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The Determinants of Income Polarization on the Household and Country Level across the EU

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Mario Holzner

The Determinants of Income Polarization on the Household and Country Level across the EU

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Abstract

A multi-level approach to test for the determinants of income polarization both at the household as well as the country level is applied to a panel of about 300,000 households in EU countries over the period of 2003-2009. Among the policy relevant macro variables, higher progressive labour taxation and to a certain extent capital taxation is positively correlated with lower levels of income polarization. Also public expenditures on social protection, education and economic subsidies are related to a lower degree of polarization. Finally, lower unemployment, a stronger industrial base and more trade openness are also associated with lower levels of polarization.

Keywords: *government expenditures, taxes, income polarization, multi-level model*

JEL classification: *D63, H23, H5*

The determinants of income polarization on the household and country level across the EU

Introduction

Apart from inequality and poverty the issue of polarization is an important topic in the income distribution discussion. Interestingly, polarization touches on both of the former mentioned variables, inequality and poverty, as well as wealthiness. Polarization occurs when observations disperse from the middle of the distribution to either of the two tails. Standard inequality measures cannot distinguish this polarization from other kinds of inequality (Levy and Murnane, 1992). It can even be shown that increasing income polarization might go together with a fall in inequality measures. As described by Duclos, Esteban and Ray (2004), it seems fairly widely accepted that polarization is a concept that is distinct from inequality or that at least adds another dimension to it (see Yitzhaki, 2010), and that, at least in principle, it could be connected to several aspects of social, economic, and political change. A number of authors have emphasized the link between polarization and conflict. For a formal analysis of the connections between polarization and the equilibrium level of conflict in a model of strategic interaction see Esteban and Ray (1999) and for a more recent behavioural model of conflict Esteban and Ray (2011). Recent results also show that income polarization has a detrimental effect on health (see Blanco-Perez and Ramos, 2010). Thus, the possible negative socio-economic effects of income polarization are the main motivation for this research on the determinants of income polarization.

In their seminal work on measuring the polarization of income, Foster and Wolfson (1992) showed that a polarization curve could be calculated by constructing a median tangent touching the Lorenz curve of income inequality (see also Lambert, 2010 and Foster and Wolfson, 2010). Most of the literature so far has analysed aggregate measures of polarization, such as the Wolfson index (Wolfson, 1994) and many other indices established since then (such as the Esteban-Ray measure in Esteban and Ray, 1991, 1994, or the DER index from Duclos, Esteban, and Ray, 2004). Another strand of the literature uses kernel density estimates of income distributions in order to describe for instance changes in polarization patterns over time. A rather recent paper that uses both approaches and employs a decomposition exercise of the relative distribution for one country only (Italy) is Massari, Pittau and Zelli (2009).

Using cross-country data a few articles provide results on wage polarization in a number of European industries (Crocchi, Angelini, Farina and Pianta, 2009) or on regional income polarization in Europe (Ezcurra et al., 2005). Again, aggregate indices and density functions of income distributions are used for the analysis. Others have derived conclusions about

polarization by simply comparing relative aggregate income levels of states (e.g. Bandyopadhyay, 2011, on Indian states) or individual wage data (e.g. Afxentiou and Kutasovic, 2011, on the United States of America).

Thus, while polarization has been analysed in a cross-section or time series setting at both the macro and micro level separately, our interest in the issue of income polarization is related to analysing the determinants of income polarization at both the micro and macro level simultaneously in a panel data setting. This implies the use of multi-level modelling across a set of micro-economic country data sets. For instance, Lohmann (2009) used data on 20 European countries from the EU-SILC database to estimate poverty rates using both micro and macro variables. Among the country level data, variables such as bargaining centralization were considered. Also several other studies have used multi-level models to explain various aspects of inequality, such as Yodanis and Lauer (2007) who considered the institutional context. However, to our knowledge so far nobody has used a multi-level approach to test for the determinants of income polarization.

Empirical model

The focus of our analysis will be on fiscal determinants of polarization at the country level, with micro explanatory variables at the household level being part of a set of standard control variables. Following the empirical work on the United States by Larudee (2009) our main conjecture to test is that a shift from corporate and capital taxation towards personal income and value added taxation increases the polarization of incomes.

