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Changes in income inequality in Lithuania: the role of policy, labour market structure, returns and demographics

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Nerijus Černiauskas

(Bank of Lithuania, Vilnius University)[*]

Denisa M. Sologon

(Luxembourg Institute of Socio-Economic Research (LISER))[†]

Cathal O'Donoghue

(The National University of Ireland, Galway)[‡]

Linas Tarasonis

(Bank of Lithuania, Vilnius University)[§]

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[*] nerijus.cerniauskas@evaf.vu.lt, Bank of Lithuania and Vilnius University.

[†] *Corresponding author*: denisa.sologon@liser.lu, Luxembourg Institute of Socio-Economic Research (LISER).

[‡] cathal.odonoghue@nuigalway.ie, The National University of Ireland, Galway.

[§] linas.tarasonis@evaf.vu.lt, Vilnius University and Bank of Lithuania.

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ABSTRACT

We model the household disposable income distribution in Lithuania and explore the drivers of the increase in income inequality between 2007 and 2015. We quantify the contributions of four factors to changes in the disposable income distribution: (i) demographics; (ii) labour market structure; (ii) returns and prices; and (iv) tax-benefit system. Results show that the effects of the factors were substantial and reflected heterogeneous developments over two sub-periods: changes in the tax and benefit system successfully accommodated a rapid rise in market income inequality due to the global financial crisis during 2007-2011, but failed to do so during the subsequent years of economic expansion, when rising returns in the labour and capital markets significantly increased disposable income inequality. We also find that declining marriage rates contributed to the increase of income inequality in Lithuania.

Keywords: income distribution, inequality, decompositions, microsimulation, tax-benefit policies, crisis, austerity, overtime comparison.

JEL codes: D31, H23, J21, J31, I38.

Contents

1 Introduction

Since the 1980s, income inequality has increased in most advanced economies, as well as in post-Soviet countries and other emerging markets. Indeed, as identified by the 2011 World Economic Forum, this inequality constitutes one of the "two most serious challenges the world is facing today". According to Eurostat, in 2015, the Gini index of household equivalized disposable income in Lithuania was 37 Gini points[1], the second highest across the whole of the European Union (EU). Understanding what drives changes in income distributions over time is a central issue in economic research and policy analysis.

We study changes in the income distribution in Lithuania between 2007 and 2015, a period during which Lithuania continued transitioning from a planned economy to a market one, and converging to the EU. At the beginning of this period, the country was one of the hardest hit by the global financial crisis (also known as the Global Economic Crisis, or Great Recession): real GDP plummeted by almost 15% in 2009 as compared to 2008. A rapid recovery followed, with a GDP growth of 6% in 2011. Additionally, the Lithuanian economy was affected by important secular demographic changes, namely, negative net migration, ageing, and declining marriage rates. These large shocks to the private sector and to public finance resulted in significant fluctuations in household disposable income despite numerous changes in the tax and benefit system. To effectively combat these income inequality fluctuations, it is necessary to identify the main drivers of income inequality and determine whether the existing tax and benefit system is capable of dealing with the challenges.

Various strategies have been used to analyse changes in the distribution of income over time. Traditional approaches compute one particular inequality summary index over time, and then decompose it into the contribution of specific characteristics, such as age, gender, or labour market status, or the source of income (see Reynolds and Smolensky 1977, Shorrocks 1980, Shorrocks 1982, Shorrocks 1984 and Lerman and Yitzhaki 1985). A newer approach relies on modelling (components of) the market income distribution using parametric and semi-parametric econometric techniques and building counterfactual distributions under alternative scenarios. This approach allows us to assess the role of various factors in explaining distributional changes, as in Juhn et al. (1993), DiNardo et al. (1996) and Bourguignon et al. (2008). Finally, a sizeable literature has documented the use of the counterfactual approach in assessing the role of the tax-benefit

[1]Eurostat reports the Gini index based on the year the survey was conducted. By contrast, survey respondents are asked to provide their previous calendar year's income. Throughout the text, we report statistics of the income year, not the survey year.

system for determining changes in the disposable income distribution. These studies use tax-benefit microsimulation models (see, for example, Bourguignon and Spadaro 2006 and Bargain 2014) to simulate counterfactual distributions by changing the tax-benefit rules, while keeping fixed the observed market income distribution. The main limitation of these approaches is they refer to the analysis of either a summary measure or only one part of the income distribution, be it market incomes or taxes and benefits.

We build on the approach developed in Sologon et al. (2018), adapting it to study changes in income distributions over time for a single country instead of differences in income distributions across countries at one given moment.[2] This method integrates micro-econometric and microsimulation approaches into a flexible parametric household income-generation process based on a system of equations for multiple income sources for the household and the European tax-benefit microsimulation engine EUROMOD (Sutherland and Figari, 2013). Such an infrastructure permits an accurate representation of the relationship between household characteristics, market incomes (from labour and capital), and tax-benefit rules. This is used to generate counterfactual distributions of household disposable incomes obtained via transformations of the income generation process by "swapping" the characteristics between different periods along four dimensions: (i) labour market structure, (ii) returns structure, (iii) demographic composition of the population, and (iv) tax-benefit rules. The comparison of these counterfactual distributions allows us to quantify the contribution of each factor to the changes in the income distribution observed over time. By applying this approach, we provide a more detailed decomposition than existing studies that seek to unpack the drivers of inequality changes. Most existing studies on the topic follow the approach proposed by Bargain and Callan (2010) and Bargain (2012), which uses two "swaps": market incomes and tax-benefit rules. We engage in a higher level of disaggregation by breaking up market income into institutional structures in terms of employment rates, number of people with income sources, distribution of returns, and demographics. The model is constructed on the basis of the European Union Statistics on Income and Living Conditions (EU-SILC) survey, a household survey that is available in a harmonised form for all European Union (EU) countries.

The remainder of the paper is organised as follows: Section 2 discusses the income generation model used to characterize and simulate the distribution of household disposable income and the decomposition methodology; Section 3 presents the context and results of the decomposition analysis in Lithuania between 2007 and 2015; Section 4 concludes and discusses several policy

[2]Sologon et al. (2019) use the same approach to study the changes in the income distribution in Portugal between 2007 and 2013, accounting for the distributional effects of the 2007-2008 crisis and aftermath policies.

implications.

2 Methodology

The objective of this paper is to decompose changes in the distribution over time in Lithuania. Given the complex drivers of the income distribution, including demographics, factor markets, market income, and public policy, we require a multidimensional framework to undertake the decomposition. Decomposing by population characteristics, income sources, and policy drivers, we utilise the simulation-based approach developed in Sologon et al. (2018) for the purpose of cross-national decompositions.

Many personal characteristics affect the distribution of income. Changes in the structure of the labour market impact the size of population in work and the nature of their work when in the labour market. For those in receipt of market incomes, the return to factors like education or to the characteristics of their employment can have an important impact on the distribution of labour. Changes in the composition of the population in terms of age, demography, and education distribution also matter, while public policy in OECD countries is a significant redistributive mechanism. All of these components vary over time and are important to consider when trying to disentangle the factors influencing the distribution of income over time. The methodology simulates counter-factual incomes associated with market, policy, and demographic characteristics of the alternative year, and assesses the impact of changes in these individual components on the total household disposable income distribution. Specifically, we take the underlying demographic structure in time period (s) and simulate the presence of counter-factual market incomes and their levels of income and incomes of public policies that exist in the alternative year (t). Doing this in sequence allows us to assess the impact of replacing the market structure, the distribution of market incomes, or the structure of public policies of time (s) with time (t), holding all other components constant. This enables us to work out how much of the change in the distribution of disposable income was due to individual components (see Sologon et al. 2018 for a more detailed description).

The modelling of market income utilises an approach developed in Bourguignon et al. (2008).[3] In this section, we describe the individual simulation components used and the mechanism for decomposing total income inequality.

[3]It is important to note that model parameters do not capture causal relationships between the various endogenous and exogenous variables considered. Rather, parametric relationships are reduced-form projections which describe statistical relationships between basic conditioning variables and various components of income.

2.1 Components of the income distribution

We consider 5 broad components of disposable income:

- gross labour incomes, y_h^L (including employee, self-employed incomes),
- household capital incomes, y_h^K (including capital, rental incomes),
- and other household non-benefit pre-tax incomes, y_h^O(including private pension, private transfers and other incomes),
- public benefits, y_h^B , and
- household direct taxes, y_h^T.

Summing, we define household disposable income as:

$$y_h = \underbrace{y_h^L + y_h^K + y_h^O}_{Market} + \underbrace{y_h^B - y_h^T}_{Non-market} \tag{1}$$

Some market income components are aggregates of smaller components of income, which are modelled separately in order to achieve a fine level of disaggregation. *Gross labour income* is aggregated from employment and self-employment income*, while capital income* - from investment and property income. Each component of market income is estimated at the individual level; then, for each household, the incomes of all individual members are added to obtain the household's income. For each income source, we first estimate a binary participation indicator $I_{hi}()$ equal to one if the individual receives that type of income, and zero otherwise. For the individuals receiving it, we estimate the level $y_{hi}()$. For labour income, we first estimate a binary indicator equal to one if the individual is working, and zero otherwise. Then, for those individuals working, we assign the estimated income, either from employment or self-employment. *Other non-benefit pre-tax income* were not modelled at such a granular level because too few households had such income. Formally, this is represented by:

$$y_h^L = \sum_{i=1}^{n_h} I_{hi}^{lab} \left(I_{hi}^{emp} y_{hi}^{emp} + I_{hi}^{semp} y_{hi}^{semp} \right) \tag{2}$$

$$y_h^K = \sum_{i=1}^{n_h} \left(I_{hi}^{inv} y_{hi}^{inv} + I_{hi}^{prop} y_{hi}^{prop} \right) \tag{3}$$

$$y_h^O = \sum_{i=1}^{n_h} I_{hi}^{O} y_{hi}^{O} \tag{4}$$

where: n_h is the total number of individuals in household h; I_{hi}^{lab} is an indicator equal to one if individual i belonging to household h (individual hi from now on) is working; and for $S \in$\{emp, semp, inv, prop, other\}, I_{hi}^{S} is an indicator equal to one if individual hi receives any income from source S, and y_{hi}^{S} refers to the level of income received from source S.

