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# INCOME INEQUALITY AND REDISTRIBUTION IN LITHUANIA: THE ROLE OF POLICY, LABOR MARKET, INCOME, AND DEMOGRAPHICS

BY NERIJUS ČERNIAUSKAS

*Vilnius University*

DENISA M. SOLOGON*

*Luxembourg Institute of Socio-Economic Research (LISER)*

CATHAL O'DONOGHUE

*The National University of Ireland*

AND

LINAS TARASONIS

*Vilnius University*
*Bank of Lithuania*

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) labor market structure; (iii) returns and prices; and (iv) tax–benefit system. Results show that the effects of the factors were substantial and reflected heterogeneous developments over two subperiods: changes in the tax and benefit system cushioned a rapid rise in market income inequality because of the global financial crisis during 2007–2011, but failed to do so during the subsequent years of economic expansion, when rising returns in the labor and capital markets significantly increased disposable income inequality. We also find that declining marriage rates contributed to the increase in income inequality in Lithuania.

**JEL Codes**: D31, H23, J21

**Keywords**: income inequality, redistribution, decompositions, microsimulation, tax–benefit policies

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*Correspondence to: Denisa M. Sologon, Luxembourg Institute of Socio-Economic Research (LISER), 11 Prte des Sciences, 4366 Esch-sur-Alzette, Luxembourg (denisa.sologon@liser.lu)

## 1. Introduction

Economic inequality has been rising since the 1980s in most advanced economies, as well as in post-Soviet countries and other emerging markets (Atkinson *et al*., 2011; OECD, 2011; Nolan *et al*., 2014; Alvaredo *et al*., 2018). Concerns about inequality have surged in the aftermath of the Great Recession, fueled also by the rise in economic distress caused by the unequal distribution of gains stemming from globalization and economic growth. Rising inequalities in market incomes, changes in taxes and benefits, changes in the structure of the labor market (e.g., increasing female labor market participation or occupational structure dynamics), and changes in demographics (e.g., expansion of postsecondary education and spread of non-traditional family structures) are highlighted among the main determinants of the increase in income inequality in most OECD countries since the 1980s (e.g., Daly and Valletta, 2006; OECD, 2011; Smeeding *et al*., 2011).

The role of tax–benefit systems in tackling inequality increases has been extensively studied, as disposable income is a product of both market incomes and tax–benefit rules. Much less research has examined why redistribution did not manage to tame the increase in inequality. The evidence is at odds with conclusions reached by the majority of studies that tax–benefit systems have become more redistributive since the 1980s (e.g., Immervoll and Richardson, 2011. This is due to a methodological limitation that did not control for interactions between market incomes and tax–benefit rules. Failing to control for changes in market income distributions may lead one to wrongly conclude that redistribution has increased, when in fact the effect has been driven by increasing market income inequality; any progressive system will show an increase in redistribution with increasing inequalities in market incomes. The literature shows that inequality in market income grew twice as much as redistribution. This implies that the redistributive effect has weakened over time in most countries, which is consistent with redistributive policies failure to tackle inequality increases (Immervoll and Richardson, 2011; Alvaredo *et al*., 2018).

This question becomes even more important for countries where the increase in inequality was striking, especially in the recovery period following the Great Recession. The post-Soviet countries stand out in the European context with respect to their dramatic changes in the distribution of disposable income over time. Despite this, they have received little attention in the inequality literature. We contribute to this literature with a systematic analysis that seeks to understand the trends in income inequality and the redistributive effects of the tax–benefit system in Lithuania by disentangling the role played by changes in policy design from changes in market income distributions (and their driving forces: labor market structure, returns, and demographics).

Since regaining independence from the Soviet Union in 1990, Lithuania has implemented numerous liberal reforms, which allowed the country to move rapidly from a centrally planned to a market economy. After joining the European Union (EU) along with the other Baltic states in 2004, Lithuania enjoyed high growth rates and economic convergence toward EU-15. The period of rapid economic expansion came to a halt in 2008, when the country was hit by a deep recession because of the Global Financial Crisis and the real GDP plummeted by almost 15 percent in 2009 as compared to 2008. A rapid recovery followed, with a GDP growth of 6 percent in

2011. Since then, the growth has stabilized but income inequality has shot up as well, despite numerous changes in the tax and benefit system. According to Eurostat, the Gini index of household equivalized disposable income in Lithuania grew by 5 points over the period 2011–2015, the highest growth rate of income inequality observed in the European Union (EU) (which saw an average increase in the Gini index of only 0.2 points over the same period).[1] As a result, as measured by the Gini index, Lithuanian income distribution was the second most unequal in the EU in 2015. While unequal economic growth could explain this rising inequality, there are also other possible explanations. The Lithuanian economy was affected by important secular demographic changes, namely, negative net migration, aging, and declining marriage rates. The goal of this paper is to quantify what factors drove large changes in Lithuanian income distributions over the period 2007–2015, which is a central issue for economic research and policy analysis.

