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Joint determinants of fiscal policy, income inequality and economic growth

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ABSTRACT

This paper analyses the relationship between income inequality and economic growth through fiscal policy. To this end, we present and estimate two systems of structural equations with error components through which gross income inequality determines different fiscal policy outcomes, which subsequently affects the evolution of economic growth and net income inequality.

The empirical results, obtained using an unbalanced panel data of 21 high-income OCDE countries during the period 1972–2006, suggest that gross income inequality is a significant determinant of fiscal policy outcomes. Additionally, the results show that distributive expenditures and direct taxes may produce significant reductions in GDP growth and net income inequality reflecting the standard efficiency–equity trade-off associated to certain fiscal policy measures. Finally, the results also indicate that the most adequate fiscal policy strategy in a context of fiscal consolidation is to cut non distributive expenditure, since this could increase GDP growth while reducing income inequality.

1. Introduction

The reduction of economic disparities has emerged as one of the most challenging public policy topics in macroeconomic literature. A central concern of this discussion is the role that government policies may play in reducing economic inequalities, and determining the effects on economic growth rate.[1] In this context, the selection of a distributive fiscal policy strategy has become of crucial importance in achieving a broad-based stable path of economic growth across countries.

Nevertheless, fiscal policies vary considerably across nations. Some have low tax rates, others a sharply progressive fiscal system; in many countries the public sector is responsible for financing essential services (such as social protection, education, health, and housing), while others have left a large part to families, local communities, and employers.[2]

The choice of different public policies may be the outcome of the economic and political interests of different social groups. In this context, gross income inequality (pre-tax and government transfers' income inequality) could be an important determinant of economic policy decisions. In turn, these policy outcomes may be determinants of the joint evolution of economic growth and net income inequality (post tax and government transfers income distribution).

Growth and inequality political economy models relate income distribution with economic growth through fiscal policy (see Bénabou, 1996b). These models allow the incorporation of political and economic structures in the analysis of the relationship between growth and inequality. Thus, political processes capture the way in which citizens' preferences are transferred to different fiscal policy outcomes, while economic structures determine both the effects in terms of the efficiency and equity of these policies.

Despite its demonstrated relevance, few empirical studies have attempted to analyse the possibility of a mutually influential relationship between inequality and growth through the "fiscal channel".[3] Besides, most of this empirical evidence is based on separately estimated regressions, analysing the growth effect of fiscal policy,[4] or alternatively the distributive effects of fiscal policy.[5] None of these studies considers the role of gross income inequality on the determination of fiscal policy outcomes in a mutually influential relationship between growth and net income inequality, as we propose in this paper.

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[1] See Bénabou (2000, 2002, 2005) and Seshadri and Yuki (2004).

[2] See, for example, Hindriks and Myles (2006; chapter 3).

[3] The joint response of economic growth and income inequality to fiscal policies has been largely overlooked, with significant exceptions in recent papers referring to a specific country (Ramos and Roca-Sagalés, 2008; Roca-Sagalés and Sala, 2011) or a panel of countries (Muinelo-Gallo and Roca-Sagalés, 2011b).

[4] For a survey of this empirical literature see Myles (2009).

[5] For a survey of these empirical studies see Atkinson and Brandolini, (2006; table 14.1).

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Based on the approach by Bénabou (2000), the aim of this research is to develop and estimate a complete empirical model of joint determinants of fiscal policy, inequality, and economic growth. The study first analyses the importance of gross income inequality and other institutional, demographic and economic explanatory factors on the election of different fiscal policy outcomes. And secondly, it evaluates how effective these policies are in reducing net income inequality and also their effects in terms of macroeconomic efficiency. For this purpose, a complete system of three equations has been constructed for an unbalanced panel of 21 high income-countries for the period 1972–2006.

This paper's contribution is thus twofold. First, it analyses the importance of different institutional, demographic and economic factors in determining the fiscal policy options of an extended panel of high-income countries. Second, it allows us to identify the potential effects and policy implications of different fiscal policy strategies in a mutually influential relationship between economic growth and net income inequality.

The paper is organised as follows. Section 2 provides a theoretical framework, where different hypotheses concerning the determinants of fiscal policy and their impact on economic growth and net income inequality are discussed. Section 3 discusses the model, while Section 4 describes the database and details the empirical methodology. In Section 5, the empirical results are presented. Finally, Section 6 contains some concluding remarks.

2. Fiscal policy, growth and inequality

The theoretical priors underlying the empirical model come from the political economy literature, where fiscal policy, inequality and growth are jointly determined in democratic societies. These political economy models of inequality and growth stress how fiscal policy can play a major role in explaining the evolution of both macro aggregates. In this context, fiscal policy is an endogenous variable which reflects, through political processes, the voters' preferences for income distribution (each individual behaves like an economic agent and a citizen who votes on the distributive policies).[6]

Early political economy models under the assumption of perfect capital markets highlight a negative relationship between inequality and growth.[7] The main idea is that a more unequal democratic society demands a redistribution financed by distortionary taxes, and a rise in these taxes decreases private investment and consequently reduces economic growth. Later empirical contributions using cross-country data, however, do not seem very supportive of this traditional explanation, as they show that distributive policies are often correlated with income inequality in quite the opposite way to that predicted by these first-born models: among industrial democracies, more unequal economies tend to distribute less, not more.[8]

More recent models in the political economy literature sought to relax the main assumptions of the aforementioned approaches. Within this new literature, Bénabou (2000), in a context of imperfect capital and insurance markets and heterogeneous agents who vote on distributive policies, discusses how countries with similar preferences and technologies as well as equal democratic political systems, can nonetheless make very different choices with respect to fiscal policies. In Bénabou's model, there are two aspects relating inequality and distributive preferences to be taken into account. The first follows from the fact that, for some range of income inequities, the level of distribution that individuals vote for is a decreasing function of inequality, due to the accumulation process with imperfect asset markets. While imperfect credit and asset markets create a framework for efficient distributive institutions (as a way of providing social insurance and relaxing credit constraints), these institutions have much less support in an unequal society than a homogeneous one. Redistributing wealth from the rich (whose marginal productivity of investment is relatively low, due to decreasing returns on individual investments) to the poor (whose marginal productivity of investment is relatively high, but who cannot invest more than their limited endowments), would enhance aggregate efficiency and growth. These potential gains in efficiency, in turn, imply political support that varies with inequality in a radically different way from the traditional models of political economy literature. Intuitively, these "efficient" distributive policies receive a wide consensus in a fairly income homogenous society, but strong opposition in an unequal one.

