067 | 11 | 1.080 | 19 | 1.087 | 16 | 1.133 | 14 |
| *El Salvador* | 1.075 | 22 | 1.081 | 21 | 1.088 | 18 | 1.134 | 16 |
| *Estonia* | 1.074 | 17 | 1.076 | 15 | 1.089 | 19 | 1.130 | 11 |
| *Finland* | 1.075 | 21 | 1.109 | 22 | 1.096 | 21 | 1.084 | 4 |
| *France* | 1.145 | 27 | 1.259 | 32 | 1.266 | 31 | 1.270 | 24 |
| *Germany* | 1.073 | 15 | 1.079 | 17 | 1.079 | 10 | 1.119 | 7 |
| *Greece* | 1.091 | 24 | 1.179 | 30 | 1.155 | 25 | 1.312 | 26 |
| *Hungary* | 1.062 | 10 | 1.060 | 8 | 1.077 | 8 | 1.127 | 8 |
| *Iceland* | 1.068 | 12 | 1.068 | 12 | 1.051 | 1 | 1.206 | 20 |
| *Ireland* | 1.075 | 19 | 1.073 | 14 | 1.077 | 9 | 1.129 | 9 |
| *Israel* | 1.047 | 4 | 1.140 | 24 | 1.259 | 30 | 1.864 | 34 |
| *Italy* | 1.596 | 35 | 1.592 | 35 | 1.547 | 35 | 1.522 | 33 |
| *Japan* | 1.214 | 30 | 1.218 | 31 | 1.470 | 34 | 1.875 | 35 |
| *Latvia* | 1.159 | 28 | 1.051 | 6 | 1.131 | 22 | 1.388 | 30 |
| *Lithuania* | 1.053 | 7 | 1.057 | 7 | 1.088 | 17 | 1.210 | 21 |
| *Luxembourg* | 1.061 | 9 | 1.072 | 13 | 1.087 | 15 | 1.131 | 12 |
| *Netherlands* | 1.037 | 2 | 1.050 | 5 | 1.067 | 5 | 1.151 | 18 |
| *Norway* | 1.262 | 32 | 1.177 | 29 | 1.187 | 27 | 1.284 | 25 |
| *Peru* | 1.073 | 14 | 1.078 | 16 | 1.087 | 14 | 1.133 | 13 |
| *Poland* | 1.123 | 25 | 1.173 | 28 | 1.179 | 26 | 1.247 | 23 |
| *Portugal* | 1.068 | 13 | 1.045 | 2 | 1.237 | 29 | 1.327 | 27 |
| *Slovak Republic* | 1.074 | 16 | 1.081 | 20 | 1.089 | 20 | 1.133 | 15 |
| *Slovenia* | 1.289 | 33 | 1.437 | 33 | 1.405 | 33 | 1.449 | 31 |
| *South Africa* | 1.075 | 20 | 1.079 | 18 | 1.081 | 12 | 1.111 | 6 |
| *Spain* | 1.508 | 34 | 1.501 | 34 | 1.402 | 32 | 1.453 | 32 |
| *Sweden* | 1.035 | 1 | 1.046 | 3 | 1.068 | 7 | 1.076 | 2 |
| *Switzerland* | 1.241 | 31 | 1.129 | 23 | 1.056 | 2 | 1.077 | 3 |
| *United Kingdom* | 1.087 | 23 | 1.167 | 27 | 1.133 | 23 | 1.237 | 22 |
| *United States* | 1.170 | 29 | 1.156 | 25 | 1.138 | 24 | 1.338 | 28 |
| *Average* | 1.125 | | 1.136 | | 1.152 | | 1.247 | |

*Note:* Output-oriented variable returns to scale (VRS) technical efficiency. Efficiency score: = 1 represents maximum efficiency and > 1 means greater inefficiency. All results are based on one output (absolute redistribution) and four inputs (cash transfers and direct taxes at CG level and at SNG level). Estimation method: DEA bootstrap with 10,000 repetitions.
*Source:* Own estimations.

Table 2 reports the efficiency scores employing the relative redistribution measure as an output. This is, we account for initial income inequality conditions in calculating the redistributive measure. In other words, we account for the proportional change of the redistribution. The most relevant finding is that Belgium is the most efficient in the sample regardless of the sub-period examined (ranks first). Additionally, other countries that show good performance are Finland, Hungary, Lithuania, Netherlands, Norway and Sweden throughout the 2000-2016 period. During this timeframe, Italy (2000-2014) and Israel (2015-2016) are the least efficient. Other countries that present low redistributive efficiency include Greece, Japan, Portugal, South Africa, Spain and United States in the period 2000-2016. The economic intuition is as above, for instance, Belgium has an

efficiency score of 1.042 in the 2015-2016 period, that means it could increase relative redistribution by 4.2% without changing the cash transfers and direct taxes resources and their degree of decentralization. On the other hand, Italy could improve their redistribution by more than 50% without altering the amount of cash transfers and direct taxes resources and decentralization degree.

**Table 2 – Relative redistribution: Efficiency scores and country rankings**

| *Country* | *2000-2004* | | *2005-2009* | | *2010-2014* | | *2015-2016* | |
|---|---|---|---|---|---|---|---|---|
| | *Efficiency score* | *Ranking* | *Efficiency score* | *Ranking* | *Efficiency score* | *Ranking* | *Efficiency score* | *Ranking* |
| *Australia* | 1.095 | 29 | 1.058 | 12 | 1.044 | 3 | 1.310 | 27 |
| *Austria* | 1.084 | 26 | 1.071 | 23 | 1.127 | 22 | 1.130 | 19 |
| *Belgium* | 1.022 | 1 | 1.023 | 1 | 1.033 | 1 | 1.042 | 1 |
| *Canada* | 1.037 | 7 | 1.053 | 10 | 1.082 | 14 | 1.102 | 7 |
| *Chile* | 1.051 | 17 | 1.053 | 11 | 1.055 | 4 | 1.123 | 16 |
| *Czech Republic* | 1.039 | 9 | 1.050 | 7 | 1.077 | 11 | 1.123 | 12 |
| *Denmark* | 1.051 | 15 | 1.065 | 19 | 1.084 | 18 | 1.123 | 14 |
| *El Salvador* | 1.053 | 22 | 1.065 | 21 | 1.084 | 19 | 1.124 | 17 |
| *Estonia* | 1.052 | 20 | 1.065 | 18 | 1.085 | 21 | 1.123 | 15 |
| *Finland* | 1.025 | 2 | 1.040 | 3 | 1.034 | 2 | 1.043 | 2 |
| *France* | 1.095 | 30 | 1.183 | 30 | 1.216 | 28 | 1.222 | 23 |
| *Germany* | 1.051 | 14 | 1.062 | 15 | 1.073 | 8 | 1.099 | 5 |
| *Greece* | 1.070 | 24 | 1.263 | 33 | 1.242 | 29 | 1.311 | 28 |
| *Hungary* | 1.035 | 5 | 1.041 | 4 | 1.068 | 7 | 1.101 | 6 |
| *Iceland* | 1.050 | 13 | 1.064 | 16 | 1.083 | 17 | 1.109 | 8 |
| *Ireland* | 1.052 | 18 | 1.059 | 14 | 1.073 | 9 | 1.119 | 11 |
| *Israel* | 1.139 | 31 | 1.182 | 29 | 1.247 | 30 | 1.734 | 35 |
| *Italy* | 1.523 | 35 | 1.530 | 35 | 1.528 | 35 | 1.507 | 32 |
| *Japan* | 1.043 | 12 | 1.084 | 24 | 1.388 | 34 | 1.602 | 34 |
| *Latvia* | 1.065 | 23 | 1.098 | 26 | 1.131 | 24 | 1.290 | 26 |
| *Lithuania* | 1.035 | 4 | 1.039 | 2 | 1.082 | 15 | 1.273 | 25 |
| *Luxembourg* | 1.041 | 11 | 1.052 | 9 | 1.081 | 13 | 1.116 | 10 |
| *Netherlands* | 1.039 | 10 | 1.052 | 8 | 1.077 | 12 | 1.072 | 3 |
| *Norway* | 1.092 | 28 | 1.049 | 6 | 1.065 | 5 | 1.135 | 20 |
| *Peru* | 1.051 | 16 | 1.065 | 17 | 1.083 | 16 | 1.123 | 13 |
| *Poland* | 1.085 | 27 | 1.166 | 28 | 1.130 | 23 | 1.185 | 22 |
| *Portugal* | 1.038 | 8 | 1.087 | 25 | 1.266 | 32 | 1.336 | 29 |
| *Slovak Republic* | 1.052 | 19 | 1.065 | 20 | 1.085 | 20 | 1.124 | 18 |
| *Slovenia* | 1.071 | 25 | 1.143 | 27 | 1.186 | 25 | 1.169 | 21 |
| *South Africa* | 1.052 | 21 | 1.070 | 22 | 1.252 | 31 | 1.589 | 33 |
| *Spain* | 1.354 | 34 | 1.406 | 34 | 1.373 | 33 | 1.414 | 30 |
| *Sweden* | 1.033 | 3 | 1.042 | 5 | 1.065 | 6 | 1.075 | 4 |
| *Switzerland* | 1.036 | 6 | 1.058 | 13 | 1.075 | 10 | 1.111 | 9 |
| *United Kingdom* | 1.192 | 32 | 1.217 | 32 | 1.210 | 27 | 1.262 | 24 |
| *United States* | 1.201 | 33 | 1.206 | 31 | 1.193 | 26 | 1.435 | 31 |
| *Average* | 1.086 | | 1.109 | | 1.142 | | 1.222 | |

*Note:* Output-oriented variable returns to scale (VRS) technical efficiency. Efficiency score: = 1 represents maximum efficiency and > 1 means greater inefficiency. All results are based on one output (relative redistribution) and four inputs (cash transfers and direct taxes at CG level and at SNG level). Estimation method: DEA bootstrap with 10,000 repetitions.
*Source:* Own estimations.

In general, the results of Table 1 and 2 confirm the lower redistributive efficiency of Southern Europe and the United States pointed to by Kyriacou et al. (2018) while the other European countries perform in general much better. We also identify that the three

Latin American countries (i.e., Chile, El Salvador, and Peru) present higher levels of redistributive efficiency.

Finally, we observe that the efficiency scores using absolute and relative redistribution outputs show different outcomes. Specifically, the efficiency scores employing the absolute redistribution measure as an output depict more countries' inefficiencies than the efficiency scores using the relative redistribution measure as an output (see Tables 1 and 2). However, the plot representation of the sample of countries does not show a substantial difference of efficiency scores between both redistributive measures (see Figure E.1 of Appendix E, the countries are setting around the 45-degree line).

#### *3.7.1.2. Influence of fiscal decentralization variables on efficiency score*

Now, we focus on analysing the contribution of each fiscal variable to explain efficiency score. In order to do so, we consider the duality property of the linear programming problem (equations 1-5 of Subsection 6.1), that identical efficiency results can be found from estimates the dual problem (Charnes et al. 1978). Following Førsund (2018), the formulation of the dual problem is:

$$\min \theta_{i_0} = \min_{v,u} \left( \sum_{n=1}^{N} v_{ni_0} x_{ni_0} + u_{i_0} \right) \tag{8}$$

subject to

$$\sum_{m=1}^{M} u_{mi_0} y_{mi_0} = 1 \tag{9}$$

$$-\sum_{m=1}^{M} u_{mi_0} y_{mi_0} + \sum_{n=1}^{N} v_{ni_0} x_{ni} + u_{i_0} \geq 0, \quad i = 1 \dots, i_0, \dots I \tag{10}$$

$$v_{ni_0}, u_{mi_0} \geq 0, u_{i_0} \geq 0 \text{ sign free} \tag{11}$$

The variables $v_{ni_0}$ and $u_{mi_0}$ are the weights (also called multipliers or shadow prices) associated with inputs ($n = 1 \dots N$) and outputs ($m = 1 \dots M$), respectively. The $\theta_{i_0} = \sum_{n=1}^{N} v_{ni_0} x_{ni_0} + u_{i_0}$ is the efficiency score and optimal solution for the analysed unit. In particular, the product of a weight and an input, $v_{ni_0} * x_{ni}$, so-called virtual input,

represent the direct contribution to the efficiency score at the optimal solution. Therefore, a zero-weight value for an input means that this input does not influence on the efficiency score, in spite of the relevance of the input. However, the results of the dual problem showed a prevalence of zero weights, which leads to introduce restrictions on them to be positive. Førsund (2013) indicates that researchers commonly introduce value judgements on weights restrictions (e.g., direct restriction on the weights, adjust the observed input-output data, restricting the virtual inputs and outputs and identification of a common set of weights). To identify the relative importance of the different fiscal variables (inputs) to explain efficiency score (output), based on Allen et al. (1997), we introduce restrictions.

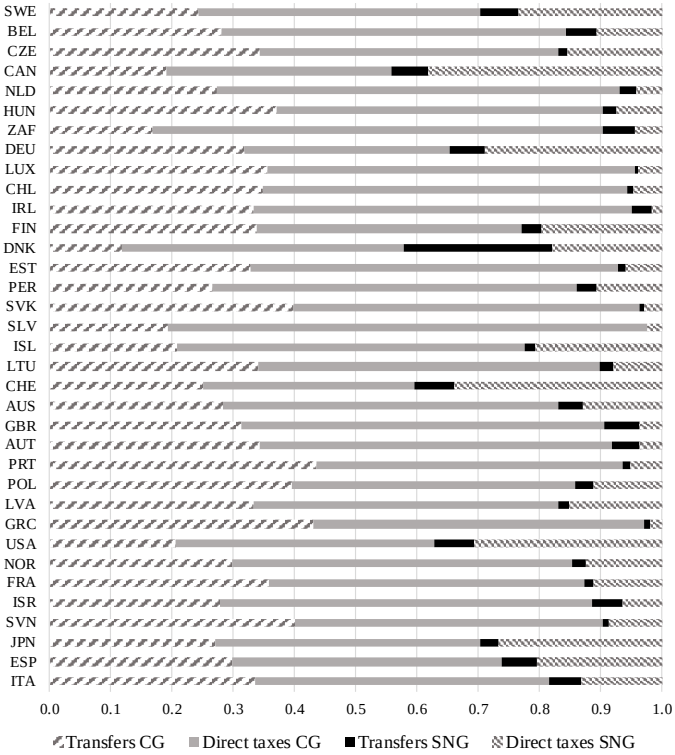
Figure 5 represents the contributions on absolute and relative redistribution efficiency of each fiscal variables analysed (inputs). From the visual exploration of both panels, first, we observe that the contribution of cash transfers and direct taxes at the CG level are higher than them at SNG level to redistributive efficiency, this outcome is in line with the decentralization theory that redistribution should be a national-level policy. Therefore, fiscal centralisation may play an important role to explain redistributive efficiency. Second, the contribution of direct taxes is higher than cash transfer to redistributive efficiency both at the CG and SNG levels – note that the empirical literature indicates a greater redistributive impact of cash transfers than direct taxes on income redistribution level. Our result may be explained because the progressivity of the tax systems (e.g., income taxes) could be more efficient in affecting income redistribution targets than the cash transfers systems (e.g., old-age benefits), and; because we analyse the redistributive impact of cash transfers, excluding transfers in kind.[36] Thus, we conclude that fiscal decentralization may be able to explain important differences in redistributive efficiency across countries in this first stage of the analysis.

[36] Social benefits represent about 44% in terms of total GG expenditure (cash benefits 26% and benefits in kind 18%) in OECD countries over 2000-2016 period.

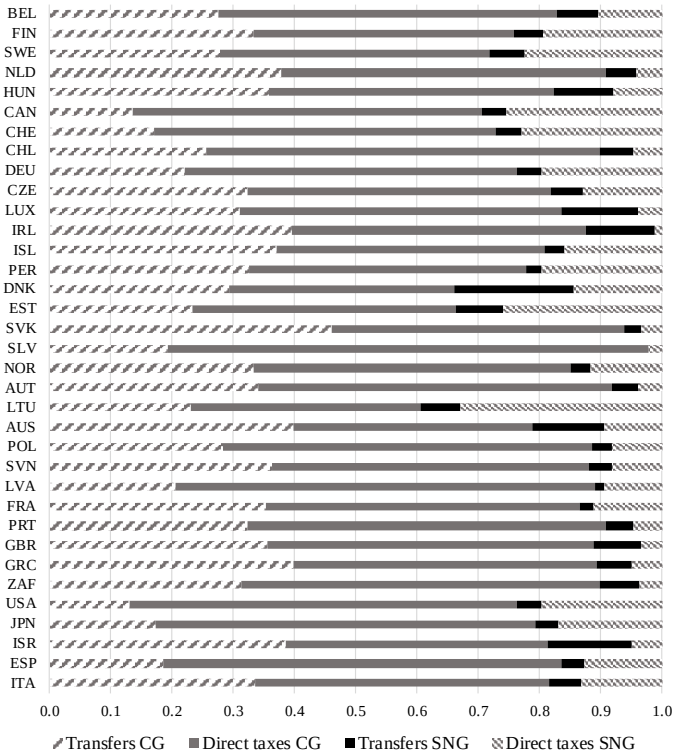
## Figure 5 – Contributions of fiscal variables to efficiency score

## (%, mean period 2000-2016)

***Panel (a) Absolute redistribution output***




***Panel (b) Relative redistribution output***




*Note:* Countries are listed in order of their rankings over 2000-2016. The country code and description are detailed in Table D.1 of Appendix D and their exact values in Table E.1 of Appendix E.
*Source:* Own estimations.

Table 3 describes the exact percentage of the contributions of fiscal variables to absolute and relative efficiency scores by the sub periods of analysis. We observe that the contributions of fiscal variables remain relatively stable over time while inefficiency score increases during the period of analysis. In addition, it also shows that direct taxes at the CG level is the most important variable to explain redistributive (in)efficiency, contributing -on average- about 50% to (in)efficiency score; following by cash transfers at the CG level that contributes -on average- about 30%. The contribution of cash transfers and direct taxes at SNG level are -on average- less than 6% and 13% respectively. To sum, the contributions of the fiscal centralisation and decentralization variables are important to explain (in)efficiency scores.

**Table 3 – Contributions of fiscal decentralization variables to efficiency score by subperiod**

| *Period* | *Cash transfers* | | *Direct taxes* | | *Efficiency score* |
|---|---|---|---|---|---|
| | *CG* | *SNG* | *CG* | *SNG* | |
| *Output: Absolute redistribution* | | | | | |
| *2000-2004* | 29.8% | 3.8% | 54.0% | 12.4% | 1.125 |
| *2005-2009* | 29.8% | 3.4% | 53.1% | 13.7% | 1.136 |
| *2010-2014* | 32.6% | 3.6% | 51.2% | 12.6% | 1.152 |
| *2015-2016* | 29.4% | 4.6% | 53.4% | 12.6% | 1.247 |
| *Average* | 30.4% | 3.8% | 52.9% | 12.8% | 1.165 |
| *Output: Relative redistribution* | | | | | |
| *2000-2004* | 27.8% | 7.3% | 52.6% | 12.2% | 1.086 |
| *2005-2009* | 29.3% | 5.4% | 52.8% | 12.4% | 1.109 |
| *2010-2014* | 31.9% | 5.1% | 52.1% | 10.8% | 1.142 |
| *2015-2016* | 30.1% | 5.7% | 52.1% | 12.1% | 1.222 |
| *Average* | 29.8% | 5.9% | 52.4% | 11.9% | 1.140 |

*Note:* Efficiency score: = 1 represents maximum efficiency and > 1 means greater inefficiency.
*Source:* Own estimations.

### *3.7.2 Second-stage results*

Table 4 summarises the main findings arising from the estimation of the Equation (7) where we regress the score of efficiency previously estimated on a set of non-discretionary potential explanatory factors by using a bootstrap truncated regression model. Importantly, as we have already remarked from the analysis of the previous sub-section, the higher the score the less redistributive efficient is the country, or alternatively the more redistributive inefficient is. Since we focus on fiscal policies at central and subnational level, in particular, we examine four alternative measures of PD. Our baseline

models are represented in columns 1 to 8 of Table 4; (a) and (b) correspond to the absolute and relative redistribution outputs, respectively.[37]

#### *3.7.2.1. The role of political decentralization*

In the case of PD, we use four different variables from different sources capturing diverse aspects of PD: federalism (model 1 and 2), autonomous regions (models 3 and 4), regional authority index (models 5 and 6) and electoral decentralization (models 7 and 8). In most of the cases we find a positive and significant coefficient, indicating that PD increases the efficiency score and therefore PD reduces redistributive efficiency (see Table 4). The economic intuition of this outcome is that local officials may be prone to local interests, diminishing the redistributive efficiency of fiscal policy. Thus, our outcomes may be in line with the statement that decentralization reduce available resources to CG and redistribution is principally a national level policy (Oates 1999, 2005). This result is in line with Gerring and Thacker (2004) paper, which find that federal states are more corrupt than unitary ones, and therefore, that may reduce redistributive efficiency.

In a nutshell, our analysis report empirical evidence that countries characterised by greater PD, in the form of federalism, regional authority, autonomous regions and electoral decentralization, tends to be less redistributive efficient.

#### *3.7.2.2. Control variables*

For models 1 to 8, we found that the log of per capita GDP does not display a significant effect on redistributive efficiency showing wealthier countries do not necessarily report a higher level of redistributive efficiency. The economic intuition is that the countries' available resources do not imply necessarily an efficient use of them to redistributive aims by the fiscal policy. In addition, we control for population age 65 years and above and unemployment rate, but do not have a significant impact on redistributive efficiency. For elderly population, one possible reason is that may not be the focus of the redistributive fiscal policy due to having on average lower but less unequal income than the working population. In the case of unemployment rate, it may not explain redistributive efficiency because benefits, such as unemployment subsidies, are conditional on past contributions and are earnings-related in most countries (Joumard et al. 2013).

[37] For the different number of observations in the regressions, see Table D.4 of Appendix D.

Moreover, we account for a significant negative impact of government effectiveness variable on redistributive efficiency for Model 2 (coefficient in models 1 and 3-8 are not significant). Based on previous findings (Gupta et al. 2002; Afonso et al. 2010b), we interpret and explain this result based on the idea that "better" government quality improves the design of the fiscal policy and its credibility as well as reducing the levels of corruption, which might foster redistributive efficiency.

Contrary to what one would expect, we find an insignificant impact (at the 5% level) of ethnic fractionalisation on redistributive efficiency in models 1 to 8. Given that developed countries are less ethnically divided than developing countries and our sample of countries cover mainly developed countries, this probably can explain this outcome.

Furthermore, we find that more education inequality reduces the redistributive efficiency, being only significant at the 5% level in the case of models 2 and 4. Inequality in education has been decreasing in the last period but inequality remains high (Castelló-Climent and Doménech 2014). Possibly, more educated people increase pressure on monitoring activities of politicians and bureaucrats to be more efficient and also increase social demands to reduce inequality (Afonso et al. 2010b).

The democratic accountability variable directly affects redistributive efficiency of fiscal policy and most of the models significant at an at least 5% level. One possible interpretation of the negative coefficient (indicating that it reduces the efficiency score) is because it captures the voters control over politicians, such as to punish them at re-election, which directly strengthens the politicians' incentives for good behaviour (Persson and Tabellini 2004), and as a result benefits the redistributive efficiency.

Moreover, debt fiscal rules negatively affect the efficiency score (indicating that it increases the redistributive efficiency) and thus it is in line with the notion that it drives an efficient use of resources (significant at the 5% level in models 1, 3, 5 and 7).

Furthermore, most of the dummy geographical region control variables are negative and most of them significant at an at least 5% level, suggesting that there is a regional fixed effect, showing that all considered regions are more redistributive efficient than the omitted region (Southern Europe). Thus, the time-invariant characteristics of these regions (such as the geographical characteristics, the climate, or the cultural background) do have an influence over the redistributive efficiency of their fiscal policies. Contrary to Kyriacou et al. (2018), we control by geographical region instead of welfare states variable in the regression analysis; here, we believe that our outcomes constitute an

improvement because the generosity of the welfare state is discretionary fiscal policy and thus we capture it in the first stage of the DEA analysis (as input).

In sum, our empirical findings reveal that the redistributive efficiency of the fiscal policy vary across countries and over time, and it is negatively associated with political decentralization and education inequality, and positively with government effectiveness, democratic accountability as well as the existence of debt fiscal rules.