Our variable of income polarization is the ratio of household income to the median income of each country and year in percentage points. This type of dispersion measure was first used in order to describe at the aggregate level the disappearance of the middle class in the early polarization discussion of the 1980s (see e.g. Thurow, 1984, who was one of the first to point out the increased polarization of the US income distribution by defining the middle class as those with incomes between 75 and 125 per cent of the median income). Our analysis will be carried out for incomes both above and below the median separately in order to ensure a clear interpretation of the results. The median income of the full distribution will be included in both sub-samples analysed. Thereby we can indicate for instance to what extent a large share of capital taxation correlates with polarization of income above and below the overall median income. Presumably these effects will be stronger above the median where capital income is of greater importance. We believe that this is superior to earlier fiscal policy analysis (see e.g. Oliver, Piccoli and Spadaro, 2010) looking at the effects of certain policies on aggregate polarization measures only, where for example, the DER index requires a particular choice of a parameter value that can be interpreted as the relative weight given to polarization with respect to inequality.

Thus, in order to empirically analyse the possible determinants of income polarization we employ tools to combine macroeconomic data from the country level with microeconomic personal and household level data. In a multi-level (i.e. hierarchical or mixed) model, different institutional settings in aggregate macro variables can be included in a microeconometric analysis. Here we use a multi-level mixed-effects linear regression estimator similar to the one developed by Rabe-Hesketh and Skrondal (2005) and applied by Baltagi, Song and Jung (2001) for instance.

To combine the two (micro and macro) levels, the determinants of income polarization can be specified as:

$$p_{ijt} = x'_{ijt} \beta + u_{ijt}, \quad (1)$$

where p_{ijt} is the income polarization indicator of household j , in country i , at period t , x'_{ijt} is a vector of household and country specific explanatory variables. The disturbance of (1) is given by:

$$u_{ijt} = \mu_i + v_{ij} + \varepsilon_{ijt}, \quad (2)$$

where μ_i denotes the i th unobservable country specific effect, v_{ij} denotes the nested effect of the j th household within the i th country and ε_{ijt} denotes the remainder disturbance, where all three are assumed to be i.i.d. $(0, \sigma^2)$. Thus, each successive component of the error term is nested within the preceding component.

Data

For the dependent variable and the household-level explanatory variables we use the core output variables of the rotating 4-year panel sub-sample of the EU-SILC database. This data is available for 26 EU countries (Germany is not included in the panel) within the period 2003-2009. More than 300,000 households are covered in this longitudinal sample. EU-SILC is the most comprehensive dataset on EU economies available that can be drawn on for panel data analysis of household income.

However, it should be noted, that this well designed set of national surveys has a number of shortcomings concerning the representativeness and comparability of the sample. This concerns for instance the overestimation of annual incomes of wage earners in the lower deciles and underestimation of those in the upper deciles in many of the samples (see e.g. Statistik Austria, 2009). Similarly, in other samples minorities and children are underrepresented, whereas persons with higher education levels are overrepresented (Hauser, 2007).

For the purpose of our research the household income polarization status is calculated as an equivalized¹ disposable household income as a percentage share of median household income for each country and year. We analyse separately the incomes equal to or above the overall median and those equal to or below. This allows us to estimate different coefficients for our explanatory variables depending on whether polarization in the lower or upper tail of the income distribution in the society is being analysed. Apart from the fact that our estimator can't cope with the full sample of more than 600,000 observations it also would be impossible to properly interpret the coefficients of a joint estimation due to the fundamentally different impact of policies on incomes above and below the median of the income distribution.

In this respect it is worthwhile to have a look at the pooled polarization status data in a symmetry plot (see Figure 1). This plot graphs the distance from the median of points above the median against the corresponding points below the median. The interpretation of this plot is that the closer these points lie to the 45 degree line, the more symmetric the data is. Obviously this is not the case. Polarization is much more pronounced in the upper tail of the distribution for a large portion of the observations. Hence we are especially interested in the outcomes of the analysis on polarization above the median income of the total distribution.

