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Income Inequality and the Size of Government: A Causal Analysis

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Abstract

Expansion of the public sector and redistributive policies may reduce income inequality, but formal tests suffer from the problem of endogeneity of government size with respect to the distribution of income. Studying 30 European countries over the period 2004-2015, we apply instrumental variable estimation techniques to identify a causal relationship between income inequality and government size, measured as the government expenditure share in GDP. Using a novel instrument – the number of political parties in the ruling coalition – we find that accounting for the possible endogeneity of government size increases the magnitude of the estimated negative effects. Our findings thus suggest that much of the literature underestimates the true role of the government in attenuating income inequality. The estimated relationship between income inequality and government size persists in a series of robustness checks.

JEL codes: D31; D60; H20
Keywords: inequality, redistribution, government size, instrumental variable, Gini index

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1 Introduction

Income inequality and the role of redistribution policies are central topics in economic and political debates, as well as in the academic discourse. Income inequality is often seen as detrimental from the social, economic, and political perspectives, and has been documented to lead to various social and health problems (e.g. Wilkinson and Pickett, 2009; Chetty et al., 2016). Recent research shows that sustained high levels of income inequality are detrimental to economic growth, and that more equal societies create conditions for higher and more sustainable economic development (e.g. Easterly, 2007; Berg, Ostry, and Zettelmeyer, 2012; Ravallion, 2014; Cingano, 2014). Some studies have also documented that government spending aimed at reducing income inequality is not hampering economic growth, and that policies designed to reduce income inequality in fact help to improve social outcomes and also to sustain long-term growth (Ostry, Berg, and Tsangarides, 2014).

On the other hand, some arguments against redistributive and other pro-equality policies include: (i) the notion that inequality generates incentives to invest in human capital and innovation and thus stimulates economic growth (Okun, 1975); (ii) the textbook deadweight welfare losses due to an excessive or lessened exchange in subsidized or taxed markets; (iii) costs and inefficiencies of redistribution systems; (iv) preferences or ideologies of the government or ruling political parties; and (v) political, legal, or technical constraints that may prevent the government from taking welfare from some and providing it to others. Given the manifold potential benefits and costs of income redistribution, it is important to understand their true effects on income inequality in order to design optimal redistribution policies.

Income inequality varies across European countries, as well as within countries over time (Salverda et al., 2014). The within- and between-country variation in the degree of income redistribution is also significant. Many European countries have opted for large governments and substantial redistribution achieved by means of an extensive system of taxes and benefits. The relatively low inequality in disposable income observed in much of Europe is indeed generally attributed to governments' redistribution policies. Avram, Levy, and Sutherland (2014) calculate that the redistributive effect of taxes and benefits in the whole EU-27 is, on average, around 20 points on the Gini index scale. According to their study, the reduction in the Gini index after applying tax-benefit rules on market incomes ranges from 11 points in Cyprus to 26.5 points in Belgium. However, one finds significant differences in measured income inequality, as well as considerable differences both in the levels of and trends in social spending as a proxy for redistribution and the size of the welfare state across European countries (Salverda et al., 2014). Recently, the extent of government spending and income redistribution has been substantially influenced by the Great Recession, with varying length and depth across countries. European governments responded to the Great Recession by implementing various stimuli and austerity measures (e.g. Furth, 2014).

Several studies have investigated the role of government redistribution policies for income inequality. Roine, Vlachos, and Waldenström (2009) explore the determinants of income inequality using a sample of 16 countries spanning the whole of the twentieth century. Using panel estimations, the authors show that the relative amount of government spending negatively affects high-income shares (except for 1% of the highest incomes), and they document the rise of the income share in the bottom nine deciles. Milanovic and Ersado (2012) study the determinants of income distribution (using decile shares) in 26 post-communist economies during 1990-2005. In their study, government expenditure is confirmed distribution-neutral in all of their specifications. This result contrasts with Aristei and Perugini (2014), who document that a larger government expenditure significantly reduced income inequality in 27 post-communist economies during the period 1989–2009. Kahanec and Zimmermann (2014) identify a negative correlation between inequality and government expenditure on a sample of 16 OECD countries. The paper closest to our analysis in this paper is Doerrenberg and Peichl (2014), who use data for 30 OECD countries from 1981 to 2005 and provide evidence that redistributive policy measures can reduce income inequality.

The common assumption in the literature that the size of the government or the degree of redistribution of income is exogenous with respect to income inequality is, however, rather problematic. Government responses to income inequality are likely to entail redistributive fiscal instruments and thus affect the size of the government or social expenditure (Doerrenberg and Peichl, 2014). For example, a higher income inequality may motivate the government to adopt a more progressive tax system, or to increase government expenditures or social transfers. Moreover, some fiscal instruments, such as a progressive (regressive) tax system and a system of transfers (e.g. means-tested benefits and minimum income programs), may automatically increase or decrease government revenue or expenditure if the degree of inequality changes (Callan, Doorley, and Savage, 2018). However, attempts to account for this problem of endogeneity and to identify the *causal* effect of government size on income inequality are scarce.

To our knowledge, there are two studies in the literature that address this issue: Aristei and Perugini (2014) use the Generalized Method of Moments method with internal instruments (past values of the regressors), and Doerrenberg and Peichl (2014) use as instruments the extrapolated values of government spending based on the initial values of the endogenous variable measuring government size, GDP growth rates, and marginal tax rates. These studies help us to better understand the effects of government size on income inequality by alleviating the issue of reverse causality to an extent. However, in both of these studies, the past values of the endogenous policy variable (government size) may be serially correlated with its more recent values. In addition, a similar problem arises with marginal tax rates and GDP growth rates in Doerrenberg and Peichl (2014), as they are likely to be correlated with income inequality (the authors include these variables in each stage of their instrumental variable (IV)

framework to partly control for that possibility). Such possible correlations undermine a causal interpretation of the estimated effects.

In this paper, we identify the causal effect of government size on income inequality by exploring the variation in income inequality and government size in a panel of 30 European countries from 2004 to 2015. Specifically, we propose a novel instrument, *the number of political parties in the ruling coalition*, to address the possible endogeneity of government size. As we explain below, the suggested instrument captures the party polarization that reduces the political response to growing income inequalities (Finseraas, 2010) and it correlates with government size (Bawn and Rosenbluth, 2006). There are also no obvious signs indicating why it should be systematically and directly related to inequality.

Previewing the results, we find that government expenditure is negatively associated with income inequality, which is consistent with much of the literature. A key contribution of this paper is that by using a new instrument, we identify a negative *causal* effect of government expenditure on income inequality. Our results also suggest that the OLS method underestimates the magnitude of this effect. The inequality measures used in the analysis are based on disposable income, and we show that the size of redistribution has no statistical relevance to the inequality based on market income. In addition to the Gini index, we use decile shares to see whether these effects are concentrated in a certain segment of the income distribution. We corroborate the results obtained using the Gini index by showing that government expenditure increases income shares for lower income deciles and decreases them for the top deciles of the income distribution. A battery of control variables accounts for the possibility that additional factors may interact with the relationship between government expenditure and income inequality.