## Table 4 – Determinants of redistributive efficiency of fiscal policy

| *Dependent variable – Efficiency score: (a) absolute and (b) relative redistribution outputs* | *Model 1 (a)* | *Model 2 (b)* | *Model 3 (a)* | *Model 4 (b)* | *Model 5 (a)* | *Model 6 (b)* | *Model 7 (a)* | *Model 8 (b)* |
|---|---|---|---|---|---|---|---|---|
| *Log of per capita GDP* | 0.038 | 0.044 | 0.031 | 0.065 | 0.007 | 0.002 | -0.020 | -0.073 |
| | (0.064) | (0.062) | (0.065) | (0.062) | (0.066) | (0.062) | (0.104) | (0.087) |
| *Elderly people (% of total population)* | 0.000 | -0.004 | -0.003 | -0.009 | -0.005 | -0.007 | -0.012 | -0.024 |
| | (0.013) | (0.013) | (0.015) | (0.013) | (0.015) | (0.012) | (0.017) | (0.016) |
| *Unemployment rate* | -0.002 | 0.005 | -0.003 | 0.006 | -0.003 | 0.001 | -0.006 | -0.000 |
| | (0.004) | (0.005) | (0.004) | (0.005) | (0.005) | (0.005) | (0.005) | (0.005) |
| *Government effectiveness* | -0.054 | -0.144** | -0.040 | -0.110 | -0.038 | -0.110 | 0.002 | -0.016 |
| | (0.082) | (0.073) | (0.081) | (0.076) | (0.083) | (0.071) | (0.114) | (0.089) |
| *Ethnic fractionalisation* | -0.171 | -0.064 | -0.167 | -0.037 | -0.230* | -0.137 | -0.267* | -0.147 |
| | (0.123) | (0.108) | (0.125) | (0.098) | (0.118) | (0.096) | (0.147) | (0.121) |
| *Education inequality* | 0.014 | 0.952** | -0.257 | 0.320 | 0.018 | 0.833** | -0.415 | -0.221 |
| | (0.375) | (0.403) | (0.358) | (0.354) | (0.369) | (0.387) | (0.480) | (0.424) |
| *Democratic accountability* | -0.179*** | -0.141* | -0.206*** | -0.195*** | -0.201*** | -0.142** | -0.213*** | -0.217*** |
| | (0.064) | (0.073) | (0.067) | (0.076) | (0.063) | (0.064) | (0.083) | (0.083) |
| *Debt fiscal rules* | -0.125** | -0.022 | -0.144*** | -0.045 | -0.142** | -0.035 | -0.143** | -0.042 |
| | (0.057) | (0.047) | (0.057) | (0.037) | (0.056) | (0.040) | (0.069) | (0.051) |
| *Federalism* | 0.014 | 0.050*** | --- | --- | --- | --- | --- | --- |
| | (0.017) | (0.017) | | | | | | |
| *Autonomous regions* | --- | --- | 0.107** | 0.193*** | --- | --- | --- | --- |
| | | | (0.049) | (0.045) | | | | |
| *Regional authority index* | --- | --- | --- | --- | 0.004* | 0.006*** | --- | --- |
| | | | | | (0.002) | (0.002) | | |
| *Electoral decentralization* | --- | --- | --- | --- | --- | --- | 0.047* | 0.070*** |
| | | | | | | | (0.027) | (0.022) |

*(continue)*

**Table 4 (continued) – Determinants of redistributive efficiency of fiscal policy**

| *Dependent variable – Efficiency score: (a) absolute and (b) relative redistribution outputs* | *Model 1* *(a)* | *Model 2* *(b)* | *Model 3* *(a)* | *Model 4* *(b)* | *Model 5* *(a)* | *Model 6* *(b)* | *Model 7* *(a)* | *Model 8* *(b)* |
|---|---|---|---|---|---|---|---|---|
| *Region fixed effects:* | | | | | | | | |
| *Eastern Europe* | -0.366*** | -0.186** | -0.329*** | -0.102 | -0.383*** | -0.210** | -0.531*** | -0.533*** |
| | (0.113) | (0.094) | (0.106) | (0.086) | (0.117) | (0.095) | (0.205) | (0.164) |
| *Western Europe* | -0.317*** | -0.253*** | -0.248*** | -0.114 | -0.333*** | -0.254*** | -0.389*** | -0.352*** |
| | (0.102) | (0.092) | (0.098) | (0.077) | (0.099) | (0.081) | (0.147) | (0.109) |
| *Northern Europe* | -0.336*** | -0.125 | -0.321*** | -0.118 | -0.327*** | -0.132* | -0.511*** | -0.427*** |
| | (0.101) | (0.078) | (0.095) | (0.075) | (0.095) | (0.077) | (0.178) | (0.140) |
| *Developing countries* | -0.653** | -0.547** | -0.616** | -0.376 | -0.750*** | -0.658** | -0.863** | -0.860*** |
| | (0.281) | (0.258) | (0.282) | (0.232) | (0.303) | (0.280) | (0.405) | (0.332) |
| *Other Developed countries* | -0.206** | 0.023 | -0.182** | 0.094 | -0.224** | 0.018 | -0.348** | -0.227 |
| | (0.099) | (0.101) | (0.094) | (0.094) | (0.096) | (0.089) | (0.165) | (0.141) |
| *Period fixed effects:* | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| *Wald chi2* | 52.28 | 56.16 | 57.07 | 57.35 | 56.53 | 62.21 | 44.65 | 55.64 |
| *Log pseudolikelihood* | 158.843 | 184.656 | 160.373 | 187.470 | 153.410 | 183.471 | 140.677 | 163.089 |
| *Observations* | 140 | 140 | 140 | 140 | 136 | 136 | 124 | 124 |

*Notes:* The dependent variable is the bias-corrected efficiency scores derived from the bootstrap-DEA method (1,000 repetitions). Southern Europe is the region excluded. All regressions include a constant (not shown). Bootstrap standard errors are presented in parentheses. Level of significance: 10% (*), 5% (**) and 1% (***).
*Source:* Own estimations.

## 3.8 Sensitivity analysis

In this section, we propose some robustness tests. Our analysis concerns assessment of the impact of using interactions term between PD and government effectiveness and additional explanatory variables on redistributive efficiency in our baseline models of Table 4. Besides, we report in Tables E.2 to E.5 of Appendix E the impact of using interactions term between PD and government effectiveness variables and also additional explanatory variables on redistributive efficiency. Finally, we report in Tables E.6 to E.9 of Appendix E the sensitivity of our bootstrap estimations of the baseline models, generating robust and clustered standard error estimations. In particular, robust standard errors allow to control for some kinds of misspecification and clustered standard errors, at the region level, allow to control for intragroup correlations. We find that our four alternative measures of PD remain robust to different variance estimators; apart from that, we do not find substantial differences in the significance of the other outcomes.

### *3.8.1 Interaction term between political decentralization and government effectiveness*

We find that a greater PD may lead to reduce redistributive efficiency. In other words, we obtain a negative effect of PD, measured using four different variables, on redistributive efficiency. One possible channel thought which PD may reduce redistributive efficiency can be associated to the fact that the local politically powerful groups could better manipulate the subnational authorities than they could the central authority, that possibly leads to redistributive inefficiencies. Nevertheless, Neyapti (2006) find that revenue decentralization increase redistribution only in cases of good governance, for instance, by checks and balances in fiscal activities. Following this argument, we next analyse whether the "good" quality of government may lead to foster redistribution efficiency in countries having politically decentralised systems. To do this, we introduce in our models an interaction term between "PD" and "government effectiveness" variables, expecting to find a significant and negative impact on the efficiency score.

In Table 5 we present the results when we introduce an interaction term between the "PD" and "government effectiveness" variables, and in general the results show a significant and negative impact on the efficiency score. The economic intuition is having high PD reduces redistributive efficiency, but its effect is diminished or even reversed in

case of countries that enjoy a high levels of government effectiveness. This result is in line with our expected statement.

**Table 5 – Robustness checks: Interactions term between political decentralization and government effectiveness**

| *Dependent variable – Efficiency score:* | *Model 1* | *Model 2* | *Model 3* | *Model 4* | *Model 5* | *Model 6* | *Model 7* | *Model 8* |
|---|---|---|---|---|---|---|---|---|
| *(a) absolute and (b) relative redistribution outputs* | *(a)* | *(b)* | *(a)* | *(b)* | *(a)* | *(b)* | *(a)* | *(b)* |
| *Log of per capita GDP* | -0.038 | -0.059 | 0.084 | -0.042 | -0.115 | -0.114 | -0.056 | -0.114 |
| | (0.072) | (0.062) | (0.079) | (0.076) | (0.083) | (0.071) | (0.103) | (0.084) |
| *Elderly people (% of total population)* | 0.002 | -0.001 | 0.001 | -0.011 | -0.004 | -0.007 | -0.008 | -0.016 |
| | (0.012) | (0.010) | (0.016) | (0.015) | (0.013) | (0.010) | (0.015) | (0.013) |
| *Unemployment rate* | -0.007 | -0.004 | -0.001 | 0.006 | -0.001 | 0.003 | -0.009 | -0.006 |
| | (0.005) | (0.004) | (0.005) | (0.005) | (0.004) | (0.004) | (0.006) | (0.005) |
| *Government effectiveness (GE)* | 0.101 | 0.061 | -0.135 | -0.067 | 0.222* | 0.146 | 0.210 | 0.263* |
| | (0.099) | (0.076) | (0.093) | (0.092) | (0.116) | (0.089) | (0.159) | (0.139) |
| *Ethnic fractionalisation* | -0.160 | -0.061 | -0.172 | -0.035 | -0.229** | -0.160* | -0.193 | -0.044 |
| | (0.114) | (0.089) | (0.123) | (0.098) | (0.106) | (0.084) | (0.147) | (0.123) |
| *Education inequality* | -0.103 | 0.657** | -0.191 | 0.294 | -0.286 | 0.469 | -0.316 | -0.079 |
| | (0.352) | (0.303) | (0.361) | (0.348) | (0.344) | (0.316) | (0.472) | (0.408) |
| *Democratic accountability* | -0.121** | -0.045** | -0.183** | -0.203*** | -0.160*** | -0.102* | -0.186** | -0.165** |
| | (0.058) | (0.059) | (0.074) | (0.079) | (0.053) | (0.057) | (0.077) | (0.071) |
| *Debt fiscal rules* | -0.140*** | -0.031 | -0.152*** | -0.041 | -0.162*** | -0.059 | -0.144** | -0.034 |
| | (0.059) | (0.039) | (0.057) | (0.038) | (0.055) | (0.036) | (0.070) | (0.049) |
| *Federalism* | 0.126*** | 0.185*** | --- | --- | --- | --- | --- | --- |
| | (0.048) | (0.038) | | | | | | |
| *Federalism*GE* | -0.080** | -0.104*** | --- | --- | --- | --- | --- | --- |
| | (0.035) | (0.026) | | | | | | |
| *Autonomous regions* | --- | --- | -0.105 | 0.288 | --- | --- | --- | --- |
| | | | (0.209) | (0.223) | | | | |
| *Autonomous regions *GE* | --- | --- | 0.135 | -0.061 | --- | --- | --- | --- |
| | | --- | (0.125) | (0.135) | | | | |
| *Regional authority index* | --- | --- | --- | --- | 0.022*** | 0.022*** | --- | --- |
| | | | | | (0.007) | (0.006) | | |
| *Regional authority index*GE* | --- | --- | --- | --- | -0.014*** | -0.013*** | --- | --- |
| | | | | | (0.005) | (0.004) | | |
| *Electoral decentralization* | --- | --- | --- | --- | --- | --- | 0.136** | 0.187*** |
| | | | | | | | (0.058) | (0.057) |
| *Electoral decentralization*GE* | --- | --- | --- | --- | --- | --- | -0.070 | -0.096** |
| | | | | | | | (0.045) | (0.041) |

*(continue)*

**Table 5 (continued) – Robustness checks: Interactions term between political decentralization and government effectiveness**

| *Dependent variable – Efficiency score:*<br>*(a) absolute and (b) relative redistribution outputs* | *Model 1*<br>*(a)* | *Model 2*<br>*(b)* | *Model 3*<br>*(a)* | *Model 4*<br>*(b)* | *Model 5*<br>*(a)* | *Model 6*<br>*(b)* | *Model 7*<br>*(a)* | *Model 8*<br>*(b)* |
|---|---|---|---|---|---|---|---|---|
| *Region and period fixed effects:* | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| *Wald chi2* | 66.27 | 104.59 | 53.56 | 59.57 | 80.94 | 102.30 | 52.92 | 69.50 |
| *Log pseudolikelihood* | 162.366 | 194.189 | 160.917 | 187.598 | 157.816 | 188.690 | 141.600 | 165.952 |
| *Observations* | 140 | 140 | 140 | 140 | 136 | 136 | 124 | 124 |

*Notes:* All regression include a constant (not shown). Bootstrap standard errors are presented in parentheses. Level of significance: 10% (*), 5% (**) and 1% (***).
*Source:* Own estimations

### *3.8.2 Additional explanatory variables*

One of the most typical and relevant questions is whether the partisan orientation of governments affects redistribution, and commonly the expectation is that left-wing party orientation can be expected to favour social benefits policies to low- and medium- income groups (Mahler and Jesuit 2006). Indeed, Bradley et al. (2003) find that leftist government has a direct positive impact on redistribution while right-wing government tends to affect it negatively. They also point out that leftist government is highly correlated with union density and bargaining centralization, consequently, we do not consider these variables in the analysis. To check whether party orientation determines redistributive efficiency, we introduce the control variable "party orientation" concerning economic policy (right, centre and left) from the DPI. The estimate results are present in Tables 6-9, models 3 and 4. We find that the party orientation does not affect redistributive efficiency and our main results do not change; additionally, our findings are complementary to Bradley et al. (2003) given that we focus on efficiency.

Moreover, Gupta et al. (2002) find that high levels of corruption lead to increased inequality in market income. Corruption involves the manipulation of public policies for private gain by the governing authorities. The authors argue that one possible channel operates by affecting redistribution programs of poor-income groups, such as siphoning off or redirecting social transfers funds to benefits well-connected wealthy groups. Afonso et al. (2010b) argue that "good" quality of institutions (e.g., rule of law) is associated with less corruption, diminishing income inequality. In this context, we are interested in examining how corruption affects redistributive efficiency of fiscal policy. To do this, we introduce the variable "control of corruption" from the ICRG; the highest value of the variable represents least corruption and the lowest value represents more corruption. In addition, we exclude "government effectiveness" to estimates the base models given that both variables are high linked (correlation of 0.86); we would expect our corruption variable to directly impact redistributive efficiency. Note that the degree of corruption reduces the efficiency of politics and business, and also high corruption could lead in a fall of the government or restructuring of the country's political institutions (ICRG 2013a). The estimate results are report in Tables 6-9, models 5 and 6. We find a significant positive impact of "control of corruption" on redistributive efficiency, without substantially altering coefficients and significance of the rest of the variables. While previous studies provide evidence of the effect of corruption on income distribution, we

present evidence that lower degree of corruption is significant and positively associated with more redistributive efficiency.

Furthermore, Adam et al. (2014) find a direct effect of presidential government on public sector efficiency. This is explained based on the fact that elected officials have incentives to perform well under presidential regimes because changes in the delegation of power are simpler than in parliamentary regimes (Persson and Tabellini 2004). To examine the potential effect of the forms of government on redistributive efficiency, we include a dummy variable in our baseline models that takes a value of 1 when the system of government is presidential regime, and a value of 0 otherwise (parliamentary or assembly-elected president), data are obtained from the DPI. The estimate results are reported in models 7 and 8 of Tables 6-9, which describe an insignificant effect of presidential governments on redistributive efficiency. In conclusion, our empirical findings are robust in the face of each of these checks. Besides, the results are maintained when we consider the interaction term between the political decentralization variable and government effectiveness and also these additional explanatory variables (see Table E.2 to Table E.5 of Appendix E).

## Table 6 – Robustness checks: Additional control variables (political decentralization variable: federalism)

| *Dependent variable – Efficiency score: (a) absolute and (b) relative redistribution outputs* | *Model 1* *(a)* | *Model 2* *(b)* | *Model 3* *(a)* | *Model 4* *(b)* | *Model 5* *(a)* | *Model 6* *(b)* | *Model 7* *(a)* | *Model 8* *(b)* |
|---|---|---|---|---|---|---|---|---|
| *Log of per capita GDP* | 0.038 | 0.044 | 0.035 | 0.043 | 0.063 | 0.056 | 0.038 | 0.046 |
| | (0.064) | (0.062) | (0.065) | (0.058) | (0.046) | (0.043) | (0.065) | (0.063) |
| *Elderly people (% of total population)* | 0.000 | -0.004 | 0.000 | -0.003 | 0.002 | -0.002 | 0.000 | -0.004 |
| | (0.013) | (0.013) | (0.012) | (0.012) | (0.013) | (0.012) | (0.013) | (0.013) |
| *Unemployment rate* | -0.002 | 0.005 | -0.002 | 0.004 | -0.004 | 0.002 | -0.002 | 0.006 |
| | (0.004) | (0.005) | (0.004) | (0.004) | (0.005) | (0.040) | (0.004) | (0.004) |
| *Government effectiveness* | -0.054 | -0.144** | -0.034 | -0.127* | --- | --- | -0.054 | -0.148* |
| | (0.082) | (0.073) | (0.085) | (0.072) | | | (0.082) | (0.076) |
| *Ethnic fractionalisation* | -0.171 | -0.064 | -0.124 | 0.014 | -0.117 | -0.083 | -0.172 | -0.065 |
| | (0.123) | (0.108) | (0.121) | (0.104) | (0.117) | (0.099) | (0.122) | (0.107) |
| *Education inequality* | 0.014 | 0.952** | 0.158 | 1.261*** | -0.005 | 0.925** | 0.013 | 0.942** |
| | (0.375) | (0.403) | (0.416) | (0.432) | (0.342) | (0.365) | (0.376) | (0.396) |
| *Democratic accountability* | -0.179*** | -0.141* | -0.187*** | -0.135** | -0.140** | -0.084 | -0.180*** | -0.133* |
| | (0.064) | (0.073) | (0.066) | (0.066) | (0.062) | (0.067) | (0.064) | (0.071) |
| *Debt fiscal rules* | -0.125** | -0.022 | -0.138** | -0.054 | -0.126** | -0.026 | -0.126** | -0.021 |
| | (0.057) | (0.047) | (0.057) | (0.049) | (0.054) | (0.044) | (0.057) | (0.047) |
| *Federalism* | 0.014 | 0.050*** | 0.015 | 0.056*** | 0.014 | 0.049*** | 0.015 | 0.049*** |
| | (0.017) | (0.017) | (0.019) | (0.017) | (0.016) | (0.017) | (0.017) | (0.017) |
| *Party orientation: Right* | --- | --- | 0.037 | 0.025 | --- | --- | --- | --- |
| | | | (0.075) | (0.070) | | | | |
| *Centre* | --- | --- | -0.031 | -0.068 | --- | --- | --- | --- |
| | | | (0.081) | (0.076) | | | | |
| *Left* | --- | --- | -0.010 | -0.008 | --- | --- | --- | --- |
| | | | (0.074) | (0.070) | | | | |
| *Control of corruption* | --- | --- | --- | --- | -0.063* | -0.099*** | --- | --- |
| | | | | | (0.035) | (0.029) | | |
| *Presidential systems* | --- | --- | --- | --- | --- | --- | -0.007 | 0.049 |
| | | | | | | | (0.088) | (0.090) |
| *Region and period fixed effects:* | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| *Wald chi2* | 52.28 | 56.16 | 56.72 | 64.46 | 57.50 | 55.82 | 52.48 | 58.95 |
| *Log pseudolikelihood* | 158.843 | 184.656 | 155.654 | 179.644 | 160.483 | 188.003 | 158.85 | 184.88 |
| *Observations* | 140 | 140 | 135 | 135 | 140 | 140 | 140 | 140 |

*Notes:* All regression include a constant (not shown). Bootstrap standard errors are presented in parentheses. Level of significance: 10% (*), 5% (**) and 1% (***).
*Source:* Own estimations.

## Table 7 – Robustness checks: Additional control variables (political decentralization variable: autonomous regions)

| *Dependent variable – Efficiency score: (a) absolute and (b) relative redistribution outputs* | *Model 1* (a) | *Model 2* (b) | *Model 3* (a) | *Model 4* (b) | *Model 5* (a) | *Model 6* (b) | *Model 7* (a) | *Model 8* (b) |
|---|---|---|---|---|---|---|---|---|
| *Log of per capita GDP* | 0.031 | 0.065 | 0.033 | 0.077 | 0.061 | 0.085 | 0.031 | 0.066 |
| | (0.065) | (0.062) | (0.067) | (0.062) | (0.045) | (0.043) | (0.065) | (0.062) |
| *Elderly people (% of total population)* | -0.003 | -0.009 | -0.004 | -0.009 | -0.001 | -0.006 | -0.003 | -0.009 |
| | (0.015) | (0.013) | (0.013) | (0.013) | (0.014) | (0.012) | (0.015) | (0.013) |
| *Unemployment rate* | -0.003 | 0.006 | -0.002 | -0.007 | -0.005 | 0.004 | -0.003 | 0.007 |
| | (0.004) | (0.005) | (0.004) | (0.005) | (0.005) | (0.004) | (0.004) | (0.005) |
| *Government effectiveness* | -0.040 | -0.110 | -0.022 | -0.095 | --- | --- | -0.040 | -0.115 |
| | (0.081) | (0.076) | (0.084) | (0.077) | | | (0.081) | (0.077) |
| *Ethnic fractionalisation* | -0.167 | -0.037 | -0.147 | -0.017 | -0.168 | -0.039 | -0.167 | -0.041 |
| | (0.125) | (0.098) | (0.122) | (0.098) | (0.121) | (0.092) | (0.124) | (0.099) |
| *Education inequality* | -0.257 | 0.320 | -0.185 | 0.456 | -0.259 | 0.330 | -0.257 | 0.305 |
| | (0.358) | (0.354) | (0.409) | (0.390) | (0.326) | (0.313) | (0.359) | (0.346) |
| *Democratic accountability* | -0.206*** | -0.195** | -0.208*** | -0.173** | -0.166** | -0.138** | -0.206*** | -0.185*** |
| | (0.067) | (0.076) | (0.069) | (0.067) | (0.065) | (0.070) | (0.066) | (0.071) |
| *Debt fiscal rules* | -0.144*** | -0.045 | -0.142** | -0.040 | -0.144*** | -0.052 | -0.144** | -0.045 |
| | (0.057) | (0.037) | (0.059) | (0.039) | (0.053) | (0.035) | (0.057) | (0.037) |
| *Autonomous regions* | 0.107** | 0.193*** | 0.111** | 0.196*** | 0.100** | 0.183*** | 0.107** | 0.194*** |
| | (0.049) | (0.045) | (0.049) | (0.047) | (0.048) | (0.043) | (0.050) | (0.045) |
| *Party orientation: Right* | --- | --- | 0.015 | -0.015 | --- | --- | --- | --- |
| | | | (0.073) | (0.068) | | | | |
| *Centre* | --- | --- | -0.059 | -0.127* | --- | --- | --- | --- |
| | | | (0.080) | (0.076) | | | | |
| *Left* | --- | --- | -0.039 | -0.058 | --- | --- | --- | --- |
| | | | (0.073) | (0.070) | | | | |
| *Control of corruption* | --- | --- | --- | --- | -0.058* | -0.085*** | --- | --- |
| | | | | | (0.034) | (0.028) | | |
| *Presidential systems* | --- | --- | --- | --- | --- | --- | 0.002 | 0.074 |
| | | | | | | | (0.087) | (0.090) |
| *Region and period fixed effects:* | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| *Wald chi2* | 57.07 | 57.35 | 62.33 | 64.58 | 63.11 | 59.81 | 57.669 | 59.97 |
| *Log pseudolikelihood* | 160.373 | 187.470 | 157.355 | 182.145 | 161.885 | 190.724 | 160.374 | 188.064 |
| *Observations* | 140 | 140 | 135 | 135 | 140 | 140 | 140 | 140 |

*Notes:* All regression include a constant (not shown). Bootstrap standard errors are presented in parentheses. Level of significance: 10% (*), 5% (**) and 1% (***).
*Source:* Own estimations.