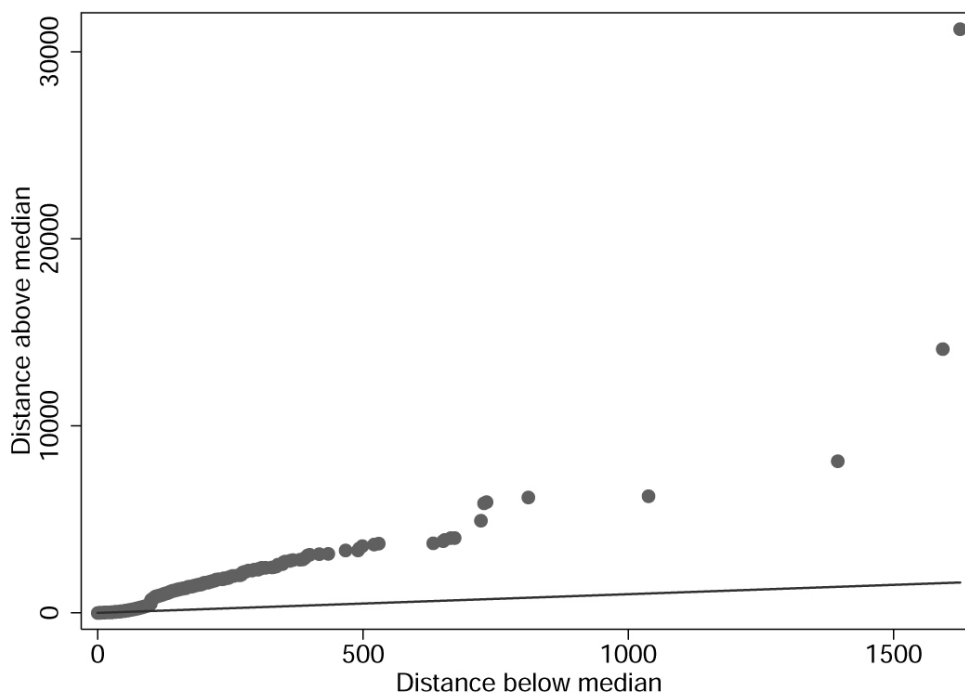
There are a number of huge outliers in the upper part of the distribution. The top ten upper outliers run from about 4,000% to more than 31,000% of the respective median income. These include households from the UK, Estonia, Slovakia, Finland, Luxemburg and Belgium, mainly for the boom year 2006. In the lower part polarization is less pronounced but not necessarily bound to positive values. The top ten lower outliers have negative income² from -560% to around -1,500% of the respective median income. These are households from Belgium, Denmark, Spain and France, and mainly for the crisis year 2009. We refrained from an initial impulse to drop all the outliers as it is often lamented that household surveys do not cover extreme cases. Moreover we believe that the few extreme outliers will not spoil our regressions given the huge amount of total observations, an assumption which will be tested.

¹ Household income was weighted using the modified OECD equivalence scale, which is currently used by Eurostat. A weight of 1.0 was given to the first adult, 0.5 to the second and each subsequent person aged 14 and over and 0.3 to each child aged under 14.

² According to Van Kerm (2007) EU-SILC income data can be negative due to the following reasons. First, some elements are counted as income deductions. Negative incomes can arise because of taxes that have to be paid on incomes received in an earlier year. Losses can be observed with self-employment income. Inter-household mandatory payments (alimonies) may also be a source of substantial income deductions. Second, several sources of income are not captured in standard definitions of disposable income (e.g. capital gains or home-production). Furthermore, income is measured during a limited time period but people can draw on past (and future) incomes to maintain their command over goods and services.

Figure 1

Symmetry plot of household polarization status, EU countries, 2003-2009



Source: EU-SILC database, own calculations.

On average Northern (e.g. Denmark and Sweden) and Central European (e.g. Slovenia and Austria) countries tend to have lower levels (about 110% of the median) of mean polarization while Southern (e.g. Portugal and Greece), Eastern (e.g. the Baltic countries) and Western European (e.g. Ireland and the UK) countries tend to have rather higher levels (about 125% of the median) of mean polarization (see Appendix Table 1 for descriptive statistics of polarization status by country).

The micro level control variables in our analysis comprise the following household head and average household characteristics. A household head sex dummy variable controls for income discrimination of women. A household head age variable in years controls for the impact of seniority on income. In order to grasp the employment situation of the households we use the employment rate in per cent for all those members of the household above the age of 15 who are employed and not in education. Finally we make use of an education variable constructed as the average of standard schooling years up to the highest level of education completed among all those members of the household above the age of 15 who finished education.