2 Description of data and descriptive statistics

The data cover information for 30 European countries in the period 2004-2015.[2] The estimation sample includes 346 country-year observations, which is more than in most of the previous studies.[3] Our baseline measure of income inequality is the Gini index based on equalized disposable income (Eurostat, 2017a). This measure is based on individual level data that is harmonized and standardized both over

[2] The sample includes Austria (AT), Belgium (BE), Bulgaria (BG), Croatia (CR), Cyprus (CY), Czech Republic (CZ), Denmark (DK), Estonia (EE), Finland (FI), Germany (DE), Greece (EL), Hungary (HU), Ireland (IE), Iceland (IS), Italy (IT), Latvia (LV), Lithuania (LT), Luxemburg (LU), Malta (MT), Netherlands (NL), Poland (PL), Portugal (PT), Romania (RO), Slovakia (SK), Slovenia (SI), Spain (ES), Sweden (SE), Switzerland (CH), United Kingdom (GB). We could not include France in the sample due to missing data in the Eurostat database.

[3] Gustafsson and Johansson (1999) have 89 observations; Kahanec and Zimmermann (2008) have 109 observations; Roine, Vlachos, and Waldenström (2009) include 126 observations; Milanovic and Ersado (2012) work with 177 observations; Aristei and Perugini (2014) have 327 observations; and the size of the estimation sample varies between 113 and 437 in Doerrenberg and Peichl (2014).

time and between countries. Additionally, we use net income shares of decile groups from the World Income Inequality Database (WIID)[4], which give a much more detailed picture of changes in the entire distribution beyond a single inequality index. To analyze the role of government and the effect of redistributive policies on inequality trends and income shares, we use the total expenditure of government expressed in percent of GDP as the measure of government size (Eurostat, 2017b).[5] To control for a range of possible confounding factors, we further compile data on the unemployment rate, trade openness (measured as exports plus imports as a share of GDP), the share of employment in science and technology (S&T), industry structure (employment in the agricultural sector), and union density (Visser, 2016). Data for the number of political parties in the ruling coalition, which is used as an instrument for government size, is sourced from the ParlGov database (Döring and Manow, 2018). In the Appendix, Table A1 provides the definitions and sources of all the variables.

Table 1 reports the basic descriptive statistics of the main variables used in the analysis (Table A2 in the Appendix presents statistics for each country). The key variables – the measures of inequality and government size – exhibit large variation in the studied sample (see also Figures A1 and A2). The Gini index takes values from 22.5 to 38.9, while the government expenditure share on GDP ranges from 32.9 to 65.1 in our sample. The varying levels of the Gini index are illustrated as a scatterplot with a 45-degree line in Figure 1. Between 2005 and 2015, inequality decreased in many countries, with the index above 30 Gini points in 2005 (i.e. countries which lie below the diagonal 45-degree line), although inequality noticeably increased in Bulgaria, Lithuania, and Spain. Among the countries with a Gini index below 30 points in 2005, inequality increased most steeply in Cyprus, Denmark, Germany, and Sweden, while it substantially decreased in Norway.

Figure 2 then illustrates the changes in government expenditure between 2005 and 2015. In most European countries, government expenditure remained high in 2015 compared to 2005 (note that in Figure 2 most countries are positioned above the diagonal 45-degree line). Responding to the Great Recession and other factors, government expenditure followed different trajectories across countries (see Figure A2). On average, government expenditure temporarily increased from 42.9 in 2005 to 47.2 percent in 2009, and decreased to 44.5 by 2015. It is this variation in the key variables within the studied European countries that we exploit in our analysis.

[4] UNU-WIDER, World Income Inequality Database (WIID3.4)
[5] The indicator is compiled on a national accounts (ESA 2010) basis.

Table 1 Summary statistics for our main variables

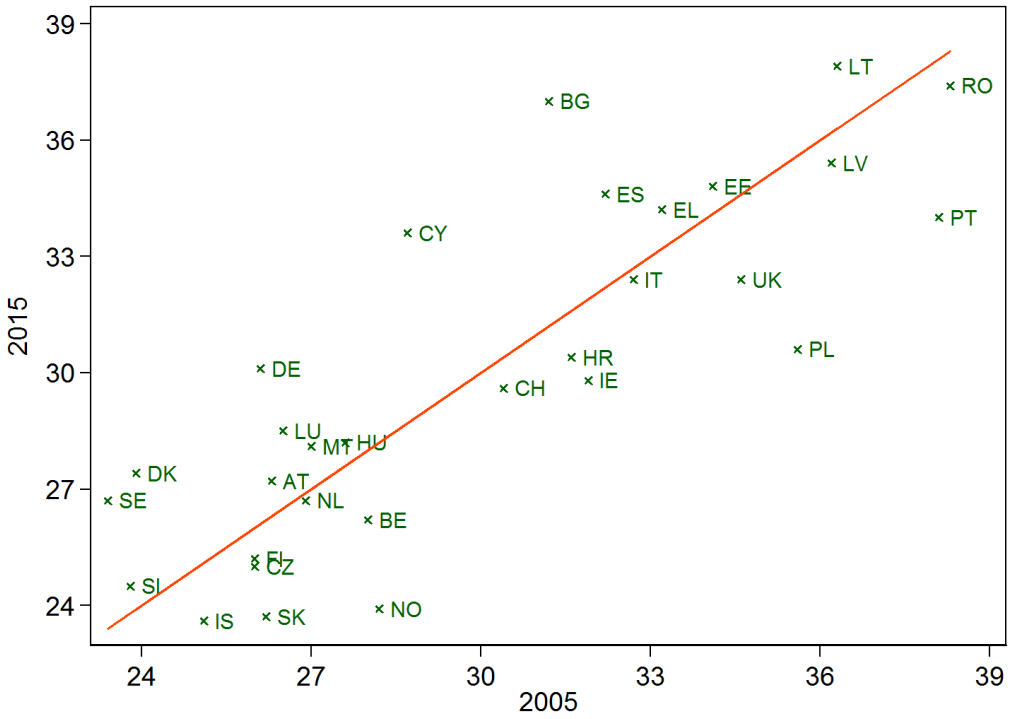
	Mean	S.D.	Min	Max
Gini	29.4	4.1	22.5	38.9
Decile 1	3.2	0.7	1.4	4.4
Decile 2	5.2	0.7	3.5	6.3
Decile 3	6.3	0.6	4.8	7.4
Decile 4	7.3	0.5	5.9	8.3
Decile 5	8.3	0.4	7.1	9.2
Decile 6	9.3	0.3	8.2	10.1
Decile 7	10.6	0.3	9.5	11.1
Decile 8	12.1	0.4	11.0	13.2
Decile 9	14.5	0.7	12.6	16.3
Decile 10	23.3	2.4	19.0	30.3
Government expenditure	45.0	6.1	32.9	65.1
GDP per capita	10.0	0.7	8.4	11.3
Unemployment rate	8.6	4.4	2.3	27.5
Openness	4.7	0.4	3.9	5.8
Empl in S&T	12.0	5.2	3.2	24.9
Empl in agriculture	5.42	4.76	0.92	27.73
Union density	32.5	21.3	5.8	99.1

Source: Eurostat, ICTWSS and WIID

In Figure 3 we summarize the relationship between the Gini index and the government expenditure share. We plot these two variables and compute the predicted values of a locally weighted scatterplot smoothed fit (Royston and Cox, 2005) to illustrate their relationship. The pattern is suggestive that, for the most part, inequality is a negative function of government expenditure share.