## Table 8 – Robustness checks: Additional control variables (political decentralization variable: regional authority index)

| *Dependent variable – Efficiency score: (a) absolute and (b) relative redistribution outputs* | *Model 1* (a) | *Model 2* (b) | *Model 3* (a) | *Model 4* (b) | *Model 5* (a) | *Model 6* (b) | *Model 7* (a) | *Model 8* (b) |
|---|---|---|---|---|---|---|---|---|
| *Log of per capita GDP* | 0.007 | 0.002 | 0.011 | 0.010 | 0.038 | 0.019 | 0.007 | 0.004 |
| | (0.066) | (0.062) | (0.071) | (0.063) | (0.046) | (0.046) | (0.067) | (0.062) |
| *Elderly people (% of total population)* | -0.005 | -0.007 | -0.005 | -0.006 | -0.003 | -0.005 | -0.005 | -0.007 |
| | (0.015) | (0.012) | (0.014) | (0.012) | (0.014) | (0.011) | (0.015) | (0.012) |
| *Unemployment rate* | -0.003 | 0.001 | -0.002 | -0.000 | -0.005 | -0.002 | -0.003 | 0.001 |
| | (0.005) | (0.005) | (0.005) | (0.005) | (0.006) | (0.005) | (0.005) | (0.005) |
| *Government effectiveness* | -0.038 | -0.110 | -0.024 | -0.108 | --- | --- | -0.038 | -0.111 |
| | (0.083) | (0.071) | (0.086) | (0.075) | | | (0.083) | (0.073) |
| *Ethnic fractionalisation* | -0.230* | -0.137 | -0.189 | -0.077 | -0.234** | -0.156* | -0.230** | -0.137** |
| | (0.118) | (0.096) | (0.120) | (0.102) | (0.113) | (0.091) | (0.117) | (0.093) |
| *Education inequality* | 0.018 | 0.833** | 0.108 | 0.986** | -0.005 | -0.811** | 0.018 | 0.837** |
| | (0.369) | (0.387) | (0.424) | (0.414) | (0.332) | (0.337) | (0.369) | (0.383) |
| *Democratic accountability* | -0.201*** | -0.142** | -0.204*** | -0.131** | -0.160*** | -0.093 | -0.201*** | -0.137** |
| | (0.063) | (0.064) | (0.069) | (0.065) | (0.060) | (0.059) | (0.063) | (0.062) |
| *Debt fiscal rules* | -0.142** | -0.035 | -0.145** | -0.037 | -0.143*** | -0.045 | -0.142** | -0.034 |
| | (0.056) | (0.040) | (0.058) | (0.041) | (0.053) | (0.036) | (0.056) | (0.039) |
| *Regional authority index* | 0.004* | 0.006*** | 0.004 | 0.005** | 0.004* | 0.006*** | 0.004* | 0.006*** |
| | (0.002) | (0.002) | (0.002) | (0.002) | (0.002) | (0.002) | (0.002) | (0.002) |
| *Party orientation: Right* | --- | --- | 0.026 | 0.024 | --- | --- | --- | --- |
| | | | (0.078) | (0.071) | | | | |
| *Centre* | --- | --- | -0.030 | -0.056 | --- | --- | --- | --- |
| | | | (0.080) | (0.071) | | | | |
| *Left* | --- | --- | -0.018 | -0.013 | --- | --- | --- | --- |
| | | | (0.078) | (0.071) | | | | |
| *Control of corruption* | --- | --- | --- | --- | -0.062* | -0.086*** | --- | --- |
| | | | | | (0.035) | (0.028) | | |
| *Presidential systems* | --- | --- | --- | --- | --- | --- | 0.000 | 0.048 |
| | | | | | | | (0.092) | (0.083) |
| *Region and period fixed effects:* | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| *Wald chi2* | 56.53 | 62.21 | 56.08 | 62.41 | 59.72 | 69.78 | 56.94 | 65.07 |
| *Log pseudolikelihood* | 153.410 | 183.471 | 149.840 | 176.886 | 155.129 | 187.21 | 153.410 | 183.752 |
| *Observations* | 136 | 136 | 131 | 131 | 136 | 136 | 136 | 136 |

*Notes:* All regression include a constant (not shown). Bootstrap standard errors are presented in parentheses. Level of significance: 10% (*), 5% (**) and 1% (***).
*Source:* Own estimations

## Table 9 – Robustness checks: Additional control variables (political decentralization variable: electoral decentralization)

| *Dependent variable – Efficiency score: (a) absolute and (b) relative redistribution outputs* | *Model 1* (a) | *Model 2* (b) | *Model 3* (a) | *Model 4* (b) | *Model 5* (a) | *Model 6* (b) | *Model 7* (a) | *Model 8* (b) |
|---|---|---|---|---|---|---|---|---|
| *Log of per capita GDP* | -0.020 | -0.073 | 0.014 | -0.042 | 0.037 | -0.010 | -0.020 | -0.070 |
| | (0.104) | (0.087) | (0.105) | (0.102) | (0.066) | (0.059) | (0.105) | (0.090) |
| *Elderly people (% of total population)* | -0.012 | -0.024 | -0.012 | -0.023 | -0.007 | -0.018 | -0.012 | -0.024 |
| | (0.017) | (0.016) | (0.015) | (0.015) | (0.015) | (0.014) | (0.017) | (0.016) |
| *Unemployment rate* | -0.006 | 0.000 | -0.005 | 0.001 | -0.007 | -0.001 | -0.006 | 0.000 |
| | (0.005) | (0.005) | (0.005) | (0.005) | (0.005) | (0.005) | (0.006) | (0.005) |
| *Government effectiveness* | 0.002 | -0.016 | 0.008 | -0.019 | --- | --- | 0.002 | -0.022 |
| | (0.114) | (0.089) | (0.107) | (0.091) | | | (0.116) | (0.094) |
| *Ethnic fractionalisation* | -0.267* | -0.147 | -0.218 | -0.104 | -0.240 | -0.116 | -0.267* | -0.149 |
| | (0.147) | (0.121) | (0.140) | (0.127) | (0.136) | (0.111) | (0.149) | (0.121) |
| *Education inequality* | -0.415 | -0.221 | -0.033 | -0.196 | -0.260 | -0.028 | -0.417 | -0.211 |
| | (0.480) | (0.424) | (0.507) | (0.530) | (0.486) | (0.438) | (0.485) | (0.426) |
| *Democratic accountability* | -0.213*** | -0.217*** | -0.199** | -0.183** | -0.167** | -0.159** | -0.214** | -0.205** |
| | (0.083) | (0.083) | (0.089) | (0.085) | (0.078) | (0.078) | (0.084) | (0.080) |
| *Debt fiscal rules* | -0.143** | -0.042 | -0.143** | -0.043 | -0.135** | -0.038 | -0.143** | -0.041 |
| | (0.069) | (0.051) | (0.069) | (0.055) | (0.063) | (0.047) | (0.070) | (0.050) |
| *Electoral decentralization* | 0.047* | 0.070*** | 0.046* | 0.069*** | 0.040 | 0.062*** | 0.047* | 0.069*** |
| | (0.027) | (0.022) | (0.025) | (0.021) | (0.025) | (0.020) | (0.027) | (0.022) |
| *Party orientation: Right* | --- | --- | -0.009 | -0.027 | --- | --- | --- | --- |
| | | | (0.098) | (0.090) | | | | |
| *Centre* | --- | --- | -0.077 | -0.128 | --- | --- | --- | --- |
| | | | (0.102) | (0.094) | | | | |
| *Left* | --- | --- | -0.056 | -0.050 | --- | --- | --- | --- |
| | | | (0.101) | (0.093) | | | | |
| *Control of corruption* | --- | --- | --- | --- | -0.049 | -0.061* | --- | --- |
| | | | | | (0.044) | (0.035) | | |
| *Presidential systems* | --- | --- | --- | --- | --- | --- | -0.006 | 0.065 |
| | | | | | | | (0.099) | (0.091) |
| *Region and period fixed effects:* | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| *Wald chi2* | 44.65 | 55.64 | 43.97 | 55.23 | 43.46 | 60.35 | 43.97 | 57.57 |
| *Log pseudolikelihood* | 140.677 | 163.089 | 137.190 | 156.859 | 141.447 | 164.751 | 140.679 | 163.493 |
| *Observations* | 124 | 124 | 119 | 119 | 124 | 124 | 124 | 124 |

*Notes:* All regression include a constant (not shown). Bootstrap standard errors are presented in parentheses. Level of significance: 10% (*), 5% (**) and 1% (***).
*Source:* Own estimations.

## 3.9 Conclusions

In this article, we empirically analyse the redistributive efficiency of fiscal policy instruments -cash transfers and direct taxes at central and subnational level- for a sample of 35 countries during the 2000-2016 period, using a two-step approach that consider first a bootstrap DEA analysis. Given that we would expect to find that redistribution efficiency performance differs across countries and over time due to the influence of non-discretional or exogenous determinants, we investigate the impact of demographic, economic, political, and institutional factors on redistributive efficiency score estimated, applying bootstrap truncated panel regression techniques.

Our paper contains several contributions and findings. First, we analyse the redistributive efficiency of the fiscal policy instruments and their degree of decentralization for a set of 35 countries composed of both developed and developing countries. Specifically, the study is novel in that it introduces fiscal policies and their degree of decentralization to compute efficiency scores and country efficiency rankings. We find evidence that redistributive efficiency varies across countries and -on average- has diminished over the analysed period. In particular, our outcomes indicate that fiscal decentralization may affect income redistribution efficiency. Second, our analysis complements other recent works in this field by using different explanatory factors to explain redistributive efficiency variation across countries and over time. In particular, we account for political decentralization and find that it is directly associated with less redistributive efficiency. However, this effect is diminished or even reversed in case of countries that enjoy good institutions that allow for high levels of government effectiveness. The policy implication which emerges here is that political decentralization may be harmful for redistributive efficiency aims when is accompanied by low government quality levels, but may be beneficial in the case of countries with good institutional quality.

Given that the analysed fiscal policies may have other goals, it is important to keep in mind that the objective of this paper is not trying to evaluate its efficiency beyond the redistribution. In addition, this work is also limited since it does not include all the policies that governments may use to redistribute beyond cash transfers and direct taxes at central and subnational level.

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## Appendix D. List of countries and regions, definition of variables and sources, and descriptive statistics

### Table D.1 – List of countries and regions

| *Code - Country* | *Code – Country* |
|---|---|
| *Southern Europe* | *Developing countries* |
| GRC – Greece | CHL – Chile |
| ITA – Italy | SLV – El Salvador |
| PRT – Portugal | PER – Peru |
| SVN – Slovenia | ZAF – South Africa |
| ESP – Spain | |
| *Eastern Europe* | *(Other) Developed countries* |
| CZE – Czech Republic | AUS – Australia |
| HUN - Hungary | CAN – Canada |
| POL – Poland | ISR – Israel |
| SVK – Slovak Republic | JPN – Japan |
| | USA – United States |
| *Western Europe* | |
| AUT – Austria | |
| BEL – Belgium | |
| FRA – France | |
| DEU – Germany | |
| LUX – Luxemburg | |
| NLD – Netherlands | |
| CHE – Switzerland | |
| *Northern Europe* | |
| DNK – Denmark | |
| EST – Estonia | |
| FIN – Finland | |
| ISL – Iceland | |
| IRL – Ireland | |
| LVA – Latvia | |
| LTU – Lithuania | |
| NOR – Norway | |
| SWE – Sweden | |
| GBR – United Kingdom | |

*Note:* The list of geographic regions is from United Nations. https://unstats.un.org/unsd/methodology/m49/
*Source:* Own elaboration.

**Table D.2 – Definition of variables and sources**

| *Variable* | *Definition* | *Sources* |
|---|---|---|
| GDP per capita | Gross Domestic Product (GDP) in terms of population (constant 2010 U$S). | World Development Indicators (WDI). Frequency data: annual. |
| Elderly people | Population ages 65 years old and above. | WDI. Frequency data: annual. |
| Unemployment rate | Unemployment, total (% of total labour force) (modeled ILO estimate). | WDI. Frequency data: annual. |
| Ethnic fractionalisation | The probability that two randomly selected individuals belong to different ethnical groups, and so increase with the number of groups. Complete ethnic homogeneity (an index of 0) to complete heterogeneity (an index of 1). | Alesina et al (2003). Frequency data: one-year observation between 1979 to 2001. |
| Government effectiveness | Describes 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. Estimate gives the country's score on the aggregate indicator, in units of a standard normal distribution, i.e., ranging from approximately -2.5 (lowest) to 2.5 (highest). | World Governance Indicators (WGI) (Kaufmann et al. 2011). Frequency data: annual (except for 1996–2002, biannual data basis). |
| Education inequality | Gini coefficient for education, average years of schooling in the population 25 years old and above. | Castelló-Climent and Doménech (2014). Frequency data: five-year, from 1950 to 2010. |
| Democratic accountability | This is compute based on the type of the governance enjoyed by the country. The highest value (6) is assigned the lowest potential political risk (Alternating Democracies) and the lowest value (0) indicating the highest potential political risk (Autarchies) –total range = 0-6. | International Country Risk Guide (ICRG 2013). Frequency: annual data (from 1996 to 2002 biannual data). |
| Debt fiscal rules | Dummy variable: 1 if there is a debt rule (national, supranational or both), 0 otherwise. | Lledó et al. (2017). Frequency: annual data. |
| Federalism | Federalism involves 5 categories: 1, non-federal; 2, semi-federal (elective regional legislatures/constitutional sovereignty at national level); 3, federal (elective regional legislatures and constitutional recognition of subnational authority); add 1 if weak bicameral; add 2 if strong bicameral. Total range = 1-5, with higher values indicating more federal. | Gerring and Thacker (2004). Frequency data: one observation in 1997. |
| Regional authority index | The sum of "self-rule" and "shared-rule". See the article for full details. | Regional Authority Index (Hooghe et al. 2016). Frequency: annual. |
| Autonomous regions | Dummy variable = 1 if the country's constitution designated a region, area, or district as "autonomous" or self-governing; 0 otherwise. | Database of Political Institutions (DPI) (Cruz et al. 2018). Frequency: annual. |
| Electoral decentralization | Capture the existence of elections at the municipal or state/provincial governments. Both variables take the values of 0 if neither local executive nor local legislature are locally elected; 1 if the executive is appointed, but the legislature elected; 2 if they are both locally elected. We compute a scale between 0 and 4 with higher values representing more decentralization. | DPI. Frequency: annual. |

*(continue)*

**Table D.2 (continued) – Definition of variables and sources**

| *Variable* | *Definition* | *Sources* |
|---|---|---|
| Party orientation | Party orientation with respect to economic policy. Right: for parties that are defined as conservative, Christian democratic, or right-wing. Left: for parties that are defined as communist, socialist, social democratic, or left-wing. Centre: for parties that are defined as centrist or when party position can best be described as centric. | DPI. Frequency: annual. |
| Control of corruption | This is an assessment of the corruption within the political system. The highest value (6) is assigned the lowest potential political risk (least corruption) and the lowest value (0) indicating the highest potential political risk (most corruption). | ICRG. Frequency: annual data (from 1996 to 2002 biannual data). |
| Presidential systems | Dummy variable = 1 if presidential system - president is elected directly by the people or by an electoral college, and also include system with unelected executive-, 0 if parliamentary or assembly-elected president. | DPI. Frequency: annual. |

*Source:* Own elaboration.

**Table D.3 – Descriptive statistics of input-output variables**

| *Statistics* | *Input* | | | | *Output* | |
|---|---|---|---|---|---|---|
| | *I1* | *I2* | *I3* | *I4* | *O1* | *O2* |
| | | | *2000 - 2004* | | | |
| *Mean* | 10.180 | 17.506 | 1.319 | 4.443 | 15.973 | 33.833 |
| *Std. Dev.* | 4.279 | 5.766 | 1.865 | 3.913 | 5.333 | 11.530 |
| *Min* | 0.708 | 5.578 | 0 | 0.102 | 1.360 | 2.895 |
| *Max* | 16.884 | 28.269 | 10.920 | 12.972 | 23.020 | 48.467 |
| | | | *2005 - 2009* | | | |
| *Mean* | 10.322 | 17.693 | 1.291 | 4.530 | 16.177 | 33.941 |
| *Std. Dev.* | 4.094 | 5.284 | 1.881 | 3.942 | 5.400 | 11.391 |
| *Min* | 2.188 | 7.000 | 0 | 0.173 | 2.200 | 4.909 |
| *Max* | 17.183 | 27.090 | 10.992 | 13.178 | 23.720 | 48.799 |
| | | | *2010 - 2014* | | | |
| *Mean* | 11.334 | 17.458 | 1.412 | 4.564 | 16.486 | 34.257 |
| *Std. Dev.* | 4.600 | 5.438 | 2.101 | 3.945 | 5.410 | 11.133 |
| *Min* | 1.735 | 7.725 | 0 | 0.228 | 2.900 | 6.161 |
| *Max* | 18.819 | 27.918 | 12.289 | 13.316 | 23.980 | 48.386 |
| | | | *2015 - 2016* | | | |
| *Mean* | 11.083 | 18.076 | 1.461 | 4.771 | 16.423 | 34.136 |
| *Std. Dev.* | 4.671 | 5.434 | 2.193 | 4.173 | 5.413 | 11.005 |
| *Min* | 1.728 | 8.354 | 0 | 0.189 | 2.850 | 6.064 |
| *Max* | 19.534 | 28.581 | 12.516 | 14.106 | 23.95 | 47.948 |

*Note:* O1 = absolute redistribution, O2 = relative redistribution, I1 = cash transfers at CG level, I2 = direct taxes at CG level, I3 = cash transfers at SNG level, I4 = direct taxes at SNG level. Number of countries: 35.

*Source:* Own estimations.

**Table D.4 – Descriptive statistics of determinant variables**

| *Variable* | *Observation* | *Mean* | *Std. Dev.* | *Min* | *Max* |
|---|---|---|---|---|---|
| *Log of per capita GDP* | 140 | 10.239 | 0.815 | 7.901 | 11.584 |
| *Elderly people* | 140 | 15.208 | 4.151 | 4.160 | 26.290 |
| *Unemployment rate* | 140 | 8.384 | 5.125 | 2.962 | 31.326 |
| *Government effectiveness* | 140 | 1.253 | 0.629 | -0.515 | 2.237 |
| *Ethnic fractionalisation* | 140 | 0.269 | 0.213 | 0.012 | 0.752 |
| *Education inequality* | 140 | 0.158 | 0.073 | 0.026 | 0.386 |
| *Democratic accountability* | 140 | 5.647 | 0.502 | 3.992 | 6 |
| *Federalism* | 140 | 2.086 | 1.386 | 1 | 5 |
| *Regional authority index*[a] | 136 | 13.252 | 10.767 | 0 | 37.44 |
| *Electoral decentralization*[b] | 124 | 2.863 | 1.069 | 1 | 4 |
| *Party orientation*[c] | 135 | 1.696 | 1.031 | 1 | 3 |
| *Control of corruption* | 140 | 3.907 | 1.092 | 2 | 6 |

*Note:* The table presents the number of observations and summary statistics of the variables used in the second stage analysis (excluding the dummy variables). [a] South Africa data are not available. [b] Estonia, Latvia, Luxembourg, and Slovenia data are not available. [c] Switzerland data are not available and for Chile one missing observation for the subperiod 2015-2016.
*Source:* Own estimations.

## Appendix E. Additional results and robustness checks

### Table E.1 – Contributions of fiscal variables to efficiency score (mean period 2000-2016)

| *Country* | *Output: absolute redistribution* | | | | *Output: relative redistribution* | | | |
|---|---|---|---|---|---|---|---|---|
| | *Cash transfers* | | *Direct taxes* | | *Cash transfers* | | *Direct taxes* | |
| | *CG* | *SNG* | *CG* | *SNG* | *CG* | *SNG* | *CG* | *SNG* |
| *AUS* | 0.282 | 0.041 | 0.547 | 0.130 | 0.399 | 0.390 | 0.118 | 0.094 |
| *AUT* | 0.343 | 0.043 | 0.577 | 0.038 | 0.342 | 0.576 | 0.043 | 0.039 |
| *BEL* | 0.280 | 0.050 | 0.564 | 0.106 | 0.275 | 0.552 | 0.068 | 0.105 |
| *CAN* | 0.191 | 0.061 | 0.367 | 0.381 | 0.136 | 0.569 | 0.041 | 0.255 |
| *CHL* | 0.348 | 0.010 | 0.595 | 0.048 | 0.256 | 0.642 | 0.056 | 0.046 |
| *CZE* | 0.343 | 0.015 | 0.487 | 0.155 | 0.322 | 0.495 | 0.053 | 0.130 |
| *DNK* | 0.119 | 0.242 | 0.458 | 0.181 | 0.292 | 0.369 | 0.195 | 0.144 |
| *SLV* | 0.193 | 0.000 | 0.783 | 0.024 | 0.193 | 0.785 | 0.000 | 0.022 |
| *EST* | 0.329 | 0.012 | 0.600 | 0.060 | 0.233 | 0.429 | 0.078 | 0.260 |
| *FIN* | 0.339 | 0.033 | 0.431 | 0.197 | 0.334 | 0.425 | 0.046 | 0.194 |
| *FRA* | 0.357 | 0.014 | 0.516 | 0.113 | 0.354 | 0.511 | 0.023 | 0.112 |
| *DEU* | 0.319 | 0.058 | 0.335 | 0.288 | 0.220 | 0.542 | 0.040 | 0.198 |
| *GRC* | 0.432 | 0.010 | 0.539 | 0.019 | 0.399 | 0.495 | 0.057 | 0.050 |
| *HUN* | 0.372 | 0.023 | 0.531 | 0.074 | 0.358 | 0.464 | 0.098 | 0.080 |
| *ISL* | 0.209 | 0.017 | 0.568 | 0.207 | 0.370 | 0.437 | 0.033 | 0.160 |
| *IRL* | 0.333 | 0.033 | 0.617 | 0.017 | 0.397 | 0.479 | 0.113 | 0.012 |
| *ISR* | 0.279 | 0.051 | 0.606 | 0.063 | 0.387 | 0.426 | 0.139 | 0.049 |
| *ITA* | 0.336 | 0.052 | 0.481 | 0.132 | 0.336 | 0.481 | 0.052 | 0.132 |
| *JPN* | 0.270 | 0.030 | 0.434 | 0.266 | 0.172 | 0.622 | 0.036 | 0.170 |
| *LVA* | 0.334 | 0.017 | 0.497 | 0.153 | 0.205 | 0.684 | 0.017 | 0.093 |
| *LTU* | 0.341 | 0.024 | 0.556 | 0.079 | 0.231 | 0.374 | 0.066 | 0.329 |
| *LUX* | 0.355 | 0.005 | 0.601 | 0.040 | 0.310 | 0.525 | 0.125 | 0.041 |
| *NLD* | 0.272 | 0.029 | 0.657 | 0.041 | 0.378 | 0.529 | 0.051 | 0.042 |
| *NOR* | 0.298 | 0.022 | 0.555 | 0.125 | 0.333 | 0.518 | 0.031 | 0.117 |
| *PER* | 0.266 | 0.034 | 0.595 | 0.106 | 0.325 | 0.453 | 0.024 | 0.198 |
| *POL* | 0.396 | 0.030 | 0.462 | 0.113 | 0.283 | 0.603 | 0.032 | 0.082 |
| *PRT* | 0.435 | 0.012 | 0.501 | 0.051 | 0.324 | 0.585 | 0.044 | 0.047 |
| *SVK* | 0.398 | 0.007 | 0.565 | 0.030 | 0.460 | 0.478 | 0.027 | 0.035 |
| *SVN* | 0.400 | 0.010 | 0.502 | 0.088 | 0.364 | 0.518 | 0.036 | 0.082 |
| *ZAF* | 0.168 | 0.053 | 0.735 | 0.043 | 0.312 | 0.586 | 0.064 | 0.038 |
| *ESP* | 0.297 | 0.059 | 0.441 | 0.203 | 0.186 | 0.651 | 0.037 | 0.127 |
| *SWE* | 0.243 | 0.063 | 0.460 | 0.234 | 0.279 | 0.439 | 0.059 | 0.223 |
| *CHE* | 0.252 | 0.063 | 0.345 | 0.340 | 0.170 | 0.557 | 0.043 | 0.230 |
| *GBR* | 0.314 | 0.058 | 0.593 | 0.036 | 0.355 | 0.532 | 0.078 | 0.035 |
| *USA* | 0.206 | 0.065 | 0.421 | 0.307 | 0.131 | 0.632 | 0.041 | 0.196 |

*Source:* Own estimations.

## Table E.2 – Robustness checks: Interaction terms (federalism and GE) and additional control variables

| *Dependent variable – Efficiency score:*<br>*(a) absolute and (b) relative redistribution outputs* | *Model 1*<br>*(a)* | *Model 2*<br>*(b)* | *Model 3*<br>*(a)* | *Model 4*<br>*(b)* | *Model 5*<br>*(a)* | *Model 6*<br>*(b)* |
|---|---|---|---|---|---|---|
| *Log of per capita GDP* | -0.049 | -0.063 | 0.042 | 0.015 | -0.040 | -0.058 |
| | (0.074) | (0.062) | (0.045) | (0.037) | (0.074) | (0.064) |
| *Elderly people (% of total population)* | 0.003 | 0.001 | 0.003 | 0001 | 0.002 | 0.001 |
| | (0.011) | (0.009) | (0.0122) | (0.010) | (0.012) | (0.010) |
| *Unemployment rate* | -0.007 | -0.004 | -0.006 | -0.004 | -0.007 | -0.004 |
| | (0.005) | (0.004) | (0.005) | (0.003) | (0.005) | (0.004) |
| *Government effectiveness (GE)* | 0.131 | 0.072 | --- | --- | 0.105 | 0.060 |
| | (0.100) | (0.077) | | | (0.103) | (0.080) |
| *Ethnic fractionalisation* | -0.153 | -0.031 | -0.160 | -0.058 | -0.162 | -0.061 |
| | (0.115) | (0.091) | (0.111) | (0.086) | (0.103) | (0.301) |
| *Education inequality* | -0.226 | 0.656* | -0.084 | -0.694** | -0.113 | 0.658** |
| | (0.389) | (0.358) | (0.321) | (0.281) | (0.350) | (0.058) |
| *Democratic accountability* | -0.112* | -0.038 | -0.114** | -0.031 | -0.124** | -0.044 |
| | (0.061) | (0.058) | (0.058) | (0.054) | (0.057) | (0.058) |
| *Debt fiscal rules* | -0.121** | -0.022 | -0.132** | -0.031 | -0.142** | -0.031 |
| | (0.052) | (0.038) | (0.054) | (0.036) | (0.059) | (0.038) |
| *Federalism* | 0.132** | 0.184*** | 0.080** | 0.148*** | 0.129** | 0.184*** |
| | (0.053) | (0.042) | (0.039) | (0.029) | (0.051) | (0.039) |
| *Federalism*GE* | -0.091** | -0.106*** | -0.047* | -0.076*** | -0.082** | -0.103*** |
| | (0.041) | (0.032) | (0.027) | (0.019) | (0.037) | (0.027) |
| *Party orientation: Right* | 0.056 | 0.054 | --- | --- | --- | --- |
| | (0.073) | (0.065) | | | | |
| *Centre* | -0.004 | -0.020 | --- | --- | --- | --- |
| | (0.075) | (0.066) | | | | |
| *Left* | -0.004 | 0.006 | --- | --- | --- | --- |
| | (0.072) | (0.065) | | | | |
| *Control of corruption* | --- | --- | -0.034 | -0.045** | --- | --- |
| | | | (0.034) | (0.023) | | |
| *Presidential systems* | --- | --- | --- | --- | -0.029 | 0.007 |
| | | | | | (0.080) | (0.069) |
| *Region and period fixed effects:* | Yes | Yes | Yes | Yes | Yes | Yes |
| *Wald chi2* | 66.831 | 96.601 | 65.076 | 83.755 | 66.576 | 106.777 |
| *Log pseudolikelihood* | 159.246 | 187.104 | 162.181 | 195.151 | 162.458 | 194.197 |
| *Observations* | 135 | 135 | 140 | 140 | 140 | 140 |

*Notes:* All regression include a constant (not shown). Bootstrap standard errors are presented in parentheses. Level of significance: 10% (*), 5% (**) and 1% (***).
*Source:* Own estimations.