To answer this question, we apply the latest methodological advancements in inequality decomposition techniques, which rely on counterfactual scenarios to isolate the impact of relevant factors. We build on the approach developed in Bourguignon *et al*. (2008) and Sologon *et al*. (2021), and adapt it to study changes in income distributions over time instead of differences in income distributions across countries at one given moment.[2] Traditional approaches compute one particular inequality summary index over time, and then decompose it into the contribution of specific characteristics, such as age, gender, labor market status, or the source of income (see Reynolds and Smolensky 1977; Shorrocks 1980, 1982, 1984 and Lerman and Yitzhaki 1985). Rather than looking at summary measures, the main object of our analysis are changes in the whole income distribution. Our 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 micro-simulation engine EUROMOD (Sutherland and Figari, 2013). Such an infrastructure permits an accurate representation of the relationship between household characteristics, market incomes (from labor 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) labor market structure (e.g., employment, occupation, industry, and sector), (ii) returns structure (e.g., labor income and capital incomes), (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 research on the topic follows the approach proposed by Bargain and Callan (2010) and Bargain (2012), which uses two "swaps" : market incomes and tax–benefit rules.

[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.

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

For Lithuania, Navickė (2020), besides the policy and income effect, also added the demographic effect via re-weighting following DiNardo *et al*. (1996) to decompose the changes in the Gini index. The findings suggest that while the income effect dominated the increase in the Gini index, the rising income inequality was partly offset by the policy effects. Across the EU, Paulus and Tasseva (2020) identified the direct effect of policy changes, as well as the effect of automatic stabilizers and of changes in market incomes and demographics. For Australia, Li *et al*. (2021) identifies the policy, demographic, and market income effect, with the extension that the income effect captures both a semi-parametric re-weighting of the industrial and occupational distribution, besides the income adjustment, similar to the semi-parametric approach in Biewen and Juhasz (2012). Tasseva (2020) decomposes disposable income changes in the UK, focusing on the role of education on income inequality. Specifically, the study used policy swaps to identify the tax and benefit effect, re-weighting techniques to identify the composition effect of education, and parametric techniques to identify the effect of returns to education, while other market income components were allocated to the residual. We, however, engage in a higher level of disaggregation by breaking up market income into institutional structures in terms of employment rates, the number of people with income sources, the distribution of income sources, the distribution of the returns, and the demographics using both parametric and semi-parametric techniques.[3] We clearly need to trade off parsimony and complexity. Given the novelty of the work, the computational time, and the limit of how much we can disaggregate, we tried to optimize the balance between model complexity and degree of disaggregation. Future work will assess the sensitivity to different degrees of disaggregation. We have more disaggregation than Bargain and Callan (2010) and Bargain (2012), as we wanted to decompose the drivers of market incomes. 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 harmonized form for all European Union (EU) countries.

The next section presents the evolution of income inequality and of the economic climate in Lithuania. This is followed by Section 3, which discusses the income generation model used to characterize and simulate the distribution of household disposable income, the decomposition methodology, and the data. Section 4 describes the changes in the income distribution and redistribution between 2007 and 2015 in Lithuania. In Section 5 we present the results of the decomposition analysis in Lithuania between 2007 and 2015, followed by a concluding section that discusses several policy implications.

## 2. Evolution of Income Inequality in Lithuania

Lithuania 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

[3]We could potentially break it up even further, namely, in terms of individual markets; for example, we could swap different industries, swap different parts of the tax–benefit system, and swap taxes and benefits separately.