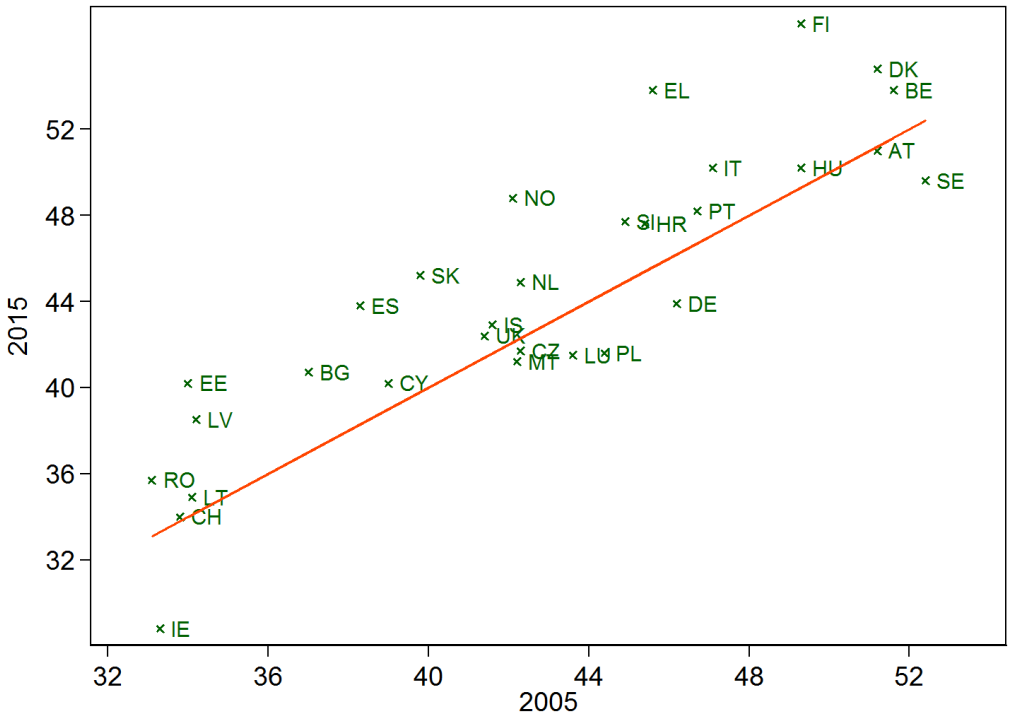
To show the impact of government redistribution along the income distribution, we explore changes in the income decile shares in the analysis. Figure 4 presents the evolution of the decile's share of total net income averaged across 30 countries from 2004 to 2015. The bottom two deciles of the income distribution register a decline in the share of income that has accelerated in recent years. The income share in the middle part of the income distribution (deciles 3-9) fell in the beginning of the studied period but rose in later years until 2012, with a small downtick in 2008 and 2009 in higher income deciles. Interestingly, income shares fell after 2012 in deciles 3-7 but remained flat in decile 8 and even increased in decile 9. The top decile exhibits large fluctuations over time with a decreasing income share between 2007 and 2012, and a rising trend from 2012. The top decile correlates with the Gini index (correlation is 0.95), while the lower segments of the income distribution are less volatile as they consist of employed wage earners with a stable income (e.g. Leigh 2007; Atkinson, Piketty, and Saez, 2011).

Figure 1 Comparison of the Gini index in 2005 and 2015



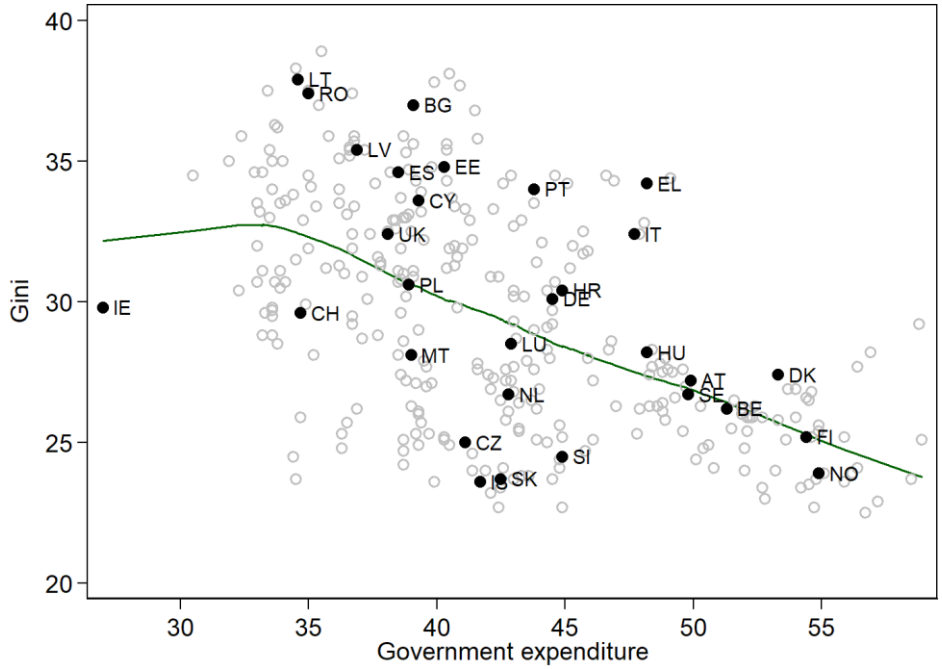
Source: Eurostat (2017a)
Note: The 45-degree line is shown.

Figure 2 Comparison of government expenditure in 2005 and 2015 (% GDP)



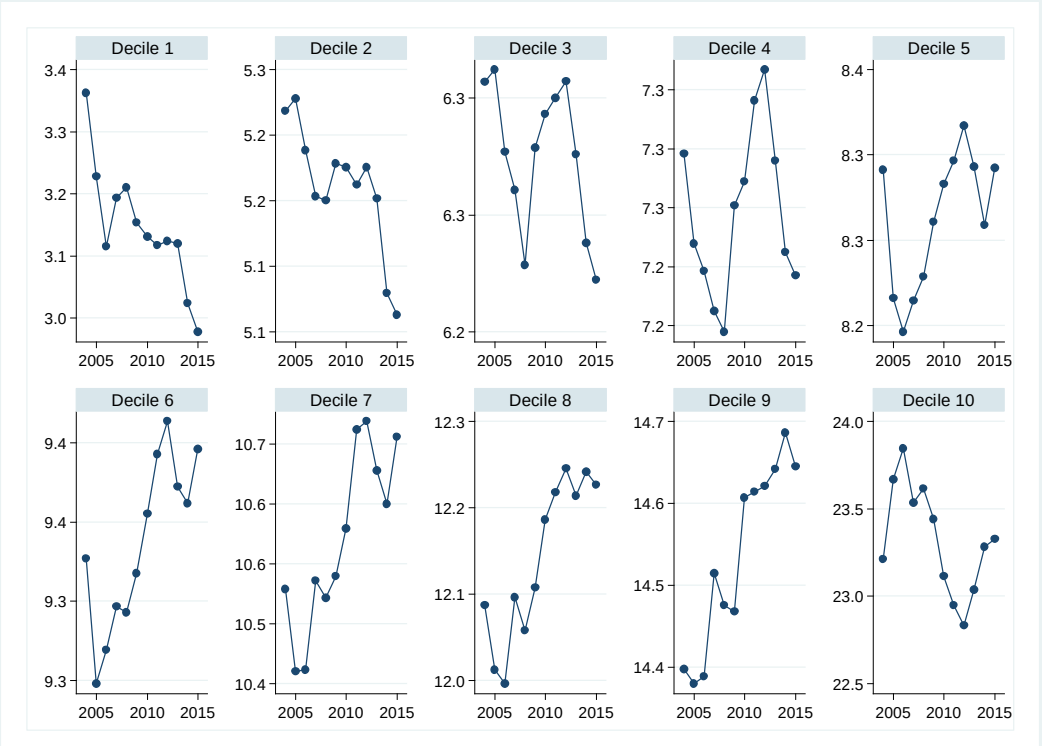
Source: Eurostat (2017b)
Note: The 45-degree line is shown.