For the macroeconomic explanatory variables we use data available from Eurostat. Given that the rather persistent income distributions are typically affected by macro variables slowly, all our macroeconomic explanatory variables are calculated as three year simple moving averages (3ySMA) of the current as well as lag t-1 and t-2 values. The use of the

moving average also allows us to smooth out short-term fluctuations and highlight longer-term trends and cycles. Again, this will be checked in a sensitivity analysis.

We further include a number of macroeconomic variables. These include the real GDP growth rate, the level of nominal GDP in EUR million, the unemployment rate, the CPI inflation rate, the share of industry in GVA as well as the share of the current account debit position in goods trade (i.e. imports) in GDP. While the reasoning behind the inclusion of the former variables appears to be quite straightforward as controls for the dynamics and size of the economy, the inclusion of the latter two variables controlling for the situation in the labour market and price developments, might be somewhat less obvious. The industry share should be an indicator of the industrial base of a country and how well it can cope with competition on international goods markets. The import share is an indicator of the openness of an economy. We include these variables as the recent literature emphasizes the impact of international trade on the distribution of income. For instance Helpman et al. (2012) show in their theoretical and empirical model that relatively low levels of trade openness and export capacity can be related to higher wage inequality.

Also the rate of unionization (OECD data including intra- and extrapolations) as well as the level of the local stock exchange's trading index (2005=100) will be controlled for in order to see how the involvement of trade unions and stock market booms and busts influence income polarization. For the latter two indicators data is not available for all countries in the sample.

Finally we include government policy variables which are the focus of our analysis. This encompasses both detailed general government revenue as well as expenditure items as shares in GDP. Eurostat provides for the structure of taxes by economic function. Here we include the variables taxes on consumption, taxes on labour and taxes on capital. We also include general categories of state expenditures as shares of GDP according to the COFOG classification. This comprises general government expenditures for economic affairs (i.e. subsidies), housing and community amenities, health, education and social protection.

We restrained from including other expenditure variables such as general public services, defence, public order and safety, as these are likely to have less of an impact on broad incomes as compared to the aforementioned and thus we would have considerable difficulties in interpreting the coefficients. Our *a priori* expectations regarding the coefficients of the fiscal indicators are the following. Following Larudee (2009), our main conjecture to test is that a shift from capital taxation towards taxation of labour and consumption increases the polarization of incomes. Regarding general government expenditures for subsidies, education, health, housing and especially social protection, the expected effect is a polarization reducing one. Table 1 presents descriptive statistics for all the variables employed in our analysis.

Table 1

Descriptive statistics for EU households and countries between 2003 and 2009

	Obs.	Mean	Std. Dev.	Minimum	Maximum
Dependant variable					
Household income in % of median	638322	116.4	94.8	-1525.5	31314.2
Micro control variables					
Female household head	637276	0.39	0.49	0.00	1.00
Age of household head	638322	54.8	15.4	14.0	83.0
Household employment rate	638322	49.3	42.2	0.0	100.0
Average years of education	638322	10.2	4.2	0.0	17.0
Macro control variables 3ySMA					
GDP growth rate	638322	3.0	2.5	-3.8	10.3
GDP level in EUR mn	638322	565648	631375	5692	1945798
Goods imports in GDP	638322	39.3	16.1	19.3	78.5
Unemployment rate	638322	7.6	2.9	2.8	18.8
Industry share in GVA	638322	21.0	5.1	8.7	30.5
CPI inflation rate	638322	2.9	1.6	0.7	10.7
Trade union density	574536	29.5	17.9	7.3	78.0
Stock market index (2005=100)	633804	109.1	25.3	49.8	259.8
Government taxes in GDP 3ySMA					
Taxes on consumption	638322	11.7	1.6	8.3	16.8
Taxes on capital	638322	8.0	2.5	2.4	13.1
Taxes on labour	638322	18.0	4.5	10.0	29.7
Gov. expenditures in GDP 3ySMA					
Subsidies	638322	4.7	1.0	2.9	8.4
Education	638322	5.4	0.9	3.6	7.7
Health	638322	6.2	1.2	3.0	8.0
Housing	638322	0.9	0.5	0.2	2.8
Social protection	638322	16.3	3.6	9.2	23.8

Source: EU-SILC database, Eurostat and OECD, own calculations.