In order to simulate counter-factual distributional characteristics, we first statistically estimate individual equations for the presence and level of each of the income sources. For the presence of a market incomes source, we first estimate a binary participation using a logistic model. We model occupation (8 categories, based on the ISCO-08 classification) and industry (primary, secondary, or tertiary) using a multinomial logistic regression model.

For the distribution of wage income, we utilise individual characteristics conditional on the whole wage distribution and not only on the conditional mean, as in the regressions used for other income sources; assuming a Singh-Maddala distribution, F_X:

$$F_{X=z}(w) = \mathrm{SM}(w; a(z), b(z), q(\mathrm{z})) = 1 - \left[1 + \left(\frac{w}{b(z)}\right)^{a(z)}\right]^{-q(z)} \tag{5}$$

where X indicates that the distribution is conditional on a vector of characteristics z; $q(z)$ is a shape parameter for the 'upper tail'; $a(z)$ is a shape parameter ('spread') affecting both tails of the distribution, and $b(z)$ is a scale parameter. $a, b$and q paramters are allowed to vary log-linearly with individual characteristics, as in Biewen and Jenkins (2005) or Van Kerm (2013). The approach utilises a flexible unimodal three-parameter distribution which provides a good fit to wage distributions (Van Kerm et al. 2016). The wage, estimated separately for males and females, is then given by:

$$w_{hi} = F_{X=z}^{-1}(\upsilon_{hi}^{emp}) = b(z)[(1 - \upsilon_{hi}^{emp})^{-\frac{1}{q(z)}} - 1]^{\frac{1}{a(z)}} \tag{6}$$

where υ_{hi}^{emp} is a random term uniformly distributed and z contains both x_{hi} and occupation, occ_{hi} and industry, ind_{hi}. The female wage model is participation-corrected (Van Kerm 2013).

Non-market incomes resulting from public policy such as income taxes, social insurance contributions, social assistance benefits (including housing support), social insurance benefits, and universal benefits are simulated using the EUROMOD tax-benefit microsimulation model (see Sutherland and Figari, 2013). EUROMOD incorporates the tax-benefit schemes of EU member countries, with harmonised input datasets. It simulates social benefits, taxes, and social insurance contribution entitlements, utilising the actual legal rules of the individual policies. As a library of tax-benefit policies, it allows a user to swap policies between different periods (see for e.g. Levy

et al. 2007,Bargain and Callan 2010 and Bargain 2012).

$$y_h^B = y_h^{pens} + y_h^{mtb} + y_h^{nmtb} \tag{7}$$

Direct taxes are defined as a combination of income taxes and social security contributions (ssc):

$$y_h^T = y_h^{tax} + \sum_{i=1}^{n_h} y_{hi}^{ssc} \tag{8}$$

A summary of the modelling and aggregation of variables, as well as characterising their transformations, is available in Appendix Tables A–1 and A–2.

2.2 Simulating counterfactual distributions

As outlined at the start of the section, we utilise these market and non-market models to simulate counterfactual distributions and to undertake a decomposition of changes in the income distribution over time. The income generation process (IGP), can be defined as:

$$Y = m(X, \Upsilon; \xi) \tag{9}$$

where:

- Y is household disposable income,
- X is a vector of exogenous characteristics,
- ξ is the vector of parameter values and
- Υ is a vector of unobserved heterogeneity terms.

The income generating process is not a 'structural' model, but rather a statistical representation of the structure of the presence and the level of market incomes, and the tax-benefit rules describing policy incomes.

The objective of this approach is to understand how the distribution F of a random variable Y (such as disposable income) as well as any functional of interest $\theta(F)$ (such as inequality indices, quantiles) varies over time, to answer the question: 'What would the income distribution of time t be if its IGP was the one of time s along one or more of the dimensions considered?'. In particular, we are interested in the degree to which changes in the above-identified individual components affect changes in the distribution of disposable income.

The change depends on the (joint) distribution of X and Υ in the population through m and ξ resulting from differences in the distributions of observable characteristics as well as unobservable residual heterogeneity and differences in the model's parametric structure and parameter values. We assume that all years can be represented by a common parametric model of the form m but that years differ in the values taken by the parameters ξ. We undertake the decomposition in the income distribution over time by swapping individual income components between periods, one at a time. To do this, we estimate the IGP for each year separately and calibrate transformations so as to replace components of the IGP of year t with components of the IGP of year s.This is analogous to the standard Oaxaca-Blinder decomposition, but implemented in a multiple equations model and over time.

In swapping components between periods, there are many combinations that are possible, given the range of different incomes and income components. In this study, we focus on four 'transformations':

- a labour market structure transformation;
- a returns transformation;
- a demographic transformation; and
- a tax-benefit system transformation.

The labour market structure transformation changes important characteristics of the labour market structure such as employment, occupation, industry, and sector, and involves modifying certain elements of the parameter vector ξ to simulate an alternative parameter vector, $\tilde{l}(\xi)$,which will result in an alternative outcome Y^l :

$$Y^l = m(X, \Upsilon; \tilde{l}(\xi)). \tag{10}$$

The returns transformation acts through the parameter vector ξ, changing the parameters of the equations for each market income source (employment income, self-employment income, capital income, modelled benefit income, other income) to produce an alternative parameter vector,$\tilde{r}(\xi)$, which would result in an alternative outcome Y^r :

$$Y^r = m(X, \Upsilon; \tilde{r}(\xi)). \tag{11}$$

This follows the logic of the manipulation of the vector of coefficients in Mincerian earnings regressions aimed to capture 'price' effects (as distinct from 'composition' effects) in traditional Oaxaca-Blinder decomposition exercises. It resembles the decomposition of Juhn et al. (1993) in the way residual variances are accounted for: it swaps the variance terms by rescaling the residuals of time t for each of the five income components, but preserves the rank correlation of the residuals.

The demographic composition transformation changes the values of variables relating to socio-demographic characteristics of the population such as education, age, etc. and involves a modification of the distribution of the random variables in X. The alternative distribution of $\tilde{X}(X)$ results in obtaining a counterfactual outcome for income,Y^d:

$$Y^d = m(\tilde{X}(X), \Upsilon; \xi). \tag{12}$$

The tax-benefit system transformation modifies the level and eligibility of benefits and tax liabilities, simulated by EUROMOD, to produce an alternative parameter vector $\tilde{tb}(\xi)$. This involves swapping model parameters as above for the equations describing the benefits not fully simulated by EUROMOD, and using EUROMOD to apply the tax-benefit rules and parameters of period s onto the market incomes and household characteristics of period t. Similar swapping of tax-benefit policy rules and parameters were implemented for analysing trends in income distributions (see Bargain and Callan 2010,Bargain 2012, Herault and Azpitarte 2016, Paulus and Tasseva 2017) and cross-country differences (see Dardanoni and Lambert 2002, Levy et al. 2007, Sologon et al. 2018). The resulting counterfactual is formalized as:

$$Y^{tb} = m(X, \Upsilon; \tilde{tb}(\xi)) \tag{13}$$

For each of the four transformations, the impact is assessed by comparing the original distribution with each counterfactual. We can compute the impact on any distribution functional of interest, θ, such as the Gini index or the quantiles. This type of measure is called a partial distributional policy effect in Rothe (2012) or simply a policy effect in Firpo et al. (2009). For transformation k with $k \in$\{l, r, d, tb\}, this impact is given by:

$$\Delta^k_\theta(F) = \theta(F) - \theta(F^k). \tag{14}$$

2.3 Decomposition of changes in the income distribution over time

Next, we decompose the observed differences between income distributions and corresponding functionals in years t and s. We compute a certain functional $\theta(F)$ for each of the two years, $\theta(F^t)$ and $\theta(F^s)$. Our procedure aims to decompose the total observed difference, $\theta(F^s) - \theta(F^t)$, into the contributions of each of the individual determinants k of a set K:

$$\Delta_\theta(F^t, F^s) = \theta(F^t) - \theta(F^s) = \sum_{k=1}^{K} \Delta_\theta^k(F^t, F^s) \tag{15}$$

One approach is to apply each transformation sequentially, one after the other, from the original distribution, F^t, to the target distribution, F^s, and take the difference between two consecutive steps of the sequence. The drawback of such a sequential decomposition is path-dependence, i.e. the estimated contribution of each factor depends on the chosen sequence. In order to reduce issues of path-dependence, we focus on 'direct effects' following Biewen and Juhasz (2012) and Biewen (2014). The direct effect assesses the impact of each factor from the same initial benchmark distribution:

$$D_\theta^k(F^t, F^s) = \theta(F^t) - \theta(F_t^k) \tag{16}$$

where F_t^k is the counterfactual distribution obtained by applying one transformation k to the initial distribution F^t. Comparing direct effects is a natural way to assess the effects of alternative transformations (Biewen and Juhasz 2012). The sum of all direct effects and unexplained factors does not add up to the overall observed difference. The discrepancy reflects interactions between components. In the context of our decomposition, we have four direct effects of each transformation, the unexplained component, and an interaction term:

$$D_\theta^l(F^t, F^s) = \theta(F^t) - \theta(F_t^l) \tag{17}$$

$$D_\theta^r(F^t, F^s) = \theta(F^t) - \theta(F_t^r) \tag{18}$$

$$D_\theta^d(F^t, F^s) = \theta(F^t) - \theta(F_t^d) \tag{19}$$

$$D_\theta^{tb}(F^t, F^s) = \theta(F^t) - \theta(F_t^{tb}) \tag{20}$$

$$\Delta\Upsilon_\theta(F^t, F^s) = \theta(F^t) - \theta(F_s^{l,r,d,tb}) \tag{21}$$

$$I_\theta(F^t, F^s) = \Big(\theta(F^t) - \theta(F^s)\Big) - \left[\left(\sum_{k\in\{l,r,d,tb\}} D_\theta^k(F^t, F^s)\right) - \Delta\Upsilon_\theta(F^t, F^s)\right]. \tag{22}$$

The term $\Delta\Upsilon_\theta(F^t, F^s)$ captures the contribution of differences in the distribution of scaled residual or unobserved heterogeneity terms Υ.[4] $I_\theta(F^t, F^s)$ is an interaction term equal to the total difference in θ and the sum of direct effects, accounting for all two-way and three-way interactions between the four components in the model (Biewen 2014).