Figure 3 Scatterplot of the Gini index as a function of government expenditure



Source: Eurostat (2017a, b)
Note: The line represents a locally weighted scatterplot smoothed fit (Royston and Cox, 2005). Full circles with labels identify the most the recent year 2015.

Figure 4 Evolution of net income shares of decile groups averaged across 30 countries



Source: WIID
Note: Decile shares sum up to 100 in each year.

3 Empirical results

The analysis relies on the estimation of a general empirical model of the drivers of income inequality. We consider the following panel data model:

$$inequality_{ct} = \beta \ \ govsize_{ct-1} + X_{ct-1}\gamma + \omega_c + \varphi_t + \mu_{ct} \quad (1)$$

where $inequality_{ct}$ is a measure of inequality for country c at time t and $govsize_{ct}$ is a measure of government expenditure in percent of GDP. The vector X_{ct} includes a set of control variables possibly affecting inequality motivated by the literature surveyed above, including the log of GDP per capita and its square, the unemployment rate, openness to trade, the share of science and technology (S&T) personnel among workers, industrial structure, and union density. The composite error term includes unobserved country-specific effects ω_c, time-specific effects φ_t, and the stochastic error term μ_{ct}. We take advantage of the panel structure of our data and estimate fixed effects models.[6] Including country-fixed effects helps to remove the effect of institutional differences (e.g. wage bargaining institutions) that affect income inequality but do not change substantially during the period observed. All of the explanatory variables are lagged by one year to partly alleviate the possible simultaneity bias. In our estimations, observations are weighted by countries' population size, and standard errors are corrected by applying the Huber and White robust variance estimator.

Table 2 shows the estimates from fixed effects models with the Gini index as the dependent variable and government expenditure. The (parsimonious) specification in Column 1 includes linear and quadratic GDP per capita, openness of the economy, and the unemployment rate. Our preferred specification is the full model with the complete set of control variables presented in Column 2. The inclusion of additional variables affects the estimated coefficients for government expenditure only marginally.

The negative and significant estimates on government expenditure support this paper's argument that a larger government size implies redistribution that decreases income inequality. The magnitude of the estimated effect can be illustrated with an example: an increase in the government expenditure share from 44.4 to 50.7% of GDP (corresponds to an increase of one standard deviation from the mean value) is associated with a Gini decrease from 30.9 to 29.8 points. The change in expenditure of such a magnitude is observed in at least a quarter of countries in the sample during the studied period. When coefficients of government expenditure in Table 2 are interpreted in terms of elasticities, the calculated elasticity of 0.22 and 0.26 in Columns 1 and 2, respectively, are consistent with the literature; Doerrenberg and Peichl (2014) estimate these elasticities in the range of 0.23-0.38.

[6] The estimates on government expenditure obtained from the specification with random effects are very similar (see Table A3). The Hausman test rejects the random effects model (at 0.1 significance level) and therefore the fixed effects model is the preferred specification.

Table 2 Determinants of income inequality. Fixed-effects panel estimations.

	(1)		(2)	
Government expenditure	-0.15	**	-0.18	**
	(0.06)		(0.07)	
GDP pc	-108.24	**	-85.36	
	(48.29)		(52.36)	
GDP pc sq.	5.64	**	4.5	
	(2.54)		(2.69)	
Unempl. rate	0.16	**	0.19	***
	(0.06)		(0.06)	
Openness	1.04		1.13	
	(3.08)		(3.06)	
Empl S&T			-0.8	*
			(0.44)	
Empl S&T sq. /100			2.89	**
			(1.27)	
Empl in agricul.			0.12	
			(0.38)	
Union density			0.03	
			(0.06)	
Constant	547.87	**	438.51	*
	(224.78)		(257.49)	
N	316		316	
R2	0.236		0.267	

Source: Authors' estimations based on the data from Eurostat and ICTWSS.
Notes: Dependent variable is the Gini index based on equivalized disposable income. Explanatory variables are lagged 1 year and all models include year fixed effects. Observations weighted by population size. Heteroskedastic-consistent standard errors are in parentheses. * $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$.

The sign and significance of the other variables are in line with the literature. Empirical research documents that the economic growth in industrialized countries is associated with increasing inequality (e.g. Freeman and Katz, 1994; Alderson and Doran, 2013). In a recent study, Castells-Quintana, Ramos, and Royuela (2015) show that in wealthier European regions an increase in GDP per capita is associated with an increase in inequality, while in poorer European regions inequality decreases with increasing GDP per capita. In our parsimonious model, both linear and quadratic forms of GDP per capita are significant, although in the full model both terms fall short of significance by a relatively narrow margin. The positive estimate on unemployment in our models is consistent with previous studies (Kahanec and Zimmermann, 2012; Doerrenberg and Peichl, 2014; Castells-Quintana et al., 2015). A possible explanation is that the risk of unemployment is higher for workers with lower human capital, who also are more likely to have less stable employment contracts. Higher unemployment thus decreases the disposable income of those already at the lower end of the income distribution. The literature points to a positive link between trade liberalization and within-country inequality, possibly because trade benefits more skill-intensive production, providing higher returns to skilled workers. Trade openness is

not significant in the fixed-effect model, and hence changes in openness occurring within a country are not confirmed as relevant to the within-country variation in income inequality (trade openness is not identified as significant by Doerrenberg and Peichl (2014) either).

The literature suggests that the relationship between income inequality and technological changes can be non-linear. Kahanec and Zimmermann (2012) develop a theoretical model predicting a U-shaped pattern of the relationships between inequality and the share of the skilled workforce. The authors argue that, for a range of parameters, an increasing share of skilled workers (e.g. resulting from immigration) reduces inequality by lowering the premium for skilled labor, and they empirically document the prediction on a sample of OECD countries. Our results are consistent with this finding: the minimum of the U-shape relationship between inequality and the share of science and technology workers is estimated to be at 13.9 percent. Half of the studied countries in our sample had the share of employment in S&T above this level in 2015. The calculated elasticity at mean values is 6.2 based on estimates in Table 2. We further show that the share of agriculture in employment, a complementary measure of the changing industrial structure, is not related to income inequality in our models. The variation in union density within countries over time also does not show a significant association with income inequality.[7]

We perform a series of checks to test the robustness of the estimated relationship between income inequality and government expenditure. First, we test whether the relationship is non-linear by adding the quadratic term of government expenditure into the model. The quadratic term is not significant in any specification.[8] Second, we test whether our results are driven by a specific country in the sample. To this end, we estimate the full model, omitting one country from the sample at a time. The coefficients on the government expenditure retain their significance at the 0.05 level in all cases of excluding individual countries from the sample, signifying a high degree of the robustness of our results. Third, we estimate the models of Table 2 using the share of total government revenues in GDP instead of the share of government expenditures in GDP; however, the coefficients are not significant (t-stat is below 0.9). Similarly, we obtain insignificant results (t-stat below 0.7) when using the total tax receipts in GDP as a measure of government size.[9] These results are not surprising, as the literature documents that the direct effects of taxation on reducing income inequality are relatively small (e.g. Doerrenberg and Peichl, 2014; Roine et al., 2009; Roser and Cuaresma, 2016). Our findings thus corroborate the general result from the other studies that the size of expenditure is related to income inequality, but the amount of revenues earned by a government is less so.[10]

[7] Doerrenberg and Peichl (2014) find that the power of employees in wage bargaining is negatively related to inequality in some, but not in all specifications they study.