In fact, according to Bénabou (2000), the relationship between inequality and distributive policy support is U-shaped. Thus, when income dispersion is relatively low there is near-unanimous support for the efficient distributive policy, and as inequality increases it also increases the fraction of agents rich enough to lose from, and therefore oppose, all but relatively low levels of distributive policies. And, at high enough levels of inequality, there are so many poor that they impose distributive policies beyond the point where it ceases to be efficient.

The second relationship stressed by Bénabou (2000) focuses on the process of human capital accumulation. Distributive and progressive fiscal policies relax credit constraints, allowing greater investment in human capital by poor individuals, thereby increasing their relative income. In this context, aggregate income inequality is a decreasing function of the rate of distribution.

Since these two relationships are decreasing functions of inequality, they may intersect more than once, rising to two stable equilibriums. One is characterized by low inequality and high government transfers (Welfare State), while in the other higher inequality is associated with lower levels of distributive spending (Laissez-Faire). These two societies are not Pareto rankable, and the one that has the faster economic growth depends on the balance between tax distortions to effort and employment, and the greater productivity of investment resources allocated to more severe credit constraint agents.

Considering the main implications of Bénabou's framework, the next section describes the empirical model considered in order to test the most relevant relationships between fiscal policy, inequality and growth. The proposed empirical model makes it possible to evaluate the main determinants of different fiscal policy outcomes, and simultaneously evaluates their impacts on the evolution of economic growth and net income inequality.

3. The empirical model

This section presents the methodological approach to empirically explore the relationship between fiscal policy, growth and inequality. Given the potential degree of interdependence between the variables, it is necessary to apply an empirical method that considers their mutual influence in order to avoid severe errors of specification. Consequently a full system for the joint determination of growth, inequality and fiscal policy has been considered. The next subsections describe the benchmark specifications, the equation systems considered, and the included control variables.

3.1. Benchmark specifications

The basic econometric specification consists of a series of three equations describing the relevant endogenous variables: economic growth, net income inequality and fiscal policy outcomes.

The macroeconomic analysis distinguishes basically two general theoretical approaches when analysing the capacity of fiscal policy to affect economic activity. From a neoclassical approach, several models

[6] For a complete discussion of these political economy models, see, for example, Drazen (2000; chapter 11) and Persson and Tabellini (2000; chapter 14).

[7] See, for example Alesina and Rodrik (1994), Bértola (1993) and Persson and Tabellini (1994).

[8] See, for example Alesina et al. (2002), Bénabou (1996a, 2000) and Perotti (1994, 1996).

emphasise the short-term effects of different instruments of fiscal policy. In this approach, the steady-state growth is driven by exogenous factors, such as the dynamics of population and the technological progress. Thus, the conventional wisdom has been that differences in tax and expenditure policies can be important determinants of the level of output, but are unlikely to have a significant permanent effect on the economic growth rate. However, these public-policy neoclassical growth models contrast with the predictions of the endogenous growth models, where growth is not conducted by exogenous factors. In the endogenous growth models, investment in human and physical capital does affect the steady-state growth rate and, consequently, there is much more scope for tax and government expenditure to play a role in the growth process. This approach tends to transform the temporary growth effects of fiscal policy that the neoclassical model involves, into permanent effects. Thus, endogenous growth models that incorporate public policies predict that distorting taxes, as well as productive public expenditures, affect economic growth. It follows that fiscal policy can affect the level of output as well as its growth rate.[9]

In line with these endogenous approaches, the benchmark equation of economic growth is based on the models developed by Barro (1990) and Barro and Sala-i-Martin (1992). Additionally, and in order to avoid the biases associated with an incomplete specification of the government budget constraint, the analysis follows Kneller et al's (1999) strategy concerning the inclusion of fiscal variables.[10] In this context, the economic growth rate of the country i during period t, y_{it} is a function of a two sets of fiscal variables (FP vector) and non-fiscal variables (X vector):

$$\Delta y_{it} = \alpha + \beta \sum_{k=1}^{k} X_{it}^{k} + \sum_{j=1}^{m-1} \left(\gamma_j - \gamma_m\right) FP_{it}^{j} + u_{it}. \quad (1)$$

Assuming that vector *FP* includes all the relevant elements of the government budget constraint, it is necessary to exclude one element of vector *FP* in order to avoid perfect collinearity in the estimation of growth equation. The omitted variable $FP_{i,t}^{m}$ is effectively the assumed compensating element within the government's budget constraint. According to this strategy, the interpretation of the estimated coefficient of each fiscal variable is the effect of a unitary change in the relevant variable (included in the regression) offset by a unitary change in the omitted fiscal variable, which is the implicit financial element (m-variable). The interpretation of the estimated coefficients of the non-omitted fiscal variables varies if the omitted category is altered.

For economic inequality, the benchmark equation is based on the empirical approaches of Castelló and Doménech (2002), Li and Zou (1998), Li et al. (1998) and Lundberg and Squire (2003). The fiscal policy variables are incorporated following the same strategy used for the growth equation that excludes one of the elements of vector FP. Thus, the performance of income inequality depends on two sets of non fiscal (Z vector) and fiscal (FP vector) variables:

$$NetInequality_{it} = \delta + \psi \sum_{l=1}^{l} Z_{it}^{l} + \sum_{j=1}^{m-1} \left(\xi_j - \xi_m\right) FP_{it}^{j} + \varepsilon_{it}. \quad (2)$$

And finally, the third benchmark equation considered is based on the empirical approaches of Persson and Tabellini (2000, 2003), and refers to the j-th fiscal policy outcome that depends on a set of control variables (vector W) to which the gross income inequality lagged one period is added as a novel regressor. Thus, the general formulation of fiscal policy equations is:

$$FP_{it}^{j} = \chi + \lambda GrossInequality_{i(t-1)} + \phi \sum_{g=1}^{g} W_{it}^{g} + \eta_{it} \quad (3)$$

where FP_{it}^{j} denotes a specific policy outcome j in country i at time t; $GrossInequality_{i(t-1)}$ is the Gini index lagged one period and calculated considered gross income (pre tax and government transfers).