The total observed change over time is decomposed as:

$$\Delta_\theta(F^t, F^s) = D_\theta^l(F^t, F^s) + D_\theta^r(F^t, F^s) + D_\theta^d(F^t, F^s) + D_\theta^{tb}(F^t, F^s) + \Delta\Upsilon_\theta(F^t, F^s) + I_\theta(F^t, F^s) \tag{23}$$

As a robustness check, we also use the Shapely value approach as in Shorrocks (2013) and Sastre and Trannoy (2002) (see, e.g., Deutsch et al., 2018, for a recent application). The procedure calculates marginal contributions of each component in all possible decompositions, and then averages them out. We report the Shapely value decomposition results for the full sample period in the Appendix, while we use the direct effects throughout the text.

3 An application to Lithuania between 2007 and 2015

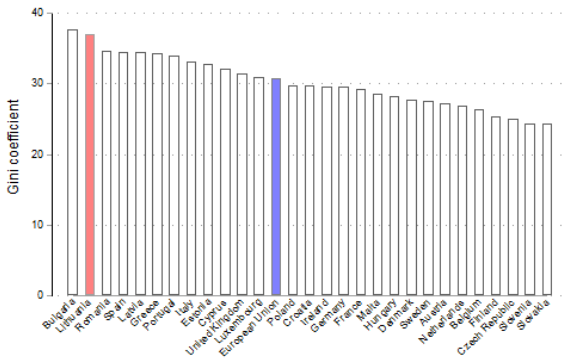
We now apply the method presented in the previous section to study the changes in the income distribution in Lithuania between 2007 and 2015.

[4] $D_\theta^\Upsilon(F^t, F^s)$ is obtained by transplanting residuals across periods. This is achieved, in reverse, by starting from time s and jointly applying all four transformations calibrated to period t parameters. The difference between this construct and time t's orginal distribution reflects the direct effect of transplanting residuals from t to s.

3.1 Evolution of income inequality in Lithuania

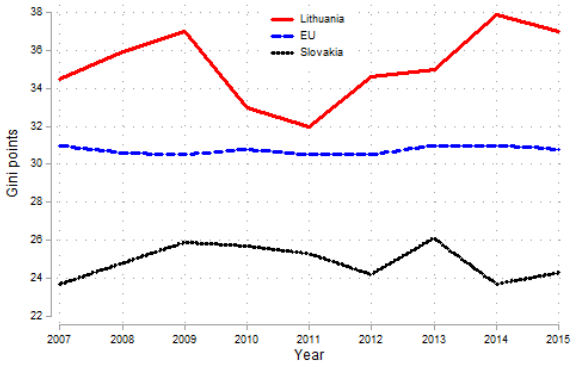
Lithuania is an interesting case study because it displayed one of the highest levels of income inequality across the European Union (EU) in 2015. According to the European Union Statistics on Income and Living Conditions (EU-SILC), the most reliable data on income inequality currently available, the Gini index of household equivalized disposable income was 37 Gini points in Lithuania in 2015 (see Figure 1). This made Lithuania the second most unequal country in the EU, ranking 6.2 Gini points higher than the EU average and and a staggering 12.7 Gini points higher than Slovakia, a country with the most equal income distribution in the European Union and another country formerly behind the Iron Curtain.

Figure 1: Gini coefficient, European Union, 2015



Source: Eurostat data.

Figure 2: Gini coefficient, Lithuania, 2007-2015



Source: Eurostat data.

Income inequality in Lithuania has been on the rise over the past two decades. Figure 2 portrays the dynamics of the Gini coefficient for Lithuania, Slovakia, and the European Union as a reference from 2007 to 2015. The rise in income inequality has not been monotonic: the Gini index in Lithuania shows strong procyclicality. It fell during the crisis and then grew rapidly during the post-crisis expansion. Moreover, it appears to be significantly more volatile than the Gini coefficient in Slovakia. Overall, income inequality in Lithuania has consistently exceeded income inequality in the European Union and Slovakia. In what follows, we discuss potential drivers of changes in the Lithuanian income distribution: demographics, structural and cyclical changes in the economy, and changes in the tax and benefits system.

Demographics

The demographic situation of Lithuania has been affected by three important trends over this period: negative net migration, ageing, and changing household composition. Outmigration, which accelerated significantly after Lithuania's accession to the EU, had a sizeable negative effect on the total size of the population. Specifically, the population of Lithuania decreased by 18% from 2004 to 2016, most of which was due to the negative net migration over the period. This trend has also affected the composition of the population: according to Statistics Lithuania, young workers (those between 15 and 34) are significantly more likely to migrate, causing an increase in the share of elderly in Lithuania. In addition, and similarly to most of Europe, life expectancy has been on the rise. As a result of these two trends, Lithuania's population has become older. In 2004, there were 22 people over 65 for every 100 working-age persons. This number has risen to 28 by 2016. This shift might have had important consequence for income distribution, since a greater fraction of the population became dependent on pension income. Finally, the household composition in Lithuania changed. In 2007, almost 60% of households had dependent children, but this has fallen to 51% in 2015. Likewise, there were fewer married households: 48% of the households indicated that they were married in 2007, but only 39% in 2015. Since the income of married households, or more generally households with more than one adult, tend to be more equal, this could also contribute to income inequality.

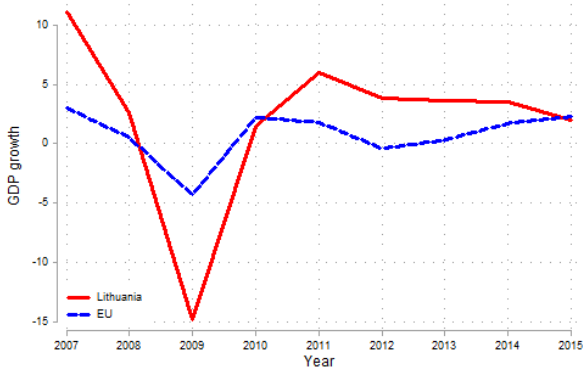
Cyclical and structural changes in the economy

Looking at Figure 2, the Gini coefficient in Lithuania appears to be strongly procyclical, much more so than in Slovakia or the average in European Union, which appears highly stable in the period under discussion. The Gini in Lithuania grew somewhat during 2005-2008, peaked at 37% in 2009 and then fell to a low of 32% in 2011, before starting to rise again, reaching 37% in 2015. This pattern coincides with the business cycle of Lithuania with a bit of a lag.

The financial and economic turmoil that emerged in the global economy following the eruption of the 2007-2008 crisis in the US first hit Lithuania particularly hard. Figure 3 portrays GDP growth of the Lithuanian economy versus the average in the European Union. During the peak of the crisis in 2009, the Lithuanian economy contracted by almost 15% in real terms. Although similar contractions where observed in other Baltic states, this is about three times as severe as in the EU. The contraction in Lithuania was due to both internal and external reasons. The economic expansion preceding the crisis was characterized by significant imbalances: double-digit inflation,

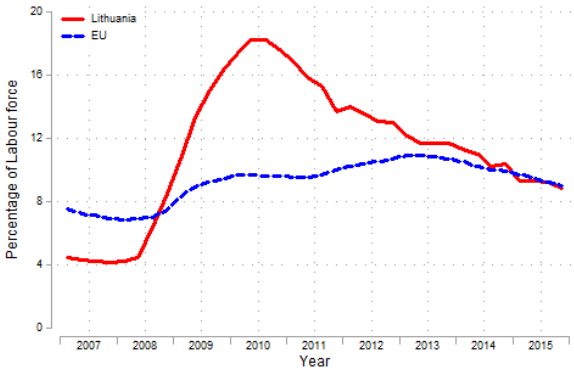
a housing boom, appreciating real exchange rates, and accelerating wage growth—that exceeded productivity growth. The domestic bubbles burst in early 2008, when the credit supply decelerated and banks started tightening credit conditions. The downturn was further exacerbated by negative developments in the external economic environment after the Lehman Brothers' bankruptcy. The sharp decline followed a rapid recovery in Lithuania, with growth rates above the EU average in the early 2010s.

Figure 3: GDP growth



Source: Eurostat data.

Figure 4: Unemployment rate



Source: Eurostat data.