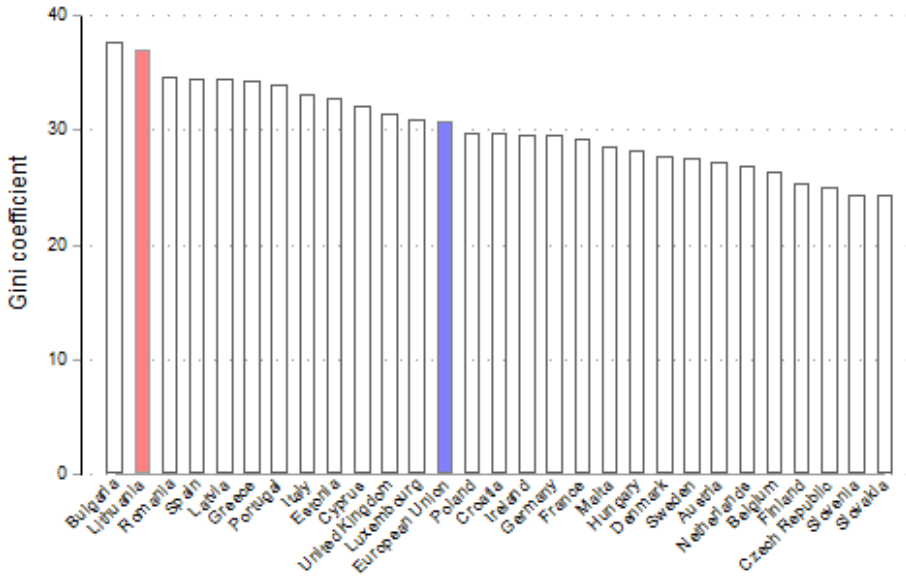



Figure 1. Gini Index, European Union, 2015 [Colour figure can be viewed at wileyonlinelibrary.com]

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 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.

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. In Lithuania, the rise in income inequality (as measured by the Gini index) has not been monotonic, displaying a 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 Slovakia and the EU in general. 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 benefit systems.

### 2.1. *Demographics*

The demographic situation of Lithuania has been affected by three important trends over this period: negative net migration, aging, 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 percent from 2004 to 2016, most of which was due to the negative net migration over the period. This

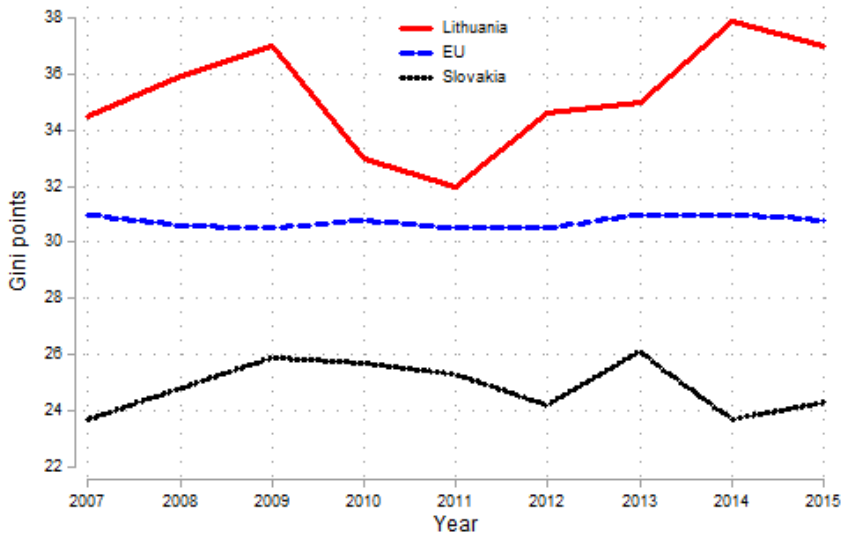



Figure 2. Gini Index, Lithuania, 2007–2015
*Note*: Gini index refers to equivalized disposable income.
*Source*: Eurostat. [Colour figure can be viewed at wileyonlinelibrary.com]

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 similar 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 rose to 28 by 2016. This shift might have had important consequences for income distribution, because a greater fraction of the population became dependent on pension income. Finally, the household composition in Lithuania changed. In 2007, almost 60 percent of households had dependent children, but this fell to 51 percent in 2015. Likewise, there were fewer (legally) married households: 48 percent of the households indicated that they were married in 2007, but only 39 percent in 2015. As the income of married households tends to be more equally distributed, this could also contribute to income inequality.