3.2. The equation systems

In order to analyse the interdependence between the growth, inequality and fiscal policy variables, the novel empirical strategy of this paper considers two types of equation systems. In a first instance, a complete system of seemingly unrelated regressions (SUR) has been considered:

$$\begin{cases} \Delta y_{it} = \alpha + \beta \sum_{k=1}^{k} X_{1,it}^{k} + \sum_{j=1}^{m-1} \left(\gamma_j - \gamma_m\right) FP_{1,it}^{j} + u_{1,it} & (4) \\ NetInequality_{it} = \delta + \psi \sum_{l=1}^{l} Z_{2,it}^{l} + \sum_{j=1}^{m-1} \left(\zeta_j - \zeta_m\right) FP_{2,it}^{j} + u_{2,it} & (5) \\ FP_{it}^{j} = \chi + \lambda GrossInequality_{3,i(t-1)} + \phi \sum_{g=1}^{g} W_{3,it}^{g} + u_{3,it} & (6) \end{cases}$$

One of the main advantages of this system of equations is that it allows considering the empirical interdependence between growth, inequality and fiscal policies. In particular, in the SUR model, we assume that the disturbances from the different regression equations, at a given point in time, are correlated because of common unobservable factors. In this context, and compared to the single-equation approach, the SUR system exploits the efficiency gains derived from the assumed interdependence of the error terms of the three equations.

However, the SUR system of Eqs. (4) to (6) does not take into account the influence of the relevant endogenous variables on the right hand side of each equation. Accordingly, in order to more appropriately take into account the relationship between the three relevant endogenous variables, a simultaneous equation model (SEM) has also been considered. In this case, net inequality is considered to be an additional explanatory variable in the economic growth equation, growth rate is considered as an additional explanatory variable in the net income inequality equation, and the relevant endogenous fiscal policy variable is considered as an additional regressor in the growth and inequality equations. Therefore, the considered *simultaneous equation model* has the following form:

$$\begin{cases} \Delta y_{it} = \alpha + \kappa NetInequality_{1,it} + \beta \sum_{k=1}^{k} X_{1,it}^{k} + \sum_{j=1}^{m-1} \left(\gamma_j - \gamma_m\right) FP_{1,it}^{j} + u_{1,it} & (7) \\ NetInequality_{it} = \delta + \varpi \Delta y_{2,it} + \psi \sum_{l=1}^{l} Z_{2,it}^{l} + \sum_{j=1}^{m-1} \left(\zeta_j - \zeta_m\right) FP_{2,it}^{j} + u_{2,it} & (8) \\ FP_{it}^{j} = \chi + \lambda GrossInequality_{3,i(t-1)} + \phi \sum_{g=1}^{g} W_{3,it}^{g} + u_{3,it} & (9) \end{cases}$$

This empirical approach based on the simultaneous equation model (SEM) makes it possible to analyse both the relationship between economic growth and net income inequality, and simultaneously investigate the role of fiscal policy in their relationship. Consequently, this strategy makes it possible to obtain more appropriate estimations of the relevant fiscal policy parameters.

[9] Since the pioneering contributions of Barro (1990), King and Rebelo (1990) and Lucas (1990), several papers have extended the analysis of taxation, public expenditure and growth. See, for example Chatterjee and Turnovsky (2010) and García-Peñalosa and Turnovsky (2007).

[10] For a detailed exposition of the empirical growth equation structure, see Muinelo-Gallo and Roca-Sagalés (2011b).

To determine the exclusions and inclusions needed for the identification of the two systems, the equations are estimated on the basis of a priori theoretical and empirical arguments. The set of control variables for the baseline specifications are detailed in the next section. In every equation, the number of exclusions is sufficient for the order condition of the identification to be satisfied. In turn, the rank condition can be safely assumed to hold in a model of this size.[11]

3.3. The control variables[12]

The set of control variables for each equation in the systems is based on prior specifications of growth, inequality and fiscal policy. The empirical studies analysing economic growth usually estimate a broader version of the neoclassical growth model that includes the convergence property as well as other variables that determine the steady state. In order to reduce the specification error bias, we select a commonly accepted specification in the cross-country growth literature that considers initial income and population growth (see Barro, 1991), and also human capital, international trade and inflation rate (see Lundberg and Squire, 2003; Mendoza et al., 1997) as control variables.

For economic inequality, the benchmark equation is based on the empirical approaches of Castelló and Doménech (2002), Li and Zou (1998), Li et al. (1998), and Lundberg and Squire (2003). In line with these contributions, controls for the inequality equation should take into account a measure of civil liberties, and a measure of educational inequality as a proxy of asset inequality. The first measure makes it possible to consider the political control of the richest segment of society and its influence on income distribution, given this segment's political ability to protect its wealth. On the other hand, the inclusion of an educational inequality variable makes it possible to measure the importance of the distribution of human capital in explaining differences in income inequality.[13] Additionally, in the case of the SUR system we include a dummy variable in order to control for the difference in the construction of the net income inequality variable (the value is 1 if the income inequality measure is calculated from an income concept net of taxes and 0 otherwise).

The analysis of the empirical determinants of different fiscal policy outcomes is determined by the specific predictions derived from the theory summarised in Section 2. Thus, the control variables have been selected to correspond to those appearing in the theoretical model by Bénabou (2000). Logically, the policy outcomes investigated here may reflect many economic, social, cultural and historical factors besides any influence that the analysis may receive from inequality measures. In this sense, based on the empirical works by Persson and Tabellini (2000, 2003), institutional, demographic and economic variables have been considered as additional control variables. Thus, the fiscal policy equations incorporate one fundamental aspect of constitutions: the forms of government. This factor determines how the power to make decisions on economic policy can be exercised once in office and how conflicts between elected representatives can be resolved. The considered constitutional variable takes the values of either 2 (in parliamentary regimes), 1 (in assembly-elected presidential regimes), or 0 (in presidential regimes). According to the separation-of-powers argument, presidential regimes should be associated with less rent extraction and lower taxation and expenditures than parliamentary regimes. According to the confidence requirement argument, they should also be associated with more targeted programs at the expense of broad expenditure programs. Overall, parliamentary regimes should have larger governments (more expenditures and revenues) than presidential ones.[14] Other basic country characteristics are likely to correlate systematically with fiscal policy outcomes. One idea suggested by Wagner's law (Wagner, 1893) is that government spending goes up with national income. In order to take into account the influence of the differences in countries' level of development in the selection of fiscal policy outcomes, we include each country's real per capita income as an explanatory variable. Additionally, most of the empirical work on the size of government finds strong correlations between the demographic composition of the population and government expenditures, where older populations are associated with larger governments. To consider these aspects, we include the percentage of the population aged 65 years old or more. Finally, earlier empirical works have found that more open economies have larger governments. This might reflect the increased demand for social insurance in more open (and hence, more risky) economies (see Rodrik, 1998); but it might also reflect readily available tax bases resulting from taxes on exports and imports (see Goode, 1984). To take these hypotheses into account, a measure of a country's openness is considered, defined as the sum of exports and imports as a percentage of GDP.