Labour market conditions following the the financial crisis of 2008 worsened dramatically. As can be seen in Figure 4, the unemployment rate rose steadily between 2008 and 2011, from 4% to almost 18%. For the sake of comparison, the fluctuations in the average unemployment rate in the European Union was significantly less pronounced. Again, the labour market bounced back rather quickly during the expansion period: the unemployment rate fell below the EU average in 2015. In the face of economic turbulence, the government of Lithuania had to choose between internal and actual devaluation. Internal devaluation was chosen to tackle the external and domestic macroeconomic instability. This generated sharp declines in public and private earnings in the labour market: top public salaries were cut by more than 20 percent, the gross average wages declined by 12.4 percent from the pre-crisis peak to the bottom.

The labour market has also experienced several important structural changes common to most developed countries. One of the most significant changes was a gradual move away from employment in agriculture towards employment in the service sector. The share of employed in agriculture almost halved, from 14% in 2004 to 8% in 2016. As agriculture is the least productive sector, these structural changes in the economy might have affected the income inequality. Additionally, around

8% of Lithuania's population is self-employed and subject to different tax regimes. The share of self-employed has been rising steadily since 2011.

Reforms in the tax and benefit system

The government implemented a large number of reforms of the tax and benefit system during this period.

In 2007-2009, many existing benefit levels were increased. The largest increase in benefit expenditure was due to old age pensions, which constituted 62% of all social protection benefits in 2007. This was partly due to the 35% increase in the state-approved social insurance basic monthly pension. Since pensioners are bunched at the bottom of income distribution, this had an important redistributive impact. The second highest change in benefit expenditure was due to family/child benefits. The length of parental leave benefit payout duration increased from one to two years. The effect was particularly strong since parental leave benefits are calculated based on average monthly reimbursable income (AMRI), which largely consisted of earnings. Since 1 July 2009, AMRI was averaged over the 9 months, and since 1 October 2009 – over 12 months, one month before the right to parental leave benefits. This implies that payouts in 2009-2010 were paid based on the all-time-high pre-crisis earnings of 2007-2008. In addition, several child benefits were also increased in this period. The combined result was that expenditure on family/child benefits increased by 2.6 times in 2009 as compared to 2007, and constituted close to 16% of social protection benefits paid in 2009, up from 9% in 2007. The state supported income, which affects the social benefit payouts and unemployment insurance payouts, also increased by 70%.

The legislation which took effect in the 2007-2009 period was largely accepted prior to the crisis and proved unsustainable under a crumbling economy. Therefore, the government cut the spending on benefits substantially in an effort to stabilize the budget deficit by passing the Provisional Law on Recalculation and Payment of Social Benefits. The plan was to reduce the benefits, but only provisionally - between 1 January 2010 and 1 December 2011. The new law capped or reduced a number of benefits in Lithuania. For example, unemployment benefits were capped at 188 euro and old-age pensions either were frozen or decreased. Additionally, a lower ceiling was applied to parental leave benefits. While most of these temporary provisions expired at the end of 2011, several, such as reduced state pensions for officers, soldiers, and academic workers, persisted until the end of 2013.

During 2011-2015, the benefit system gradually recovered and extended payouts. The Provisional

Law on Recalculation and Payment of Social Benefits ended, resulting in higher payout ceilings. Additionally, in 2015, the sickness benefit, which is paid from the State Social Insurance Fund, was increased. The economy, moreover, started to recover, leading to higher earnings and payouts linked to them.

Overall, benefit payouts increased much more in 2007-2011 period as compared to 2011-2015. The average benefit payouts for the two periods are found in Table 1. As can be seen, social assistance increased by 95%, maternity and paternity benefits by 83%, and old age pensions by 26% in the first period. This meant that the increase in benefits in 2007-2009 greatly outweighed the provisional cuts in 2009-2011. In contrast, we see much milder increases or even declines in average payouts in the 2011-2015 period (with sickness benefits being the exception). This table does not let us identify the extent to which changes in the tax structure (such as changing social insurance basic monthly pension or prolonging parental leave benefits) and market forces (such as dynamics of earnings) affected these payouts. However, it is expected that both factors should play a strong role and that the decomposition procedure should help disentangle the two.

Table 1: Growth of average benefit levels

	2007-2011	2011-2015
Old-age pension	26%	13%
Disability and work incapacity pension	27%	4%
Maternity and paternity benefits	83%	-29%
Sickness benefit	1%	31%
Social assistance	95%	-13%
Benefits for bringing up children	49%	1%

Notes: the figures represent percent changes over the period 2007-2011 and 2011-2017 for average social protection expenditures by selected benefit types. Old-age pension refers to average old-age state social insurance pension payout per person per month. Sickness benefits refer to average expenditure on state social insurance sickness benefit per sick day. Other calculations are available on request. The statistics were calculated by the authors using administrative data on social protection from Statistics Lithuania.

There were important changes in retirement policies over the period. First, from 2006 to 2011, the old-age pension age in Lithuania was 62.5 for men and 60 women. Since 1 January 2012, the state pension age gradually increased by 4 months annually, from 60 to 65 years, for women, and by 2 months annually, from 62.5 to 65 years, for men. In 2015, it was 63 years and 2 months for men and 61 years and 4 months for women. Second, in 2004, the pension system was reformed to allow for an opportunity to accumulate and invest a part of the funds in the private sector. Every person insured for full pension insurance was allowed to voluntarily choose either to stay only in the public social insurance system or to switch to the 2nd pension pillar by directing a part of social insurance contributions to a personal account in a chosen privately managed pension fund.

In addition, there have been a number of reforms in the tax system. The personal income tax rate was decreased from 33 to 24% during the course of 2005-2008. Since 2011, all income, except income from distributed profit and income which is subject to a tax rate of 5%, is subject to a uniform tax rate of 15%. During the period of 2011-2013, income from distributed profit was taxed at a 20% rate. Since 1 January 2014, this tax rate was lowered to 15%.

There were also changes in one of the largest components of labour costs - social insurance contributions. These are flat-rate without ceilings, but they differ for employees and self-employed. Employees contribute 3% of gross wages and salaries as contributions to pension social insurance and, since 2009, an additional 6% to health social insurance. Employers, for their part, pay on behalf of their employees 31% of gross wages and salaries to pension social insurance, sickness and maternity social insurance, unemployment social insurance, health insurance, employment injuries, and occupational diseases social insurance. Until 2009, self-employed persons paid contributions only to pension social insurance depending on their income. Since 2009, self-employed persons additionally contribute to sickness and maternity social insurance. Starting 2009, social insurance contributions had to be paid on income from sports, performing or authorship/copyright agreements (until 2009, those were only taxed by the personal income tax).

In what follows, we focus on the period between 2007 and 2015, which was a very intense period for the Lithuanian economy. We divide this period into two sub-periods: 2007-2011 and 2011-2015. The former period is dominated by the effects of the financial crisis of 2008, while the latter comprises the recovery period taken from 2011 onwards. 2011 also corresponds to the year the Gini index fell to the lowest point in our data sample.

3.2 Data

We use the nationally representative household survey for Lithuania: the European Union Statistics of Income and Living Conditions (EU-SILC) for period 2007 to 2015. This survey contains detailed information about income as well as the socio-economic characteristics of households and their members. In the case of Lithuania, most income variables in the survey are matched with administrative sources, while others (such as number of hours worked) are self-reported.[5]

Given that a central component of our income generation process is the tax-benefit microsimulation engine EUROMOD, we use the 'EUROMOD input data' versions of the EU-SILC dataset for Lithuania, which have been standardized for common definitions of income variables and household

[5]See full country reports here: https://circabc.europa.eu/faces/jsp/extension/wai/navigation/container.jsp.

characteristics (Sutherland and Figari, 2013). The disposable household income in EUROMOD is composed of the sum across all household members of market incomes and public pensions plus cash benefits minus taxes and social insurance contributions. Cash benefits, taxes, and social insurance contributions are calculated by EUROMOD. EUROMOD assumes full take-up of benefits (no tax evasion). All income are expressed in single adult equivalent by dividing total household income by the square root of household size. Furthermore, all income are CPI adjusted. Sample sizes exceed 10 thousand individuals, corresponding to just under 5 thousand households in each year.

Table 2: Population socio-economic characteristics (shares of total population)

	2007	2011	2015
Demographic			
Tertiary Education	0.287	0.332	0.358
People 16-65	0.684	0.670	0.665
People >65	0.148	0.173	0.179
Child 0-3	0.038	0.037	0.039
Child 4-11	0.080	0.073	0.081
Child 12-15	0.049	0.047	0.036
Married	0.578	0.530	0.469
Citizen	0.995	0.995	0.992
Male	0.444	0.450	0.451
Labour market structure			
Months worked	6.629	5.903	6.479
Employee/Self-Employed	0.897	0.942	0.910
Occupation			
Managers	0.139	0.115	0.115
Professionals	0.168	0.233	0.229
Associate Prof.	0.104	0.084	0.071
Clerks	0.041	0.038	0.043
Service	0.118	0.125	0.122
Craft	0.204	0.193	0.189
Plant	0.112	0.103	0.103
Unskilled	0.113	0.110	0.129
Industry			
Agriculture	0.078	0.058	0.052
Industry	0.246	0.155	0.151
Services	0.676	0.788	0.797
Business certificate	0.262	0.191	0.215
Price and returns			
With wage income	0.615	0.606	0.653
Wage growth		0.073	0.281
With capital income	0.085	0.075	0.164
Capital income growth		-0.331	0.956
Nr. of observations	12130	12659	10895

Notes: The estimates are weighted. The shares for education refer to age-group 25-64; for married, sex to age >= 16; for months worked to ages 16 to 80; for employees, occupation, industry and sector to those in work aged [16, 80); for citizen to the entire sample; for buisness sertificates to self-employed. The shares for capital refer to age>= 16.