### 2.2. *Cyclical and Structural Changes in the Economy*

Figure 2 shows that the Gini coefficient in Lithuania appears to be strongly procyclical, much more so than in Slovakia or the average in the EU, which appears highly stable in the period under discussion. The Gini in Lithuania grew somewhat during 2005–2008, peaked at 37 percent in 2009, and then declined to 32 percent in 2011, before starting to rise again, reaching 37 percent 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 hit Lithuania particularly hard. Figure 3 portrays GDP growth of the Lithuanian economy versus the

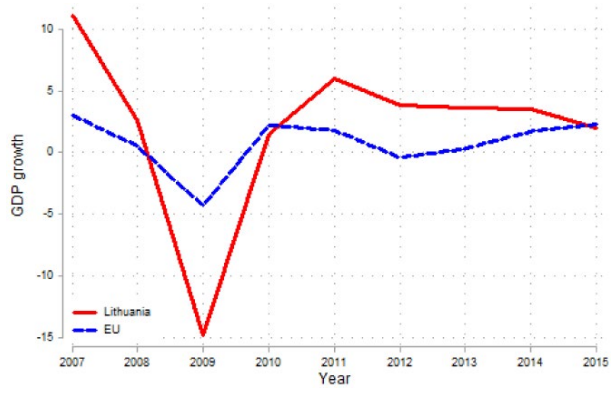



Figure 3. GDP Growth
*Source*: Eurostat. [Colour figure can be viewed at wileyonlinelibrary.com]

average in the EU. During the peak of the crisis in 2009, the Lithuanian economy contracted by almost 15 percent in real terms. Although similar contractions were observed in other Baltic states, this is about thrice as severe as in the EU overall. 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—which 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 was followed by a rapid recovery in Lithuania, with growth rates above the EU average in the early 2010s.

Labor market conditions following the financial crisis of 2008 worsened dramatically. As shown in Figure 4, the unemployment rate rose steadily between 2008 and 2011, from 4 percent to almost 18 percent. For the sake of comparison, the fluctuations in the average unemployment rate in the EU were significantly less pronounced. Again, the labor 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 labor market: top public salaries were cut by more than 20 percent and the gross average wages declined by 12.4 percent from the pre-crisis peak to the bottom.

The labor 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 toward employment in the service sector. The share of employed in agriculture almost halved, from 14 percent in 2004 to 8 percent in 2016. As agriculture is the least productive sector, these structural changes in the economy might have affected the income inequality. In

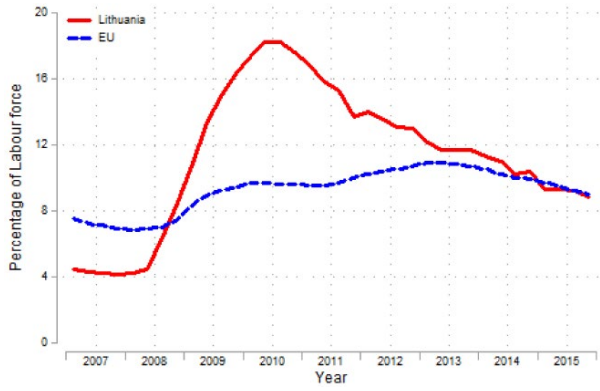



Figure 4. Unemployment Rate
*Source*: Eurostat. [Colour figure can be viewed at wileyonlinelibrary.com]

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

### 2.3. *Reforms in the Tax and Benefit System*

The government implemented a large number of reforms in 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 percent of all social protection benefits in 2007. This was partly due to the 35 percent increase in the state-approved social insurance basic monthly pension. Because pensioners are bunched at the bottom of the 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 1 to 2 years. The effect was particularly strong because parental leave benefits are calculated based on the basis of average monthly reimbursable income (AMRI), which largely consisted of earnings. Since July 1, 2009, AMRI was averaged over 9 months, and since October 1, 2009—over 12 months, 1 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 percent of social protection benefits paid in 2009, up from 9 percent in 2007. State Supported Income, which affects the social benefit payouts and unemployment insurance payouts, also increased by 70 percent.

The legislation that took effect in the period 2007–2009 was largely accepted before the crisis and proved unsustainable in 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

TABLE 1
Nominal Growth of Average Benefit Levels

| | 2007–2011 | 2011–2015 |
|---|---|---|
| Old-age pension | 26% | 13% |
| Work incapacity and invalidity pensions | 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 percentage changes over the period 2007–2011 and 2011–2015 for average social protection expenditures in current prices 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.

*Source*: Author calculation based on administrative data on social protection from Statistics Lithuania.

of Social Benefits. The plan was to reduce the benefits, but only provisionally—between January 1, 2010, and December 1, 2011. The new law capped or reduced a number of benefits in Lithuania. For example, unemployment benefits were capped at 188 euros, and old-age pensions either were frozen or decreased. In addition, a lower ceiling was applied to parental leave benefits. While most of these temporary provisions expired at the end of 2011, several of them, such as reduced state pensions for officers, soldiers, and academic workers, remained in effect 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. In addition, in 2015, the sickness benefit, which is paid from the State Social Insurance Fund, was increased. Moreover, the economy started to recover, leading to higher earnings and payouts linked to them.