4. Database and empirical methodology

4.1. Database

The empirical analysis uses a panel dataset of 21 OECD countries catalogued as high-income by the *World Bank*.[15] The selection of countries was determined by the following factors. First, the availability, frequency, quality and comparability of long data series. Second, in line with Castelló-Climent (2010) and Fölster and Henrekson (1999), the empirical analysis of the relationships between growth, inequality and fiscal policy was restricted to countries with similar wealth ranges.

The panel covering the 1972–2006 period is unbalanced, uses three-year average data, and contains harmonised economic, political and social data obtained from different sources. Economic variables related to the product are taken from the Penn World Table. In turn, the measures of openness, inflation and also population, are taken from the World Development Indicators of the World Bank. The human capital variables are obtained from Barro and Lee (2001), while the Gini index of education is obtained from Castelló and Doménech (2002).

The variables related to gross and net income inequality are taken from UNU-WIDER version 2c.[16] The compilation of inequality data carried out by the United Nations has certainly helped to improve the empirical analysis of inequality, although the provided data is not always methodologically homogeneous between and within countries. In order to build a homogeneous and comparable inequality database, the available observations are adjusted and selected according to the following criteria. First, low quality observations are eliminated (quality "4" and "3", the minor values in the ranking). Second, for each country only data coming from the same source and survey are considered. Third, in order to maximise the sample of net income inequality measures, household equivalent net income has been considered as well as consumption by the whole population of the country (the coverage had to be representative of the national population); in addition, all uses of consumption had to be accounted for, including own-consumption.

[11] For a complete exposition of the identification of equation systems, see Bjorn and Krishnakumar (2008), Greene (2003) or Theil (1971).

[12] The Appendix A provides the definitions and sources of all variables.

[13] It should be noted that this measure of education refers to the quantity of schooling, and does not take into account the quality of the education system (see Castelló and Doménech, 2002; Castelló-Climent, 2010).

[14] For a more detailed exposition of these arguments see Persson et al. (1997, 1998, 2000) and Persson and Tabellini (2000, 2003).

[15] The 21 high income countries considered are: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Israel, Italy, Japan, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, the United Kingdom and the United States.

[16] Another homogenous and comparable dataset for Gini coefficients is compiled by the Luxembourg Income Study (LIS) project. However, the LIS dataset only has a few observations before the eighties based on net income measures.

The variables concerning fiscal policies are taken from the Government Finance Statistics of the International Monetary Fund (GFS-IMF). In line with Bénabou (2000), we consider four groups of fiscal policy variables. The composition of government spending is measured by two main components: distributive and non distributive expenditures. Similarly, taxes are classified as direct and indirect, depending on whether they do or do not directly affect the revenues of private agents. This classification evaluates both the progressivity and distortionary effects of tax measures.[17]

The institutional political system variable is taken from the Database of Political Institutions 2009 from the Development Research Group of the World Bank, while the civil liberties index is taken from the Freedom House database.

We have considered three-year averages of all variables for different reasons. First, because year-to-year changes in fiscal policy variables are not expected to have an annual effect on changes in economic growth and inequality. Second, taking three-year averages reduces the short-run fluctuations and therefore the influence of the economic cycle, thus permitting a focus on the structural relationships. Third, by using three-year means, the limited availability of annual inequality data is partially compensated, allowing for a more balanced dataset to be considered. In this sense, it is important to remark that considering three-year averages will not result in much loss of information because the aggregate measures of inequality are relatively stable over time. Finally, each country should have a minimum of five observations (with a maximum of twelve for the 1972–2006 period).

4.2. Empirical methodology

The formulation of the SUR and SEM systems containing each one the three relevant equations is too general. In particular, without further restrictions, the structural parameters cannot be identified. Consequently, the empirical methodology needs to impose the following restrictions. Firstly, the presence of the lagged dependent variable has not been considered in the equations; this ensures that the models are not dynamic. And secondly, the coefficients for specific variables and the equation relationships are constrained to be equal across time.

In addition, the empirical model accounts for temporal and cross-sectional heterogeneity of panel data by means of an error components structure in the three structural equations of each system. The specific effects associated with pooled data are incorporated in an additive manner in each error term. Following an error components pattern, it is assumed that each structural equation error $u_{n,it}$ is composed of three terms: an individual effect μ_i^n, a time effect ε_t^n and a residual errorv_{it}^n. Formally, the error terms of each equation have the following structure:

$$u_{n,it} = \mu_i^n + \varepsilon_t^n + v_{it}^n \quad \begin{matrix} n = 1,2,3 \\ i = 1,\ldots,N \\ t = 1,\ldots,T. \end{matrix} \tag{10}$$

The country dummies are included to control for time-invariant omitted-variable bias, and the period dummies to control for global shocks which might affect dependent variables in any period but are not otherwise captured by the explanatory variables.

The specification for each equation of both systems is selected on the basis of theoretical and empirical reasons. Thus, in the case of the growth equation, a model with individual and temporal dummies variables has been considered to deal with one of the major potential problems, which is omitted variable bias. This makes it possible to control for cross-country heterogeneity as well as period-specific factors common to all cross-section units. Among other things, the unobserved country-specific effects may reflect differences in the initial level of efficiency, while the period-specific intercepts pick up productivity changes that are common to all countries.

In relation to the inequality equation, two important aspects concerning the income inequality variable used (Gini index) should be highlighted. First, this variable is relatively stable within countries during the analysed period, and second, it changes significantly between countries (see Table 2 of Appendix A). Therefore, the primary statistical evidence offers sufficient evidence that inequality is determined by factors that differ substantially between countries though they tend to be relatively stable inside the same ones, showing that differences across countries may have an important influence on income inequality.[18] Thus, in the inequality equation, a model with only temporal dummies has been considered as the most appropriate specification.

In the case of the fiscal policy equations, the same behaviour as in the case of the net income inequality variable has been observed (see Table 2 of Appendix A) showing the convenience of including temporal dummies to control for global shocks common to all individuals.

As a way of taking into account potential endogeneity problems with right hand regressors (including fiscal policy variables), the explanatory variables of both systems (SUR and SEM) have been included as measured at the start of each three-year period. This strategy should reduce any endogeneity (although it could still be a potential problem).[19]

Finally, in order to exploit efficiency gains from the correlation of error terms cross equation, the full set of equations of each system (*SUR* and *SEM*) is jointly estimated trough full information methods. Thus, the SUR model is estimated using seemingly unrelated regression techniques (SURE) that account for heteroskedasticity and contemporaneous correlation of errors across the three equations.[20] Meanwhile, the SEM model is estimated using three-stage least squares (3SLS) accounting again for heteroskedasticity and contemporaneous correlation of the errors across equations; the 3SLS is an IV-GLS estimator which achieves consistency through instrumentation and efficiency through appropriate weighting.[21] Compared to a single-equation approach, these system estimation methods are able to spell out feed-back simultaneities among the endogenous variables of fiscal policy, growth and inequality, and obtain more efficient estimations of the relevant explaining variables.