## Table E.3 – Robustness checks: Interaction terms (autonomous regions and GE) and additional control variables

| *Dependent variable – Efficiency score:* *(a) absolute and (b) relative redistribution outputs* | *Model 1* *(a)* | *Model 2* *(b)* | *Model 3* *(a)* | *Model 4* *(b)* | *Model 5* *(a)* | *Model 6* *(b)* |
|---|---|---|---|---|---|---|
| *Log of per capita GDP* | 0.085 | 0.050 | 0.101 | 0.064 | 0.084 | 0.043 |
| | (0.080) | (0.075) | (0.073) | (0.072) | (0.079) | (0.076) |
| *Elderly people (% of total population)* | 0.000 | -0.011 | 0.004 | -0.006 | 0.001 | -0.011 |
| | (0.015) | (0.014) | (0.015) | (0.013) | (0.016) | (0.015) |
| *Unemployment rate* | -0.001 | 0.006 | -0.003 | 0.003 | -0.001 | 0.006 |
| | (0.005) | (0.005) | (0.005) | (0.005) | (0.004) | (0.005) |
| *Government effectiveness (GE)* | -0.115 | -0.044 | --- | --- | -0.135 | -0.073 |
| | (0.091) | (0.086) | | | (0.094) | (0.092) |
| *Ethnic fractionalisation* | -0.154 | -0.013 | -0.186 | -0.040 | -0.172 | -0.039 |
| | (0.119) | (0.100) | (0.116) | (0.090) | (0.123) | (0.098) |
| *Education inequality* | -0.114 | 0.422 | -0.169 | 0.322 | -0.190 | 0.280 |
| | (0.414) | (0.387) | (0.341) | (0.321) | (0.361) | (0.342) |
| *Democratic accountability* | -0.186** | -0.180** | -0.127* | -0.134* | -0.182** | -0.192*** |
| | (0.076) | (0.071) | (0.074) | (0.076) | (0.073) | (0.074) |
| *Debt fiscal rules* | -0.151** | -0.036 | -0.159*** | -0.052 | -0.152*** | -0.042 |
| | (0.060) | (0.039) | (0.055) | (0.036) | (0.057) | (0.037) |
| *Autonomous regions* | -0.098 | 0.306 | -0.157 | 0.214 | -0.106 | 0.288 |
| | (0.216) | (0.212) | (0.201) | (0.211) | (0.208) | (0.222) |
| *Autonomous regions*GE* | 0.133 | -0.071 | 0.155 | 0.048 | 0.135 | -0.060 |
| | (0.129) | (0.127) | (0.137) | (0.133) | (0.124) | (0.135) |
| *Party orientation: Right* | 0.009 | -0.014 | --- | --- | --- | --- |
| | (0.075) | (0.068) | | | | |
| *Centre* | -0.063 | -0.126 | --- | --- | --- | --- |
| | (0.082) | (0.078) | | | | |
| *Left* | -0.044 | -0.057 | --- | --- | --- | --- |
| | (0.075) | (0.070) | | | | |
| *Control of corruption* | --- | --- | -0.095* | -0.103** | --- | --- |
| | | | (0.054) | (0.047) | | |
| *Presidential systems* | --- | --- | --- | --- | 0.006 | -0.076 |
| | | | | | (0.082) | (0.092) |
| *Region and period fixed effects:* | Yes | Yes | Yes | Yes | Yes | Yes |
| *Wald chi2* | 57.088 | 67.383 | 56.020 | 59.013 | 54.044 | 61.970 |
| *Log pseudolikelihood* | 157.934 | 182.331 | 163.272 | 190.956 | 160.921 | 188.189 |
| *Observations* | 135 | 135 | 140 | 140 | 140 | 140 |

*Notes:* All regression include a constant (not shown). Bootstrap standard errors are presented in parentheses. Level of significance: 10% (*), 5% (**) and 1% (***).
*Source:* Own estimations.

## Table E.4 – Robustness checks: Interaction terms (RAI and GE) and additional control variables

| *Dependent variable – Efficiency score:*<br>*(a) absolute and (b) relative redistribution outputs* | *Model 1*<br>*(a)* | *Model 2*<br>*(b)* | *Model 3*<br>*(a)* | *Model 4*<br>*(b)* | *Model 5*<br>*(a)* | *Model 6*<br>*(b)* |
|---|---|---|---|---|---|---|
| *Log of per capita GDP* | -0.130 | -0.119 | 0.021 | -0.001 | -0.121 | -0.113 |
| | (0.090) | (0.076) | (0.049) | (0.044) | (0.086) | (0.073) |
| *Elderly people (% of total population)* | -0.004 | -0.005 | -0.002 | -0.004 | -0.004 | -0.007 |
| | (0.012) | (0.010) | (0.013) | (0.011) | (0.013) | (0.010) |
| *Unemployment rate* | -0.001 | 0.002 | -0.004 | -0.001 | -0.001 | 0.003 |
| | (0.004) | (0.004) | (0.006) | (0.005) | (0.004) | (0.004) |
| *Government effectiveness (GE)* | -0.238** | 0.144 | --- | --- | 0.236* | 0.145 |
| | (0.117) | (0.090) | | | (0.124) | (0.095) |
| *Ethnic fractionalisation* | -0.228** | -0.124 | -0.219** | -0.143* | -0.231** | -0.160** |
| | (0.112) | (0.095) | (0.105) | (0.082) | (0.104) | (0.082) |
| *Education inequality* | -0.339 | 0.514 | -0.134 | 0.635** | -0.322 | 0.472 |
| | (0.400) | (0.360) | (0.341) | (0.315) | (0.231) | (0.314) |
| *Democratic accountability* | -0.163 | -0.093 | -0.147** | -0.078 | -0.162*** | -0.101* |
| | (0.059) | (0.058) | (0.058) | (0.056) | (0.322) | (0.101) |
| *Debt fiscal rules* | -0.149*** | -0.047 | -0.146*** | -0.050 | -0.165*** | -0.059 |
| | (0.055) | (0.039) | (0.052) | (0.035) | (0.055) | (0.036) |
| *Regional authority index (RAI)* | 0.022*** | 0.022*** | 0.010* | 0.012*** | 0.023*** | 0.022*** |
| | (0.007) | (0.006) | (0.005) | (0.004) | (0.007) | (0.006) |
| *RAI*GE* | -0.014** | -0.013*** | -0.005 | -0.005* | -0.014*** | -0.013*** |
| | (0.006) | (0.004) | (0.004) | (0.003) | (0.005) | (0.004) |
| *Party orientation: Right* | 0.051 | 0.045 | --- | --- | --- | --- |
| | (0.073) | (0.066) | | | | |
| *Centre* | 0.007 | -0.022 | --- | --- | --- | --- |
| | (0.075) | (0.065) | | | | |
| *Left* | 0.007 | 0.007 | --- | --- | --- | --- |
| | (0.074) | (0.066) | | | | |
| *Control of corruption* | --- | --- | -0.032 | -0.052* | --- | --- |
| | | | (0.039) | (0.028) | | |
| *Presidential systems* | --- | --- | --- | --- | -0.045 | 0.004 |
| | | | | | (0.086) | (0.074) |
| *Region and period fixed effects:* | Yes | Yes | Yes | Yes | Yes | Yes |
| *Wald chi2* | 79.713 | 85.618 | 66.768 | 84.230 | 80.464 | 100.915 |
| *Log pseudolikelihood* | 154.282 | 181.653 | 156.093 | 188.904 | 158.043 | 188.692 |
| *Observations* | 131 | 131 | 136 | 136 | 136 | 136 |

*Notes:* All regression include a constant (not shown). Bootstrap standard errors are presented in parentheses. Level of significance: 10% (*), 5% (**) and 1% (***).
*Source:* Own estimations.

## Table E.5 – Robustness checks: Interaction terms (electoral decentralization and GE) and additional control variables

| *Dependent variable – Efficiency score:*<br>*(a) absolute and (b) relative redistribution outputs* | *Model 1*<br>*(a)* | *Model 2*<br>*(b)* | *Model 3*<br>*(a)* | *Model 4*<br>*(b)* | *Model 5*<br>*(a)* | *Model 6*<br>*(b)* |
|---|---|---|---|---|---|---|
| *Log of per capita GDP* | -0.029 | -0.094 | 0.036 | 0.000 | -0.057 | -0.111 |
| | (0.109) | (0.099) | (0.076) | (0.065) | (0.104) | (0.085) |
| *Elderly people (% of total population)* | -0.008 | -0.015 | -0.007 | -0.016 | -0.008 | -0.016 |
| | (0.014) | (0.013) | (0.015) | (0.014) | (0.015) | (0.013) |
| *Unemployment rate* | -0.008 | -0.005 | -0.006 | -0.001 | -0.009 | -0.006 |
| | (0.006) | (0.005) | (0.005) | (0.005) | (0.006) | (0.005) |
| *Government effectiveness (GE)* | 0.187 | 0.232* | --- | --- | 0.214 | 0.248* |
| | (0.162) | (0.140) | | | (0.162) | (0.137) |
| *Ethnic fractionalisation* | -0.170 | -0.029 | -0.244 | -0.089 | -0.193 | -0.046 |
| | (0.142) | (0.135) | (0.156) | (0.125) | (0.150) | (0.124) |
| *Education inequality* | -0.059 | 0.181 | -0.269 | 0.037 | -0.321 | -0.073 |
| | (0.502) | (0.500) | (0.480) | (0.433) | (0.479) | (0.413) |
| *Democratic accountability* | -0.178** | -0.142* | -0.167** | -0.152* | -0.188** | -0.158** |
| | (0.082) | (0.075) | (0.081) | (0.078) | (0.078) | (0.071) |
| *Debt fiscal rules* | -0.141** | -0.032 | -0.135** | -0.034 | -0.145** | -0.033 |
| | (0.071) | (0.054) | (0.066) | (0.048) | (0.071) | (0.049) |
| *Electoral decentralization* | 0.122** | 0.173*** | 0.038 | 0.078 | 0.138** | 0.181 |
| | (0.061) | (0.061) | (0.051) | (0.041) | (0.059) | (0.055) |
| *Electoral decentralization*GE* | -0.060 | -0.086* | 0.002 | -0.015 | -0.071 | -0.093** |
| | (0.047) | (0.046) | (0.040) | (0.031) | (0.046) | (0.040) |
| *Party orientation: Right* | 0.006 | -0.001 | --- | --- | --- | --- |
| | (0.103) | (0.097) | | | | |
| *Centre* | -0.058 | -0.093 | --- | --- | --- | --- |
| | (0.108) | (0.101) | | | | |
| *Left* | -0.044 | -0.034 | --- | --- | --- | --- |
| | (0.106) | (0.100) | | | | |
| *Control of corruption* | --- | --- | -0.050 | -0.048 | --- | --- |
| | | | (0.052) | (0.041) | | |
| *Presidential systems* | --- | --- | --- | --- | -0.016 | 0.043 |
| | | | | | (0.095) | (0.080) |
| *Region and period fixed effects:* | Yes | Yes | Yes | Yes | Yes | Yes |
| *Wald chi2* | 47.906 | 62.323 | 43.100 | 56.092 | 51.297 | 71.697 |
| *Log pseudolikelihood* | 137.858 | 158.955 | 141.449 | 164.889 | 141.620 | 166.164 |
| *Observations* | 119 | 119 | 124 | 124 | 124 | 124 |

*Notes:* All regression include a constant (not shown). Bootstrap standard errors are presented in parentheses. Level of significance: 10% (*), 5% (**) and 1% (***).
*Source:* Own estimations.

**Table E.6 – Truncated regression results by variance estimators (political decentralization variable: federalism)**

| *Estimator of variance* | *Bootstrap (benchmark model)* | | *Robust* | | *Cluster (at the region level)* | |
|---|---|---|---|---|---|---|
| *Dependent variable: Efficiency score* | *Output absolute redistribution* | *Output relative redistribution* | *Output absolute redistribution* | *Output relative redistribution* | *Output absolute redistribution* | *Output relative redistribution* |
| | *(1)* | *(2)* | *(3)* | *(4)* | *(5)* | *(6)* |
| *Log of per capita GDP* | 0.038 | 0.044 | 0.038 | 0.044 | 0.038 | 0.044 |
| | (0.064) | (0.062) | (0.056) | (0.052) | (0.066) | (0.070) |
| *Elderly people (% of* | 0.000 | -0.004 | 0.000 | -0.004 | 0.000 | -0.004 |
| *total population)* | (0.013) | (0.013) | (0.013) | (0.012) | (0.008) | (0.008) |
| *Unemployment rate* | -0.002 | 0.005 | -0.002 | 0.005 | -0.002 | 0.005 |
| | (0.004) | (0.005) | (0.004) | (0.004) | (0.004) | (0.006) |
| *Government* | -0.054 | -0.144** | -0.054 | -0.144** | -0.054** | -0.144*** |
| *effectiveness* | (0.082) | (0.073) | (0.077) | (0.067) | (0.023) | (0.038) |
| *Ethnic fractionalisation* | -0.171 | -0.064 | -0.171 | -0.064 | -0.171 | -0.064 |
| | (0.123) | (0.108) | (0.117) | (0.097) | (0.215) | (0.181) |
| *Education inequality* | 0.014 | 0.952** | 0.014 | 0.952** | 0.014 | 0.952* |
| | (0.375) | (0.403) | (0.328) | (0.403) | (0.305) | (0.487) |
| *Democratic* | -0.179*** | -0.141* | -0.179*** | -0.141** | -0.179** | -0.141** |
| *accountability* | (0.064) | (0.073) | (0.060) | (0.070) | (0.073) | (0.064) |
| *Debt fiscal rules* | -0.125** | -0.022 | -0.125** | -0.022 | -0.125 | -0.022 |
| | (0.057) | (0.047) | (0.057) | (0.043) | (0.079) | (0.088) |
| *Federalism* | 0.014 | 0.050*** | 0.014 | 0.050*** | 0.014 | 0.050** |
| | (0.017) | (0.017) | (0.015) | (0.015) | (0.027) | (0.023) |
| *Region fixed effects:* | Yes | Yes | Yes | Yes | Yes | Yes |
| *Period fixed effects:* | Yes | Yes | Yes | Yes | Yes | Yes |
| *Wald chi2* | 52.28 | 56.16 | 64.50 | 72.84 | --- | --- |
| *Log pseudolikelihood* | 158.843 | 184.656 | 158.843 | 184.656 | 158.843 | 184.656 |
| *Observations* | 140 | 140 | 140 | 140 | 140 | 140 |

*Notes:* All regression include a constant (not shown). Standard errors are presented in parentheses. Level of significance: 10% (*), 5% (**) and 1% (***).
*Source:* Own estimations.

**Table E.7 – Truncated regression results by variance estimators (political decentralization variable: autonomous regions)**

| *Estimator of variance* | *Bootstrap (benchmark model)* | | *Robust* | | *Cluster (at the region level)* | |
|---|---|---|---|---|---|---|
| *Dependent variable: Efficiency score* | *Output absolute redistribution* | *Output relative redistribution* | *Output absolute redistribution* | *Output relative redistribution* | *Output absolute redistribution* | *Output relative redistribution* |
| | *(1)* | *(2)* | *(3)* | *(4)* | *(5)* | *(6)* |
| *Log of per capita GDP* | 0.031 | 0.065 | 0.031 | 0.065 | 0.031 | 0.065 |
| | (0.065) | (0.062) | (0.061) | (0.056) | (0.085) | (0.090) |
| *Elderly people (% of* | -0.003 | -0.009 | -0.003 | -0.009 | -0.003 | -0.009 |
| *total population)* | (0.015) | (0.013) | (0.014) | (0.012) | (0.009) | (0.008) |
| *Unemployment rate* | -0.003 | 0.006 | -0.003 | 0.006 | -0.003 | 0.006 |
| | (0.004) | (0.005) | (0.004) | (0.004) | (0.003) | (0.005) |
| *Government* | -0.040 | -0.110 | -0.040 | -0.110 | -0.040* | -0.110*** |
| *effectiveness* | (0.081) | (0.076) | (0.077) | (0.071) | (0.021) | (0.030) |
| *Ethnic fractionalisation* | -0.167 | -0.037 | -0.167 | -0.037 | -0.167 | -0.037 |
| | (0.125) | (0.098) | (0.123) | (0.092) | (0.249) | (0.198) |
| *Education inequality* | -0.257 | 0.320 | -0.257 | 0.320 | -0.257 | 0.320 |
| | (0.358) | (0.354) | (0.318) | (0.335) | (0.455) | (0.472) |
| *Democratic* | -0.206*** | -0.195*** | -0.206*** | -0.195** | -0.206*** | -0.195*** |
| *accountability* | (0.067) | (0.076) | (0.066) | (0.076) | (0.079) | (0.071) |
| *Debt fiscal rules* | -0.144*** | -0.045 | -0.144** | -0.045 | -0.144** | -0.045 |
| | (0.057) | (0.037) | (0.058) | (0.034) | (0.060) | (0.034) |
| *Autonomous regions* | 0.107** | 0.193*** | 0.107** | 0.193*** | 0.107*** | 0.193*** |
| | (0.049) | (0.045) | (0.042) | (0.043) | (0.) | (0.024) |
| *Region fixed effects:* | Yes | Yes | Yes | Yes | Yes | Yes |
| *Period fixed effects:* | Yes | Yes | Yes | Yes | Yes | Yes |
| *Wald chi2* | 57.07 | 57.35 | 68.10 | 69.32 | --- | --- |
| *Log pseudolikelihood* | 160.373 | 187.470 | 160.373 | 187.470 | 160.373 | 187.470 |
| *Observations* | 140 | 140 | 140 | 140 | 140 | 140 |

*Notes:* All regression include a constant (not shown). Standard errors are presented in parentheses. Level of significance: 10% (*), 5% (**) and 1% (***).
*Source:* Own estimations.

**Table E.8 – Truncated regression results by variance estimators (political decentralization variable: regional authority index)**

| *Estimator of variance* | *Bootstrap (benchmark model)* | | *Robust* | | *Cluster (at the region level)* | |
|---|---|---|---|---|---|---|
| *Dependent variable: Efficiency score* | *Output absolute redistribution* | *Output relative redistribution* | *Output absolute redistribution* | *Output relative redistribution* | *Output absolute redistribution* | *Output relative redistribution* |
| | *(1)* | *(2)* | *(3)* | *(4)* | *(5)* | *(6)* |
| *Log of per capita GDP* | 0.007 | 0.002 | 0.007 | 0.002 | 0.007 | 0.002 |
| | (0.066) | (0.062) | (0.063) | (0.057) | (0.059) | (0.076) |
| *Elderly people (% of* | -0.005 | -0.007 | -0.005 | -0.007 | -0.005 | -0.007 |
| *total population)* | (0.015) | (0.012) | (0.013) | (0.011) | (0.008) | (0.009) |
| *Unemployment rate* | -0.003 | 0.001 | -0.003 | 0.001 | -0.003 | 0.001 |
| | (0.005) | (0.005) | (0.005) | (0.004) | (0.004) | (0.005) |
| *Government* | -0.038 | -0.110 | -0.038 | -0.110* | -0.038 | -0.110*** |
| *effectiveness* | (0.083) | (0.071) | (0.078) | (0.065) | (0.032) | (0.039) |
| *Ethnic fractionalisation* | -0.230* | -0.137 | -0.230** | -0.137 | -0.230 | -0.137 |
| | (0.118) | (0.096) | (0.117) | (0.090) | (0.178) | (0.122) |
| *Education inequality* | 0.018 | 0.833 | 0.018 | 0.833** | 0.018 | 0.833** |
| | (0.369) | (0.387) | (0.319) | (0.368) | (0.320) | (0.384) |
| *Democratic* | -0.201*** | -0.142*** | -0.201*** | -0.142** | -0.201*** | -0.142*** |
| *accountability* | (0.063) | (0.064) | (0.058) | (0.059) | (0.070) | (0.053) |
| *Debt fiscal rules* | -0.142** | -0.035 | -0.142** | -0.035 | -0.142* | -0.035 |
| | (0.056) | (0.040) | (0.056) | (0.036) | (0.075) | (0.069) |
| *Regional authority* | 0.004* | 0.006*** | 0.004** | 0.006*** | 0.004 | 0.006 |
| *index* | (0.002) | (0.002) | (0.002) | (0.002) | (0.004) | (0.004) |
| *Region fixed effects:* | Yes | Yes | Yes | Yes | Yes | Yes |
| *Period fixed effects:* | Yes | Yes | Yes | Yes | Yes | Yes |
| *Wald chi2* | 56.53 | 62.21 | 71.74 | 75.45 | --- | --- |
| *Log pseudolikelihood* | 153.410 | 183.471 | 153.410 | 183.471 | 153.410 | 183.471 |
| *Observations* | 136 | 136 | 136 | 136 | 136 | 136 |

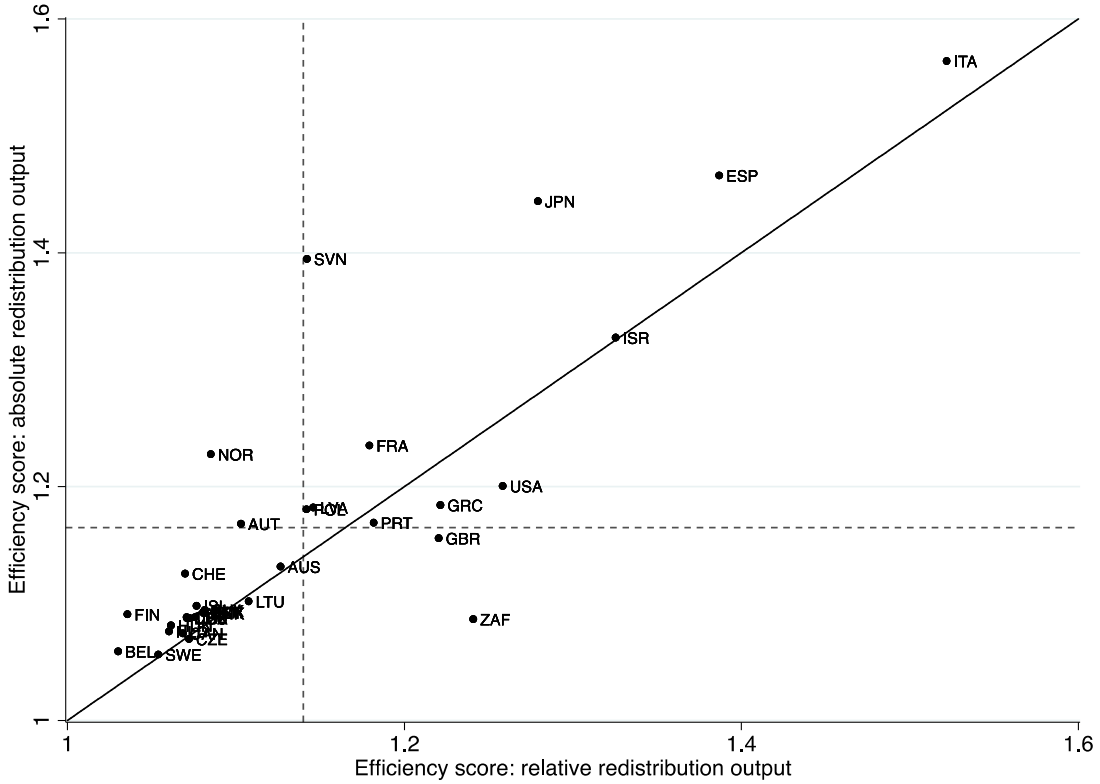
*Notes:* All regression include a constant (not shown). Standard errors are presented in parentheses. Level of significance: 10% (*), 5% (**) and 1% (***).
*Source:* Own estimations.