Overall, benefit payouts increased in nominal terms much more in the 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 percent, maternity and paternity benefits by 83 percent, and old-age pensions by 26 percent in the first period in nominal terms. This means 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). Changes in real terms are harder to interpret in this case, as they crucially depend on the deflator. The relative decline in real growth rates would be just as apparent if we deflate the benefit payouts by wages (e.g., old-age pensions grew in the first period by 11 percent, but fell in the second by 6 percent), but less apparent if we deflate by the harmonized index of consumer prices (e.g., old-age pensions grew by 3 percent in the first and by 9 percent in the second). This is because wages have grown much faster than inflation in Lithuania since 2011. This table does not allow us to 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.

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 for women. From January 1, 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 second 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 percent during the course of 2005–2008. Since 2011, all income, except income from distributed profit and income that is subject to a tax rate of 5 percent, is subject to a uniform tax rate of 15 percent. During the period of 2011–2013, income from distributed profit was taxed at a 20 percent rate. Since January 1, 2014, this tax rate was lowered to 15 percent.

There were also changes in one of the largest components of labor costs, namely, social insurance contributions. These contributions are flat-rate without ceilings, but they differ for employees and self-employed. Employees contribute 3 percent of gross wages and salaries as contributions to pension social insurance and, since 2009, an additional 6 percent to health social insurance. Employers, for their part, pay on behalf of their employees 31 percent 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 in 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 dynamic period for the Lithuanian economy. We further divide this period into two subperiods. We are particularly interested in the 2011–2015 subperiod for two reasons. First, the business cycle was in the economic expansion phase throughout the period, making the results easier to interpret. Second, income inequality in Lithuania increased dramatically during this period. This naturally leaves us with the period 2007–2011 as the second subperiod, which was dominated by the financial crisis of 2008.[4]

## 3. Methodology and Data

The objective of this paper is to decompose changes in the income distribution over time in Lithuania. Given the complex drivers of the income

[4]We also avoid analyzing the period before 2007 as fewer variables were available in EU-SILC.

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 utilize the simulation-based approach developed in Sologon *et al*. (2021) (for disposable income) and Bourguignon *et al*. (2008) (for market income) for the purpose of cross-national decompositions and extended in O'Donoghue *et al*. (2020) to "nowcast" the distributional impact of the COVID-19 crisis. We used the generic household income-generation model (IGM) developed by Sologon *et al*. (2021) to simulate the labor market situation and household market income distribution as a function of personal and household attributes and to generate counterfactual distributions under alternative scenarios. The IGM relies on a system of hierarchically structured, multiple equation models for detailed income sources, combining a set of personal characteristics, parameters describing how the receipt and level of income sources vary with personal characteristics, and residuals linking model predictions to observed income sources. Taxes and benefits are partly calculated using the EUROMOD microsimulation model (Sutherland and Figari, 2013) and partly with the help of equation models, as done for IGM. The framework is flexible in comparing disposable income distributions across countries, across regions, or over time to disentangle the role of labor market structure, returns, demographics, and tax–benefit rules. The same factors identified as driving cross-national differences are valid when studying changes in inequality over time.

This framework allows us to decompose overall changes in inequality to changes into four factors. The first factor is called "demographics", which captures changes in income distribution because of changes in the distribution of demographic characteristics such as age, sex, and family composition. The second factor is called "labor market structure," which assesses the impact of a changing distribution of the employed, unemployed, the industry at which people work, and their occupations on the income distribution. The third factor is called "prices and returns". This factor quantifies the returns because of demographic factors and labor market factors. Therefore, it includes wages per hour worked, returns for a given occupation, industry, and capital returns (the price of rent and dividends). The fourth factor is the "tax–benefit" system. It quantifies changes in the tax–benefit policy rules on the distribution of disposable income.

All four factors and their components vary over time, and crucial to consider when trying to disentangle the factors influencing the distribution of income over time. The methodology simulates counterfactual 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 level as well as incomes from 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*., 2021) for a detailed

description of the micro-simulation micro-econometric approach using the household income distribution model).[5]

In this section, we describe the individual simulation components of the IGM and the mechanism for decomposing disposable income inequality.