[8] When the quadratic of government expenditure is added to the full model, the linear term remains marginally significant (t-stat is 1.69) and the quadratic term is not significant (t-stat 1.50). Results are available from the authors upon request.

[9] Government revenue is sourced from Eurostat (gov_10a_main) and total tax receipt is sourced from Eurostat (gov_10a_taxag).

[10] One reason for the difference between the effects of expenditure- and revenue-based measures of government size on income inequality may be the relationship between inequality and fiscal stabilization policy, which drives

Fourth, we estimate the full model using decile shares, which test the robustness of our results on the effects of government expenditure on income distribution across all deciles of income distribution. Decile share is defined as the net income share of i-th decile (deciles running from 1, the poorest, to 10, the richest) in the total income of the country in a given year. The results in Table 3 show that government expenditure is positively associated with the share of income in the lowest deciles and negatively associated with the share of income in the top deciles of income distribution. This lends further support to our baseline results that government expenditure reduces income inequality. Larger government expenditures thus imply, in line with our findings for the Gini coefficient, more redistribution of resources from the richer towards the poorer strata of the society, and thus it reduces net income inequality. The calculated elasticity for the bottom four deciles ranges from 0.45 to 0.11, and elasticity is -0.20 for the top decile.

Table 3 Explaining decile shares

	D1		D2		D3		D4		D5	D6	D7	D8	D9	D10	
	(1)		(2)		(3)		(4)		(5)	(6)	(7)	(8)	(9)	(10)	
Govern. Expend.	0.03	**	0.03	**	0.02	**	0.02	*	0.01	0.01	0	0	-0.01	-0.11	**
	(0.01)		(0.01)		(0.01)		(0.01)		(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.05)	
Elasticity	0.45		0.26		0.17		0.11		0.04	0.04	-0.01	0	-0.03	-0.2	
N	303		303		303		303		303	303	303	303	303	303	

Source: Authors' estimations based on the data from Eurostat, ICTWSS, and WIID.
Notes: Dependent variable is the net income share in the i-th decile group. The presented estimates are obtained using the full model with fixed effects as in Table 2, Column 2. Data for Cyprus is missing in the WIID database. See also notes to Table 2. * p < 0.10; ** p < 0.05; *** p < 0.01.

Finally, as another robustness check, we estimate the baseline model for the Gini index based on market income as the dependent variable.[11] The coefficient on government expenditure is estimated to be insignificant (t-stat is 0.87). Hence, gross income inequality is not affected by the variation in government expenditure. This result further supports our interpretation that the coefficients obtained for the models with net income can be interpreted as representing the redistributive impact of government size in income inequality.

4 Identification strategy to measure causal effects

a wedge between the two measures of government size (and affects the budget deficit). The relationship between inequality and fiscal stabilization policy may arise over the business cycle because (i) due to stabilization policies the cyclicality of government expenditures differs from the cyclicality of tax revenues (Lane, 2003), and (ii) income inequality is correlated with the business cycle (Castañeda et al. 1998; Maliar et al. 2005).

[11] Results are available from the authors upon request. We use the Gini index of equivalized disposable income before social transfers (Eurostat table ilc_di12b).

The problem with the interpretation of the results reported above is that income inequality may trigger the government to respond by implementing less or more redistributive fiscal instruments, which are likely to affect government size (Doerrenberg and Peichl, 2014). As mentioned above, some fiscal instruments may in fact create an automatic relationship between inequality and redistribution without any additional response on the side of the government. Any such channel of reverse causality, however, biases our results and undermines their causal interpretation.

As a key contribution of this paper, we propose a new instrument to address the potential endogeneity issue in the literature by means of the IV technique (also known as two-stage least squares, 2SLS). This requires a variable that is correlated with government size, but not with inequality shocks. As in Giulietti et al. (2013), we argue that the number of political parties in the ruling coalition is a valid instrument for government expenditure. The choice of IV is motivated by Bawn and Rosenbluth (2006), who show that government spending as a fraction of GDP increases when coalitions are formed by more political parties. The rationale is that multiparty coalitions show large inefficiencies resulting in greater public spending. A similar argument is used by Milesi-Ferretti et al. (2002), who document that proportional systems favor social welfare spending to accommodate the greater variety of interests, while majoritarian systems are more prone to public good spending. Finseraas (2010) shows that political polarization, which is likely to occur in a larger coalition, is related to lower government redistribution. As a corollary, a coordination argument is that larger coalitions tend to have difficulties agreeing on austerity measures.

At the same time, we do not see strong arguments as to why the number of parties in the ruling coalition should be directly correlated with income inequality. One argument could be that inequality and the number of parties in the ruling coalition could be related by means of a channel operating though inequality's effects on the polarization of voters' views and their resulting preferences for parties, even if smaller, that most closely match their preferences. While this could lead to fragmentation of the offer of political parties, it is difficult to argue that during the period of a relatively stable political situation in Europe (2004-2015), increased inequality systematically led to situations in which more parties were needed to attain a parliamentary majority. Indeed, no clear upward or downward patterns in the numbers of parties in the ruling coalitions emerge across Europe; between 2004 and 2015 the average number of parties in ruling coalitions in the 30 European countries reported in Figure A3 in the Appendix in fact decreased by 0.24.

Table 4 presents the results from estimating the econometric model (1) using the two-stage least squares (2SLS) technique with the number of parties in the ruling coalition as an exogenous instrument. The first stage regression includes the instrumental variable, and the same controls as well as country and year fixed effects as the second stage. The estimated coefficient on the number of political parties from the first-stage is positive and significant at the 1% level. The first-stage Cragg–Donald Wald F-statistics is equal to 12.79 that surpasses the value 10 for the test of weak instrument (Stock, Wright

and Yogo, 2002). We can also reject at the 1% level the null hypotheses of under-identification and weak instruments as proposed by Sanderson and Windmeijer (2016). The first-stage Sanderson-Windmeijer chi-squared and F-statistics are equal to 13.89 and 11.74, respectively.

The results obtained using the 2SLS technique are consistent with those obtained in the fixed effects models (in Table 2 and Table 3); however, the magnitude of the point estimates with the measures of government expenditure increases. Accounting for the possible endogeneity of government expenditure in 2SLS models increases the elasticity by a factor of four relative to conditional correlations based on OLS techniques.[12] It is also reassuring that the 2SLS model with the market-income Gini index yields insignificant estimates on the government size (t-stat is 0.47), like in the OLS model above.[13]

Table 4 Explaining inequality and decile shares. 2SLS models.