5. Empirical results

This section presents the empirical results of the different model specifications using the sample of 21 OECD high income countries for the 1972–2006 period. Table 3 of Appendix A summarises the results of the system considering the SURE and the 3SLS estimates of both the Seemingly Unrelated Regression (SUR) and the Simultaneous Equations Model (SEM), respectively.[22] In each system, four scenarios are considered according to the implicit financing elements (distributive and non-distributive expenditures, and direct and indirect taxes).[23]

[17] Table 1 in Appendix A shows the categories included in each fiscal policy variable.

[18] An analysis of the variance components (ANOVA) of the net income Gini coefficients shows that, for the entire sample, 92.5% of the variance is cross-country.

[19] For an example of a similar methodology, see Lundberg and Squire (2003).

[20] For an introduction to SURE estimation methodology, see Zellner (1962, 1963) and Zellner and Huang (1962).

[21] See Greene (2003), Kmenta (1997) and Zellner and Theil (1962) for references on 3SLS estimation methodology. However, see Avery (1977) and Baltagi (1981, 2008) for applications of 3SLS to an error components model.

[22] In order to reduce any inconsistency resulting from the fact that some net income gini coefficients are based on income whereas a few are based on expenditure, in the equations of the SEM model we follow Deininger and Squire's suggestion and add 6.6 percentage points to Gini coefficients based on expenditure (see Castelló-Climent, 2010; Forbes, 2000).

[23] In Table 3, only the estimates of relevant and significant fiscal variables are reported (other revenues and the surplus/deficit variables, included in all regressions, are neither statistically nor economically significant).

A first noteworthy result is that estimations of the SUR and SEM models are fairly similar; none of the control and fiscal policy variables present significant changes between both models. Additionally, it should be emphasized that in order to fathom whether the empirical results are being driven by one particular country in the sample, the estimations of both equation systems have been re-estimated, after removing each of the countries one at time. The results are stable, indicating that no single country in the sample is driving the results. The next sub-sections describe the results obtained from the different equations.

5.1. Effects of fiscal policy on growth

The growth equations appearing in the first part of Table 3, allow the efficiency effects of fiscal policies to be analysed. Focusing on the control variables, first the initial GDP enters the regressions with a significant negative coefficient, indicating a conditional convergence of growth rates over the period; this result is in line with those obtained by Barro (1991 and 2008), Castelló-Climent (2010) and Kneller et al. (1999). Second, population growth, despite having the expected negative sign, is not significant, showing that in high income countries the growth of the population is not a relevant variable and does not affect economic growth. Third, as Barro (1991) predicts, the human capital variable is significant and positively related to economic growth. Finally, in relation with the last two control variables, a significant and expected positive sign is found in the case of the international trade variable, indicating that an increase in openness raises economic growth, while no significant impact could be observed in the case of the inflation rate (similar results are also found by Barro, 1990; Castelló-Climent, 2010; Mendoza et al., 1997, respectively). In general, control variables perform as expected.

An important additional result derived from the SEM model is that net income inequality, measured by the Gini coefficient, has a positive significant impact on economic growth. This result is in line with the conventional textbook arguments indicating that inequality is good for incentives and therefore good for growth. The strand of literature pointing to the pro-growth effects of inequality basically focuses on the following factors: different saving propensity of economic agents, investment indivisibilities and incentive considerations.[24] In turn, this empirical result also is confirmed by more recent contributions that use a panel data approach for a sample of high income countries.[25]

In relation with the fiscal policy variables, distributive expenditure has a negative and significant impact on GDP growth only when it is financed by a reduction in non-distributive expenditure, and non-distributive expenditures have a significant and negative effect on economic growth, regardless of whether it is financed by an increase in direct taxes or by a reduction in distributive expenditures. In any case, the results show that the effects of increases in government expenditure certainly depend on the financial counterpart and that they may reduce but not promote economic growth. In this sense, the strategy of considering the initial values of the explanatory variables and the three year means of the dependent variable, allow us to interpret that the estimated effects are not just contemporaneous.

On the other hand, a significant negative effect on growth is found in the case of direct taxes, regardless of whether their financing counterparts are indirect taxes, non-distributive or distributive expenditures. This result, which is also obtained by Kneller et al. (1999), is consistent with economic theory because of the distorting effects of this type of tax on the labor and investment decisions of economic agents. In contrast, indirect taxes do not have a significant impact on growth. This latter result would reflect the fact that the indirect tax variable, due to limitations of information, considers all taxes on goods and services without discriminating between the types of goods taxed; for example taxes on intermediate or consumer goods (see Hindriks and Myles, 2006).

5.2. Distributional effects of fiscal policy

Inequality equations appearing in the second part of Table 3 enable the analysis of the distributive and non-distributive effects of fiscal policies. The control variables (civil liberties and education inequality) are significant and have the expected sign, which basically coincides with the results of Li and Zou (1998) and Li et al. (1998). Thus, increases in civil liberties reduce income inequality while an increase in initial educational inequality raises income inequality. It is also important to emphasise that in the SUR model the dummy variable that controls for the differences caused by the source of the Gini indices is positive and significant.

Concerning the fiscal variables, one would expect, as different authors indicate, distributive expenditure to reduce income inequality, because it includes different social expenditures with distributive implications through the immediate benefits.[26] In this sense, the obtained results confirm a significant negative effect of distributive expenditure on income inequality, regardless of whether it is financed by a reduction in non-distributive expenditures, or by an increase in direct or indirect taxes. On the other hand, the effect of non distributive expenditure on inequality is positive and statistically significant in all equations. This is an important and very novel result; to our knowledge no empirical work has tested this type of relationship.

The effect of direct taxes on inequality is negative and significant in all estimations. This negative impact may reflect the progressive structure of the tax systems of the analysed countries, many of which have a modern fiscal system. With a progressive tax system, increases in direct tax revenue – whether through increases in the tax base, in the overall average tax rate or in the progression of the tax structure – would yield a larger distributive effect and thus lower inequality (Lambert, 2001). Finally, indirect taxes have no significant effects on inequality. Again, this latter result may reflect the fact that the indirect tax variable, due to limitations of information, considers all taxes on goods and services without discriminating between the types of goods taxed; for example taxes on necessities or on luxury goods (see Hindriks and Myles, 2006).