### 3.1. *Components of the Income Distribution*

We consider five broad components of disposable income:

- gross labor 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, $y_h^T$, which include social security contributions.

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, which are modeled separately to achieve a fine level of disaggregation. *Gross labor 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. For each household, the incomes of all individual members are added to obtain the household's income. For each income source, we follow two steps. First, we estimate a binary participation indicator $I_{hi}()$ equal to one if the individual $i$ of household $h$ receives that type of income, and zero otherwise. Second, for the individuals receiving it, we estimate the level $y_{hi}()$. For labor 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 from either employment or self-employment. *Other non-benefit pre-tax income* are not modeled at such a granular level because too few households had such income. Formally, this is represented by:

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

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

[5]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 that describe statistical relationships between basic conditioning variables and various components of income.

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

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 $S$.

To simulate counterfactual 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 (eight categories, based on the ISCO-08 classification) and industry (primary, secondary, or tertiary) using a multinomial logistic regression model.

For the distribution of wages, we utilize 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, $F_X$:

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

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 $q$ parameters are allowed to vary log-linearly with individual characteristics, following Biewen and Jenkins (2005) and Van Kerm (2013). The approach utilizes 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 $\upsilon_{hi}^{emp}$ is a random term uniformly distributed and $z$ contains both demographic variables, $x_{hi}$ occupation, $occ_{hi}$ and industry sector, $ind_{hi}$. The female wage model is participation-corrected (Van Kerm, 2013). The level of non-wage income sources is estimated using a log-linear model for those individuals receiving the income source.

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 harmonized input data sets. It simulates social benefits, taxes, and social insurance contribution entitlements, utilizing the actual legal rules of the individual policies. Encompassing present and historic tax–benefit policies, EUROMOD allows a user to swap policies between different periods (see, e.g.,

Levy *et al*., 2007; Bargain and Callan 2010; Bargain 2012). We sum income derived from household benefits ($y_h^B$) and household direct taxes ($y_h^T$) individually. Household benefits are defined as the sum of household pension income, means-tested benefits, and non-means-tested benefits:

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

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

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

All direct taxes and some of the benefits are modeled by EUROMOD. We use regression techniques to model the partially simulated and non-simulated variables. A summary of the variables modeled by EUROMOD and by regression models is available in Appendix Tables A1 and A2.

### 3.2. *Simulating Counterfactual Distributions*

As outlined at the start of the section, we utilize these market and non-market models to simulate counterfactual distributions and to undertake a decomposition of changes in the income distribution over time, between period *t* and period *s*. The income generation model (IGM) can be defined as:

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

where:

- $Y$ is household disposable income,
- X is a vector of exogenous characteristics,
- $\xi$ is the vector of parameter values, and
- $\Upsilon$ 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, as well as the tax–benefit rules.

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 *IGM* 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 individual components affect changes in the distribution of disposable income.

The change depends on the (joint) distribution of $X$ and $\Upsilon$ in the population through $m$ and $\xi$ 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 $\xi$. 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 IGM for each year separately and calibrate transformations so as to replace components of the IGM of year $t$ with components of the IGM 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 labor market structure transformation;
- a returns transformation;
- a demographic transformation; and
- a tax–benefit system transformation.

Below we outline the transformation in a general form and leave the exact variables on which the transformations are applied to the Appendix Tables A1 and A2 (see columns "variables" and "factors" in particular). We also included the main model tables (Tables A4–A19 in the Appendix), while the rest of the model tables are available on request.

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

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

$Y^l$ is the counterfactual distribution that would prevail in period $t$ if we "import" the labor market structure of period $s$, while keeping everything else the same.

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

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

$Y^r$ is the counterfactual distribution that would prevail in period $t$ if we "import" the structure of returns of period $s$, while keeping everything else constant. 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 transformation changes the values of variables relating to sociodemographic characteristics of the population (education, age, sex, number of children by age, legal marital status, citizenship, and whether the individual is over 65 without any children to account for single elderly households) and involves a modification of the distribution of the random variables in X as in Sologon *et al*. (2021). We reweigh the population at time $t$ to resemble the population structure at time $s$ by a factor obtained semi-parametrically following DiNardo *et al*. (1996) and Barsky *et al*. (2002):

$$\omega(X) = \frac{\Pr(X|s)}{\Pr(X|t)} = \frac{\Pr(s|X)}{\Pr(t|X)} \frac{\Pr(t)}{\Pr(s)}. \tag{12}$$

The alternative distribution of $\tilde{X}(X)$ results in obtaining a counterfactual outcome for income, $Y^d$:

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

$Y^d$ is the counterfactual distribution that would prevail in period $t$ if we "import" the demographic structure of period $s$, while keeping everything else constant.