Table 2 shows a number of population socio-economic characteristics for each of the three years, based on the samples in our database. It uncovers the evolution of the Lithuanian economy over the period of 2007-2015. The observed dynamics further quantify the demographic and labour market effects discussed in Section 3.1. In terms of demographics characteristics, Lithuania experienced a considerable increase in the share of people with tertiary education among the population aged 25-64 - by more than 7 percentage points (pp). Most of the increase is concentrated in the period between 2007 and 2011. The table shows a significant ageing effect of the population: the share of people aged 65 or more increased by more than 3 pp over the whole period. Two reasons are potentially behind this. First, people expect to live longer due to a rapidly increasing life expectancy. Second, this period was marked by high emigration flows significantly exceeding immigration. Since the working-age population has a significantly larger probability of migrating, the share of elderly in Lithuania increased as a consequence. There was also a noticeable decline in the presence of children, especially those aged 12 to 15 and a decline in marriage rates (from 58 percent in 2007 to 47 percent in 2015).

Changes in the labour market structure are more nuanced. In 2007, an average respondent worked for 6.6 months during the year; this fell to 5.9 in 2011. This constitutes a greater than 10% reduction in employment time during the crisis years. The economy recovered in 2015, when an average person worked for 6.5 months. The crisis has also changed the composition of employees and self-employed among those who were employed. In 2011, self-employment plummeted by about half, reflecting the vulnerability of this type of work during turbulent times. The distribution of workers across types of occupation also experienced some changes: the economy experienced an increase in the share of professionals and a decrease in the share of associate professionals. This change in composition of occupations relates to an increase in people with tertiary education: a larger share of high-skilled workers were able to take more qualified jobs. There was also a large shift towards the service sector at the expense of the agricultural and industry sectors, as expected.

Finally, looking at the participation and returns in the labour and capital markets, we can see that the share of people with capital income doubled since 2007. Importantly, average capital income almost doubled during the expansion years, while it decreased by a third during the first sub-period. We observe similar dynamics in the labour market: wages have grown by 7.3 and 28.1 pp during the first and second sub-periods, respectively. We take this as evidence of significant changes in the returns of investments in both the labour and the capital markets.

3.3 Changes in the income distribution between 2007 and 2015

We start by characterizing the changes in the distribution of household disposable incomes in Lithuania between 2007 and 2015, considering both the period 2007-2015 as a whole and two sub-periods, namely, 2007-2011 and 2011-2015. The three distributions (2007, 2011, and 2015) were obtained using the methodology presented in Section 2

Table 3 shows the mean and median monthly incomes and Gini index associated with each of these distributions. The mean and median income hardly changed between 2007 and 2011. This is not surprising, as we capture a segment of the upturn (2007-2008), the downturn (2008-2010) and the start of the recovery (2010-2011). In contrast, the mean and median income rose to 618 and 508 in 2015, roughly a 40% increase since 2011. Interestingly, the Gini responded differently. It slightly fell from 2007 to 2011, but then increased by 2.9 Gini points in 2015 despite the rising incomes.

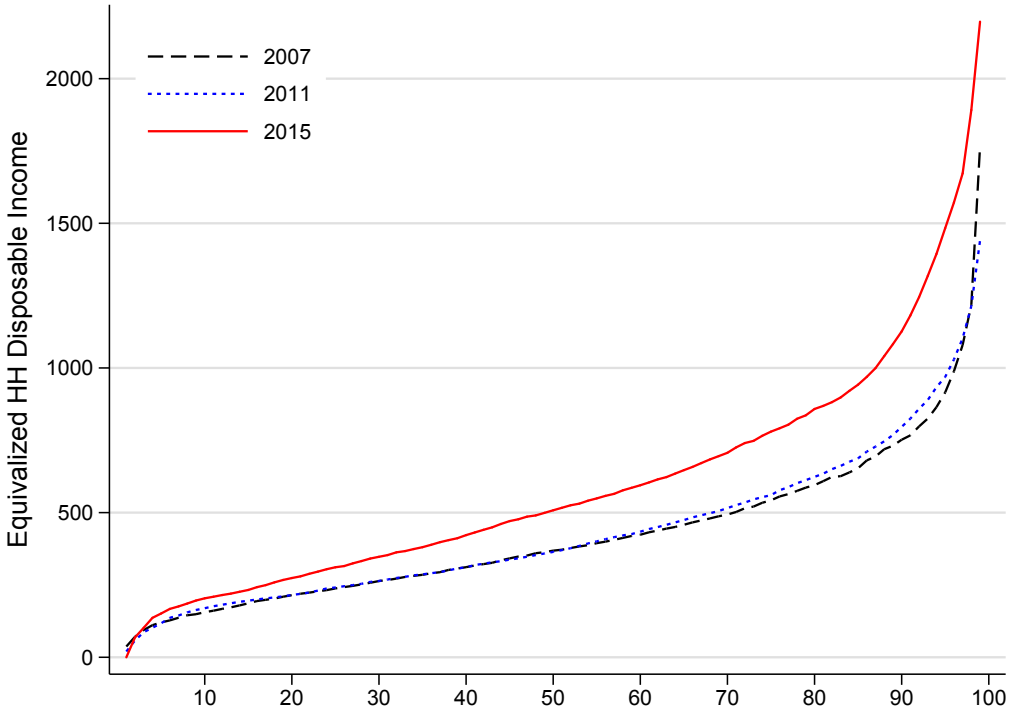
Table 3: Summary statistics of household disposable income (monthly, in euros)

	Mean	Median	Gini
2007	440	370	0.339
2011	441	364	0.331
2015	618	508	0.360

The rise of the Gini alongside rising mean and median incomes suggests that incomes rose unevenly for the population, particularly from 2011 to 2015. We see this in Figure 5 in the form of Pen's parades. When comparing the distributions of 2007 and 2015, it can be seen that almost all quantiles experienced an income increase, including the quantiles at the bottom of the income distribution. Furthermore, income increased the most since 2011 and barely changed in the previous period. What we also see is that the income of different quantiles increased by different absolute amounts - those at the top gained significantly more than those at the bottom.

The relative increase in income is presented in Figure 6. It shows the pairwise differences between the three distributions shown in Figure 5, as a percentage of the 2015 distribution. For each percentile, the change between 2007 and 2015 is equal to the sum of the change between 2007 and 2011, and the change between 2011 and 2015. Therefore, for each percentile, the change over the whole period can be decomposed into the contributions of each of the two sub-periods. The 2007-2015 period comprised two very distinct sub-periods in what concerns the evolution of incomes across the income distribution. The years between 2007 and 2011 brought mild increases in the income of some of the poorer and the richer, while the bottom 5% and the 40-50% actually lost incomes. This contrasts with the 2011-2015 period, where income of the entire distribution rose.

Figure 5: Distribution of equivalised household disposable income (Pen's parades)

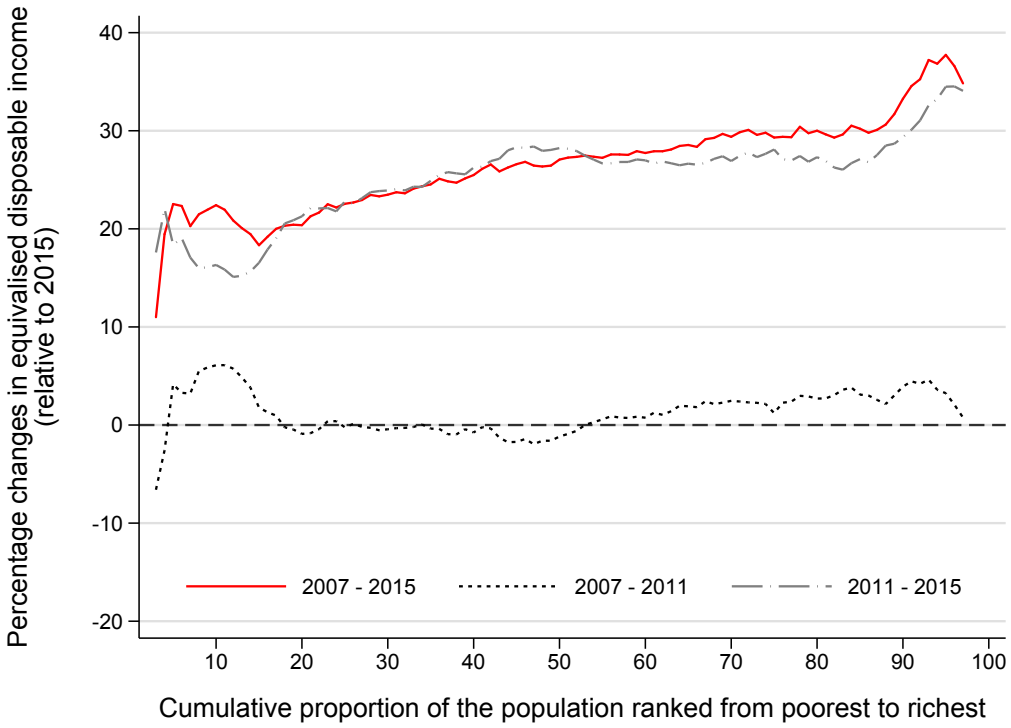


However, the rise in income in 2011-2015 period differs along the distribution: it rose by around 20% for the bottom 20% of the population and around 30% for the top of the population. The top 10% of the distribution gained even more than 30% in their disposable income. Therefore, the economic upturn increased inequality between the tails of the distribution.