**Table E.9 – Truncated regression results by variance estimators (political decentralization variable: electoral decentralization)**

| *Estimator of variance* | *Bootstrap (benchmark model)* | | *Robust* | | *Cluster (at the region level)* | |
|---|---|---|---|---|---|---|
| *Dependent variable: Efficiency score* | *Output absolute redistribution* | *Output relative redistribution* | *Output absolute redistribution* | *Output relative redistribution* | *Output absolute redistribution* | *Output relative redistribution* |
| | *(1)* | *(2)* | *(3)* | *(4)* | *(5)* | *(6)* |
| *Log of per capita GDP* | -0.020 | -0.073 | -0.020 | -0.073 | -0.020 | -0.073 |
| | (0.104) | (0.087) | (0.095) | (0.077) | (0.071) | (0.070) |
| *Elderly people (% of* | -0.012 | -0.024 | -0.012 | -0.024 | -0.012 | -0.024 |
| *total population)* | (0.017) | (0.016) | (0.017) | (0.015) | (0.016) | (0.016) |
| *Unemployment rate* | -0.006 | 0.000 | -0.006 | 0.000 | -0.006 | 0.000 |
| | (0.005) | (0.005) | (0.005) | (0.005) | (0.006) | (0.008) |
| *Government* | 0.002 | -0.016 | 0.002 | -0.016 | 0.002 | -0.016 |
| *effectiveness* | (0.114) | (0.089) | (0.103) | (0.080) | (0.069) | (0.023) |
| *Ethnic fractionalisation* | -0.267* | -0.147 | -0.267* | -0.147 | -0.267 | -0.147 |
| | (0.147) | (0.121) | (0.146) | (0.113) | (0.263) | (0.193) |
| *Education inequality* | -0.415 | -0.221 | -0.415 | -0.221 | -0.415 | -0.221 |
| | (0.480) | (0.424) | (0.416) | (0.385) | (0.666) | (0.461) |
| *Democratic* | -0.213*** | -0.217*** | -0.213*** | -0.217*** | -0.213* | -0.217** |
| *accountability* | (0.083) | (0.083) | (0.082) | (0.081) | (0.122) | (0.097) |
| *Debt fiscal rules* | -0.143** | -0.042 | -0.143** | -0.042 | -0.143 | -0.042 |
| | (0.069) | (0.051) | (0.071) | (0.047) | (0.101) | (0.088) |
| *Electoral* | 0.047* | 0.070*** | 0.047* | 0.070*** | 0.047 | 0.070*** |
| *decentralization* | (0.027) | (0.022) | (0.024) | (0.025) | (0.046) | (0.025) |
| *Region fixed effects:* | Yes | Yes | Yes | Yes | Yes | Yes |
| *Period fixed effects:* | Yes | Yes | Yes | Yes | Yes | Yes |
| *Wald chi2* | 44.65 | 55.64 | 56.278 | 72.156 | --- | --- |
| *Log pseudolikelihood* | 140.677 | 163.089 | 140.677 | 163.089 | 140.677 | 163.089 |
| *Observations* | 124 | 124 | 124 | 124 | 124 | 124 |

*Notes:* All regression include a constant (not shown). Standard errors are presented in parentheses. Level of significance: 10% (*), 5% (**) and 1% (***).
*Source:* Own estimations.

**Figure E.1 – Efficiency scores of absolute and relative redistribution outputs (mean period 2000-2016)**




*Note:* Efficiency score: = 1 represents maximum efficiency and > 1 means greater inefficiency. The solid line represents the 45-degree line and the dash line represents the average of the axis variable. The country code and description are detailed in Table D.1 of Appendix D.
*Source:* Own estimations.

# Chapter 4

# Human development and decentralization: The importance of public health expenditure

## 4.1 Introduction

The capacity of governments to improve economic and human development is a major societal concern, being the public expenditure on health and education probably one of the main instruments and basic supports of modern welfare states and certainly the essential policies to improve the quality of life of their citizens. But the impact of these public policies on the economic and human development of a society is not just a matter of the volume of public spending. Like public policies more generally, organizational aspects will also have an influence, and one important dimension of organization is the extent to which public expenditures are decentralized.

Over the past decades, there has been a global trend across countries towards fiscal decentralization with the objective of improving citizen welfare and economic development (see Martinez-Vazquez et al. (2017) for a survey). Decentralization has the potential to increase the quality and effectiveness of public policies for a variety of reasons including better informed sub-central officials, the adaptation of policies to local conditions, experimentation and thus learning by doing, and stronger accountability mechanisms at subnational levels (Oates 1972, 1999; Christl et al. 2020). However, decentralization may also weaken the effectiveness of public policies insofar as these policies experience spillovers or economies of scale, if it leads to uneven access to public resources across subnational jurisdictions, if accountability mechanisms are weaker, and if sub-central officials are more vulnerable to capture by special interests (Prud'homme 1995; Oates 2005; Arends 2020). Recently, a high number of empirical cross-country studies have dealt with the estimation of the economic effects of decentralization with no clear consensus emerging.

Many of the empirical contributions have considered the extent to which decentralizing general government expenditure or revenues impact on GDP per capita growth (Canare 2021a), governance (Kyriacou and Roca-Sagalés 2021), or alternatively

on education and health outcomes (Martinez-Vazquez et al. 2017). In general, as can be appreciated in the cited surveys, the evidence on the effects of decentralizing are mixed in the case of economic growth, positive on governance, and also positive in health and specially education outcomes. Surprisingly, although the objective of many decentralization initiatives is to improve economic welfare and human development, there is lack of empirical literature on the effects of decentralization on variables reflecting human welfare, such as poverty, per capita PPP income, and the human development index, being Canare (2021b) one of the exceptions. And, on the other hand, the majority of cross-country contributions focusing on education and health outcomes, have used subnational government spending or revenue as a percentage of total spending or revenue to account for decentralization, and just a few employed more disaggregated decentralization indicators reflecting the decentralization of spending in these specific policy areas.[38] But preferably, when trying to evaluate the impact of decentralizing on health or education outcomes, we should account for the level of central and subnational governments health or education spending.

In this paper we employ cross-country evidence to analyse how central and subnational expenditure in the areas of health and education can affect to a broader measure of economic and human development, the Human Development Index (HDI), and we also examine the impact on each of the HDI components. The HDI is a multidimensional, composite index of human and economic development, that allows us to include outcomes related to health, education, and income (UNDP 2020). Based on a sample of 57 developed and developing countries over the period 2000-2018, and applying data panel analysis, we find robust evidence that both central and subnational expenditure in the area of health have a positive impact on the HDI, and in each of their dimensions (life expectancy, education, and income), while in the case of the education expenditure, this positive and statistically significant effect on human development can only be confirmed on the educational dimension of HDI. These findings are robust to different lagged structures of the government expenditure variables, alternatives estimations techniques, and the presence of a range of potential confounding variables including measures of the autonomy of subnational governments.

[38] Some of the exceptions are Arends (2017), that used subnational (regional and local) public health expenditure as a percentage of total health expenditure to evaluate the performance of the health sector in a sample of 32 OECD countries, and Kyriacou and Roca-Sagalés (2019) who employed local education, health, and social spending as a share of total spending on these areas to analyse the effects of local decentralization on the quality of public services.

The remainder of the paper is organised as follows. Section 2 offers a brief theoretical and empirical overview of the link between fiscal decentralization, health and education expenditure and human development. Section 3 discusses the key indicators employed in the article to conduct the empirical analysis. Section 4 presents the empirical methodology. Section 5 presents the estimation results. Section 6 discusses the outcomes of several robustness checks. Section 7 concludes.

## 4.2 Fiscal decentralization and human development: Theory and evidence

In this section, we first provide a comprehensive conceptual framework of the potential channels through which fiscal decentralization might affect human development, and second, we review the relevant empirical literature.

Fiscal decentralization is commonly conceptualised as the transfer of responsibilities (or power) and resources from central government to subnational governments (Schneider 2003). Specifically, fiscal decentralization theories are mostly based on Musgrave (1959) allocation functions of government, consisting in assigning resources to the level of government such that social welfare is maximised. In this sense, fiscal decentralization can play an important role in the efficiency allocations of resources and improvement of the political, economic, and social activities (Oates 1972, 1999).

Many reasons justify the potential gains from decentralizing health and education. Some authors have indicated that subnational governments are more efficient in the provision of public goods and services than the central government because they can better formulate and implement public policies to specific local development needs – local officials have superior knowledge about local preferences (see, for instance, Oates 1999). In other words, it is claimed that decentralization improves preference matching and allocative efficiency of delivery of government goods and services (Barankay and Lockwood 2007; Channa and Faguet 2016). Additionally, fiscal decentralization can enhance greater electoral accountability and yardstick competition among competing jurisdictions, reducing incentives for overspending of subnational government authorities and, especially, the "bad" use of the resources by the politicians (Besley and Smart 2007; Adam et al. 2014; Christl et al. 2020). Moreover, fiscal decentralization, as a policy instrument, may contribute to improving the quality and accessibility of important basic public services, such as education, health care, and infrastructure. Also, it can encourage

citizens to take part in the political decision-making process and make local fiscal authorities more accountable, improving the human development of society (Scott 2006). Furthermore, the subnational governments policies could serve as laboratories of experimentation because may cause a variety of policies to be applied to other subnational jurisdictions, and eventually scaled up to the national government level – being less risky than applied them directly at the national level (Vanberg and Kerber 1994).

However, decentralization may not always be an effective via for the provision of public goods and services due to the presence of externalities or spillovers, such as imperfect information, economies of scale, and selfish officials (e.g., political rent-seeking) (Oates 2005). Additionally, decentralization may make it more difficult for citizens to discern which level of the government is responsible for good and bad policy – political institutions via clarity of responsibilities reduce corruption (Tavits 2007). Moreover, decentralization may shift the control of resources from central government to subnational governments reducing the capacity of central government to address essential programs (e.g., poverty, redistribution, and human development) (Oates 1972, 1999). In this sense, the existence of cross-regional disparities may only be addressed by the central government with redistributive powers. But, in case that subnational governments may have to deliver on essential responsibilities that national governments failed to achieve, the decentralized government provision of services may lead to poorer fiscal efficiency due to the lack of capacities to implement the programs and the limited financial resources – especially when subnational governments are funded by transfers rather than by direct taxation (Scott 2006; Diaz-Serrano and Rodríguez-Pose 2015). Furthermore, the government's provision of some public services, such as health and education, probably need larger amounts of public funds on capital and technological investment as well as general planning capacities, which may be limited at the subnational government level (Jiménez-Rubio and García-Gómez 2017).

Focusing now on the empirical contributions, we should first acknowledge that public spending on health and education could have an important effect on increasing economic growth, promoting income equality, reducing poverty, and improving human development (Barro 1991; Chu 1995; Sen 1999). However, the empirical evidence of the impact of public spending on health and education remains unclear, at least at the macro level. For instance, Baldacci et al. (2003) and Gupta et al. (2002) study a large sample of developing countries and transition economies and find that public social spending plays a significant role in the health and education sectors. Specifically, these studies show that

spending on education has more effect on human development indicators than health spending. Nevertheless, some studies consistently find a clear significant positive impact of health spending on health outcomes in poor countries.[39] Other studies have shown that the relationship between health spending and health outcomes depends on the composition and efficacy of spending (Filmer and Pritchett 1999) and the quality of institutions (Liang and Mirelman 2014).

Recently, Paliova et al. (2019) have analysed the effect of public social spending on HDI dimensions for a sample of 68 countries over the period 1995-2016. This study estimates the effects of social government spending (social protection, healthcare, and education) on gross national income (GNI) per capita (in PPP in $), expected years of schooling, and life expectancy. The authors find a significant positive effect of government education expenditure on education and gross national income dimensions, and government health expenditures on life expectancy. In other related work, Castells-Quintana et al. (2019) analyse a panel of 117 countries during the 1970-2010 period and find an insignificant impact of government consumption (i.e., government spending excluding government gross investment) on human development.

The empirical literature to date has mostly explored the effect of fiscal decentralization on specific components of the HDI. With regard to the two main public services emphasized here, the most resounding finding is a positive impact of decentralizing health and education spending on health and education outcomes – this is particularly confirmed for the latter (Channa and Faguet 2016; Arends 2020). A handful of studies have found a positive impact of fiscal decentralization on health outcomes, such as the infant mortality rate.[40] Concerning education, many studies support the view that fiscal decentralization improves education outcomes, such as education attainment (Barankay and Lockwood 2007), public-school enrolment rates (Habibi et al. 2003; Sanchez and Faguet 2008; Faguet and Sánchez 2014), and student achievement (Falch and Fischer, 2012). Finally, Sepulveda and Martinez-Vazquez (2011), study a sample of 65 developed and developing countries covering the period 1971-2000, and find a significant and positive effect of fiscal decentralization on the HDI; variable that they

[39] Anyanwu and Erhijakpor (2009) study a sample of 47 African countries over the 1999-2004 period and find that health expenditures have a significant positive impact on health outcomes; while Nixon and Ulmann (2006) study 15 EU countries over the period 1980-1995 finding that increases in health spending reduces infant mortality, but influences life expectancy at birth only marginally.

[40] For instance, Robalino et al. (2001) for low- and high-income countries over 1970-1995, Habibi et al. (2003) for Argentinian provinces between 1970 and 1994, Jiménez-Rubio (2011) for 20 OECD countries from 1970 to 2001, and Samadi et al. (2013) for Iranian regions in the period 2007-2010.

used as a proxy for poverty. However, these authors do not analyse the effects on human development components.

To the best of our knowledge, such an analysis has not given the attention before to the impact of fiscal decentralization, in particular on health and education expenditure, on the HDI and its three dimensions. Therefore, the existing evidence needs further in-depth empirical work. Our paper aims to fill this gap by analysing this issue using updated data of a broad sample of developed and developing countries.

### 4.3 Key variables

In this section we provide information about our main variables of interest, the Human Development Index (HDI), and the public expenditure variables. Our sample consists on a panel of 57 countries during the 2000-2018 period.[41]

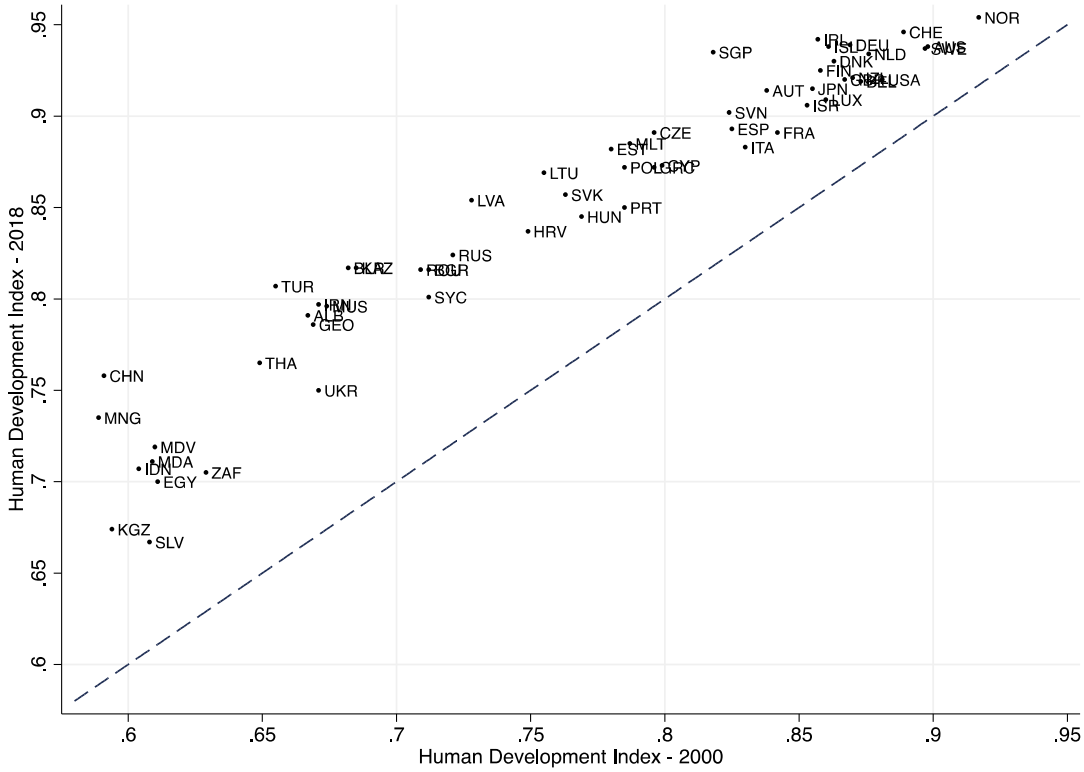
Our dependent variable is human development as measured by the HDI and its three dimensions. The HDI is published annually by the United Nations Development Programme (UNDP) in their Human Development Reports since 1990 to provide an alternative index to the GDP and income-based indicators to measure human development.[42] The HDI is a summary measure of average achievements in three key dimensions of human development in the country: a long and healthy life, access to knowledge, and a decent standard of living. The health dimension is measured by life expectancy at birth, which is used to build the health index; the knowledge dimension is measured by the expected years of schooling (for children of school entering age) and the mean of years of schooling (for adults aged 25 years and more), both are used to build the education index; and, the living conditions dimension is measured by the gross national income (GNI) per capita (PPP USD), that is used to build the income index. The HDI is the geometric mean of the three-dimensional indices.[43]

Figure 1 presents the levels of HDI in our sample of countries at the beginning and end of the analysed period, showing that all included countries have increased the HDI (all of them are on the left side of the graph). Figure 1 also illustrates an important heterogeneity across countries, being the richer countries the ones with higher levels of

[41] Table F.1 of Appendix F provides the list of included countries.
[42] Available at: http://hdr.undp.org/en/global-reports
[43] The details on the HDI calculation may be find in UNDP (2020), and Klugman et al. (2011) provide an explanation of its limitations.

HDI, especially Norway and Sweden (between 0.90 and 0.95), while in the other extreme, poorer countries, like El Salvador and Kyrgyzstan, have much lower levels (between 0.60 and 0.70). Obviously, since one of the components of HDI is the GNI per capita (PPP USD), there is a strong correlation between HDI and the GDP per capita (0.93 in our sample), although a strong correlation also exists between GDP per capita and the health and educational components of the HDI (0.78 and 0.68 respectively). Interestingly, China presents very low HDI values, but it is the country that has improved more during the analysed period.

**Figure 1 – Human Development Index in 2000 and 2018**




*Note:* The Human Development Index is between 0 and 1; 1 if the country achieves the maximum value.
*Source:* Own elaboration based on data from United Nations Developed Programme.

To obtain the public expenditure disaggregated variables, we turn to two databases that comprise updated information on different government variables for an extended group of developed and developing economies. Specifically, we consider the IMF Government Finance Statistics (GFS) database, classified by economic functions (COFOG), and the Fiscal Decentralization dataset (Lledó et al. 2018). These sources

provide a harmonised and documented set of annual fiscal data for the largest number of countries and years; data are available at general/central/subnational government (GG/CG/SNG) level.

Specifically, we focus on two of the most important expenditure functions (health and education), which are directly related to two of the three dimensions of the HDI (life expectancy and years of schooling), and that jointly represent approximately one quarter of the general government expenditure in our sample. The expenditure on health includes medical products, appliances and equipment, outpatient services, hospital services, public health services, R&H health, health n.e.c.; and the expenditure on education comprises pre-primary and primary education, secondary education, post-secondary non-tertiary education, tertiary education, education not definable by level, subsidiary services to education, R&D education, education n.e.c. To account for the remaining public expenditure, in our empirical analysis we also consider a residual catch-all category that contains the rest of the functions including social protection, general public services, economic affairs, defence and public order, and in total comprises the other three quarters of the total public expenditure. Accordingly, in the empirical analysis we consider these three categories of spending (health, education, and other expenditure) at the level of general government (GG), central government (CG), and subnational government (SNG).

Interestingly, in our sample of countries and in average terms over the whole period 2000-2018, the relative importance of public expenditure on health and education is quite similar, both accounting the same amount of resources (approximately 5% of GDP); however, we should mention that there exist a high heterogeneity across countries concerning the amount of resources dedicated to public health and education, and also these funds are differently distributed between central and subnational administrations (see Table F.3 of Appendix F).

According to OECD-UCLG (2016), at the global level, in 2013 subnational expenditure amounted to 9.0% of GDP, and 23.9% of public expenditure (subnational expenditure accounts for 1.5% of GDP in the case of health, and 2.6% of GDP in the case of education). In our sample of 57 countries, these average ratios in 2013 were similar (subnational spending accounted for 11.2% of the GDP and 27.8% of public expenditure), particularly in the case of subnational expenditure in health and education (1.5% and 2.5% of the GDP, respectively), although there is a high level of variability across countries (see Table F.3 of Appendix F). Accordingly, our sample of developed and developing countries seems to be quite representative of the global reality. On the other

hand, during the past decades, in the majority of the countries the decentralisation processes resulted in an increase in subnational government expenditure, both as a share of GDP and total public spending (OECD 2019; Martinez-Vazquez et al. 2017), phenomenon that also occurs in our sample of countries and period when analysing central and subnational expenditure on health and education.

### 4.4 Empirical model

Our sample consists on a panel of 57 countries during the 2000-2018 period. This sample is limited by the availability, frequency, and quality of data being the expenditure decentralization data the main restriction. We consider annual data and also five year means for the periods 2000-2004, 2005-2009, 2010-2014, and four year means for the last period (2015-2018). We consider annual and also longer time intervals because our main dependent variable (HDI) moves very slowly over time, and we are also interested in capturing long-term trends and structural relationships between the key variables of interest, i.e., we neutralise the business cycle effect. In this section we explain the methodological strategy applied to tackle the aim of this paper.

We estimate the following empirical model:

$$HDI_{it} = \beta_0 + \beta_1 GS_{it} + \beta_2 X_{it} + \mu_t + \varepsilon_{it} \quad (1)$$

where *i* represents the countries in the sample and *t* denotes the time period, and $\beta$ are the parameters to be estimated. In Equation (1), *HDI*, the Human Development Index, is the dependent variable. Additionally, we estimate the same specification for each dimension of the HDI: life expectancy index, education index, and income index. In this analysis, we focus on the role of government health and education expenditure, both at the CG and SNG level, on HDI and its components. Thus, we analyse the impact of government spending (*GS*) considering first, GG expenditure on health, education, and other expenditure, and second, CG and SNG expenditure on health, education, and other expenditure. *X* is a vector of control variables, $\mu_t$ represent the period fixed effects (to control for global shocks) and $\varepsilon$ the error term.

One of the questions we will be able to deal with following this approach is if the impact of public health and education spending on human development is influenced by

the level of decentralization that is by the distribution of the corresponding spending between central and subnational administrative levels. It could be the case that local and regional authorities, since they are better informed, spend the resources in a way that has a stronger impact on HDI, or alternatively that spending of central authorities has a greater impact on the HDI because of the scale economies produced. And perhaps the explanations may work in contrary directions depending on the type of expenditure (health versus education).

We estimate the model with OLS based on panel-corrected standard errors (PCSE) that are robust to heteroscedasticity and serial correlation between the residuals of a given cross-section (Period weight SUR). In data panel analysis, it is common to account for cross-section fixed effects because it allows to control for unobserved country specific characteristics or for omitted time-invariant factors (e.g., culture and geography). However, if most of the variation in the key variables is between-country rather than within-country, that limits the potential for analysis of causal effects using panel estimations with cross-section fixed effects. One reason is that long-run confounding factors could subsume into the fixed effects, producing unreliable results (Fallah and Partridge 2007; Castells-Quintana et al. 2019). In our case, this effect may be relevant since our key variables show highly between-countries variation compared to the within-country variation. For instance, the HDI variable has a mean value of 0.811 and an overall standard deviation of 0.093, and while the between standard deviation is 0.089, the within standard deviation is only 0.029 (see Table F.3 of Appendix F). Accordingly, we do not consider the inclusion of cross-section fixed effects. Nevertheless, we account for several control variables in order to minimise omitted variables bias due to the influence of country specific factors.

In our empirical model we also account for the potential long-term effects provoked by public spending on HDI. For example, increasing health spending may result in higher life expectancy after a lag of several years. In order to do that, we estimate our baseline model considering our spending variables lagged one, two, or three periods, allowing for the possibility that the effects provoked by these variables are not contemporaneous – there could be significant lags between the implementation of spending policy and the impact on human development. And, on the other hand, there may be also a feedback effect from life expectancy that should be considered because it leads to increase health spending due to older people often requiring costly medical care. Thus, to address endogeneity concerns, we apply an Instrumental Variable (IV) approach, and estimate

our baseline model using a Two-Stage Least Square (TSLS) method instrumenting the potential endogenous variables with their lagged values. Both strategies provide further reassurance that long-term impacts and endogeneity issues would not affect the estimated results, as the robustness section analyses.

In our empirical analysis, we have controlled for the variables potentially influencing the relationship between government expenditure variables and human development (and its dimensions). Our control variables are in line with those employed by previous work and aim to reduce omitted variable bias. Specifically, we control for urban population, income inequality, inflation, private health spending, political decentralization, democracy, and, finally, a dummy for being member of the European Union.[44] The need to control for these variables is obvious given their possible influence on the HDI, as we detail in the next paragraphs, and the fact that they may be related with the level, distribution, and structure of public expenditure.

In the last decades, there has been a significant growth in urban population (e.g., due to rural immigration) and it has been associated with better social facilities and services delivery, which enhances human development (Mehmood et al. 2010). To account for this, we include the variable "urban population participation" defined as the share of urban population over total population from World Bank's World Development Indicator (WDI).

An extensive literature analyses the effects of inequality on economic development, in particular on economic growth, highlighting multiple mechanisms of transmission through which inequality has predominately a negative effect on growth, but its effect continues to be hotly debated (Voitchovsky 2011; Neves and Silva 2014; Bourguignon 2015; Ferreira et al. 2021). Moreover, inequality can also affect other aspects of human development, such as education and health outcomes; again, even though it is generally pointed a negative effect, there is a lack of consensus about its effects (Ferreira et al. 2021). In a recent paper, Castells-Quintana et al. (2019) studied the relationship between income inequality and human development (and its dimensions) and identified a negative long run effect of inequality on human development, whereas in the short run find a positive effect on income and a negative effect on educational outcomes. In this article, we consider the variable "income inequality" as measured by the Gini net index (i.e.,

[44] The definitions and sources of all variables are presented in Table F.2, and descriptive statistics in Table F.3; both in the Appendix F.

income inequality after transfers and direct taxes) from The Standardized World Income Inequality Database (SWIID) developed by Solt (2020).[45]

We consider the variable "inflation" that is measured by the consumer prices index growth from WDI. The variable capture the idea that an economy with a high degree of inflation corrodes the purchasing power of the economic agents, and consequently may affect negatively human development (Paliova et al. 2019).