In general it has to be mentioned beforehand, that the interpretation of the coefficients acquired in our estimation exercise is not always that easy, as for most of the possible relationships no elaborated theory yet exists. This has to be seen as a predominantly empirical analysis that lays the foundations for future more detailed analysis of the mode of action of the single impact factors.

Results

Our multi-level estimation strategy includes the use of two different estimation methods and two different sets of explanatory variables applied at both the upper and the lower income subsamples, in order to check for the robustness of the results.

The two most popular multi-level estimation methods include the maximum-likelihood estimation (MLE) as well as the restricted maximum likelihood (REML) approach. The MLE is

based on the usual application of likelihood theory, while REML is a particular form of MLE. It assumes that a set of linear contrasts of the response can be formed that do not depend on the fixed effects, β , but instead depend only on the variance components to be estimated. In contrast to MLE, REML can produce unbiased estimates of variance and covariance parameters, although in large samples the difference between MLE and REML should be negligible³.

The difference between the two sets of explanatory variables are the stock market index and especially the trade union density indicator, both of which are available only for 20 EU countries, i.e. for several thousand observations less than the other explanatory variables employed in this research. Hence we will have estimations with and without these two indicators.

The large dataset and the sophisticated methodology are the main reason why we were not able to perform standard tests, such as tests for heteroskedasticity. Also, although we expect the data to be heteroskedastic, it is impossible to control for this, due to the estimator not being able to cope with so many observations. Hence, the results of the following specifications of our model have to be interpreted with due caution. A multicollinearity check has been made. None of the explanatory variables are correlated with each other by more than 80%. Border cases are taxes on labour and social protection expenditures (77%) as well as trade openness and GDP (-69%).

In Table 2, specifications A1-A4 present the results for the subsample of household polarization status equal or above the median. The first two specifications were acquired by MLE for the restricted and the full set of explanatory variables, while A3 and A4 are based on REML method for the restricted and the full set of explanatory variables. The micro control variables proved to be highly significant in all the specifications and of the expected sign. A female household head is correlated with incomes closer to the median, while the opposite holds true for the remaining variables, age of household head, household employment rate and average years of education.

In the group of macro control variables fewer coefficients are significant. While the GDP growth rate is insignificant in all specifications, the level of GDP remains significant only in the full specifications A2 and A4. The coefficient is positive indicating that high polarization above the median is correlated with larger economies, an expected result. The indicators of trade openness and the industrial base both have a negative sign. The former is only significant in the restricted specifications while the latter is in all four specifications. This seems to confirm the hypothesis based on Helpman et al. (2012), as countries that have high levels of trade openness and exporting capacities appear to have lower levels of income polariza-

³ For more details on the difference between the two methods see the Stata manual on the applied multi-level Stata command *xtmixed*.

tion above the median. Unsurprisingly, high unemployment rates are correlated with high polarization statuses above the median. Higher inflation is only significantly negatively correlated with polarization above the median in the full specifications. Thus inflation seems to hurt especially those households far above the median income. In the full specifications trade union density does not prove to be significant while periods of stock market booms were apparently correlated with reduced levels of polarization above the median. At first sight this comes as a surprise. However, when looked at in an inverted way, stock market crashes appear to be especially harmful to incomes closer to the median.

Table 2

Multi-level estimation results for polarization status above the median

Dependent variable: Household income in % of country median \geq 100%				
Estimator:	MLE	MLE	REML	REML
Specification:	A1	A2	A3	A4
Constant	151.76 ***	190.83 ***	150.36 ***	190.22 ***
Micro control variables				
Female household head	-5.29 ***	-5.20 ***	-5.29 ***	-5.20 ***
Age of household head	0.28 ***	0.34 ***	0.28 ***	0.34 ***
Household employment rate	0.13 ***	0.12 ***	0.13 ***	0.12 ***
Average years of education	4.05 ***	3.82 ***	4.05 ***	3.82 ***
Macro control variables 3ySMA				
GDP growth rate	-0.15	-0.28	-0.16	-0.29
GDP level in EUR mn	0.00	0.00 **	0.00	0.00 **
Goods imports in GDP	-0.20 **	-0.05	-0.19 **	-0.03
Unemployment rate	0.93 ***	0.65 ***	0.92 ***	0.66 ***
Industry share in GVA	-0.97 ***	-0.80 **	-0.97 ***	-0.79 **
CPI inflation rate	0.12	-1.23 ***	0.10	-1.24 ***
Trade union density	-	0.11	-	0.10
Stock market index (2005=100)	-	-0.06 ***	-	-0.06 ***
Government taxes in GDP 3ySMA				
Taxes on consumption	2.57 ***	2.12 ***	2.63 ***	2.14 ***
Taxes on capital	-1.67 ***	-2.53 ***	-1.70 ***	-2.59 ***
Taxes on labour	-0.86 **	-0.84 *	-0.81 *	-0.77
Gov. expenditures in GDP 3ySMA				
Subsidies	-1.70 ***	-1.45 **	-1.72 ***	-1.42 **
Education	-2.62 *	-7.44 ***	-2.55 *	-7.51 ***
Health	1.65 **	0.75	1.61 **	0.70
Housing	1.90	-0.31	1.89	-0.47
Social protection	-1.89 ***	-1.88 ***	-1.91 ***	-1.90 ***
Number of observations	318941	287061	318941	287061
Number of countries	26	20	26	20
Number of households	151188	133277	151188	133277