5.3. Determinants of fiscal policy outcomes

The third part of Table 3 reports the results concerning the determination of the different fiscal policy outcomes of the SUR and SEM models. In this case, the dependent variable changes in order to consider the four alternative measures of government fiscal policy: distributive expenditures (columns 1 and 5), non-distributive expenditures (2 and 6), direct taxes (3 and 7) and indirect taxes (4 and 8).

When discussing the determinants of fiscal policy outcomes we first focus on GDP. As the results show, GDP per capita at the start of each three year period is positively related with distributive expenditures and negatively with non distributive expenditures, indicating that richer economies perform more intensively distributive expenditures. On the other hand, GDP per capita has a significant positive impact on direct taxes and negative on indirect taxes, pointing that richer economies use direct taxes more intensively as an important source of revenue. Consequently, poorer economies in the sample perform more intensively the non-distributive component of government spending, and indirect

[24] See, Muinelo-Gallo and Roca-Sagalés (2011a).
[25] See, for example, Barro (2000), Castelló-Climent (2010) and Forbes (2000).
[26] See Afonso et al. (2010), Bulir and Gulde (1995), Galli and Von der Hoeven (2001), Gustafsson and Johansson (1999) and Li et al. (2000).

taxes as a source of government revenue; both results are very much in line with the empirical findings of Persson and Tabellini (2003). Second, more open economies are associated with more welfare spending (distributive expenditures), a result that is in line with the argument in Rodrik (1998) in the sense that more open (and hence, more risky) economies increase the demand for social insurance policies. Third, and as expected, the share of elderly people exerts a strong and positive significant influence on these distributive expenditures because of the importance of the public pension system in the countries analysed. In turn, and in line with the theoretical arguments of Bénabou (2000), the lagged gross income inequality measure has a significant negative impact on both types of expenditures, and also is significantly and importantly associated with lower direct taxes, showing that more egalitarian economies use direct taxes more intensively as a source of government revenue.

Finally, the results confirm Persson and Tabellini's hypothesis, showing that parliamentary regimes seem to be associated with larger distributive expenditures, but contradicts Persson and Tabellini (2000, 2003) in the sense that it is also possible to observe that parliamentary regimes are associated with lower non distributive expenditures.

6. Concluding remarks

Due to the importance of fiscal policy as a redistributive tool and as an instrument to promote economic growth, it is commonly considered one of the key mechanisms to achieve goals in terms of efficiency and equity. In this article we investigate whether, to what extent, and through which components, fiscal policy generates a trade-off between economic growth and income inequality. To this end we estimate two different systems of structural equations with error components through which gross income inequality determines different fiscal policy outcomes, which subsequently affect the evolution of economic growth and net income inequality.

Although empirical literature has dealt separately with, on the one hand the growth and inequality effects of fiscal policies, and on the other hand the relationship between income inequality and growth, the issue of the sign and magnitude of the efficiency and distributive effects of fiscal policies is still very much an open question. This paper contributes to the scarce existing evidence on this issue and, in turn, establishes the important role of gross income inequality on the determination of fiscal policy outcomes in a mutually influential relationship between growth and inequality.

The empirical results obtained using an unbalanced panel of 21 high-income OCDE countries for the period 1972–2006 suggest that the more egalitarian a country is, the larger its public sector (in terms of expenditures and taxes over their GDP). Moreover, richer economies in the sample use more intensively distributive expenditures and direct taxes while poorer economies distributive expenditures and indirect taxes. These results confirm the important role of gross income inequality on the determination of fiscal policy outcomes pointed out by Bénabou (2000).

Importantly, the results indicate that increasing distributive expenditure in high income countries with a well established welfare state (our sample) reduces income inequality but does not necessarily harm GDP growth (it depends on how this public spending is financed). And, alternatively, rising non-distributive expenditure decreases GDP growth while increasing income inequality, regardless of how it is financed.

The results can also be interpreted in the sense that distributive expenditures and direct taxes may produce significant reductions in GDP growth and net income inequality. This finding is consistent with previous empirical evidence, which reveal non-Keynesian effects associated to public spending or direct taxes on growth (Barro, 1990, 2008; Castelló-Climent, 2010), and also important redistributive effects of the same fiscal policies (see Afonso et al., 2010; Muinelo-Gallo and Roca-Sagalés, 2011b). In short, this result reflects the standard efficiency–equity trade-off of fiscal policy: the smaller the government, the larger the pie, but it will be less equally distributed.

The results also show that the only fiscal policy that can break the trade-off between efficiency and equity are non distributive expenditures, since a cut in this kind of government expenditures reduces inequality while increasing economic growth. However, the results are highly inconclusive concerning indirect taxes. The indirect tax equations have very low explanatory power, so their results must be treated with utmost caution.

Our results have important policy implications, particularly in a context of fiscal consolidation in the majority of the high income countries included in our sample. First, for countries which may experience difficulties in financing their public deficits (as is the case over the last years of Greece, Portugal, Spain, Ireland but also Japan, United States and United Kingdom), the most appropriate fiscal policy to increase growth while reducing income inequality is to cut non-distributive expenditures. The alternative of reducing distributive expenditure may have an important social cost in terms of increasing income inequality, something that eventually may aggravate problems related to poverty (Bourguignon, 2003).

In summary, and according to the results presented, we claim first that it is important to incorporate gross income inequality as a significant determinant of fiscal policies, and consequently, it is also an important variable to take into account when estimating the growth and distributive effects of fiscal policies. And second, the choice of fiscal policy strategy is of crucial importance for promoting balanced economic development. The alternative could be a scenario of economic recovery but also increasing interpersonal income disparities.

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Appendix A

Table 1
Theoretical aggregation of fiscal policy.

Theoretical classification	Government Finance Statistics classification
Revenues	
Direct taxes	• Taxes on income, profits, and capital gains • Taxes on payroll and workforce • Taxes on property
Indirect taxes	• Taxes on goods and services • Taxes on international trade and transactions
Other revenues	• Other taxes • Grants • Other revenue
Expenditures — functional classification	
Distributive expenditures	• Social protection • Health • Housing and community amenities • Education
Non distributive expenditures	• General public services • Defence • Public order and safety • Economic affairs
Others categories	
Government surplus/deficit	• Total revenues minus total outlays

Note: the classification is based on the manual *GFS-2001* and corresponds to the general government.

Table 2
Summary statistics (within and between variations).