	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	Gini
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Govern. Expend.	0.12**	0.07**	0.07**	0.06**	0.05*	0.03	0.04	0.04	-0.03	-0.43**	-0.67***
	(0.05)	(0.03)	(0.03)	(0.03)	(0.03)	(0.02)	(0.03)	(0.03)	(0.04)	(0.20)	(0.25)
Elasticity	1.91	0.63	0.55	0.39	0.26	0.12	0.16	0.15	-0.1	-0.82	-0.98
N	303	303	303	303	303	303	303	303	303	303	316

Source: Authors' estimations based on the data from Eurostat, ICTWSS, and WIID.
Note: Dependent variable is the net income share in the decile group and the Gini index based on equivalized disposable income. The presented estimates are obtained from the second stage regression using the full model with fixed effects as in Table 2, Column 2. The instrument is the number of political parties in the ruling coalition obtained from Döring and Manow (2018). Stata command ivreg2 developed by Baum, Schaffer, and Stillman (2016) is used for estimation. We reject the null hypotheses of under-identification (the first-stage Sanderson-Windmeijer chi-square is 13.89) and weak instruments (F-statistics is 11.74). Data for Cyprus is missing in the WIID database so the sample is smaller in models with decile variable. Regressions are weighted by the population size. Heteroskedastic-consistent standard errors are in parentheses. * < 0.10, ** < 0.05, *** < 0.01.

[12] We note, however, that the elasticities calculated based on the coefficients identified by the 2SLS model are not directly comparable to those based on the OLS estimates. This is because whereas the latter can be interpreted as the average treatment effects, the former can be interpreted in the same way only if most of the sampled countries are "compliers", i.e. they increase the government expenditure if the number of parties in the ruling coalition increases (that is, there are statistically insignificant groups of countries that never or always increase their expenditure, or actually decrease their government expenditure, if there are more parties in the ruling coalition).
[13] The results are available from the authors upon request.

5 Concluding remarks

In a recent paper, Ostry, Berg, and Tsangarides (2014) argue that redistributive policies have little direct effect on economic growth, but result in a more equal distribution of income. In this paper, we ascertain the role of government redistribution, measured as total government expenditure, as a powerful instrument capable of reducing a broad range of measures of net income inequality. The results are obtained on a sample of 30 advanced European economies with comprehensive social policies, which we follow over a period of twelve years (2004-2015).

The key contribution of this paper is that it goes beyond the conditional correlations present in most of the literature and identifies the causal effect of government expenditure on income inequality. To this end, it proposes a novel instrument: the number of political parties in the ruling coalition. The key assumption is that this instrument is directly related to government expenditure, but not directly related to income inequality. The coefficients estimated using 2SLS techniques accounting for the possible endogeneity of government size, with the instrument mentioned above, are statistically significant and larger in magnitude than those obtained by means of fixed effects and random effects methods. This indicates that indeed a higher income inequality may lead to a larger government, or more redistribution, which results in underestimation of the true effects of government redistribution on income inequality if OLS (fixed – or random effects) models are used. After accounting for the possible endogeneity of government redistribution, our estimates imply that a 1% increase in government expenditure decreases inequality (as measured by the Gini index) by 1%. The validity of the external instrument, and the contribution of this paper, is supported in a series of robustness checks.

This result is significant with respect to its policy implications. Whereas most of the literature does find an attenuating effect of government expenditure on income inequality, using the 2SLS method and a novel instrumental variable we justify the causal interpretation of this statistically significant and negative effect. In addition, our results suggest that this attenuating effect is likely to be larger than that predicted in most of the literature that estimates conditional correlations based on OLS techniques. In other words, we argue that government redistribution through expenditures (but not so much taxes) is a useful tool capable of reducing net income inequality, and even more effectively than has been predicted by previous studies. On the other hand, redistribution and taxation are likely to generate deadweight losses and distort incentives to invest or engage in various economic activities. The discussion regarding the optimal size of government needs to account for such efficiency costs. This study thus contributes to better-informed research and policy in relation to questions about the effectiveness of redistribution and the optimal size of government.

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7 Appendix

Table A1 Variable definitions

Variable	Source	Variable definition
Gini index	Eurostat (ilc_di12)	Gini coefficient for equivalized disposable income (based on EU-SILC)
Market income gini index	Eurostat (ilc_di12b)	Gini coefficient for equivalized disposable income before social transfers (based on EU-SILC)
D1-D10	WIID 3.4 database	Income share of decile groups (in %)
Government expenditure	Eurostat (gov_10a_main)	Total general government expenditure (% of GDP)
GDP per capita	Eurostat (nama_10_pc)	Gross domestic product at market prices, euro per capita, in log
Unemployment rate	Eurostat (tsdec450)	Total unemployment rate
Openness	Eurostat (nama_gdp_c)	Sum of exports and imports (% of GDP), in log
Empl S&T	Eurostat (lfsi_emp_a, rd_p_persocc)	Employment share in science and technology
Empl in agriculture	Eurostat (lfsa_egana, lfsa_egan2)	Employment share in agriculture (including fishing, hunting and forestry)
Union density	ICTWSS 5.1 database	Share of employees who are members of trade unions
Parties in ruling coalition	ParlGov database	Number of political parties in the ruling parliamentary coalition

Table A2 Country variables (average values, 2004-2015)

Country	Gini	Market income Gini	D10	Govern. expend.	GDP per capita	Unempl. Rate	Openness	Empl. in S&T	Empl. in agriculture	Union density
Austria	26.97	46.43	22.11	51.57	10.47	5.09	4.67	14.61	4.56	29.53
Belgium	26.66	47.75	21.39	52.40	10.42	7.96	5.08	13.80	1.52	54.61
Bulgaria	34.27	49.06	25.90	36.92	8.55	9.62	4.88	5.69	6.86	17.43
Croatia	30.96	49.02	22.78	47.70	9.24	15.18	4.44	6.71	10.84	31.14
Czech Rep.	25.11	44.54	21.83	42.49	9.61	6.55	4.91	11.11	3.23	16.15
Denmark	25.75	49.24	20.95	53.87	10.71	5.78	4.59	19.66	2.56	67.74
Estonia	33.14	47.99	24.80	37.81	9.38	9.33	5.05	8.85	4.42	7.72
Finland	25.76	46.28	21.68	52.91	10.46	8.05	4.39	22.91	4.17	69.56
Germany	28.96	54.85	23.20	45.00	10.38	7.32	4.49	14.41	1.70	19.01
Greece	33.72	52.10	25.40	51.37	9.90	14.95	4.06	9.02	11.70	23.00
Hungary	27.15	51.41	22.47	49.53	9.22	9.10	5.11	8.06	4.68	13.06
Iceland	25.49	39.02	22.33	45.33	10.40	4.75	4.53	19.40	5.29	84.94
Ireland	30.74	50.88	24.21	41.46	10.56	9.47	5.14	10.76	4.59	33.06
Italy	32.23	48.05	24.73	49.04	10.21	8.66	4.01	9.74	3.67	35.34
Latvia	36.29	50.14	27.03	38.58	9.14	12.17	4.71	6.38	8.86	14.83
Lithuania	34.71	51.26	26.18	37.77	9.17	10.71	4.95	8.83	9.89	9.69
Luxembourg	27.94	45.78	22.60	42.31	11.28	4.98	5.74	22.26	1.50	36.25
Netherlands	26.40	45.29	21.99	45.39	10.55	5.51	5.01	13.13	2.44	18.94
Norway	24.61	44.45	21.28	43.36	11.11	3.41	4.25	14.49	2.58	53.33
Poland	31.91	49.73	24.85	43.91	9.12	10.54	4.45	5.49	13.17	14.30
Portugal	35.70	52.53	28.02	48.18	9.72	11.39	4.28	9.07	7.16	19.86
Romania	34.91	53.78	25.24	37.69	8.77	6.68	4.36	3.54	26.04	25.26
Slovakia	25.45	42.69	21.13	40.28	9.41	13.24	5.15	7.13	3.72	16.44
Slovenia	23.75	42.14	19.76	48.06	9.78	7.19	4.92	13.67	7.24	26.22
Spain	33.08	47.33	24.28	42.92	10.05	17.08	4.10	10.87	4.39	16.33
Sweden	24.20	49.83	19.82	51.23	10.58	7.55	4.51	17.70	1.89	70.49
Switzerland	29.22	48.72	23.74	33.42	10.94	4.34	4.54	16.66	3.08	16.46
Unit. King.	32.50	53.10	25.36	44.27	10.31	6.62	4.11	12.33	1.09	26.67