Note: *, ** and *** denote statistical significance at the 10, 5 and 1 per cent levels respectively.

Finally we turn to the fiscal indicators of interest. Results for taxes on consumption and taxes on capital are highly significant and have the expected sign. While the former coeffi-

cient has a positive sign, the latter is negative, indicating that higher levels of capital taxation are correlated with reduced polarization above the median as indicated in Larudee (2009). The interpretation of the coefficient of the capital taxation share in specification A1 for instance is the following. A one percentage point increase in the share of capital taxes in GDP is correlated with a 1.7 percentage points lower level of polarization of household incomes above the median income in country i and year t . The coefficients on taxes on labour are only weakly significant and if anything negatively correlated with polarization above the median. Hence it appears as if labour taxation might have a weakly redistributive effect.

Regarding government expenditure, the following observations can be made for the subsample of relative household income above the median. As expected, expenditures on social protection, subsidies and to a certain extent education are significantly negatively correlated with higher levels of polarization. The coefficient for housing expenditures is insignificant while, surprisingly, the coefficient for public health expenditures is positive and at least significant in specifications A1 and A3. This is even more surprising when looking at the underlying data. Especially highly egalitarian countries such as Denmark and Austria have high public health care expenditures. However, there are also a few less egalitarian countries such as the UK and Italy ranking quite high in public expenditures for health. The latter group of countries might explain the positive coefficient therefore. In any case the mode of operation would be somewhat unclear. It might be related to higher wages for doctors in the sheltered public sector or rather to an increased use of public health services by wealthier households which have higher levels of health awareness and higher life expectancies.

Analogous to the above results, Table 3 presents the estimated coefficients of the respective specifications B1-B4 for the subsample of household polarization status equal or below the median. The coefficients of the micro control variables share the same sign (and interpretation) and level of significance as in the four previous specifications. Again, the respective income increasing and decreasing factors are the expected ones. However, the signs of all the following macro coefficients have to be interpreted in a different way as compared to specifications A1-A4. Now, a positive coefficient is correlated with less polarization and a negative one with more.

Among the macro control variables some coefficients have the same effects as before, though quite a number of coefficients have changed their effects on polarization (i.e. their signs remained the same) as compared to the results of the above median subsample, while some coefficients that were previously insignificant now become significant. The meaning of the coefficients on trade openness, the industrial base, unemployment and stock market booms (or rather crashes) remains the same. Higher trade openness is correlated with less polarization below the median (again only significant in the first and third specification), a larger industrial base goes together with less polarization (see specification B2 and B4, in the other two specifications the sign switches but this is hardly significant

at all), higher unemployment with more polarization and stock market crashes hurt those households who have incomes far below the median most.

As regards the interpretation switchers (i.e. that have not changed signs), larger economies measured in nominal GDP happen to have less polarization below the median and higher rates of inflation coincide with more polarized households below the median. Thus it appears that larger countries have relatively more extremely rich inhabitants as well as relatively fewer extremely poor citizens. The results for inflation might hint at the possibility that both the rich and the poor have predominantly fixed incomes and thus are less capable of protecting themselves from inflation, or alternatively, that they can cope better with a deflationary situation for the same reasons.