		Mean	Standard deviation	Minimum	Maximum	Observations
GDP growth	Overall	2.58	1.71	−5.40	8.54	N = 231
	Between		0.60	0.92	4.06	n = 21
	Within		1.61	−5.51	6.60	T = 11
Log (Initial GDP)	Overall	9.81	0.29	8.99	10.44	N = 231
	Between		0.21	9.37	10.13	n = 21
	Within		0.20	9.35	10.53	T = 11
Inequality of gross income	Overall	41.27	9.34	18.60	54.7	N = 152
	Between		7.29	21.63	51.06	n = 21
	Within		3.62	22.65	55.71	T-bar = 7.24
Inequality of net income	Overall	29.92	4.92	18.73	40.83	N = 188
	Between		4.39	22.81	37.85	n = 21
	Within		2.31	24.25	37.41	T-bar = 8.85
Distributive public expense	Overall	31.67	9.63	3.11	65.57	N = 240
	Between		7.25	5.78	41.76	n = 21
	Within		5.68	6.62	51.38	T-bar = 11.43
Non-Distributive public expense	Overall	16.52	5.42	4.66	37.99	N = 241
	Between		4.06	7.04	25.82	n = 21
	Within		3.30	6.24	27.12	T-bar = 11.47
Direct taxes	Overall	15.57	5.97	1.84	32.22	N = 247
	Between		6.16	2.23	29.06	n = 21
	Within		2.05	6.68	23.81	T-bar = 11.76
Indirect taxes	Overall	9.37	3.98	0.66	20.62	N = 209
	Between		3.84	2.55	18.61	n = 21
	Within		1.35	6.11	15.28	T-bar = 9.95
Other revenues	Overall	4.93	2.54	0.24	14.91	N = 198
	Between		1.90	1.59	8.57	n = 21
	Within		1.74	−1.62	11.27	T-bar = 9.43
Government surplus/deficit	Overall	−2.85	7.89	−39.36	20.72	N = 244
	Between		4.34	−14.71	5.63	n = 21
	Within		6.67	−40.03	12.55	T-bar = 11.62
Population growth	Overall	0.65	0.60	−0.60	3.27	N = 252
	Between		0.50	0.14	2.28	n = 21
	Within		0.34	−0.70	2.64	T = 12
Human capital	Overall	2.81	1.16	0.51	5.09	N = 252
	Between		1.02	1.11	4.67	n = 21
	Within		0.60	1.42	4.11	T = 12
International trade	Overall	64.56	31.72	14.18	177.32	N = 252
	Between		30.21	20.66	134.89	n = 21
	Within		11.57	22.06	119.01	T = 12
Inflation	Overall	6.03	5.19	−0.60	22.62	N = 242
	Between		2.74	2.33	12.49	n = 21
	Within		4.47	−3.39	18.16	T-bar = 11.52
Education inequality	Overall	21.90	7.51	9.30	55.10	N = 252
	Between		7.09	13.18	46.20	n = 21
	Within		2.88	14.32	30.80	T = 12
Civil liberties	Overall	1.40	0.68	1	5.67	N = 252
	Between		0.49	1	2.44	n = 21
	Within		0.49	0.22	4.89	T = 12
Population of 65 years or more	Overall	13.62	2.58	7.34	20.00	N = 252
	Between		1.98	9.10	16.91	n = 21
	Within		1.70	8.36	20.82	T = 12
Political system	Overall	1.92	0.28	0	2	N = 252
	Between		0.23	0	2	n = 21
	Within		0.16	0	2.25	T = 12

Sources: fiscal variables come from *GFS-FMI*.
The *Gini* coefficients come from *UNU-WIDER version 2c*.
Investment and GDP come from the *Penn World Table 6.3*.
Human capital variable comes from Barro and Lee (2001).
Population, trade and inflation variables come from the *World Development Indicators* of the *World Bank*.
The *Gini* of education comes from Castelló and Doménech (2002).
The variable of civil liberties comes from the Gwartney et al. (2007).
The political system variable comes from the Beck et al. (2001) of the *World Bank*.

Table 3
SUR and SEM models — regressions results.

	SUR model				SEM model			
	1	2	3	4	5	6	7	8
Growth Equation	Real GDP per capita growth				Real GDP per capita growth			
Initial GDP p.c.	−0.6895***	−0.5352***	−0.7919***	−0.6634***	−0.8747***	−0.5441**	−0.6173***	−0.6598***
	(0.1531)	(0.1427)	(0.1507)	(0.1563)	(0.1818)	(0.2719)	(0.2285)	(0.1811)

(continued on next page)

Table 3 (*continued*)