3.4 The redistributive effect of the tax and transfer system

An important determinant of the disposable income distribution is the redistributive action of the tax and transfer system, which typically cushions developments in the market income distribution. In Table 4 we provide summary indicators of the effect of the system as a whole as well as the partial effects of taxes and transfers. The effectiveness of the system as a whole is measured by net redistribution, which is defined as the difference between the Gini of disposable income and the Gini of market income. Next, the effectiveness of each component of redistribution, i.e. transfers and taxes, is evaluated separately. Specifically, we present measures of (i) redistribution, given by the Reynolds-Smolensky index; (ii) average tax (transfer) rates, defined as the ratio between the total amount of taxes (transfers) paid (received) and the total pre-tax (transfer) income; and (iii)

Figure 6: Changes in the distribution of equivalised household disposable income



progressivity/regressivity effect, measured by the Kakwani index[6].

Table 4: The redistributive effect of the tax and transfer system

	2007	2011	2015	2007-2011	2011-2015	2007-2015
Gini Market Income (1)	0.473	0.513	0.515	0.040	0.002	0.042
Gini Disposable Income (2)	0.339	0.331	0.360	-0.008	0.029	0.021
Net Redistribution (1)-(2)	0.134	0.182	0.155	0.048	-0.026	0.021
Gini Market Income (+ Transfers) (3)	0.369	0.364	0.391	-0.005	0.026	0.021
Averate Transfer Rate	0.186	0.252	0.223	0.066	-0.029	0.037
Transfer Regressivity (K)	0.768	0.845	0.801	0.078	-0.044	0.034
Transfer Redistribution (RS) (1)-(3)	0.104	0.148	0.124	0.045	-0.024	0.021
Gini Market Income (+ Transfers - Taxes) (4)	0.341	0.343	0.372	0.002	0.030	0.032
Averate Tax Rate	0.177	0.100	0.107	-0.077	0.007	-0.070
Tax Progressivity (K)	0.144	0.199	0.161	0.055	-0.038	0.017
Tax Redistribution (RS) (3)-(4)	0.029	0.022	0.019	-0.007	-0.003	-0.010

Notes: K = Kakwani; RS = Reynolds-Smolensky.

The analysis of these indicators suggests several findings. First, in terms of overall redistribution, the tax and transfer system as a whole was a crucial determinant of the level of disposable income

[6]Note that in the case of transfers, higher regressivity means more transfers being *received* by lower income households, while in the case of taxes, higher regressivity means more taxes being *paid* by lower-income households. Therefore, an increase in transfer regressivity increases redistribution while an increase in tax progressivity (and therefore a decrease in tax regressivity) increases redistribution.

inequality in Lithuania. In each of the three years considered, the net redistributive effect was around 15 Gini points, or about 30% of the Gini of market income. However, the system was not equally redistributive throughout the whole period. The tax and benefit system became more redistributive in 2011 as compared to 2007, as the net redistributive effect increased by 35%, from 0.134 to 0.182. The effect was large enough to dominate the increase in market income inequality by more than 13%: the resulting disposable income inequality was smaller than in 2007. The system, however, became less redistributive in 2015 as compared to 2011: disposable income inequality increased, even though market income inequality did not change during this period.

Second, considering the redistributive effects of each part of the system, one can see that the bulk of redistribution was due to transfers. In 2007, transfers accounted for 78% of the total redistribution effect, whereas the tax system was responsible only for 21%. In addition, transfers became even more important in 2011: the average transfer rate and the benefit regressivity increased as compared to 2007 while average taxes fell. However, the increase in the importance of benefits in 2011 was partly undone by 2015, when average transfer rates and regressivity decreased.

3.5 Drivers of changes in the income distribution between 2007 and 2015

This section decomposes the changes of total income inequality presented in Subsection 3.3 into the contributions of the main factors considered in our model, as described in Subsection 2.3. This helps us understand why income inequality changed.

Decomposing changes in incomes

Figure 7 shows the contribution of each factor to the total changes in income distributions shown in Figure 6. Analogously to the results presented in Figure 6, for each percentile in each graph, the change in the period 2007-2015 is equal to the sum of the changes in the periods 2007-2011 and 2011-2015. Furthermore, for each percentile, and each period, the total change in the income distribution given in Figure 6 is equal to the sum of the four factor contributions as portrayed in Figure 7 as well as the the interaction effects and the residuals. The joint effect of the latter two can be found in Figure A–1 in the Appendix.

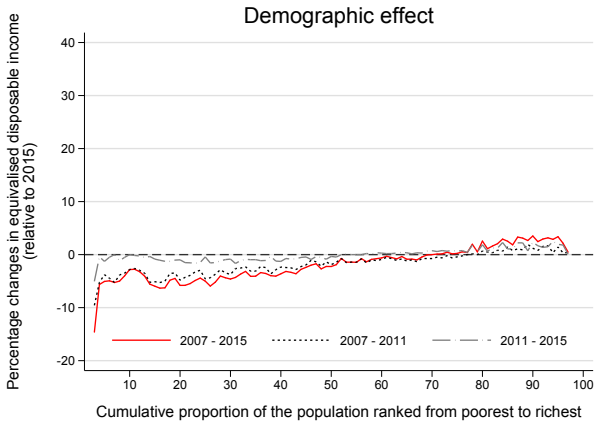
All four factors contributed to changing household disposable income distribution in Lithuania. The biggest effect was due to changes in the tax and benefit system as well as the prices and returns dynamics. Changes in tax and benefit system increased disposable income of the median household by about 35% during the whole period, whereas changes in the prices and returns contributed

another 20%. Changes in labour market structure increased income by 5% and the demographic effect generated a negative change in the disposable income of the median household.

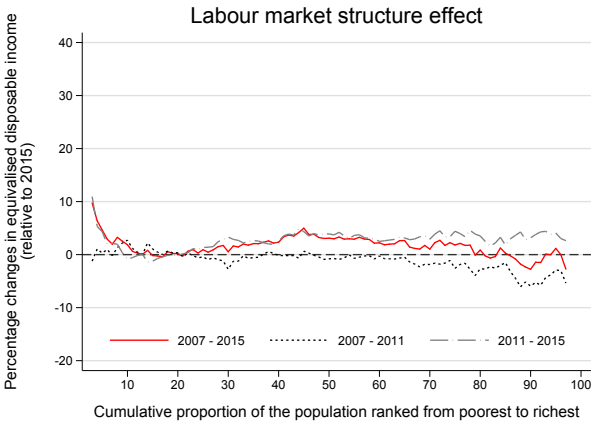
Changes in the transfer system, the prices and returns as well as the demographics, appear to have affected the income inequality: the size (and the sign in some cases) of the effects vary, depending on the position on the income distribution. As expected, changes in the tax and benefits increased the income of the bottom deciles more than the top of the income distribution. The effect generated a decrease in income inequality. Nonetheless, the top of the income distribution has benefited significantly more from the changes to the price and returns of the markets, which has contributed to the rise of the income inequality. Although the demographic effect on disposable income is smaller in size, it appears to have persistently increased inequality over the analysed period. Due to the demographic effect, the income of the bottom 30% of the population was 5% lower in 2015, whereas the income of the top has increased by 5%. This size of the difference between the top and bottom quantiles is comparable to the tax and benefit effect on inequality.

Looking at the two sub-periods, neither changes in the tax and benefit system nor the prices and returns had the same effect throughout the whole period. The largest gains for the bottom of the income distribution was due to the changes in tax and benefits over the crisis period, while the changes over the 2011-2015 period benefited the bottom 20% less than the rest of the distribution. In contrast, the price and returns played a modest role in 2007-2011; most of the effect is coming during the years of economic expansion. This speaks to the nature of the prices and returns effect and is consistent with a procyclical nature of that effect. Overall, the emerging picture implies that the measures adapted by the tax and benefit system could not deliver sufficient redistribution at a time when incomes were rising rapidly, i.e. during the upturn of the business cycle. In contrast, the demographic effect appears to be less sensitive to the business cycle conditions. It slowly but gradually increased inequality in both sub-periods, likely due to the secular nature of the demographic shifts.

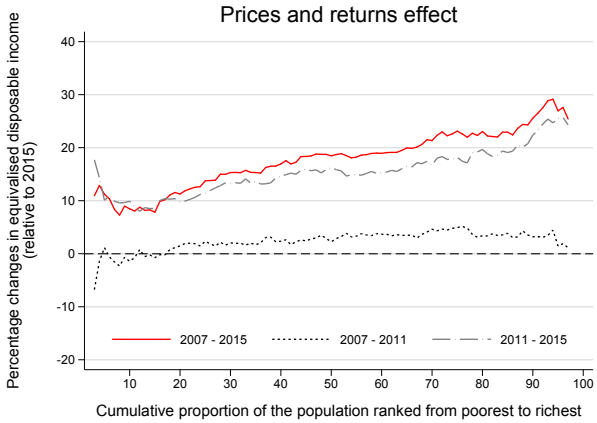
Finally, the effect of changes in the labour market structure appear to be mostly concentrated at the bottom of the income distribution. There is a positive effect on the bottom 5% of households: their income increased by almost 10% during the whole period, with most change happening in second period. The income of households in the middle of the income distribution also increased slightly. Interestingly, the top of the income distribution either did not gain or lost income because of changes in the labour market structure.