Table 3

Multi-level estimation results for polarization status below the median

Dependent variable: Household income in % of country median \leq 100%				
Estimator:	MLE	MLE	REML	REML
Specification:	B1	B2	B3	B4
Constant	35.04 ***	30.66 ***	34.82 ***	30.25 ***
Micro control variables				
Female household head	-2.08 ***	-2.13 ***	-2.08 ***	-2.13 ***
Age of household head	0.23 ***	0.23 ***	0.23 ***	0.23 ***
Household employment rate	0.10 ***	0.10 ***	0.10 ***	0.10 ***
Average years of education	0.58 ***	0.54 ***	0.58 ***	0.54 ***
Macro control variables 3ySMA				
GDP growth rate	-0.10 ***	-0.01	-0.10 ***	-0.01
GDP level in EUR mn	0.00 *	0.00 ***	0.00 *	0.00 ***
Goods imports in GDP	0.08 ***	-0.04	0.08 ***	-0.04
Unemployment rate	-0.16 ***	-0.14 ***	-0.17 ***	-0.14 ***
Industry share in GVA	-0.11 *	0.18 **	-0.12 *	0.17 **
CPI inflation rate	-0.72 ***	-0.65 ***	-0.73 ***	-0.65 ***
Trade union density	-	-0.21 ***	-	-0.21 ***
Stock market index (2005=100)	-	0.02 ***	-	0.02 ***
Government taxes in GDP 3ySMA				
Taxes on consumption	0.93 ***	0.77 ***	0.94 ***	0.78 ***
Taxes on capital	-0.24 ***	-0.15	-0.25 ***	-0.16
Taxes on labour	0.90 ***	0.94 ***	0.91 ***	0.96 ***
Gov. expenditures in GDP 3ySMA				
Subsidies	0.11	0.33 **	0.10	0.33 **
Education	0.46	1.00 ***	0.50	1.06 ***
Health	-1.31 ***	-1.51 ***	-1.32 ***	-1.52 ***
Housing	-1.76 ***	-1.29 **	-1.81 ***	-1.36 **
Social protection	-0.06	0.31 **	-0.06	0.31 **
Number of observations	318419	286577	318419	286577
Number of countries	26	20	26	20
Number of households	151845	134195	151845	134195

Note: *, ** and *** denote statistical significance at the 10, 5 and 1 per cent levels respectively.

Moreover we find now two variables to have significant results (at least in two of the specifications), which before were insignificant. In countries with higher GDP growth rates more polarized households below the median can be found. This result is mainly driven by the fact that the highly polarized Baltic countries had the highest growth rates in the period under observation. This might be related to the Kuznets curve theory, whereby fast growing but less developed countries face larger income inequalities. The negative coefficient of the trade union density variable is rather puzzling, indicating positive correlation with more polarized households below the median, especially as we find the highly egalitarian Nordic countries to have the highest trade union density shares of around 70%. It might well be however, that the trade unions mostly represent the interests of the incomes just below the median, but not those of the poorest.

For our taxation variables we again find some redistributive effects of labour taxation as higher shares of labour taxes are correlated with lower levels of polarization below the median. Here, the effects of consumption and capital taxes have the opposite impact to that found when considering incomes above the median. Now, a higher level of mass taxes such as VAT are related to less polarized household income below the median, while a larger share of capital taxation is related to more polarization below the median. One explanation might be that, in economies with a lot of poverty, consumption taxes are used to redistribute incomes below the median, while capital revenues are smaller in size and mainly curb the incomes of the rich but are less important as a source of income for the poor.

The coefficients of the government expenditure variables have the same relationship with income below the median as they did with income above the media. It is still the case that public expenditures on social protection, subsidies and education are related to less polarization below the median, while health expenditures show the opposite sign. The coefficients for public housing expenditures are now significantly correlated with higher polarization status below the median however. One possible explanation for this might be that societies which are not able to provide adequate income for large parts of their population (especially below the median income) need to provide for public housing projects in order to ensure the most basic maintenance and reproduction of large parts of their labour force.

As a sensitivity test specifications A1 and B1 were also run without outliers of the dependent variables above 1000% and below 0% of the respective median income and in another test with annual explanatory macro variables instead of the 3ySMA. The results for specification B1 without the approximately 1000 negative observations hardly differ at all from the original ones. Removing around 500 extreme outliers above 1000% of the median income has more of an effect on specification A1. The results are now quite similar to those of the original specification A2. Using annual instead of 3ySMA explanatory macro variables has the expected effect of quite a few more coefficients losing significance. In addition, the sign

and interpretation for both the level of GDP and public education expenditures changes in specifications A1 and B1.