Since we include the variable of public health spending, we need to control for the rest of resources dedicated to health that may affect HDI, that is to say the private health spending, that in our sample of countries represents a volume of resources in average terms close to 2.5% of their GDP, approximately a half part of what these countries dedicate to public health, and again we may observe a remarkable heterogeneity between countries (see Table F.3 of Appendix F).[46] This distinction is important because the level of public health spending is determined by fiscal policy, while the private public spending reflects the voluntary or individual choice based demand for health care (Linden and Ray 2017).

We are aware that the level of spending decentralization does not necessarily reflect the degree of fiscal autonomy that SNGs authorities may have to effectively decide how and where to spend. Accordingly, and in order to control for the possible importance that political decentralization (PD) may have on the relationship between public spending at CG and SNG level and the HDI, we include the variable "federalism" from Gerring and Thacker (2004), which is a time-invariant variable that ranges from 1 (unitary) to 5 (fully federal states) and that covers all the countries included in the analysis.

Besides, scholars have investigated to what extend democracy affects human development, and the most resounding conclusion is that the country's level of democracy improves human development. Several transmission channels have been suggested to affect human development through democracy, such as higher levels of citizens and civic associations participation, electoral competition and accountability, political representation, and democratic institutionalisation (Gerring et al. 2012; Bellinger 2019; Gerring et al. 2021). Thus, we consider the variable "democracy" obtained by combining the variables political rights and civil liberties from V-Dem Institute (2021) and Freedom House (2021). The political rights variable refers to the electoral process, political

[45] See Solt (2020) for a complete description of the SWIID; we employ version 8.3 (updated in May 2020).
[46] Poullier et al. (2002) provide a clear explanation on the different components of public and private health spending.

pluralism and participation, and functioning of government; meanwhile, the civil liberties variable refers to freedom of expression and belief, associational and organizational rights, rule of law, and personal autonomy and individual rights.

Finally, we also control for being a membership of the European Union (EU Member) since EU laws and policies may have an impact on the size and distribution of public expenditure, and on the different dimensions of human development (Scott 2006).

### 4.5 Results

This section presents the main findings arising from the estimation of Equation (1) where we consider the HDI and also each of its three dimensions as dependent variable, on a set of explanatory factors by panel regression analysis using annual and five-year means data. We report the results including two classifications of government spending: First, GG expenditure on health, education, and other; and second, CG and SNG expenditure on health, education, and other.

Columns 1 and 3 of Table 1 present the estimates using the general government (GG) expenditure variables showing a positive and significant impact of GG health expenditure on HDI, while the evidence on the effects of the educational expenditure is negative but not robust. In columns 2 and 4, we disaggregate the GG variables into central (CG) and subnational (SNG) expenditure, and the estimated results confirm the positive effects of health expenditure both at CG and SNG level, while the evidence in the case of the CG and SNG expenditure on education is again not conclusive.

## Table 1 – Human development and public expenditure decentralization

| *Dependent variable:* | *Annual* | | *Five-year means* | |
|---|---|---|---|---|
| *Human Development Index (HDI)* | *(1)* | *(2)* | *(3)* | *(4)* |
| *Urban population* | 0.214*** | 0.210*** | 0.217*** | 0.219*** |
| | (0.011) | (0.011) | (0.022) | (0.023) |
| *Income inequality* | -0.495*** | -0.514*** | -0.493*** | -0.514*** |
| | (0.025) | (0.024) | (0.047) | (0.047) |
| *Inflation* | -0.224*** | -0.207*** | -0.360*** | -0.343*** |
| | (0.029) | (0.028) | (0.068) | (0.072) |
| *Private health expenditure* | 0.029 | 0.011 | -0.017 | -0.028 |
| | (0.083) | (0.084) | (0.182) | (0.186) |
| *Democracy* | 0.013*** | 0.014*** | 0.006 | 0.007 |
| | (0.003) | (0.003) | (0.006) | (0.006) |
| *Federalism* | 0.013*** | 0.016*** | 0.013*** | 0.016*** |
| | (0.001) | (0.001) | (0.002) | (0.002) |
| *Dummy EU* | 0.021*** | 0.019*** | 0.017** | 0.015* |
| | (0.004) | (0.004) | (0.008) | (0.008) |
| *GG education* | -0.072 | --- | -0.085 | --- |
| | (0.123) | | (0.243) | |
| *GG health* | 0.636*** | --- | 0.666*** | --- |
| | (0.096) | | (0.204) | |
| *GG other* | -0.149*** | --- | -0.113** | --- |
| | (0.024) | | (0.053) | |
| *CG education* | --- | 0.369*** | --- | 0.212 |
| | | (0.121) | | (0.249) |
| *SNG education* | --- | -0.174 | --- | -0.255 |
| | | (0.116) | | (0.240) |
| *CG health* | --- | 0.467*** | --- | 0.516*** |
| | | (0.085) | | (0.181) |
| *SNG health* | --- | 0.612*** | --- | 0.698*** |
| | | (0.088) | | (0.187) |
| *CG other* | --- | -0.134*** | --- | -0.086* |
| | | (0.025) | | (0.052) |
| *SNG other* | --- | -0.092** | --- | -0.107 |
| | | (0.037) | | (0.077) |
| *Constant* | 0.761*** | 0.754*** | 0.775*** | 0.768*** |
| | (0.015) | (0.014) | (0.026) | (0.025) |
| *R-squared* | 0.810 | 0.813 | 0.826 | 0.829 |
| *Chi2* | 5062 | 5408 | 1180 | 1314 |
| *Countries* | 57 | 57 | 57 | 57 |
| *Observations* | 928 | 922 | 210 | 209 |

*Notes:* All regressions report PCSE in parentheses and include period fixed effects. Level of significance: 10% (*), 5% (**), and 1% (***).
*Source:* Own estimations.

In order to clarify how the different spending variables impact on the HDI, in Table 2 we proceed with the analysis considering the three HDI components separately as the dependent variable. The results confirm a robust and positive impact of health expenditure, at GG, CG and SNG level, on the three HDI components. In other words, health expenditure, no matter the level of public administration that is responsible, clearly improves human development, increasing life expectancy, years of schooling and income per capita. The impact of health spending on the education index could be also related to its relationship with a country's economic performance, since on the one hand, children who enjoy good health can attend school more regularly, and on the other hand, healthy people have the potential to be more productive at work, since more health spending can be translated to better educational and economic outcomes (Anand and Sen 2000a, 2000b).

In the case of the education expenditure, this approach allows us to identify a positive and significant effect of this spending at GG, CG and SNG level on the knowledge component of the HDI, but the impact on the other two components is mixed, depends on the level of decentralization considered, and is not always robust. These results suggest that the non-significant impact of the education expenditure on HDI shown in Table 1 may be a consequence of mixed impacts on the three HDI components that neutralise each other (the positive effect on the knowledge component is cancelled by the negative ones on the other components). And finally, the catch-up category of public spending (labelled as other expenditure) shows a negative impact on the three HDI components, but again this effect is not robust.

Insofar as the control variables are concerned, the empirical estimates on Tables 1 and 2 indicate a robust and positive impact of urban population, possibly indicating that more level of urbanization is related with high income per-capita and demand for health and education services, suggesting that urban context enhance socioeconomic conditions (Mehmood et al. 2010). This result is in line with previous studies, such as Castells-Quintana et al. (2019), that find a significant positive impact on HDI.

Furthermore, we find a significant negative impact of income inequality on human development and its three components (i.e., health, education, and income). In contrast with previous studies, we provide evidence that income inequality is significant and negatively associated also with the income dimension of the HDI. Specifically, Castells-Quintana et al. (2019) study the relationship between income inequality and human

development (and its dimensions) and identified a negative long run effect of inequality on human development, but in the short run find a positive effect on income.

Our results also show a negative and significant impact of inflation on human development and its dimensions, result that is also obtained by Castells-Quintana et al. (2019). The economic intuition is that inflation may introduce socioeconomics instability conditions, worsening the standard of living and the access to health and education services (Yolanda 2017).

On the other hand, private health spending has a positive impact on HDI (see Table 1) which is only robust in the case of the health component (see Table 2). Our findings are in line with previous work considering the effects of private and public health expenditure on health outcomes (Linden and Ray 2017; Ray and Linden 2020).

The level of political decentralization (PD) in the form of federalism shows always a positive and significant impact on HDI and its components indicating the beneficial effect of decentralized schemes on the political responsibilities and decision process.

Besides, we do not find strong evidence that democracy positively impacts on the HDI indicator, while we observe a significant and positive impact on the education dimension, it does not affect the health and income dimension (see Table 2). Our findings are not contradictory to previous works (Gerring et al. 2012; Bellinger 2019; Gerring et al. 2021) because they focus on infant mortality and we consider life expectancy at birth. Regarding the impact of democracy on the education dimension, our reported results are in line with existing studies that reveal that democracy may have greater incentives than autocrats to enhances educational enrollment and years of schooling (Stasavage 2005; Eterovic and Sweet 2014; Dahlum and Knutsen 2017).

Finally, the dummy corresponding to the EU member state is positive and mostly significant at the 1% level, indicating that being a member of the EU positively affects the HDI and its dimensions.

We next want to deal with the potential role that quality of governance (QoG) may have on human development and how it could influence the relationship between central and subnational public expenditure and HDI. In fact much empirical research suggests that good QoG can foster economic performance by providing suitable and favourable environment for production, trade, and investment in physical and human capital (Mauro 1995; Hall and Jones 1999; Acemoglu et al. 2005; Setayesh and Daryaei 2017). According to this view, the QoG could indirectly affect human development at least through economic growth. Beyond economic development, several scholars (Mauro

1998; Gupta et al. 2001; Rajkumar and Swaroop 2002) have documented that the QoG in the form of corruption adversely affects the public provision of health care and education services; by increasing their cost, decreasing their quantity, reducing investment in human capital, and reducing government revenues that limit the government expenditure on both services. In order to consider this factor, we now include a "QoG" control, using two different variables from two sources. First, from the Worldwide Governance Indicators (WGI, Kaufmann et al. 2011), we construct the QoG-WGI variable considering the average of the following dimensions: government effectiveness, rule of law, regulatory quality, and control of corruption. Second, from the International Country Risk Guide (ICRG 2013a), we construct the QoG-ICRG variable taking the mean of the following three dimensions: law and order, bureaucratic quality, and control of corruption.[47]

Table 3 reports the results when including the QoG on our baseline model and undoubtedly confirm the results previously obtained in the sense that public health expenditure, no matter the public administration responsible, improves human development. Certainly, both QoG variables yield a significant and positive coefficient, and its inclusion modifies the size of the coefficients of the expenditure variables, suggesting that indeed part of their impact on HDI may work through institutional development. Notwithstanding this, it is also true that the QoG as we measure it, is highly correlated with some of our control variables and therefore its inclusion on our baseline model may provoke multicollinearity issues that limit the validity of the estimated results.[48]

[47] These two indicators of QoG have been widely used in previous work to measure governance (e.g., Olson et al. 2000; Adedokun 2017; Kyriacou and Roca-Sagalés 2020). The QoG-ICRG variable do not comprises 5 of the 57 countries of the sample (see Table F.3 of Appendix F).

[48] Note that QoG-WGI is highly correlated with democracy (0.66**), urban population (0.65**), and also with the GG health expenditure (0.57**). And QoG-ICRG is highly correlated with urban population (0.65**), democracy (0.56**), and also with the GG health expenditure (0.52**). (**) significance at 5%.

## Table 2 – Human development per components and public expenditure decentralization

| *Dependent variable* | *Annual* | | | | | | *Five-year means* | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Life expectancy index* | | *Education index* | | *Income index* | | *Life expectancy index* | | *Education index* | | *Income index* | |
| | *(1)* | *(2)* | *(3)* | *(4)* | *(5)* | *(6)* | *(7)* | *(8)* | *(9)* | *(10)* | *(11)* | *(12)* |
| *Urban population* | 0.175*** | 0.163*** | 0.161*** | 0.163*** | 0.300*** | 0.297*** | 0.167*** | 0.163*** | 0.170*** | 0.175*** | 0.304*** | 0.310*** |
| | (0.010) | (0.009) | (0.014) | (0.014) | (0.018) | (0.018) | (0.020) | (0.018) | (0.029) | (0.027) | (0.039) | (0.038) |
| *Income inequality* | -0.461*** | -0.567*** | -0.634*** | -0.538*** | -0.353*** | -0.416*** | -0.482*** | -0.585*** | -0.634*** | -0.547*** | -0.329*** | -0.392*** |
| | (0.050) | (0.046) | (0.025) | (0.026) | (0.035) | (0.038) | (0.090) | (0.082) | (0.049) | (0.052) | (0.072) | (0.078) |
| *Inflation* | -0.376*** | -0.309*** | -0.001 | -0.034 | -0.327*** | -0.302*** | -0.608*** | -0.508*** | -0.007 | -0.073 | -0.519*** | -0.487*** |
| | (0.043) | (0.037) | (0.030) | (0.030) | (0.045) | (0.043) | (0.105) | (0.098) | (0.077) | (0.077) | (0.108) | (0.108) |
| *Private health expenditure* | 0.665*** | 0.578** | -0.021 | 0.029 | -0.445*** | -0.461*** | 0.623** | 0.549** | -0.021 | 0.014 | -0.543 | -0.537 |
| | (0.122) | (0.103) | (0.185) | (0.178) | (0.164) | (0.162) | (0.251) | (0.219) | (0.402) | (0.386) | (0.354) | (0.350) |
| *Democracy* | 0.005 | 0.005 | 0.027*** | 0.030*** | 0.003 | 0.001 | -0.004 | -0.003 | 0.024*** | 0.027*** | -0.008 | -0.009 |
| | (0.004) | (0.004) | (0.004) | (0.004) | (0.004) | (0.004) | (0.008) | (0.008) | (0.009) | (0.009) | (0.009) | (0.009) |
| *Federalism* | -0.003** | 0.007*** | 0.021*** | 0.012*** | 0.020*** | 0.027*** | -0.004 | 0.006* | 0.022*** | 0.013*** | 0.020*** | 0.027*** |
| | (0.002) | (0.002) | (0.002) | (0.002) | (0.002) | (0.002) | (0.003) | (0.004) | (0.003) | (0.004) | (0.004) | (0.004) |
| *Dummy EU* | 0.008* | 0.011*** | 0.018*** | 0.011** | 0.039*** | 0.037*** | -0.004 | 0.004 | 0.022* | 0.012 | 0.031** | 0.030** |
| | (0.004) | (0.003) | (0.005) | (0.005) | (0.005) | (0.005) | (0.008) | (0.007) | (0.011) | (0.010) | (0.013) | (0.012) |
| *GG education* | -1.201*** | --- | 1.458*** | --- | -0.552*** | --- | -1.247*** | --- | 1.574*** | --- | -0.642 | --- |
| | (0.160) | | (0.182) | | (0.195) | | (0.306) | | (0.384) | | (0.405) | |
| *GG health* | 0.831*** | --- | 0.368*** | --- | 0.731*** | --- | 0.860*** | --- | 0.392 | --- | 0.778** | --- |
| | (0.116) | | (0.118) | | (0.166) | | (0.235) | | (0.249) | | (0.350) | |
| *GG other* | -0.089*** | --- | -0.192*** | --- | -0.164*** | --- | -0.029 | --- | -0.209*** | --- | -0.096 | --- |
| | (0.033) | | (0.032) | | (0.034) | | (0.066) | | (0.067) | | (0.080) | |
| *CG education* | --- | 0.366*** | --- | 0.652*** | --- | 0.138 | --- | 0.182 | --- | 0.699* | --- | -0.178*** |
| | | (0.137) | | (0.178) | | (0.198) | | (0.269) | | (0.361) | | (0.428) |
| *SNG education* | --- | -1.379*** | --- | 1.690*** | --- | -0.996*** | --- | -1.439*** | --- | 1.702*** | --- | -1.161*** |
| | | (0.130) | | (0.179) | | (0.164) | | (0.258) | | (0.368) | | (0.362) |
| *CG health* | --- | 0.518*** | --- | 0.256** | --- | 0.637** | --- | 0.597*** | --- | 0.241 | --- | 0.727** |
| | | (0.087) | | (0.104) | | (0.143) | | (0.180) | | (0.221) | | (0.307) |
| *SNG health* | --- | 0.539*** | --- | 0.401*** | --- | 0.915*** | --- | 0.656*** | --- | 0.417 | --- | 1.047*** |
| | | (0.102) | | (0.123) | | (0.146) | | (0.217) | | (0.257) | | (0.318) |
| *CG other* | --- | -0.165*** | --- | -0.090*** | --- | -0.156*** | --- | -0.112* | --- | -0.078 | --- | -0.075 |
| | | (0.031) | | (0.031) | | (0.036) | | (0.060) | | (0.062) | | (0.078) |
| *SNG other* | --- | 0.038 | --- | -0.134** | --- | -0.173*** | --- | 0.015 | --- | -0.151 | --- | -0.177 |
| | | (0.063) | | (0.053) | | (0.054) | | (0.125) | | (0.111) | | (0.113) |
| *Constant* | 0.907*** | 0.920*** | 0.674*** | 0.637*** | 0.723*** | 0.730*** | 0.946*** | 0.953*** | 0.671*** | 0.640*** | 0.734*** | 0.739*** |
| | (0.031) | (0.027) | (0.021) | (0.020) | (0.021) | (0.021) | (0.057) | (0.049) | (0.041) | (0.038) | (0.039) | (0.038) |

*(continue)*

## Table 2 (continued) – Human development per components and public expenditure decentralization

| *Dependent variable* | *Annual* | | | | | | *Five-year means* | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Life expectancy index* | | *Education index* | | *Income index* | | *Life expectancy index* | | *Education index* | | *Income index* | |
| | *(1)* | *(2)* | *(3)* | *(4)* | *(5)* | *(6)* | *(7)* | *(8)* | *(9)* | *(10)* | *(11)* | *(12)* |
| *R-squared* | 0.665 | 0.718 | 0.713 | 0.726 | 0.691 | 0.711 | 0.709 | 0.752 | 0.746 | 0.753 | 0.704 | 0.725 |
| *Chi2* | 1668 | 2079 | 3354 | 3386 | 2015 | 2731 | 490 | 567 | 909 | 962 | 464 | 607 |
| *Countries* | 57 | 57 | 57 | 57 | 57 | 57 | 57 | 57 | 57 | 57 | 57 | 57 |
| *Observations* | 928 | 922 | 928 | 922 | 928 | 922 | 210 | 209 | 210 | 209 | 210 | 209 |

*Notes:* All regressions report PCSE in parentheses and include period fixed effects. Level of significance: 10% (*), 5% (**), and 1% (***).
*Source:* Own estimations.

**Table 3 – Human development, public expenditure decentralization and the role of quality of governance (QoG)**

| *Dependent variable: HDI* | *Annual* | | | | *Five-year means* | | | |
|---|---|---|---|---|---|---|---|---|
| | *(1)* | *(2)* | *(3)* | *(4)* | *(5)* | *(6)* | *(7)* | *(8)* |
| *Urban population* | 0.102*** | 0.106*** | 0.126*** | 0.124*** | 0.103*** | 0.110*** | 0.116*** | 0.119*** |
| | (0.009) | (0.009) | (0.011) | (0.010) | (0.018) | (0.018) | (0.020) | (0.020) |
| *Income inequality* | -0.381*** | -0.389*** | -0.422*** | -0.435*** | -0.377*** | -0.394*** | -0.362*** | -0.368*** |
| | (0.020) | (0.022) | (0.022) | (0.022) | (0.035) | (0.038) | (0.037) | (0.039) |
| *Inflation* | -0.014 | -0.025 | -0.142*** | -0.150*** | -0.012 | -0.036 | -0.175*** | -0.191*** |
| | (0.017) | (0.017) | (0.023) | (0.024) | (0.048) | (0.048) | (0.059) | (0.062) |
| *Private health expenditure* | -0.035 | -0.149** | -0.040 | -0.200** | -0.025 | -0.132 | -0.072 | -0.242 |
| | (0.063) | (0.062) | (0.089) | (0.092) | (0.137) | (0.135) | (0.171) | (0.178) |
| *Democracy* | -0.004* | -0.008*** | 0.001 | -0.003 | -0.006 | -0.009** | -0.006 | -0.008 |
| | (0.002) | (0.003) | (0.003) | (0.003) | (0.005) | (0.005) | (0.006) | (0.006) |
| *Federalism* | 0.009*** | 0.012*** | 0.012*** | 0.017*** | 0.009*** | 0.012*** | 0.013*** | 0.017*** |
| | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.002) | (0.002) |
| *Dummy EU* | 0.006*** | 0.008*** | 0.021*** | 0.020*** | 0.008 | 0.008** | 0.024*** | 0.022*** |
| | (0.002) | (0.002) | (0.003) | (0.003) | (0.005) | (0.005) | (0.007) | (0.006) |
| *GG education* | -0.405*** | --- | -0.078 | --- | -0.505*** | --- | -0.104 | --- |
| | (0.090) | | (0.119) | | (0.182) | | (0.213) | |
| *GG health* | 0.281*** | --- | 0.425*** | --- | 0.244* | --- | 0.385*** | --- |
| | (0.061) | | (0.075) | | (0.132) | | (0.147) | |
| *GG other* | 0.012 | --- | -0.106*** | --- | 0.031 | --- | -0.099** | --- |
| | (0.019) | | (0.022) | | (0.039) | | (0.042) | |
| *CG education* | --- | -0.219** | --- | 0.259** | --- | -0.359* | --- | 0.078 |
| | | (0.097) | | (0.110) | | (0.195) | | (0.204) |
| *SNG education* | --- | -0.134 | --- | 0.082 | --- | -0.243 | --- | 0.032 |
| | | (0.082) | | (0.111) | | (0.167) | | (0.199) |
| *CG health* | --- | 0.172*** | --- | 0.291*** | --- | 0.158 | --- | 0.246* |
| | | (0.053) | | (0.070) | | (0.113) | | (0.134) |
| *SNG health* | --- | 0.276*** | --- | 0.427*** | --- | 0.265* | --- | 0.403*** |
| | | (0.067) | | (0.079) | | (0.147) | | (0.157) |
| *CG other* | --- | 0.059*** | --- | -0.053** | --- | 0.076** | --- | -0.030 |
| | | (0.021) | | (0.025) | | (0.039) | | (0.045) |
| *SNG other* | --- | -0.162*** | --- | -0.241*** | --- | -0.155*** | --- | -0.249*** |
| | | (0.024) | | (0.035) | | (0.051) | | (0.064) |

*(continue)*

**Table 3 (continued) – Human development, public expenditure decentralization and the role of quality of governance (QoG)**

| *Dependent variable: HDI* | *Annual* | | | | *Five-year means* | | | |
|---|---|---|---|---|---|---|---|---|
| | *(1)* | *(2)* | *(3)* | *(4)* | *(5)* | *(6)* | *(7)* | *(8)* |
| *QoG-WGI* | 0.054*** | 0.056*** | --- | --- | 0.056*** | 0.058*** | --- | --- |
| | (0.002) | (0.002) | | | (0.004) | (0.005) | | |
| *QoG-ICRG* | --- | --- | 0.144*** | 0.152*** | --- | --- | 0.194*** | 0.205*** |
| | | | (0.008) | (0.010) | | | (0.020) | (0.022) |
| *Constant* | 0.786*** | 0.783*** | 0.729*** | 0.724*** | 0.795*** | 0.794*** | 0.697*** | 0.685*** |
| | (0.014) | (0.014) | (0.015) | (0.014) | (0.024) | (0.024) | (0.024) | (0.024) |
| *Adjusted $R^2$* | 0.904 | 0.907 | 0.859 | 0.863 | 0.914 | 0.918 | 0.889 | 0.894 |
| *Chi2* | 8731 | 8806 | 6387 | 6136 | 2327 | 2439 | 1709 | 1775 |
| *Countries* | 57 | 57 | 52 | 52 | 57 | 57 | 52 | 52 |
| *Observations* | 928 | 922 | 835 | 829 | 210 | 209 | 195 | 194 |

*Notes:* All regressions report PCSE in parentheses and include control and period fixed effects. Level of significance: 10% (*), 5% (**), and 1% (***).
*Source:* Own estimations.

### 4.6 Robustness analysis

In this section, we propose some robustness tests. Firstly, we capture the potential long-run impact of the government expenditure variables on the HDI by introducing a different lagged structure of the government expenditures variables. Secondly, we deal with the potential endogeneity that can affect the estimates of our baseline models of Table 1 by using an IV approach. And finally, we explore the sensitivity of our results to the inclusion of different political decentralization indicators and also to the inclusion of other variables potentially affecting our results, namely investment and ethnic fractionalization.

We begin by examining the possibility that the expenditure variables do not impact on the HDI contemporaneously. To do this, we estimate our baseline model employing one, two or three period lagged values of the public spending variables. As can be seen in columns 1-8 of Table 4, considering a different time structure on the effects, do not modify our substantive results since health expenditure at GG, CG and SNG level keep improving HDI, while the effects of the education and other expenditure variables are again inconclusive and not robust. It is important to remark that this strategy allow us to reduce potential reverse causality concerns provoked from our dependent variable (HDI) to the spending variables.