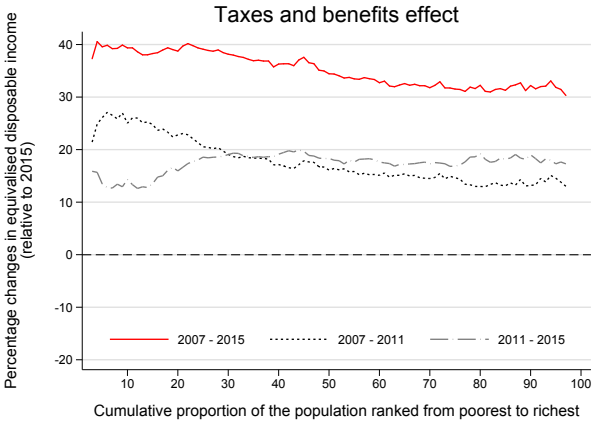
(a) Demographic effect



(b) Labour market structure effect



(c) Prices and returns effect



(d) Taxes and benefits effect

Figure 7: Decomposition of changes in the distribution of equivalised household disposable income

Further decomposing of the demographic effect

To further decompose the demographic effect, we calculated the contribution of each observable that we use to calculate the demographic effect. The results are presented in Table A–2 in the Appendix. For the sake of brevity, we only report the contributions of the most important demographic factors: age, education, and marital status. Table A–2 discloses that declining marriage rates contributed the most while increasing education rates had an important role as well. The marriage effect generated a very unequal and negative effect across almost the whole of the income distribution. The rising education rates, by contrast, resulted in a positive and significantly more equal effect across the distribution. The combination of these two effects, displayed in Figure A–2d explains the totality of the demographic effect. Interestingly, the ageing of society does not appear to have played a significant role in explaining the recent increase in income inequality.

The reason why marriage had a large effect on income inequality seems to stem from the fact

that inequality among married households is smaller than among households with a single adult. This finding is consistent Burtless (1999), who found a similar result for the United States in the late 20th century. There are several factors that might generate this effect. The low earnings of one partner can be offset by the higher earnings of the second partner - an insurance mechanism that non-married households (which are largely also single-person households) do not have. Alternatively, marriage can be seen as a "luxury" into which higher income earners self-select.

Decomposing changes in inequality and redistribution

To synthesize the findings in the previous section, we quantify the contributions of the four factors as well as their interactions to various measures of income inequality and net redistribution in the economy presented in Figure 4. Results in Figure 5 give the contributions to the following three measures: (i) Gini of disposable income, (ii) Gini of market income, and (iii) net redistribution. All decompositions are based on direct effects, as shown in Section 2.3. As a robustness check, the decompositions based on the Shapley value can be found in Table A–3 in the Appendix.

Starting from the market income inequality, one can observe that it has grown significantly over the whole period, but most of it occurred during the financial crisis of 2008: the Gini grew by 4.2 pp, with 95% of the growth concentrated in the first sub-period. Interestingly, demographics was the most important factor, contributing to about half of this increase. Going back to Table 2, this was a period when the share of married households decreased while the number of those with tertiary education increased, suggesting that household and education composition was behind this rise in inequality. Not surprisingly, the effect of prices and returns in the labour and capital markets to income inequality portrays procyclicality. The effect of prices and returns was negative during the crisis years (-0.7 pp) but positive and significant in size during the years of economic expansion (1.3 pp). Looking at the whole period, the two phases cancel each other out, and the total effect is only 0.6 pp. Changes in labour market structure appear to be the only factor that has reduced market income inequality substantially, and the effect is mainly concentrated in the first sub-period. It is important to note that the component unexplained by our methodology amounts to significant share of the total change, especially so during the first sub-period. This implies that factors not modelled by our methodology (e.g., regional composition of workers and jobs) also played a role.

Looking at the contributions to the disposable income inequality, we can see that the effects of the four factors were heterogenous. In terms of the size of the effect, the contribution of changing prices and returns was the most important and the totality of the effect is concentrated in the

second period. Over the period of economic recovery, the Gini of disposable income rose by 3.2 pp due to higher prices and returns. This number is consistent with Figure 7c, which shows that the upper tail of the disposable income distribution benefited significantly more than the lower tail. Demographic changes was another important contributor to the growing income inequality in Lithuania. Unlike the effect of prices and returns, trends in the Lithuanian demographic situation appear to be secular and independent from the business cycle conditions: the impact in both periods is similar quantitatively, amounting to a total contribution of 1.3 pp to the Gini index.

The remaining two factors acted in the opposite direction and were responsible for taming the ever-growing income inequality due to the returns and the demographic effects. Specifically, the tax and benefit system managed to counter half of the increase in market income inequality. Its contribution to *reducing* the Gini of disposable income amounted to 2.1 pp, and the effect is concentrated in the period of financial crisis. As mentioned before, this is due to the tax and benefit policy reforms applied during the first years of 2007-2011, which increased redistribution and helped to reduce disposable income inequality. As discussed in Section 3.1, no additional measures were implemented during the years of economic expansion as most of the transfers, such as pensions, were frozen. This meant that the amount of redistribution remained the same, and the tax and benefit system was not able to accommodate rising disposable income inequality during the economic upturn. Finally, the labour market structure is shown to make a smaller but also significant contribution to lowering income inequality, which occurred during the first sub-period.

Table 5: Decomposition of changes in inequality and redistribution

	2007-2015	2007-2011	2011-2015
Gini Market Income			
Total change	0.042	0.040	0.002
Demographics	0.020	0.017	0.003
Labour Market Structure	-0.015	-0.015	-0.001
Prices and Returns	0.006	-0.007	0.013
Taxes and Benefits	0.002	0.004	-0.001
Interactions	0.003	0.009	-0.006
Unexplained	0.026	0.033	-0.007
Gini Disposable Income			
Total change	0.021	-0.008	0.029
Demographics	0.013	0.008	0.006
Labour Market Structure	-0.012	-0.017	0.005
Prices and Returns	0.030	-0.002	0.032
Taxes and Benefits	-0.020	-0.021	0.000
Interactions	0.017	0.002	0.016
Unexplained	-0.008	0.022	-0.030
Net Redistribution			
Total change	0.021	0.048	-0.026
Demographics	0.006	0.009	-0.003
Labour Market Structure	-0.003	0.003	-0.006
Prices and Returns	-0.024	-0.005	-0.019
Taxes and Benefits	0.023	0.024	-0.001
Interactions	-0.014	0.007	-0.021
Unexplained	0.034	0.010	0.023

Notes: LMS: labour market structure; TB: tax-benefit system. Columns indicate the time period over which statistics where calculated (e.g. 2007-2011 refers to the change from 2007 to 2011).

4 Concluding remarks

This paper studied the drivers of changes in the distribution of income in Lithuania from 2007 to 2015 by adapting a methodology developed by Sologon et al. (2018). We assessed the role played by changes in the labour market structure, the economic returns in labour and capital markets, the demographics, and the economic policy related to tax-benefit rules. The case of Lithuania is interesting unto itself, given the country's transition from a planned economy to a market one, its ongoing convergence to the EU, and large fluctuations in disposable income over the business cycle. During the period under discussion, the Lithuanian economy experienced a global financial crisis, which significantly affected household disposable income, a series of tax and benefit reforms, and a changing demographic structure. Income inequality reached unprecedented levels as a result. To address this challenge, one must first understand the factors that contribute to income inequality and determine whether the tax and benefit system in place is able to reduce it.

Our results suggest that the growing returns in the labour and and capital markets as well as large structural changes in the demographics of the population played the main role in explaining the observed increase in income inequality. Changes in the tax and benefit system reduced income inequality somewhat, but only during the period 2007-2011. By the year 2011, those who lost work had access to relatively high unemployment benefits, parental benefits, sick leaves, old age pension, and other benefits, as compared to 2007. This was not the case in 2015 and, as a consequence, disposable income inequality increased over the next period, most likely due to the market-friendly reforms (increase in the pension age and reductions in income tax rates).

Although the returns effect was the main contributor to increasing income inequality, especially during 2011-2015 period, other important factors played a role. Our results show that the demographic effect persistently increased income inequality over the analyzed period. Specifically, we found that declining marriage rates were mostly responsible for the increase. As marriage rates continue to decline, we may expect to see rising income inequality in the future. It may be that the preferences with respect to the size of the household have changed: more people choose to live in one-adult households and forgo receiving higher and more stable income living in larger households. This question remains open for future research.

Several lessons can be drawn from the Lithuanian post 2007-2008 crisis experience. First, effective tax and benefit systems are able to reduce market income inequality, especially when the economy is facing a financial and economic crisis. Second, governments in transition countries may

consider designing their tax and benefit systems to account for rapid economic expansion following a crisis to tackle rapidly rising income inequalities.

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Appendix

A Additional tables and figures

Tables A–1 and A–2 list income generation process components. Table A–1 contains the examined income sources, states whether the variable was aggregated or modelled. In case the variable is modelled, it contains the conditioning variables. The corresponding model transformation is also included. The same is done for demographic and labour market variables in Table A–2.