Overall it can be noted that the different specifications related to the method, sample size, number and calculation of explanatory variables prove to be rather robust, with hardly any signs switching, albeit with some loss of significance in a small number of cases. The marked differences between the results for the two subsamples of household polarization status above and below the median are therefore most likely related to actual differences in the effects of certain structural characteristics and public policies with regard to the upper and lower part of the income distribution.

Conclusions

Income polarization as measured by the disposable household income as a percentage share of median household income of European households is particularly strong in Southern Europe, the Baltics and the British Isles, with the largest share of the asymmetry in the part of the distribution above the median income. A multi-level analysis is performed in order to identify the micro and macro level determinants of the polarization status above and below the median income of households in each EU country within the period 2003-2009. In this conclusion we focus on some of the policy relevant macro explanatory variables as well as the fiscal variables of interest.

For both the subsample above and below the median household income (and all the specifications) we find the overall unemployment rate to be correlated with higher levels of polarization. This hints at the important role that an active labour market policy with a full employment goal can have in achieving lower levels of polarization. Similarly, a strong industrial base as well as a high degree of trade openness is related to lower polarization both above and below the median income. This seems to confirm recent literature dealing with the impact of international trade on the distribution of income (Helpman et al., 2012). However, these latter results lacked significance in some specifications. Among public expenditure items in GDP, we find expenditures on social protection, education and subsidies to be connected to lower polarization in both subsamples. Again, these results lack significance in some specifications.

Finally, turning to our main explanatory variables of interest, the different types of government taxes in GDP, we find mixed results for the above and the below median subsamples. Our main hypothesis (in following Larudee, 2009) was that a shift from capital taxation towards taxation of labour and consumption increases polarization of incomes. This assumption was only partly confirmed in the subsample of household polarization statuses above median income however. In the above subsample higher levels of capital taxation appear to be correlated with lower polarization and larger shares of consumption taxes with

higher polarization. Yet, a higher share of labour taxes was insignificant in most specifications of the upper subsample, and if anything related to lower levels of polarization. This last result holds true for the below median subsample also, where labour taxes are significantly related to less polarization in all specifications. Nevertheless, the sign of the effect of consumption and capital taxes switches in the subsample of polarization below the median income. Here, taxes on capital seem to be related to more polarization (though not significant in all the specifications) and those on consumption to less polarization.

Putting more emphasis on polarization above the median income, where asymmetries are more pronounced we suggest the following policy recommendations. Higher levels of both capital and labour taxation are suited to reduce income polarization, given their progressive redistributive power. This should be accompanied by a well developed system of public expenditures on social protection, education and economic subsidies as well as an active labour market and industrial policy together with a high degree of trade openness.

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Appendix

Appendix Table 1

Descriptive statistics of household polarization status by country

Country	Obs.	Mean	Std. Dev.	Minimum	Maximum
Denmark	14109	106	74	-1493	3759
Sweden	22466	107	53	-296	1628
Slovenia	29976	109	56	-54	3819
Austria	22868	111	64	-72	2671
Netherlands	34268	112	67	-551	2868
Slovakia	17112	113	90	-335	5965
Hungary	27672	113	72	-204	1967
Belgium	21354	114	247	-1525	31314
Finland	24452	115	99	-51	6340
Czech Republic	34906	115	67	0	2411
Luxemburg	23473	115	96	-287	8206
Italy	76416	116	83	-390	3537
France	39419	116	77	-1295	3256
Malta	2388	116	75	-23	2107
Spain	45613	117	79	-623	1712
Poland	49011	118	83	-157	3444
Cyprus	11714	119	100	-1	3435
Romania	11557	119	94	-6	3042
Estonia	14585	119	92	-180	4097
Greece	17310	120	91	-554	1797
United Kingdom	30794	121	105	-118	6015
Bulgaria	5524	125	93	0	1253
Lithuania	16471	125	96	-98	1657
Ireland	12733	128	109	-36	3236
Latvia	16132	132	120	-114	2707
Portugal	15999	133	121	1	2517

Source: EU-SILC database, own calculations.

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