	SUR model				SEM model			
	1	2	3	4	5	6	7	8
Growth Equation	Real GDP per capita growth				Real GDP per capita growth			
Net inequality	–	–	–	–	0.5649*	0.8620**	0.4228	0.8318**
					(0.3651)	(0.4723)	(0.3907)	(0.4282)
Population growth	−0.0820	−0.0535	−0.0505	−0.0774	−0.0911	−0.1823**	−0.0912	−0.0965
	(0.0588)	(0.0589)	(0.0595)	(0.0593)	(0.0722)	(0.0858)	(0.0735)	(0.0698)
Human capital	0.6638***	0.6495***	0.5904**	0.6998***	0.4654	1.2894***	0.5469**	0.5473
	(0.2530)	(0.2598)	(0.2602)	(0.2576)	(0.4670)	(0.2789)	(0.3787)	(0.4224)
Trade	1.1771***	1.2015***	1.0454***	1.1601***	0.7593***	0.51956*	1.3184***	1.1410***
	(0.2531)	(0.2563)	(0.2535)	(0.2525)	(0.2765)	(0.3346)	(0.3533)	(0.3781)
Inflation	−0.0396	−0.0825	−0.0424	−0.0566	−0.0865	−0.0287	−0.0377	−0.0877
	(0.0606)	(0.0644)	(0.0665)	(0.0651)	(0.1461)	(0.0584)	(0.0603)	(0.0728)
Distributive expenditure	Omitted	−0.4191***	−0.0609	−0.1757	−0.9554	−0.4090**	Omitted	−0.4176***
		(0.1789)	(0.2219)	(0.2169)	(0.9749)	(0.2256)		(0.2031)
Non distributive expenditure	−0.3701***	Omitted	−0.3654***	−0.2959**	−0.5533***	−0.2774	−0.3796***	Omitted
	(0.1135)		(0.1334)	(0.1439)	(0.1052)	(0.4374)	(0.1144)	
Direct taxes	−0.4906***	−0.5803***	Omitted	−0.5153***	Omitted	−0.5546**	−0.5978*	−0.6038***
	(0.1954)	(0.1998)		(0.1993)		(0.2481)	(0.3384)	(0.2254)
Indirect taxes	−0.0804	−0.00313	0.0741	Omitted	0.1480	Omitted	0.0939	−0.8828
	(0.1340)	(0.1299)	(0.1399)		(0.1656)		(0.1333)	(0.1384)
Country effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adj. R-squared	0.75	0.74	0.74	0.75	0.64	0.75	0.75	0.61
Inequality equation	Gini index				Gini index			
Civil liberties	0.0734**	0.0650*	0.0931**	0.0510	0.0506	0.0444*	0.0575**	0.0967***
	(0.0399)	(0.0401)	(0.0398)	(0.0400)	(0.0467)	(0.0420)	(0.0409)	(0.0334)
Education inequality	0.0702*	0.0517*	0.0812*	0.0503*	0.0785*	0.0453	0.0498*	0.0366
	(0.0460)	(0.0462)	(0.0465)	(0.0461)	(0.0477)	(0.0503)	(0.0445)	(0.0475)
Growth	–	–	–	–	−0.3038	−0.0661	−0.3547**	−0.2594
					(0.3201)	(0.1987)	(0.2140)	(0.2265)
Distributive expenditure	Omitted	−0.0951**	−0.0393**	−0.1206**	−0.1759**	−0.1921***	Omitted	−0.0364**
		(0.0518)	(0.0525)	(0.0535)	(0.0775)	(0.0513)		(0.0539)
Non distributive expenditure	0.1014***	Omitted	0.1100***	0.1221***	0.1002***	0.0967**	0.1047***	Omitted
	(0.0344)		(0.0360)	(0.0354)	(0.0405)	(0.0467)	(0.0314)	
Direct taxes	−0.0977***	−0.1197***	Omitted	−0.1335***	Omitted	−0.1809***	−0.2146***	−0.1017**
	(0.0421)	(0.0436)		(0.0433)		(0.0448)	(0.0433)	(0.0541)
Indirect taxes	−0.0247	−0.0146	−0.0239	Omitted	−0.0222	Omitted	−0.0274*	−0.0478
	(0.0133)	(0.0138)	(0.0140)		(0.0131)		(0.0132)	(0.0146)
Net income dummy	0.0846***	0.0961***	0.0900***	0.0996***	–	–	–	–
	(0.0199)	(0.0207)	(0.0212)	(0.0207)				
Country effects	No	No	No	No	No	No	No	No
Time effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adj. R-squared	0.70	0.67	0.69	0.70	0.69	0.73	0.68	0.67
Fiscal policy equation	Fiscal policy				Fiscal policy			
	Distributive expenditures	Non-distrib. expenditures	Direct taxes	Indirect taxes	Distributive expenditures	Non-distrib.e expenditures	Direct taxes	Indirect taxes
Initial GDP p.c.	0.0939**	−0.1099*	0.1998***	−0.4401***	0.1140***	−0.1525**	0.1651***	−0.4695***
	(0.0451)	(0.0660)	(0.0500)	(0.1521)	(0.0417)	(0.0646)	(0.0509)	(0.1014)
Trade	0.1925***	0.2100***	0.0857	−0.0782	0.1121**	0.0627	0.0783	−0.1009
	(0.0532)	(0.0718)	(0.0665)	(0.1938)	(0.0575)	(0.0815)	(0.0645)	(0.1916)
Population > 65 years	0.8378***	0.1931	−0.2438**	1.1982***	0.7840***	0.2516*	−0.1907*	1..2076***
	(0.1031)	(0.1475)	(0.1163)	(0.3474)	(0.1286)	(0.1398)	(0.1193)	(0.3443)
Lagged gross Inequality	−0.2537**	−0.4554**	−0.8582***	0.6939	−0.2857***	−0.2394*	−1.0726***	−1.0922***
	(0.1296)	(0.1656)	(0.1265)	(0.4368)	(0.1179)	(0.1854)	(0.1464)	(0.4330)
Political system	0.1076***	−0.1016*	0.0701	0.1493	0.1526***	−0.1550***	0.0664	0.1650
	(0.0450)	(0.0646)	(0.0521)	(0.1518)	(0.0533)	(0.0639)	(0.0505)	(0.1501)
Country effects	No	No	No	No	No	No	No	No
Time effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adj. R-squared	0.75	0.59	0.76	0.17	0.64	0.63	0.75	0.16
Observations	133	133	133	133	110	110	110	110

Notes: all variables are expressed in logs except population and GDP growth, and inflation.
Standard errors in parentheses. *, **, *** measures statistical significance at the 10, 5 and 1% levels respectively.

Sources and definitions of data used in regressions

International trade: *World Development Indicators of World Bank* (*WDI*), exports plus imports as a share of GDP.

Population growth: *World Development Indicators of World Bank* (*WDI*), annual growth rate of population.

Population of 65 years or more: *World Development Indicators of World Bank* (*WDI*), population ages 65 and above as a percentage of the total population.

Civil liberties: *Freedom House*: index on a scale of 1 to 7, with 1 representing the higher level and 7 representing the lower level.

Political system: *Database of Political Institutions* (*DPI-2009*) *of The World Bank*, categorical variable with three values: Parliamentary regimens (2), Assembly-elected President (1), and Presidential (0).

Education inequality: Castelló and Doménech (2002), Gini index of education.

Inequality of income: *UNU-WIDER version 2c*, Gini index of gross and net incomes.

Human capital: Barro and Lee (2001), average years of schooling of the population aged 25 and over.

Inflation: *World Development Indicators of World Bank* (*WDI*), December-to-December change in consumer price index in logs (CPI).

GDP: *Penn World Table 6.3 database*, Real GDP per capita in logs (RGDPCH, 2005 PPP$).

GDP growth — Penn World Table 6.3 database, annual GDP growth (GDPt–GDPt-1)

Distributive public expense: *Government Finance Statistics of International Monetary Fund* (*GFS-IMF*), social protection, health, education and housing expenditures of general government as a share of GDP.

Non-Distributive public expense: *Government Finance Statistics of International Monetary Fund* (*GFS-IMF*), expenditures on general public services, defence, public order and safety, and economic affairs of general government as a share of GDP.

Direct taxes: *Government Finance Statistics of International Monetary Fund* (*GFS-IMF*), revenues of general government due to direct taxes as a share of GDP.

Indirect taxes: *Government Finance Statistics of International Monetary Fund* (*GFS-IMF*), revenues of general government due to indirect taxes as a share of GDP.

Other revenues: *Government Finance Statistics of International Monetary Fund* (*GFS-IMF*), revenues of general government due to other taxes, grants and other revenues as a share f GDP.

Government surplus/deficit: *Government Finance Statistics of International Monetary Fund* (*GFS-IMF*), total revenues minus total outlays of general government as a share of GDP.

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