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 $t$. For these simulations, pre-fiscal monetary variables are inflated (deflated) to the year of the tax–benefit system being considered using the EUROMOD uprating indices. Most non-benefit monetary variables, including employment and self-employment incomes, are uprated by the average gross monthly earnings index. Several income components, such as investment income, private pensions, private transfers, and some benefit monetary variables, are uprated by the harmonized index of consumer prices. Most benefit monetary variables are uprated by benefit specific indices (e.g., social assistance benefits are uprated by an index that captures the change in the average amount of monetary social assistance benefit received between years). Similar swapping of tax–benefit policy rules and parameters was implemented for analyzing trends in income distributions (see Bargain and Callan, 2010; Bargain, 2012; Azpitarte and Herault, 2016; Paulus and Tasseva, 2020) and cross-country differences (see Dardanoni and Lambert, 2002; Levy *et al*., 2007; Sologon *et al*., 2021).

The resulting counterfactual is formalized as:

$$Y^{tb} = m(X, \Upsilon; \tilde{tb}(\xi)). \tag{14}$$

$Y^{tb}$ is the counterfactual distribution that would prevail in period $t$ if we "import" the tax–benefit rules of period $s$, while keeping everything else constant.

For each of the four transformations, the impact is assessed by comparing the original distribution in period $t$ with each counterfactual. We can compute the

impact on any distribution functional of interest, $\theta$, 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:

$$\Delta_\theta^k(F) = \theta(F) - \theta(F^k). \tag{15}$$

In our approach, the disposable incomes obtained in the simulations are aligned to the year of the tax–benefit system being applied. For example, when we apply the period $t$ tax–benefit system to market incomes, the resulting disposable incomes are in period $t$ values. This implies that counterfactuals obtained by importing in period $t$ the demographics, labor market structure, and returns from period $s$ are aligned with period $t$ values. When we "import" the tax–benefit rules from period $s$, however, the resulting simulated incomes are aligned with period $s$, in terms of both productivity level and prices. As we need to compare this counterfactual with the original $t$ distribution using a scale-variant distributional functional, such as the quantiles, we need to index disposable incomes by the average market income index to ensure all incomes are expressed in period $t$ values (in terms of productivity and prices), in line with the other counterfactual differences. As the aim of the tax–benefit transformation is to evaluate actual policy changes, we use a distributional neutral benchmark given by the actual change in average market income levels between period $t$ and $s$ (Bargain and Callan, 2010). Specifically, we adjust the simulated incomes expressed in 2011 values by the ratio between the mean market income in 2015 and 2011. We perform a similar adjustment for 2007. This way we account for the price changes and for the productivity growth between the years. This ensures that the "tax and benefit effect" measures the change in relative position of those who do get market incomes and those who do not (e.g., welfare payments), thereby capturing the change in generosity of the system. That is, we measure the marginal effect of the tax and benefit system on disposable income when we control for the level of productivity growth and prices (as well as demography and labor market structure). When we compare distributions using scale-invariant distribution functionals, such as the Gini index, inflating (deflating) disposable incomes has no impact on the comparison.

### 3.3. *Decomposition of Changes in the Income Distribution Over Time*

Next, we decompose the observed differences between income distributions and their corresponding functionals in years $t$ and $s$. We compute a certain functional $\theta(F)$ for each of the 2 years, $\theta(F^t)$ and $\theta(F^s)$. Our procedure aims to decompose the total observed difference, $\theta(F^t) - \theta(F^s)$, into the contributions of each of the individual determinants $k$ of a set $K$:

$$\Delta_\theta(F^t, F^s) = \theta(F^t) - \theta(F^s) = \sum_{k=1}^{K} \Delta_\theta^k(F^t, F^s). \tag{16}$$

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; that is, the estimated contribution of each factor depends on the chosen sequence. To reduce issues of path-dependence,[6] 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:

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

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).[7] 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:

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

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

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

$$D_\theta^{tb}(F^t, F^s) = \theta(F^t) - \theta(F_t^{tb}) \tag{21}$$

$$\Delta\Upsilon_\theta(F^t, F^s) = \theta(F^t) - \theta(F_s^{l,r,d,tb}) \tag{22}$$

$$I_\theta(F^t, F^s) = \left(\theta(F^t) - \theta(F^s)\right) - \left[\left(\sum_{k\in\{l,r,d,tb\}} D_\theta^k(F^t, F^s)\right) + \Delta\Upsilon_\theta(F^t, F^s)\right]. \tag{23}$$

[6]We do not eliminate path-dependence completely. For example, our results are conditional on the choice of the reference year.