Table A–1: Definition of income components and summary modelling information

Table A–1 Part 1

Variable	Definition	Level	Treatment	Transformation	Model	Conditioning variables
y_h	total household disposable income	household	aggregate		–	–
y_h^L	gross labour income	household	aggregate		–	–
I_{hi}^{emp}, y_{hi}^{emp}	employee income (wage*hours)	individual	aggregate	Returns (wage rates) and /LM structure (hours)	–	–
I_{hi}^{se}, y_{hi}^{se}	self-employment income (receipt, amount)	individual	modelled	Returns	logit,log-linear	x_{hi}, $firm-size_{hi}$, occ_{hi}, ind_{hi}, $work-history_{hi}$, lse_{hi}, $lsepf_{hi}$
y_h^K	capital income (investment, property)	household	aggregate	Returns	–	
I_h^{inv}, y_h^{inv}	investment income (receipt, amount)	individual	modelled	Returns	logit,log-linear	x_{hi}
I_h^{prop}, y_h^{prop}	property income (receipt, amount)	individual	modelled	Returns	logit,log-linear	x_{hi}
y_{hi}^O	other incomes (receipt, amount)	individual	aggregate, modelled	Returns	logit, log-linear	x_{hi}

Table A–1 Part 2

Variable	Definition	Level	Treatment	Transformation	Model	Conditioning variables
y_h^B	public transfers	household	aggregate	TB	–	–
$I_{hi}^{sickness}$, $y_{hi}^{sickness}$	sickness (receipt, amount)	individual	modelled	TB	logit, log-linear	x_{hi}
$I_h^{housing}$, $y_h^{housing}$	housing benefits (receipt, amount)	household	modelled	TB	logit, log-linear	x_h
I_h^{sa}, y_h^{sa}	social assistance	household	modelled	TB	logit, log-linear	x_h
I_h^{osw}, y_h^{osw}	other social welfare	household	modelled	TB	logit, log-linear	x_h
y_h^{mb}	maternity and paternity benefits	individual	modelled	TB	EUROMOD	x_{hi},y_{hi}^L,y_{hi}^K, $work-history_{hi}$
y_h^{pcb}	pregnancy and childcare benefit	individual	modelled	TB	EUROMOD	x_{hi},y_{hi}^L,y_{hi}^K, $work-history_{hi}$
I_{hi}^{unemp}, y_{hi}^{unemp}	unemployment benefits (receipt, amount)	individual	aggregate, modelled	TB	logit, log-linear, EUROMOD	x_{hi}, $unemployed_{hi}$ (for receipt)
I_{hi}^{pens}, y_{hi}^{pens}	state old age benefits	individual	aggregate, modelled	TB	logit, log-linear, EUROMOD	x_{hi}, $work-history_{hi}$, $retired_{hi}$ (for receipt)
$I_{hi}^{disability}$, $y_{hi}^{disability}$	disability (receipt and amount)	individual	aggregate, modelled	TB	logit, log-linear, EUROMOD	x_{hi}, $disabled_{hi}$
I_{hi}^{surv}, y_{hi}^{surv}	survivor benefits (receipt, amount)	individual	aggregate, modelled	TB	logit, log-linear, EUROMOD	x_{hi}
t_h	taxes and social security contributions	individual and household	aggregate, modelled	TB	EUROMOD	y_{hi}^L, y_{hi}^K, y_{hi}^O,y_{hi}^B,x_{hi}, $expenditure_h$,lbl_{hi}
y_h^{ca}	child allowance	family	modelled	TB	EUROMOD	x_h,y_h^L,y_h^K, y_h^B,$work-history_{hi}$
y_h^{bg}	birth grant	Individual	modelled	TB	EUROMOD	x_{hi},y_{hi}^L,y_{hi}^K, $work-history_{hi}$
y_{hi}^{sb}	social benefit	individual	modelled	TB	Euromod	x_{hi},y_{hi}^L,y_h^K, y_{hi}^B,$asset_h$,$work-history_{hi}$

Table A–2: Demographic and labour market variables

Variable	Definition	Level	Treatment	Factor	Model	Conditioning variables
x_h	household-level demographic characteristics (number of children aged 0–3, 4–11 and 12–15) and individual characteristics of the household head (marital status, gender, age and age squared, university education), assets	household	observed	Demo	–	–
x_{hi}	individual-level characteristics: gender, age and age squared, university education, marital status, number of children in the household (aged 0–3, 4–11 and 12–15), citizenship, age*university, age squared*university, sex, sex*university, age*sex, work-history	individual	observed	Demo	–	–
occ_{hi}	occupation (1-digit ISCO); for working individuals only	individual	modelled	LM Struct	multinomial logit	x_{hi}
ind_{hi}	sector (primary, secondary or tertiary); for working individuals only	individual	modelled	LM Struct	multinomial logit	x_{hi}
s_{hi}	number of hours worked	individual	modelled	LM Struct	linear	x_{hi}
w_{hi}	average wage rate; for employees only	individual	modelled	Returns	Singh-Maddala	x_{hi} occ_{hi} ind_{hi}
$retired_{hi}$	retired	individual	modelled	LM Struct	logit	x_{hi}
$uenemployed_{hi}$	unemployed	individual	modelled	LM Struct	logit	x_{hi}
$occpension_{hi}$	pays voluntary pension	individual	modelled	LM Struct	logit	x_{hi}
lse_{hi}	owner of enterprise with employees (sub group of self-employed)	individual	modelled	LM Struct	logit	x_{hi}
lbl_{hi}	has business certificate (sub group of self-employed)	individual	modelled	LM Struct	logit	x_{hi}
$lsepf_{hi}$	engaged in individual activities (sub group of self-employed)	individual	modelled	LM Struct	logit	x_{hi}

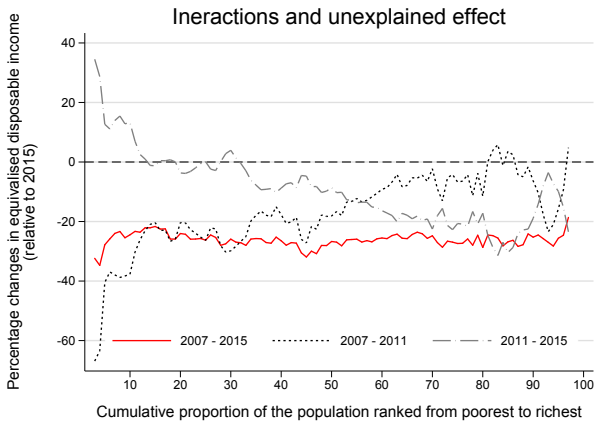
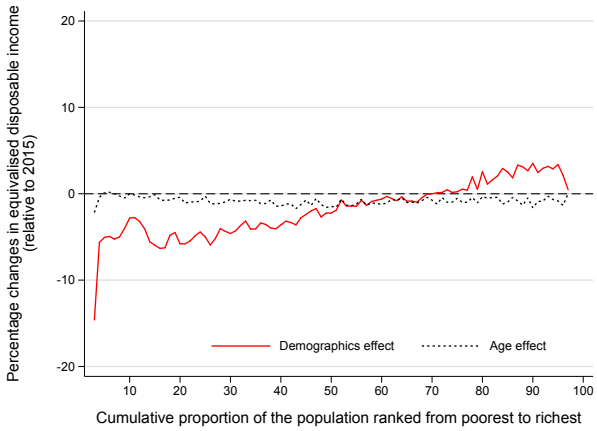
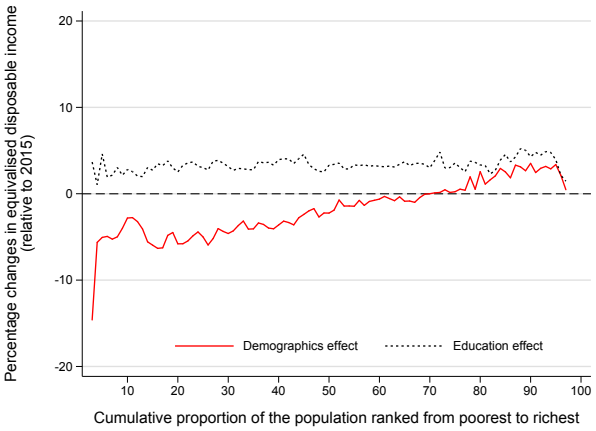


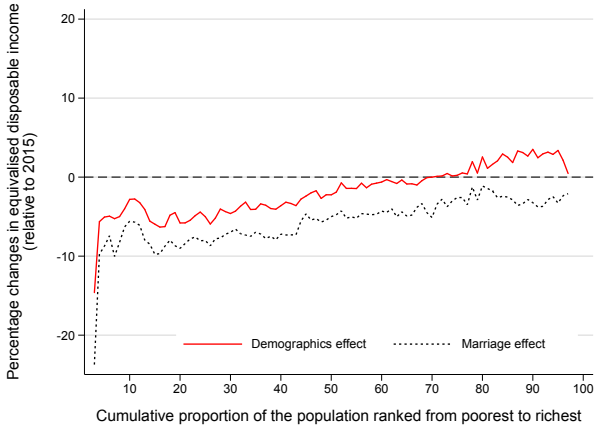
Figure A–1: Interactions and unexplained effect



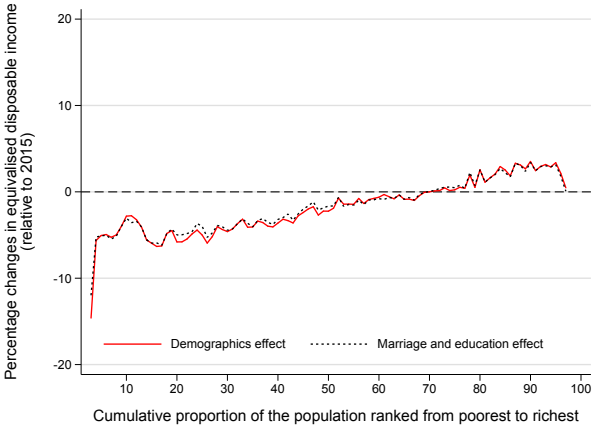
(a) Age effect



(b) Education effect



(c) Marriage effect



(d) Marriage and education effect

Figure A–2: Decomposition of the demographic effect

Table A–3: Comparison of direct effects and Shapely value effects

	Direct effect	Shapley
Demographics	0.013	0.014
Labour Market Structure	-0.012	-0.006
Prices and Returns	0.030	0.037
Taxes and Benefits	-0.020	-0.021
Unexplained and interactions	0.010	-0.004