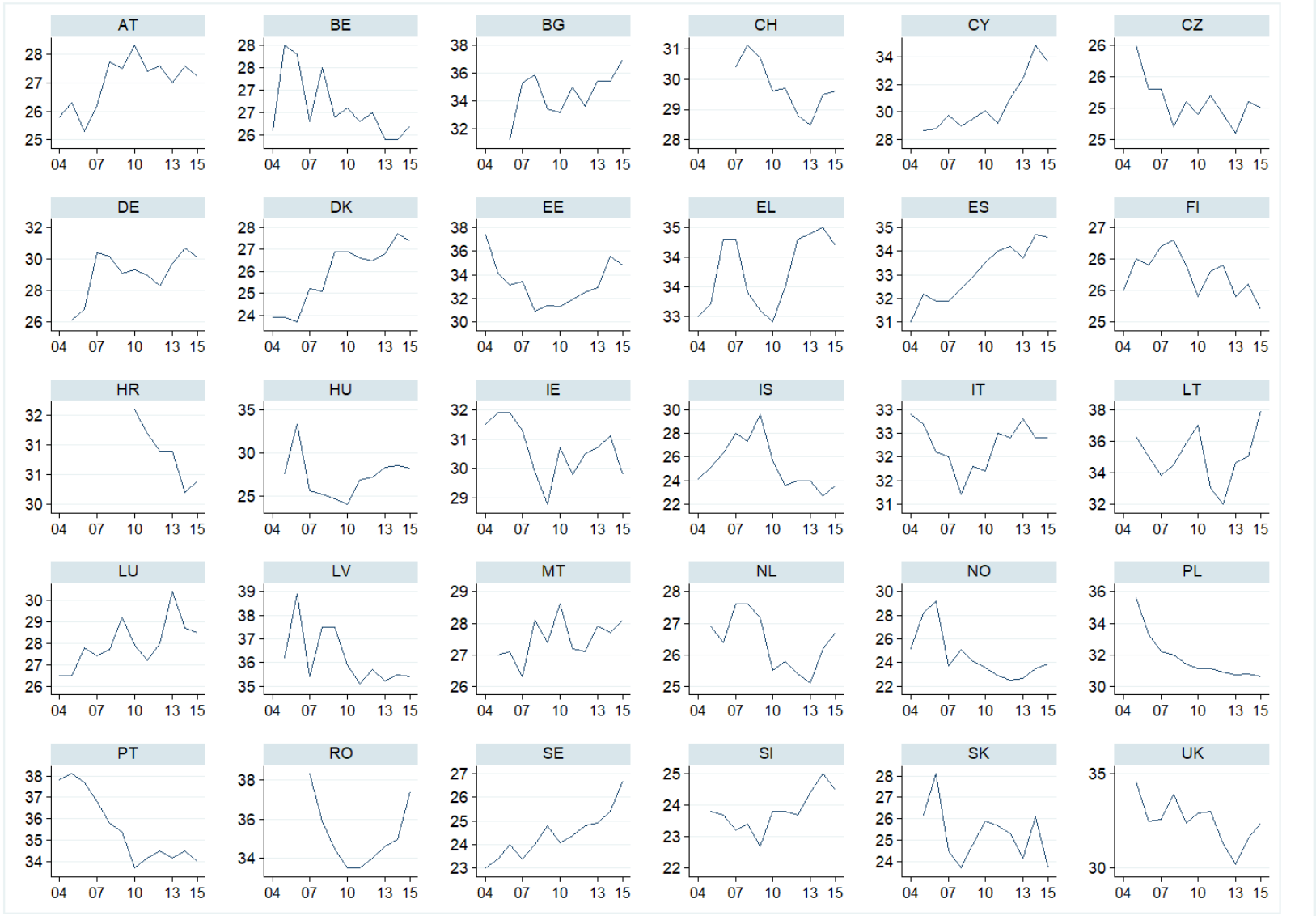
Source: Eurostat, ICTWSS

Table A3 Determinants of income inequality. Random-effects panel estimations.

	(1)		(2)	
Government expend.	-0.18	***	-0.18	***
	(0.04)		(0.04)	
GDP pc	-63.15	***	-55.92	***
	(16.00)		(19.31)	
GDP pc sq.	3.17	***	2.88	***
	(0.83)		(0.98)	
Unempl. rate	0.13	***	0.18	***
	(0.03)		(0.03)	
Openness	-2.66	**	-2.5	**
	(1.14)		(1.16)	
Empl S&T			-0.79	***
			(0.24)	
Empl S&T sq.			2.77	***
			(0.89)	
Empl in agricul.			0.05	
			(0.12)	
Union density			-0.01	
			(0.03)	
Constant	361.75	***	322.82	***
	(77.29)		(95.89)	
N	316		316	
Within R2	0.21		0.24	