We turn now to address simultaneity problems. In this sense, it may be reasonable to consider that there could be feedback effects from human development to regressors that change relatively rapidly in the short run. For instance, the short- and medium-run movements in the income dimension of the HDI may affect the policymakers spending decision (or discretionary fiscal policy), making the expenditure variables endogenous. To deal with endogeneity concerns, we estimate our baseline models using TSLS instrumental variables techniques. In the case of annual data, we instrument the potential endogenous explanatory variables (inflation, private health, and government expenditure variables) with their lagged value, while for five-year means data, we instrument them with their initial year of each period. Columns 9 to 12 of Table 4 present the results for the TSLS estimations, showing that the estimates remain basically unchanged to OLS estimates and accordingly, confirm the crucial influence of public health expenditure, at GG, CG and SNG level, on human development.[49]

[49] Table G.1 of Appendix G presents the results from the estimation of HDI per components using TSLS.

## Table 4 – Human development and public expenditure decentralization: Lagged effects and Two-Stage Least Square (TSLS)

| *Dependent variable: HDI* | *Lagged structure of government expenditure variables* | | | | | | | | *TSLS* | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *(1) Annual (h=1 lag)* | *(2) Annual (h=1 lag)* | *(3) Annual (h=2 lags)* | *(4) Annual (h=2 lags)* | *(5) Annual (h=3 lags)* | *(6) Annual (h=3 lags)* | *(7) Five-year means (h=1 lag)* | *(8) Five-year means (h=1 lag)* | *(9) Annual* | *(10) Annual* | *(11) Five-year means* | *(12) Five-year means* |
| *Urban population* | 0.214*** | 0.209*** | 0.215*** | 0.208*** | 0.214*** | 0.206*** | 0.217*** | 0.218*** | 0.208*** | 0.205*** | 0.216*** | 0.222*** |
| | (0.011) | (0.011) | (0.011) | (0.012) | (0.012) | (0.012) | (0.027) | (0.028) | (0.010) | (0.010) | (0.021) | (0.021) |
| *Income inequality* | -0.485*** | -0.504*** | -0.477*** | -0.500*** | -0.482*** | -0.502*** | -0.458*** | -0.481*** | -0.492*** | -0.505*** | -0.498*** | -0.516*** |
| | (0.027) | (0.026) | (0.028) | (0.027) | (0.028) | (0.027) | (0.055) | (0.056) | (0.026) | (0.027) | (0.051) | (0.053) |
| *Inflation* | -0.203*** | -0.182*** | -0.194*** | -0.178*** | -0.213*** | -0.193*** | -0.365*** | -0.351*** | -0.388*** | -0.367*** | -0.477*** | -0.469*** |
| | (0.032) | (0.032) | (0.037) | (0.037) | (0.040) | (0.040) | (0.108) | (0.116) | (0.046) | (0.048) | (0.092) | (0.097) |
| *Private health expenditure* | 0.042 | 0.026 | 0.062 | 0.039 | 0.090 | 0.062 | 0.120 | 0.092 | -0.062 | -0.079 | -0.127 | -0.143 |
| | (0.084) | (0.085) | (0.085) | (0.086) | (0.085) | (0.086) | (0.195) | (0.199) | (0.104) | (0.104) | (0.218) | (0.219) |
| *Democracy* | 0.014*** | 0.015*** | 0.015*** | 0.015*** | 0.014*** | 0.014*** | 0.003 | 0.003 | 0.010*** | 0.010*** | 0.002 | 0.002 |
| | (0.003) | (0.003) | (0.003) | (0.003) | (0.004) | (0.004) | (0.008) | (0.009) | (0.003) | (0.003) | (0.006) | (0.006) |
| *Federalism* | 0.013*** | 0.016*** | 0.013*** | 0.015*** | 0.013*** | 0.015*** | 0.011*** | 0.014*** | 0.013*** | 0.015*** | 0.014*** | 0.016*** |
| | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.003) | (0.003) | (0.001) | (0.001) | (0.002) | (0.003) |
| *Dummy EU* | 0.021*** | 0.019*** | 0.020*** | 0.019*** | 0.019*** | 0.018*** | 0.015 | 0.016 | 0.018*** | 0.015*** | 0.018* | 0.016 |
| | (0.004) | (0.004) | (0.004) | (0.004) | (0.004) | (0.004) | (0.010) | (0.010) | (0.004) | (0.004) | (0.011) | (0.010) |
| *GG education (t-h)* | -0.088 | --- | -0.148 | --- | -0.176 | --- | -0.243 | --- | 0.026 | --- | -0.032 | --- |
| | (0.127) | | (0.126) | | (0.128) | | (0.291) | | (0.134) | | (0.272) | |
| *GG health (t-h)* | 0.626*** | --- | 0.609*** | --- | 0.574*** | --- | 0.635*** | --- | 0.618*** | --- | 0.554*** | --- |
| | (0.100) | | (0.103) | | (0.105) | | (0.237) | | (0.105) | | (0.220) | |
| *GG other (t-h)* | -0.148*** | --- | -0.138*** | --- | -0.131*** | --- | -0.076 | --- | -0.161*** | --- | -0.099 | --- |
| | (0.025) | | (0.025) | | (0.025) | | (0.062) | | (0.027) | | (0.063) | |
| *CG education (t-h)* | --- | 0.385*** | --- | 0.358*** | --- | 0.380*** | --- | 0.114 | --- | 0.378*** | --- | 0.113 |
| | | (0.127) | | (0.127) | | (0.126) | | (0.304) | | (0.137) | | (0.277) |
| *SNG education (t-h)* | --- | -0.190 | --- | -0.220* | --- | -0.209* | --- | -0.301 | --- | -0.092 | --- | -0.174 |
| | | (0.121) | | (0.122) | | (0.125) | | (0.308) | | (0.125) | | (0.257) |
| *CG health (t-h)* | --- | 0.463*** | --- | 0.459*** | --- | 0.431*** | --- | 0.532** | --- | 0.444*** | --- | 0.457** |
| | | (0.088) | | (0.091) | | (0.093) | | (0.216) | | (0.092) | | (0.192) |
| *SNG health (t-h)* | --- | 0.608*** | --- | 0.609*** | --- | 0.594*** | --- | 0.727*** | --- | 0.639*** | --- | 0.699*** |
| | | (0.091) | | (0.094) | | (0.096) | | (0.217) | | (0.107) | | (0.228) |
| *CG other (t-h)* | --- | -0.138*** | --- | -0.137*** | --- | -0.135*** | --- | -0.061 | --- | -0.127*** | --- | -0.062 |
| | | (0.026) | | (0.026) | | (0.027) | | (0.064) | | (0.027) | | (0.059) |
| *SNG other (t-h)* | --- | -0.083** | --- | -0.078** | --- | -0.071* | --- | -0.103 | --- | -0.122*** | --- | -0.170* |
| | | (0.038) | | (0.039) | | (0.038) | | (0.087) | | (0.046) | | (0.098) |

*(continue)*

**Table 4 (continued) – Human development and public expenditure decentralization: Lagged effects and Two-Stage Least Square (TSLS)**

| *Dependent variable: HDI* | *Lagged structure of government expenditure variables* | | | | | | | | *TSLS* | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *(1) Annual (h=1 lag)* | *(2) Annual (h=1 lag)* | *(3) Annual (h=2 lags)* | *(4) Annual (h=2 lags)* | *(5) Annual (h=3 lags)* | *(6) Annual (h=3 lags)* | *(7) Five-year means (h=1 lag)* | *(8) Five-year means (h=1 lag)* | *(9) Annual* | *(10) Annual* | *(11) Five-year means* | *(12) Five-year means* |
| *Constant* | 0.801*** (0.016) | 0.798*** (0.015) | 0.755*** (0.016) | 0.753*** (0.015) | 0.765*** (0.017) | 0.805*** (0.016) | 0.796*** (0.032) | 0.808*** (0.031) | 0.814*** (0.017) | 0.806*** (0.019) | 0.819*** (0.033) | 0.816*** (0.033) |
| *R-squared* | 0.803 | 0.806 | 0.797 | 0.801 | 0.793 | 0.798 | 0.793 | 0.799 | 0.789 | 0.791 | 0.811 | 0.811 |
| *Chi2* | 4583 | 4799 | 4224 | 4407 | 3915 | 4113 | 777 | 836 | --- | --- | --- | --- |
| *F-statistic* | --- | --- | --- | --- | --- | --- | --- | --- | 131 | 119 | 76 | 62 |
| *Prob(F-statistic)* | --- | --- | --- | --- | --- | --- | --- | --- | 0.000 | 0.000 | 0.000 | 0.000 |
| *Countries* | 57 | 57 | 57 | 57 | 57 | 57 | 57 | 57 | 57 | 57 | 57 | 57 |
| *Observations* | 876 | 870 | 824 | 818 | 769 | 763 | 155 | 154 | 861 | 856 | 210 | 209 |

*Notes:* All regressions report PCSE in parentheses and include controls and period fixed effects. TSLS: The potential endogenous variables (inflation, private health expenditure, and government expenditure variables) are instrumented by their lag (annual data) and by the first year of each five-year period. Level of significance: 10% (*), 5% (**), and 1% (***).

*Source:* Own estimations.

In our main specification (Equation 1) we control for the role that political decentralization (PD) may have on the relationship between public spending at CG and SNG level and the HDI using the variable of 'federalism', but it is also true that the level of autonomy of the subnational authorities could be also different across expenditure functions and administrative levels, and that our aggregate indicator of PD may not capture all these potential differences. Consequently, since we think that PD may be an important factor, we next check the sensitivity of our main findings using alternative variables capturing different facets of PD, although we face the clear limitation that these variables do not allow us to include our entire sample of countries. Firstly, we follow Schneider (2003) that indicates that the existence of elections at the municipal level or the state/provincial level is an indicator of PD because they increase the probabilities that some political functions are decentralized, and consider the variables municipal and state governments locally elected from the Database of Political Institutions (DPI) by Cruz et al. (2018) to build the aggregate variable "electoral decentralization".[50] Secondly, we include the variable "decentralized policies" from the Territorial Self-Governance dataset published by Trinn and Schulte (2020) that measures PD considering the scope of the authoritative powers of a regional legislative or executive in the areas of i) economic, ii) cultural-educational, iii) social, or iv) internal security or regional/local institutional policy. Finally, we employ the "regional authority index" (RAI) from Hooghe et al. (2016) which is an overall indicator of "regional authority" obtained as the sum of "self-rule" and "shared-rule". We acknowledge the limited validity of the results obtained using this other PD measures since we lose a part of our sample (9, 10 and 14 countries respectively), but in any case, our main results are maintained; the important role of health spending is confirmed, and the level of PD (in the form of electoral decentralization, decentralized policies, and regional authority) keeps showing a positive and significant impact on HDI (see Table G.2 of Appendix G).

We now turn to examine the sensitive of our main finding when controlling, first, for investment, and then, for ethnic fractionalization. We consider the inclusion of the variable "investment" from the Penn World Table (Feenstra et al. 2015) since previous empirical work (Castells-Quintana et al. 2019; Paliova et al. 2019) have found a positive and significant effect of investment on human development through the income

[50] Both variables take the value 0 if neither local executive nor local legislature are locally elected, 1 if the executive is appointed, but the legislature elected, and 2 if they are both locally elected. In particular, we consider the sum of both variables and thus our variable ranges from 0 to 4, where 4 indicates high PD.

component transition channel. The results obtained when including this additional control are maintained and we do not find a clear and robust evidence of its effect on HDI. On the other hand, we consider the inclusion of ethnic fractionalization from Alesina et al. (2003) since some contributions (Easterly and Levine 1997; Alesina et al. 1999) support that schooling is adversely affected by ethnic fractionalization because of the difficulty of different ethnic groups agreeing on the type and quality of public services, and conflict may affect negatively economic development through reducing the quality of policy and of institutions (Alesina et al. 2003). The results of introducing the ethnic fractionalization variable in our baseline model are maintained, and we find a negative coefficient on ethnic fractionalization, but its effect on HDI is not always robust. To conclude, for both cases, our main result regarding the link between the spending variables and human development remains still valid (see Table G.3 of Appendix G). The reason why we do not include the investment variable in the main case is because public expenditure on health and education involves investment in form of research and development, capital, among others, and consequently we would have the risk to double accounting of some specific investment issues, while we prefer not to include the variable of ethnic fractionalization since it does not allow to maintain all our sample of 57 countries.

## 4.7 Conclusions

Public expenditure on health and education have been used as the main fiscal instruments to improve economic and human development and, as a consequence, the quality of life of the citizens. However, the impact of these public policies on the economic and human development is not just a matter of the amount of resources that they absorb since organizational aspects may have an important influence. In particular, in this paper we hypothesize that the extent to which public expenditures are distributed across different functions and are decentralized could be of great importance.

In this context, we provide novel empirical evidence using data panel techniques from a sample of 57 developed and developing countries over the period 2000 to 2018, showing that health expenditure helps improve the Human Development Index (HDI) no matter the level of administrative is in charge, while in the case of the education expenditure the effects remain unclear. These results would confirm that when analysing

the impact of decentralizing public resources on human development, the type of expenditure decentralized is crucial.

Our research offers several important findings that have other policy implications. Thus, public health spending, at general, central and subnational level, is positively associated with life expectancy, level of education, and income per capita, and consequently improves the HDI. These results are robust to estimation techniques that attempt to deal with the problem of reverse causality, to the inclusion of a measure of government quality, and also to the introduction of a range of control variables – most notably, variables that account for the degree of decision-making autonomy enjoyed by subnational governments. The results suggest that committing more public resources to improve the health of citizens, no matter the administrative level responsible of this spending, is a good policy to accomplish a higher level of human development. Importantly, our results may also be understood as an indication that decentralizing health spending to subnational authorities is not harmful for human development.

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## Appendix F. List of countries, definition of variables and sources, and descriptive statistics

**Table F.1 – List of countries and codes**

| | | |
|---|---|---|
| ALB – Albania | GRC – Greece | MUS – Mauritius |
| AUS – Australia | HRV – Croatia | NLD – Netherlands |
| AUT – Austria | HUN – Hungary | NOR – Norway |
| BEL – Belgium | IDN – Indonesia | NZL – New Zealand |
| BGR – Bulgaria | IRL – Ireland | POL – Poland |
| BLR – Belarus | IRN – Iran | PRT – Portugal |
| CHE – Switzerland | ISL – Iceland | ROU – Romania |
| CHN – China | ISR – Israel | RUS – Russian Federation |
| CYP – Cyprus | ITA – Italy | SGP – Singapore |
| CZE – Czechia | JPN – Japan | SLV – El Salvador |
| DEU – Germany | KAZ – Kazakhstan | SVK – Slovakia |
| DNK – Denmark | KGZ – Kyrgyzstan | SVN – Slovenia |
| EGY – Egypt | LTU – Lithuania | SWE – Sweden |
| ESP – Spain | LUX – Luxembourg | SYC – Seychelles |
| EST – Estonia | LVA – Latvia | THA – Thailand |
| FIN – Finland | MDA – Moldova | TUR – Turkey |
| FRA – France | MDV – Maldives | UKR – Ukraine |
| GBR – United Kingdom | MLT – Malta | USA – The United States |
| GEO – Georgia | MNG – Mongolia | ZAF – South Africa |

*Source:* Own elaboration.

## Table F.2 – Variables and sources

| *Variable* | *Sources* |
|---|---|
| Human Development Index (HDI) | United Nations Development Programme, Human Development Reports 2020 (UNDP-HDR). |
| Life expectancy index | UNDP-HDR. |
| Education index | UNDP-HDR |
| Income index | UNDP-HDR |
| Government expenditure variables | Government Finance Statistics of the International Monetary Fund (GFS-IMF) database and IMF Fiscal Decentralization dataset |
| Urban population | World Development Indicators (WDI). |
| Income inequality | Solt (2020) |
| Inflation | WDI |
| Private health spending | Global Health Expenditure database of the World Health Organization |
| Democracy | V-Dem Institute (2021) and Freedom House (2021) |
| Federalism | Gerring and Thacker (2004) |
| Quality of governance - WGI | Worldwide Governance Indicators (WGI) as developed by the World Bank (Kaufmann et al. 2011) |
| Quality of governance - ICRG | International Country Risk Guide (ICRG) as developed by the Political Risk Services Group (ICRG 2013) |
| Electoral decentralization | Database of Political Institutions (DPI) (Cruz et al. 2018). |
| Decentralized policies | Territorial Self-Governance dataset (Trinn and Schulte 2020) |
| Regional authority index (RAI) | Hooghe et al. (2016) |
| Investment | Penn World Table (Feenstra et al. 2015) |
| Ethnic fractionalization | Alesina et al. (2003) |

## Table F.3 – Summary statistics

| *Variable* | *Variation* | *Mean* | *Std. Dev.* | *Minimum* | *Maximum* | *No. Obs.* | |
|---|---|---|---|---|---|---|---|
| *Human Development Index (HDI) (0 – 1 index)* | Overall | 0.811 | 0.093 | 0.589 | 0.954 | N = | 1083 |
| | Between | | 0.089 | 0.636 | 0.938 | n = | 57 |
| | Within | | 0.029 | 0.718 | 0.885 | T = | 19 |
| *Life expectancy index (0 – 1 index)* | Overall | 0.861 | 0.083 | 0.515 | 0.992 | N = | 1083 |
| | Between | | 0.080 | 0.582 | 0.967 | n = | 57 |
| | Within | | 0.025 | 0.786 | 0.954 | T = | 19 |
| *Education index (0 – 1 index)* | Overall | 0.769 | 0.112 | 0.430 | 0.946 | N = | 1083 |
| | Between | | 0.104 | 0.494 | 0.909 | n = | 57 |
| | Within | | 0.042 | 0.626 | 0.875 | T = | 19 |
| *Income index (0 – 1 index)* | Overall | 0.811 | 0.111 | 0.447 | 1 | N = | 1083 |
| | Between | | 0.109 | 0.491 | 0.986 | n = | 57 |
| | Within | | 0.025 | 0.690 | 0.915 | T = | 19 |
| *Education GG expenditure (/GDP)* | Overall | 0.050 | 0.013 | 0.009 | 0.094 | N = | 957 |
| | Between | | 0.013 | 0.023 | 0.075 | n = | 57 |
| | Within | | 0.005 | 0.017 | 0.078 | T = | 16.790 |
| *Education CG expenditure (/GDP)* | Overall | 0.026 | 0.016 | 0.000 | 0.070 | N = | 977 |
| | Between | | 0.016 | 0.000 | 0.063 | n = | 57 |
| | Within | | 0.005 | 0.006 | 0.054 | T = | 17.140 |
| *Education SNG expenditure (/GDP)* | Overall | 0.026 | 0.019 | 0.000 | 0.073 | N = | 971 |
| | Between | | 0.018 | 0.000 | 0.068 | n = | 57 |
| | Within | | 0.005 | 0.006 | 0.055 | T = | 17.035 |
| *Health GG expenditure (/GDP)* | Overall | 0.051 | 0.021 | 0.003 | 0.093 | N = | 958 |
| | Between | | 0.021 | 0.010 | 0.081 | n = | 57 |
| | Within | | 0.006 | 0.029 | 0.075 | T = | 16.807 |
| *Health CG expenditure (/GDP)* | Overall | 0.035 | 0.023 | 0.000 | 0.085 | N = | 978 |
| | Between | | 0.022 | 0.001 | 0.077 | n = | 57 |
| | Within | | 0.006 | 0.004 | 0.063 | T = | 17.159 |
| *Health SNG expenditure (/GDP)* | Overall | 0.016 | 0.020 | 0.000 | 0.087 | N = | 972 |
| | Between | | 0.019 | 0.000 | 0.078 | n = | 57 |
| | Within | | 0.005 | 0.000 | 0.060 | T = | 17.053 |
| *Other GG expenditure (/GDP)* | Overall | 0.296 | 0.074 | 0.085 | 0.530 | N = | 957 |
| | Between | | 0.070 | 0.114 | 0.416 | n = | 57 |
| | Within | | 0.030 | 0.206 | 0.565 | T = | 16.790 |
| *Other CG expenditure (/GDP)* | Overall | 0.240 | 0.065 | 0.070 | 0.520 | N = | 977 |
| | Between | | 0.059 | 0.114 | 0.393 | n = | 57 |
| | Within | | 0.028 | 0.146 | 0.507 | T = | 17.140 |
| *Other SNG expenditure (/GDP)* | Overall | 0.071 | 0.048 | 0.000 | 0.242 | N = | 971 |
| | Between | | 0.047 | 0.000 | 0.226 | n = | 57 |
| | Within | | 0.010 | 0.009 | 0.139 | T = | 17.035 |

*(continue)*

## Table F.3 (continued) – Summary statistics

| *Variable* | *Variation* | *Mean* | *Std. Dev.* | *Minimum* | *Maximum* | *No. Obs.* | |
|---|---|---|---|---|---|---|---|
| *Urban population (0 – 1)* | Overall | 0.684 | 0.163 | 0.277 | 1 | N = | 1083 |
| | Between | | 0.162 | 0.352 | 1 | n = | 57 |
| | Within | | 0.023 | 0.566 | 0.798 | T = | 19 |
| *Income Inequality (0 – 1)* | Overall | 0.330 | 0.069 | 0.226 | 0.635 | N = | 1056 |
| | Between | | 0.069 | 0.237 | 0.628 | n = | 57 |
| | Within | | 0.010 | 0.290 | 0.379 | T = | 18.526 |
| *Inflation* | Overall | 0.044 | 0.065 | -0.045 | 0.611 | N = | 1067 |
| | Between | | 0.044 | 0.001 | 0.220 | n = | 57 |
| | Within | | 0.049 | -0.128 | 0.435 | T = | 18.719 |
| *Private health spending (/GDP)* | Overall | 0.026 | 0.015 | 0.006 | 0.085 | N = | 1083 |
| | Between | | 0.014 | 0.010 | 0.081 | n = | 57 |
| | Within | | 0.004 | 0.005 | 0.050 | T = | 19 |
| *Democracy* | Overall | 2.554 | 0.700 | 1 | 3 | N = | 1083 |
| | Between | | 0.682 | 1 | 3 | n = | 57 |
| | Within | | 0.178 | 1.607 | 3.501 | T = | 19 |
| *Federalism* | Overall | 1.719 | 1.254 | 1 | 5 | N = | 1083 |
| | Between | | 1.264 | 1 | 5 | n = | 57 |
| | Within | | 0 | 1.719 | 1.719 | T = | 19 |
| *Quality of governance (WGI)* | Overall | 0.709 | 0.930 | -1.174 | 2.185 | N = | 1083 |
| | Between | | 0.926 | -0.908 | 2.044 | n = | 57 |
| | Within | | 0.146 | -0.273 | 1.388 | T = | 19 |
| *Quality of governance (ICRG)* | Overall | 0.619 | 0.219 | 0.194 | 1 | N = | 936 |
| | Between | | 0.214 | 0.265 | 0.983 | n = | 52 |
| | Within | | 0.052 | 0.443 | 0.949 | T = | 18 |
| *Electoral decentralization* | Overall | 2.488 | 1.265 | 0 | 4 | N = | 849 |
| | Between | | 1.268 | 0 | 4 | n = | 48 |
| | Within | | 0.132 | 0.599 | 2.710 | T = | 17.688 |
| *Decentralized policies* | Overall | 1.141 | 1.239 | 0 | 4 | N = | 893 |
| | Between | | 1.221 | 0 | 4 | n = | 47 |
| | Within | | 0.275 | 0 | 2.299 | T = | 19 |
| *Regional authority index (RAI)* | Overall | 11.588 | 10.242 | 0 | 37 | N = | 707 |
| | Between | | 10.245 | 0 | 36.216 | n = | 43 |
| | Within | | 1.145 | 3.018 | 19.000 | T = | 16.442 |
| *Investment* | Overall | 0.242 | 0.069 | 0.110 | 0.733 | N = | 1083 |
| | Between | | 0.056 | 0.172 | 0.424 | n = | 57 |
| | Within | | 0.040 | 0.057 | 0.551 | T = | 19 |
| *Ethnic fractionalization* | Overall | 0.304 | 0.205 | 0.012 | 0.752 | N = | 1045 |
| | Between | | 0.207 | 0.012 | 0.752 | n = | 55 |
| | Within | | 0.009 | 0.289 | 0.580 | T = | 19 |

*Note:* The table presents the summary statistics of the variables used in the analysis (excluding the dummy variable, EU member). Quality of governance (ICRG) data are not available for Georgia, Kyrgyzstan, Maldives, Mauritius, and Seychelles. Electoral decentralization data are not available for China, Estonia, Georgia, Latvia, Moldova, Russia Federation, Seychelles, Slovenia, and Ukraine. Decentralized policies data are not available for Belarus, China, Egypt, Iceland, Iran, Kazakhstan, Maldives, Malta, Seychelles, and Singapore. Regional authority index data are not available Belarus, China, Egypt, Georgia, Iran, Kazakhstan, Kyrgyzstan, Maldives, Mauritius, Moldova, Mongolia, Seychelles, South Africa, and Ukraine.
*Source:* Own estimations.