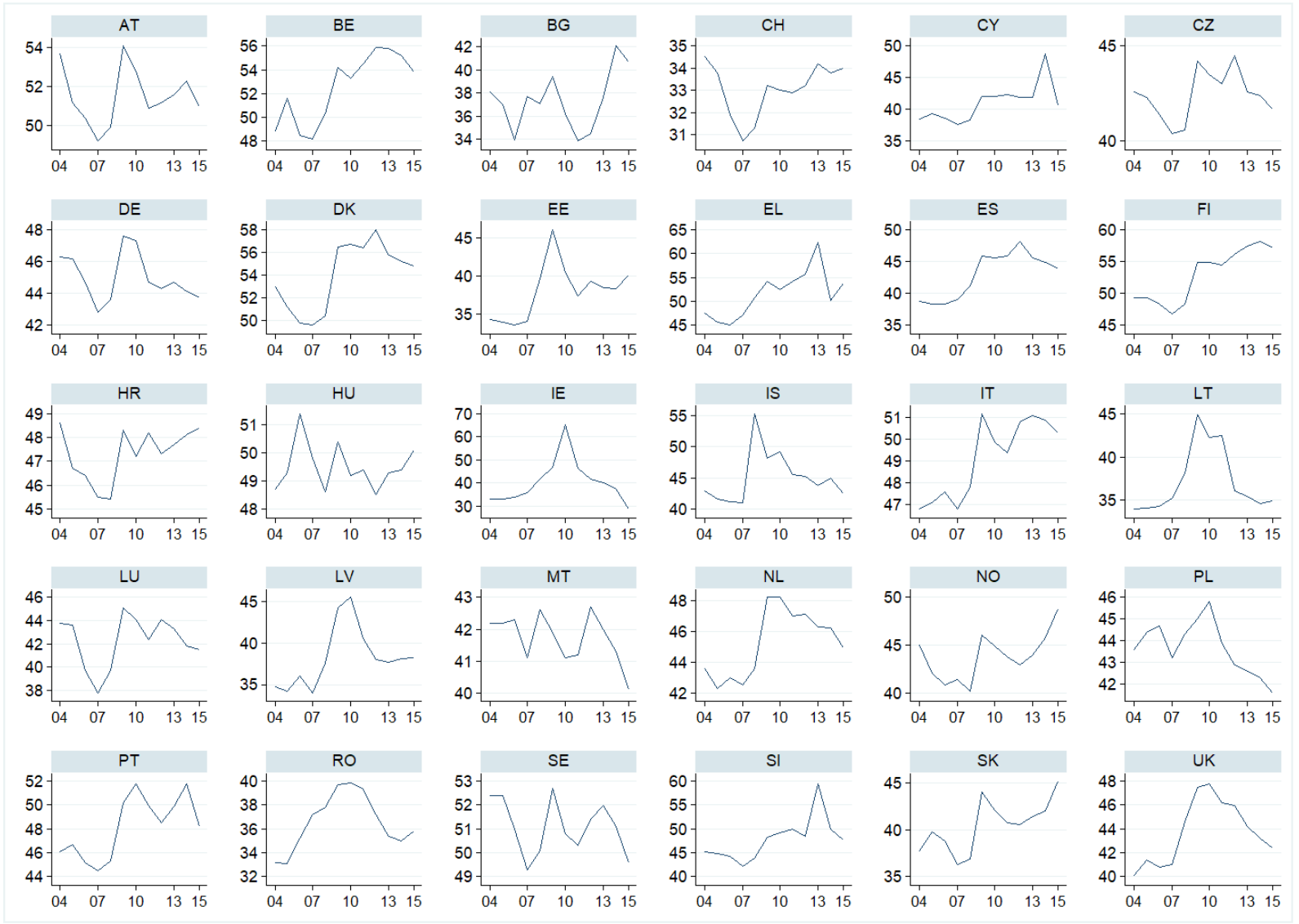
Source: Own calculations based on data from Eurostat, ICTWSS.
Notes: Dependent variable is the Gini index based on equivalized disposable income. Explanatory variables are lagged 1 year and all models include year fixed effects. Observations weighted by population size. * < 0.10, ** < 0.05, *** < 0.01.

Figure A1 Gini index, 2004-2015



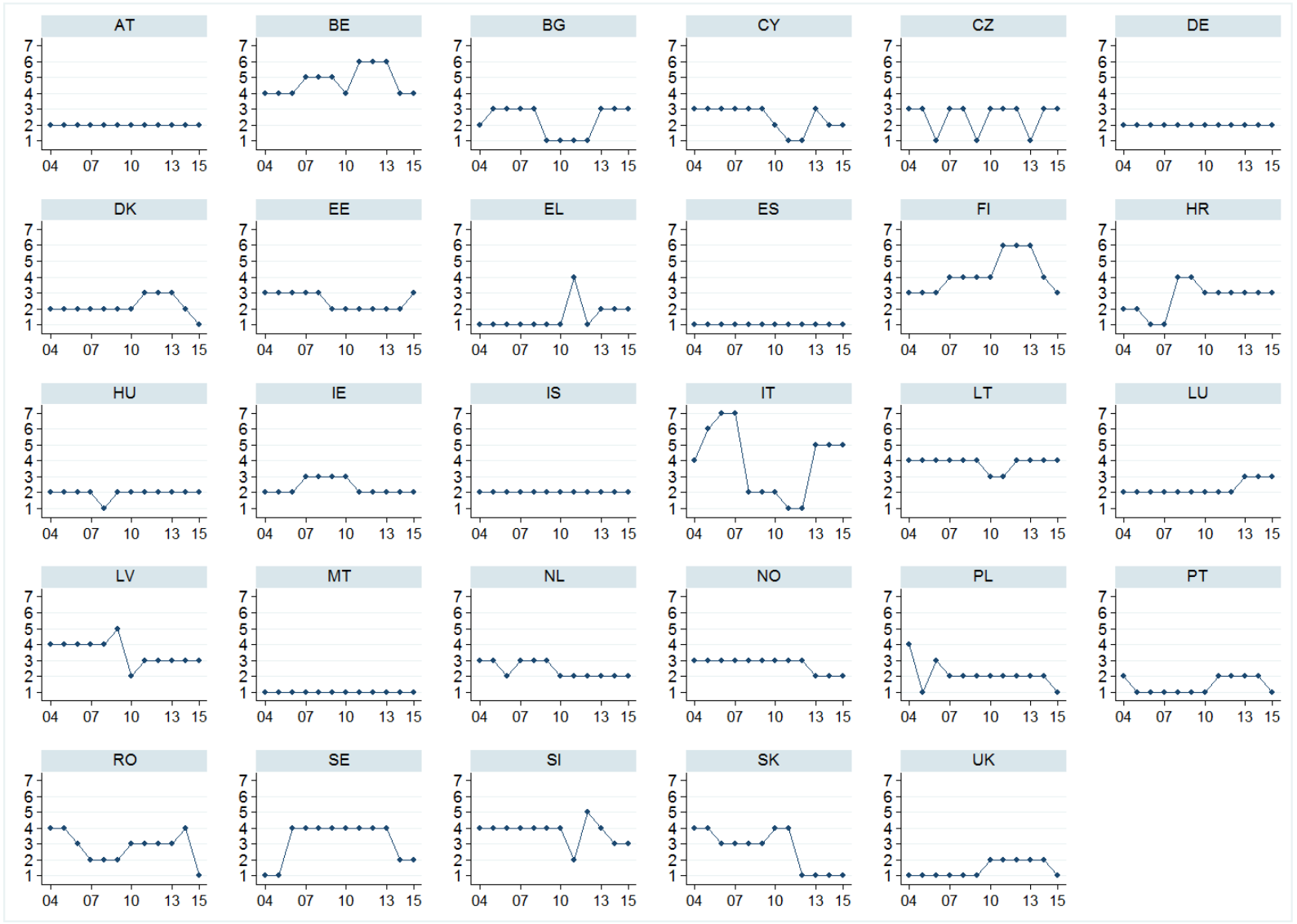
Source: Eurostat (2017a)

Figure A2 Government expenditure (% GDP), 2004-2015



Source: Eurostat (2017b)

Figure A3 Number of political parties in the ruling coalition, 2004-2015



Source: ParlGov database (Döring and Manow, 2018).