## Appendix G. Additional results and robustness checks

## Table G.1 – Human development per components and public expenditure decentralization: Two-Stage Least Square (TSLS)

| *Dependent variable* | *Annual* | | | | | | *Five-year means* | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Life expectancy index* | | *Education index* | | *Income index* | | *Life expectancy index* | | *Education index* | | *Income index* | |
| | *(1)* | *(2)* | *(3)* | *(4)* | *(5)* | *(6)* | *(7)* | *(8)* | *(9)* | *(10)* | *(11)* | *(12)* |
| *Urban population* | 0.169*** | 0.159*** | 0.158*** | 0.161*** | 0.290*** | 0.290*** | 0.165*** | 0.163*** | 0.175*** | 0.182*** | 0.300*** | 0.310*** |
| | (0.012) | (0.011) | (0.014) | (0.014) | (0.015) | (0.015) | (0.025) | (0.023) | (0.030) | (0.030) | (0.033) | (0.032) |
| *Income inequality* | -0.449*** | -0.549*** | -0.626*** | -0.523*** | -0.367*** | -0.423*** | -0.477*** | -0.579*** | -0.643*** | -0.555*** | -0.335*** | -0.391*** |
| | (0.032) | (0.031) | (0.038) | (0.039) | (0.040) | (0.041) | (0.061) | (0.059) | (0.074) | (0.076) | (0.081) | (0.081) |
| *Inflation* | -0.630*** | -0.528*** | -0.001 | -0.075 | -0.577*** | -0.536*** | -0.657*** | -0.533*** | -0.056 | -0.168 | -0.763*** | -0.734*** |
| | (0.057) | (0.054) | (0.065) | (0.067) | (0.072) | (0.073) | (0.109) | (0.104) | (0.135) | (0.139) | (0.148) | (0.151) |
| *Private health expenditure* | 0.511*** | 0.412** | -0.095 | -0.032 | -0.491*** | -0.507*** | 0.506** | 0.447* | -0.035 | -0.051 | -0.728** | -0.698** |
| | (0.127) | (0.117) | (0.151) | (0.148) | (0.160) | (0.156) | (0.257) | (0.242) | (0.312) | (0.313) | (0.342) | (0.334) |
| *Democracy* | -0.001 | 0.000 | 0.027*** | 0.030*** | -0.003 | -0.005 | -0.006 | -0.005 | 0.025*** | 0.026*** | -0.018* | -0.019** |
| | (0.004) | (0.003) | (0.004) | (0.004) | (0.005) | (0.005) | (0.007) | (0.007) | (0.009) | (0.009) | (0.010) | (0.009) |
| *Federalism* | -0.003* | 0.008*** | 0.021*** | 0.012*** | 0.020*** | 0.026*** | -0.003 | 0.007** | 0.021*** | 0.012*** | 0.022*** | 0.028*** |
| | (0.002) | (0.002) | (0.002) | (0.002) | (0.002) | (0.002) | (0.003) | (0.003) | (0.004) | (0.004) | (0.004) | (0.005) |
| *Dummy EU* | 0.001 | 0.005 | 0.018*** | 0.010* | 0.033*** | 0.029*** | 0.002 | 0.008 | 0.015 | 0.006 | 0.039** | 0.035** |
| | (0.005) | (0.004) | (0.006) | (0.005) | (0.006) | (0.005) | (0.013) | (0.011) | (0.016) | (0.014) | (0.017) | (0.015) |
| *GG education* | -1.082*** | --- | 1.573*** | --- | -0.487** | --- | -1.095*** | --- | 1.350*** | --- | -0.389 | --- |
| | (0.164) | | (0.195) | | (0.207) | | (0.320) | | (0.389) | | (0.425) | |
| *GG health* | 0.799*** | --- | 0.358** | --- | 0.721*** | --- | 0.786*** | --- | 0.308 | --- | 0.606* | --- |
| | (0.127) | | (0.151) | | (0.161) | | (0.259) | | (0.314) | | (0.345) | |
| *GG other* | -0.085*** | --- | -0.212*** | --- | -0.186*** | --- | -0.046 | --- | -0.149* | --- | -0.107 | --- |
| | (0.033) | | (0.040) | | (0.042) | | (0.074) | | (0.090) | | (0.099) | |
| *CG education* | --- | 0.403*** | --- | 0.691*** | --- | 0.087 | --- | 0.275 | --- | 0.384 | --- | -0.219 |
| | | (0.152) | | (0.194) | | (0.204) | | (0.306) | | (0.395) | | (0.421) |
| *SNG education* | --- | -1.257*** | --- | 1.762*** | --- | -0.935*** | --- | -1.354*** | --- | 1.670*** | --- | -0.960*** |
| | | (0.140) | | (0.178) | | (0.187) | | (0.283) | | (0.365) | | (0.391) |
| *CG health* | --- | 0.475*** | --- | 0.245* | --- | 0.620** | --- | 0.545*** | --- | 0.218 | --- | 0.629** |
| | | (0.103) | | (0.131) | | (0.138) | | (0.211) | | (0.274) | | (0.293) |
| *SNG health* | --- | 0.543*** | --- | 0.441*** | --- | 0.949*** | --- | 0.605** | --- | 0.478 | --- | 1.035*** |
| | | (0.120) | | (0.153) | | (0.161) | | (0.251) | | (0.325) | | (0.348) |
| *CG other* | --- | -0.136*** | --- | -0.095*** | --- | -0.155*** | --- | -0.106* | --- | -0.042 | --- | -0.047 |
| | | (0.030) | | (0.039) | | (0.041) | | (0.065) | | (0.084) | | (0.090) |
| *SNG other* | --- | 0.009 | --- | -0.160** | --- | -0.207*** | --- | -0.007 | --- | -0.220 | --- | -0.273* |
| | | (0.052) | | (0.066) | | (0.069) | | (0.108) | | (0.140) | | (0.149) |
| *Constant* | 0.956*** | 0.961*** | 0.729*** | 0.696*** | 0.778*** | 0.785*** | 0.973*** | 0.976*** | 0.722*** | 0.706*** | 0.783*** | 0.788*** |
| | (0.020) | (0.019) | (0.024) | (0.024) | (0.026) | (0.025) | (0.038) | (0.036) | (0.047) | (0.047) | (0.052) | (0.050) |

*(continue)*

**Table G.1 (continued) – Human development per components and public expenditure decentralization: Two-Stage Least Square (TSLS)**

| *Dependent variable* | *Annual* | | | | | | *Five-year means* | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Life expectancy index* | | *Education index* | | *Income index* | | *Life expectancy index* | | *Education index* | | *Income index* | |
| | *(1)* | *(2)* | *(3)* | *(4)* | *(5)* | *(6)* | *(7)* | *(8)* | *(9)* | *(10)* | *(11)* | *(12)* |
| *R-squared* | 0.630 | 0.689 | 0.693 | 0.705 | 0.661 | 0.683 | 0.687 | 0.730 | 0.727 | 0.730 | 0.673 | 0.692 |
| *F-statistic* | 59.571 | 69.095 | 73.067 | 70.340 | 70.655 | 69.206 | 32.914 | 33.162 | 41.933 | 36.806 | 41.578 | 36.294 |
| *Prob(F-statistic)* | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| *Countries* | 57 | 57 | 57 | 57 | 57 | 57 | 57 | 57 | 57 | 57 | 57 | 57 |
| *Observations* | 861 | 856 | 861 | 856 | 861 | 856 | 210 | 209 | 210 | 209 | 210 | 209 |

*Notes:* All regressions report PCSE in parentheses and include period fixed effects. Level of significance: 10% (*), 5% (**), and 1% (***).
*Source:* Own estimations.

## Table G.2 – Human development, public expenditure decentralization and the role of political decentralization

| *Dependent variable: HDI* | *Annual* | | | | | | *Five-year means* | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *(1)* | *(2)* | *(3)* | *(4)* | *(5)* | *(6)* | *(7)* | *(8)* | *(9)* | *(10)* | *(11)* | *(12)* |
| *Urban population* | 0.243*** | 0.238*** | 0.218*** | 0.213*** | 0.139*** | 0.129*** | 0.251*** | 0.249*** | 0.217*** | 0.212*** | 0.141*** | 0.140*** |
| | (0.012) | (0.013) | (0.011) | (0.012) | (0.011) | (0.012) | (0.027) | (0.028) | (0.025) | (0.025) | (0.024) | (0.026) |
| *Income inequality* | -0.533*** | -0.514*** | -0.498*** | -0.493*** | -0.544*** | -0.548*** | -0.532*** | -0.517*** | -0.502*** | -0.489*** | -0.638*** | -0.674*** |
| | (0.023) | (0.024) | (0.025) | (0.024) | (0.045) | (0.051) | (0.046) | (0.046) | (0.047) | (0.046) | (0.090) | (0.104) |
| *Inflation* | -0.223*** | -0.230*** | -0.282*** | -0.259*** | -0.318*** | -0.315*** | -0.339*** | -0.361*** | -0.478*** | -0.455*** | -0.470*** | -0.454*** |
| | (0.033) | (0.036) | (0.044) | (0.043) | (0.033) | (0.034) | (0.076) | (0.086) | (0.111) | (0.117) | (0.091) | (0.097) |
| *Private health expenditure* | 0.592*** | 0.543*** | 0.391*** | 0.445*** | 0.253** | 0.333*** | 0.528** | 0.477* | 0.336* | 0.405** | 0.241 | 0.257 |
| | (0.093) | (0.098) | (0.087) | (0.089) | (0.110) | (0.106) | (0.205) | (0.214) | (0.181) | (0.190) | (0.208) | (0.210) |
| *Democracy* | 0.006 | 0.006 | 0.016*** | 0.016*** | 0.002 | 0.001 | -0.001 | -0.001 | 0.008 | 0.009 | -0.008 | -0.006 |
| | (0.004) | (0.004) | (0.004) | (0.004) | (0.005) | (0.005) | (0.008) | (0.009) | (0.009) | (0.008) | (0.009) | (0.010) |
| *Dummy EU* | 0.010*** | 0.007* | 0.016*** | 0.015*** | 0.003 | -0.004 | 0.007 | 0.003 | 0.014 | 0.011 | -0.003 | -0.010 |
| | (0.004) | (0.004) | (0.004) | (0.004) | (0.003) | (0.003) | (0.009) | (0.008) | (0.009) | (0.008) | (0.007) | (0.007) |
| *GG education* | 0.008 | --- | -0.051 | --- | 0.975*** | --- | -0.056*** | --- | 0.036 | --- | 0.994*** | --- |
| | (0.155) | | (0.138) | | (0.146) | | (0.312) | | (0.270) | | (0.297) | |
| *GG health* | 0.552*** | --- | 0.800*** | --- | 0.381*** | --- | 0.576*** | --- | 0.813*** | --- | 0.460** | --- |
| | (0.105) | | (0.100) | | (0.096) | | (0.220) | | (0.203) | | (0.189) | |
| *GG other* | -0.116*** | --- | -0.118*** | --- | -0.190*** | --- | -0.079 | --- | -0.114** | --- | -0.193*** | --- |
| | (0.026) | | (0.026) | | (0.029) | | (0.056) | | (0.051) | | (0.063) | |
| *CG education* | --- | 0.181 | --- | 0.329*** | --- | 1.105*** | --- | -0.025 | --- | 0.226 | --- | 1.044*** |
| | | (0.144) | | (0.127) | | (0.127) | | (0.301) | | (0.255) | | (0.239) |
| *SNG education* | --- | 0.080 | --- | -0.212 | --- | 0.776*** | --- | -0.057 | --- | -0.221 | --- | 0.821*** |
| | | (0.167) | | (0.132) | | (0.144) | | (0.353) | | (0.272) | | (0.293) |
| *CG health* | --- | 0.428*** | --- | 0.748*** | --- | 0.255*** | --- | 0.479*** | --- | 0.765*** | --- | 0.269 |
| | | (0.085) | | (0.088) | | (0.084) | | (0.179) | | (0.180) | | (0.168) |
| *SNG health* | --- | 0.572*** | --- | 0.768*** | --- | 0.545*** | --- | 0.630*** | --- | 0.813*** | --- | 0.620*** |
| | | (0.097) | | (0.099) | | (0.094) | | (0.204) | | (0.208) | | (0.184) |
| *CG other* | --- | -0.074*** | --- | -0.059** | --- | -0.103*** | --- | -0.021 | --- | -0.029 | --- | -0.105 |
| | | (0.028) | | (0.027) | | (0.031) | | (0.059) | | (0.053) | | (0.065) |
| *SNG other* | --- | -0.038 | --- | -0.020 | --- | -0.129** | --- | -0.021 | --- | -0.006 | --- | -0.247** |
| | | (0.053) | | (0.041) | | (0.052) | | (0.113) | | (0.087) | | (0.110) |

*(continue)*

## Table G.2 (continued) – Human development, public expenditure decentralization and the role of political decentralization

| *Dependent variable: HDI* | *Annual* | | | | | | *Five-year means* | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *(1)* | *(2)* | *(3)* | *(4)* | *(5)* | *(6)* | *(7)* | *(8)* | *(9)* | *(10)* | *(11)* | *(12)* |
| *Electoral decentralization* | 0.010*** | 0.010*** | --- | --- | --- | --- | 0.011*** | 0.011*** | --- | --- | --- | --- |
| | (0.001) | (0.002) | | | | | (0.003) | (0.003) | | | | |
| *Decentralized policies* | --- | --- | 0.008*** | 0.010*** | --- | --- | --- | --- | 0.009*** | 0.010*** | --- | --- |
| | | | (0.001) | (0.001) | | | | | (0.002) | (0.002) | | |
| *Regional authority index* | --- | --- | --- | --- | 0.001*** | 0.001*** | --- | --- | --- | --- | 0.001*** | 0.001*** |
| | | | | | (0.000) | (0.000) | | | | | (0.000) | (0.000) |
| *Constant* | 0.755*** | 0.738*** | 0.746*** | 0.719*** | 0.859*** | 0.848*** | 0.765*** | 0.752*** | 0.774*** | 0.743*** | 0.923*** | 0.921*** |
| | (0.016) | (0.015) | (0.018) | (0.017) | (0.028) | (0.029) | (0.026) | (0.026) | (0.032) | (0.030) | (0.055) | (0.059) |
| *R-squared* | 0.790 | 0.787 | 0.787 | 0.791 | 0.736 | 0.734 | 0.809 | 0.810 | 0.809 | 0.813 | 0.769 | 0.768 |
| *Chi2* | 4143 | 4218 | 3240 | 3891 | 2126 | 2354 | 1070 | 1232 | 930 | 1205 | 637 | 665 |
| *Countries* | 48 | 48 | 47 | 47 | 43 | 43 | 48 | 48 | 47 | 47 | 43 | 43 |
| *Observations* | 736 | 730 | 797 | 791 | 654 | 649 | 175 | 174 | 178 | 177 | 161 | 160 |

*Notes:* All regressions report PCSE in parentheses and include period fixed effects. Level of significance: 10% (*), 5% (**), and 1% (***).
*Source:* Own estimations.

**Table G.3 – Human development, public expenditure decentralization and the role of investment and ethnic fractionalization**

| *Dependent variable: HDI* | *Annual* | | | | *Five-year means* | | | |
|---|---|---|---|---|---|---|---|---|
| | *(1)* | *(2)* | *(3)* | *(4)* | *(5)* | *(6)* | *(7)* | *(8)* |
| *Urban population* | 0.217*** | 0.215*** | 0.217*** | 0.212*** | 0.220*** | 0.224*** | 0.220*** | 0.223*** |
| | (0.011) | (0.011) | (0.011) | (0.012) | (0.023) | (0.023) | (0.023) | (0.024) |
| *Income inequality* | -0.487*** | -0.510*** | -0.467*** | -0.484*** | -0.487*** | -0.513*** | -0.466*** | -0.487*** |
| | (0.023) | (0.023) | (0.025) | (0.027) | (0.044) | (0.044) | (0.049) | (0.052) |
| *Inflation* | -0.222*** | -0.206*** | -0.212*** | -0.208*** | -0.355*** | -0.337*** | -0.354*** | -0.354*** |
| | (0.028) | (0.027) | (0.029) | (0.029) | (0.066) | (0.071) | (0.072) | (0.076) |
| *Private health expenditure* | 0.065 | 0.049 | 0.114 | 0.085 | 0.033 | 0.028 | 0.072 | 0.048 |
| | (0.079) | (0.080) | (0.088) | (0.087) | (0.168) | (0.174) | (0.192) | (0.190) |
| *Democracy* | 0.015*** | 0.016*** | 0.011*** | 0.011*** | 0.007 | 0.008 | 0.002 | 0.002 |
| | (0.003) | (0.003) | (0.003) | (0.004) | (0.007) | (0.008) | (0.002) | (0.002) |
| *Federalism* | 0.013*** | 0.016*** | 0.014*** | 0.016*** | 0.013*** | 0.017*** | 0.014*** | 0.016*** |
| | (0.001) | (0.001) | (0.001) | (0.001) | (0.002) | (0.002) | (0.002) | (0.002) |
| *Dummy EU* | 0.023*** | 0.021*** | 0.023*** | 0.021*** | 0.019** | 0.018** | 0.020** | 0.018** |
| | (0.004) | (0.004) | (0.004) | (0.004) | (0.008) | (0.008) | (0.009) | (0.008) |
| *GG education* | -0.046 | --- | 0.071 | --- | -0.042 | --- | 0.102 | --- |
| | (0.126) | | (0.116) | | (0.250) | | (0.220) | |
| *GG health* | 0.639*** | --- | 0.543*** | --- | 0.678*** | --- | 0.599*** | --- |
| | (0.095) | | (0.098) | | (0.199) | | (0.207) | |
| *GG other* | -0.142*** | --- | -0.155*** | --- | -0.115** | --- | -0.125** | --- |
| | (0.024) | | (0.025) | | (0.051) | | (0.056) | |
| *CG education* | --- | 0.423*** | --- | 0.386*** | --- | 0.289 | --- | 0.267 |
| | | (0.134) | | (0.122) | | (0.282) | | (0.244) |
| *SNG education* | --- | -0.153 | --- | 0.013 | --- | -0.227 | --- | -0.060 |
| | | (0.118) | | (0.108) | | (0.247) | | (0.216) |
| *CG health* | --- | 0.467*** | --- | 0.426*** | --- | 0.515*** | --- | 0.495*** |
| | | (0.083) | | (0.087) | | (0.175) | | (0.186) |
| *SNG health* | --- | 0.624*** | --- | 0.550*** | --- | 0.715*** | --- | 0.658*** |
| | | (0.085) | | (0.090) | | (0.180) | | (0.193) |
| *CG other* | --- | -0.121*** | --- | -0.137*** | --- | -0.082 | --- | -0.088 |
| | | (0.025) | | (0.026) | | (0.050) | | (0.055) |
| *SNG other* | --- | -0.106*** | --- | -0.127*** | --- | -0.123 | --- | -0.137* |
| | | (0.037) | | (0.037) | | (0.079) | | (0.078) |

*(continue)*

**Table G.3 (continued) – Human development, public expenditure decentralization and the role of investment and ethnic fractionalization**

| *Dependent variable: HDI* | *Annual* | | | | *Five-year means* | | | |
|---|---|---|---|---|---|---|---|---|
| | *(1)* | *(2)* | *(3)* | *(4)* | *(7)* | *(8)* | *(9)* | *(10)* |
| *Investment* | 0.072** | 0.090** | --- | --- | 0.074 | 0.091 | --- | --- |
| | (0.034) | (0.037) | | | (0.067) | (0.071) | | |
| *Ethnic fractionalization* | --- | --- | -0.038*** | -0.029*** | --- | --- | -0.034** | -0.024 |
| | | | (0.008) | (0.008) | | | (0.016) | (0.017) |
| *Constant* | 0.729*** | 0.716*** | 0.763*** | 0.759*** | 0.746*** | 0.732*** | 0.778*** | 0.773*** |
| | (0.020) | (0.019) | (0.015) | (0.014) | (0.036) | (0.034) | (0.026) | (0.025) |
| *R-squared* | 0.812 | 0.815 | 0.806 | 0.807 | 0.828 | 0.832 | 0.825 | 0.826 |
| *Chi2* | 5204 | 5888 | 4828 | 5208 | 1187 | 1435 | 1175 | 1322 |
| *Countries* | 57 | 57 | 55 | 55 | 57 | 57 | 55 | 55 |
| *Observations* | 928 | 922 | 904 | 898 | 210 | 209 | 204 | 203 |

*Notes:* All regressions report PCSE in parentheses and include period fixed effects. Level of significance: 10% (*), 5% (**), and 1% (***).
*Source:* Own estimations.

# Chapter 5

# Conclusions

This dissertation aims to address three different issues on fiscal policy. Firstly, it revolves around the cyclical behaviour of public social cash transfers and its components in Uruguay over the business cycle in the period 1988/Q1-2016/Q3 (Chapter 2). Secondly, it assesses the redistributive efficiency of central and subnational cash transfers and direct taxes for a sample of 35 developed and developing countries during the 2000-2016 period. After that, it is analysed how this estimated efficiency is affected by potential explanatory factors; in particular, the level of political decentralization (Chapter 3). And finally, it analyses the impact of government expenditure in the areas of health and education, at central and subnational level, on HDI and its three dimensions for a sample of 57 developed and developing countries over the period 2000 to 2018 (Chapter 4).

Over these chapters the research work delved into questions like: How have public social cash transfers components been conducted in Uruguay over the business cycle during the last decades? Which are the factors that may explain the behave of social transfers over the business cycle in Uruguay? How redistribution efficiency could be achieved through the fiscal policy? Which are the forces that underlie achieving redistribution efficiency objectives? How central and subnational government expenditure on health and education can affect human development? Hopefully, the results obtained in this thesis can provide some hints to build up answers those questions.

Chapter 2 finds that social cash transfers' components behave pro-cyclically and lagged the business cycle in the Uruguayan economy. These empirical results also suggest that this pattern is driven by old age benefits and survivors' pensions components, which is largely explained by the social security indexing mechanism used in Uruguay. Thus, it finds that the Uruguayan economy reports structural deficiencies in the design and implementation of fiscal policies, exposing the most vulnerable groups of society to macroeconomic adverse episodes. Hence, social spending policies are clearly pro-cyclical in the Uruguayan economy as tend to be in developing countries, and contrary to developed counties, which are shown an a-cyclical or counter-cyclical fiscal policy design (Michaud and Rothert 2018). For instance, the United States is shown as having a

strong counter-cyclical social transfer programs design and thus these expenditures have an anti-cyclical component in this economy. Especially, the unemployment insurance program, that is an automatic stabilizer by construction, is significantly lower in Uruguay than the United States, which additionally highlights the suboptimal design of this policy.

In Chapter 3 the focus turns to the redistributive efficiency of fiscal policy and how its influenced by explanatory factors, considering a cross-country perspective. Aftermath of the Great Recession, some authors have indicated that many countries have shown a fiscal disequilibrium. Consequently, the among of social programs (tax and transfers) have stagnated or even retrenchments because governments have focused on restore public finances, impacting adversely on most vulnerable groups in society. In this context, redistributive efficiency may contribute to the achievement of more redistribution at given tax and spending levels.

This chapter finds that redistributive efficiency varies across countries and has diminished over the analysed period, showing an important reduction after the Great Recession. Specifically, it reports empirical evidence that countries could potentially increase their redistribution efficiency without altering the volume of cash transfers and direct taxes resources and decentralization degree; by a range of 12.5%-24.7% and 8.6%-22.2% in the cases of absolute and relative redistributions, respectively. Additionally, the empirical results emphasize the crucial role of political decentralization, showing a negative impact on redistributive efficiency. However, this effect is moderate in case of country that enjoys good institutional quality indicators. In fact, improving the quality of institutions helps in making redistribution efficiency of fiscal policy work.

Chapter 4 analyses to what extent public spending in the area of health and education impact on a broader measure of economic and human development. The related empirical literature has focused on studying the impact of different fiscal variables on per capita GDP as a measure of economic development or even welfare. However, the level of welfare goes beyond per capita GDP, involving supplementary dimensions such as human development. In this sense, many authors consider the HDI as a more adequate indicator of socio-economic conditions. That provides information of the citizens' well-being as measured by per capita GDP, health outcomes (life expectancy at birth), and education indicators (years of schooling).

This chapter offers novel empirical evidence that public health spending, at GG, CG and SNG level, improves the overall HDI and in each of their dimensions (life expectancy, level of education, and income per capita). Thus, increases in the amount of

public resources in the area of health, no matter the administrative level responsible of this spending, is a good fiscal policy. However, in the case of public education spending the effects on HDI remain unclear and can only be confirmed a positive impact on the educational dimension of HDI. Also, it finds that the degree of responsibilities in the decision-making process enjoyed by subnational governments improves the human development; consequently, decentralizing health spending to subnational authorities may be not harmful for human development.

Many issues related to the three studies presented in this thesis are left for further research. Regarding Chapter 2, a deeper analysis into the potential effect of the establishment of national fiscal rules in Uruguay might provide new insights to understand the recent implementation of the new fiscal institution. In 2006, the 17,947 Law established a debt fiscal rule in the Uruguayan economy, and since 2020, the 19,889 Law has introduced a cyclically-adjusted budget balance and expenditure fiscal rules. However, there is no previous study for the Uruguayan economy that examine the implementation of these fiscal rules, and how its design could deal with the cyclical behave of social transfers. Concerning Chapter 3, it would be interesting to explore all policies that governments may use to redistribute beyond cash transfers and direct taxes at central and subnational level. And finally, related to Chapter 4, it could be relevant to extent this analysis at the regional level. In addition, inequality in human development has possibly affected the countries' capacity to support their health systems, and consequently, to respond to the COVID-19 pandemic (UNDP 2020). Thus, the agenda involves examining the relationship between decentralized public health spending and Inequality-adjusted HDI (adjusts the HDI for inequality in the distribution of each dimension across the population) and its three dimensions (Inequality-adjusted: life expectancy index, education index and income index) – these are new measures and are available for only a few years (UNDP 2020).

## References

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