[7]In equations (18)–(20), all pre-fiscal incomes are expressed in period $t$ values, to which we apply the period $t$ tax–benefit system and the resulting household disposable incomes are expressed in period $t$ values. In equation (21), the counterfactual distribution in period $t$ under the tax–benefit rules of period $s$ relies on two steps. First, as pre-fiscal incomes are expressed in period $t$ values, we adjust the vector of pre-fiscal income components $\overrightarrow{Y}_{prefiscal_t}$ with the EUROMOD uprating factors (vector $U$) to match the year of the tax–benefit system (period $s$). The resulting simulated household disposable incomes $Y_{disposable_s}$ are aligned with period s: $(\overrightarrow{U} * \overrightarrow{Y}_{prefiscal_t})|TB_s = Y_{disposable_s}$. Second, as we compare all distributions in period $t$ values, the simulated disposable income needs to be adjusted accordingly. For adjusting the household disposable income variable, we use scalar $a$ closely related to vector $\overrightarrow{U}$, namely the average market income index: $Y_{disposable_t} = 1/a * Y_{disposable_s}$. Scalar $a$ is essentially the average across elements of $\overrightarrow{U}$, weighted by corresponding income components' relative share in total pre-fiscal income $a = \overline{\overrightarrow{U}}$.

The term $\Delta\Upsilon_\theta(F^t, F^s)$ captures the contribution of differences in the distribution of scaled residual or unobserved heterogeneity terms $\Upsilon$ between period $t$ and $s$. Following the original approach in Sologon *et al*. (2021), we did not perform specific transformations involving the residual terms because they do not have clear-cut economic interpretations: they mostly reflect the correlation of scaled residuals across all income sources and differences over time in residual distributions that may be due to unmodeled heteroscedasticity or model misspecification.[8] $I_\theta(F^t, F^s)$ is an interaction term. Following Biewen (2014) and Sologon *et al*. (2021), it is calculated as the total difference in $\theta$ (net of the unexplained effect) minus the sum of direct effects, accounting for all two-way and three-way interactions between the four components in the model.

The total observed change over time is decomposed into:

$$\begin{aligned}\Delta_\theta(F^t, F^s) = {} & D^l_\theta(F^t, F^s) + D^r_\theta(F^t, F^s) + D^d_\theta(F^t, F^s) \\ & + D^{tb}_\theta(F^t, F^s) + \Delta\Upsilon_\theta(F^t, F^s) + I_\theta(F^t, F^s).\end{aligned} \tag{24}$$

As a robustness check, we also use the Shapley 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 Shapley value decomposition results for the full sample period in the Appendix, while we use the direct effects throughout the text. Our conclusions are robust across the two approaches.

### 3.4. *Data*

We use the nationally representative household survey for Lithuania: the European Union Statistics of Income and Living Conditions (EU-SILC) for the period 2007–2015. This yearly survey contains detailed information about income in the preceding year as well as the socioeconomic characteristics of households and their members, largely during the survey year. Therefore, we focus on 2008, 2012, and 2016 EU-SILC survey waves for Lithuania.

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 data set for Lithuania, which have been standardized for common definitions of income variables and household 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. The "EUROMOD input data" that we feed to EUROMOD are already modified by the IGM. That is, the labor market transformation, the returns transformation, and part of tax and benefit transformation (for values not modeled by EUROMOD) have been applied to the data to derive hypothetical income distributions. In addition, the values have been uprated (i.e., indexed to nominal averages of respective

[8] $\Delta\Upsilon_\theta(F^t, F^s)$ is obtained by swapping residuals across periods. Starting from time $s$ we jointly apply all four transformations calibrated to period $t$ parameters. Subtracting this construct from time $t$'s original distribution we capture the difference between the residuals of period $t$ and period $s$.

system years) before being fed to EUROMOD. The uprating values differ depending on the monetary value (e.g., pensions are uprated to average statutory pension each year, while labor income is uprated to average gross wages of that year). Then, direct taxes, social insurance contributions, and a part of cash benefits are calculated by EUROMOD. EUROMOD assumes full take-up of benefits (no tax evasion). All incomes are expressed in single adult equivalent by dividing total household income by the square root of household size. Sample sizes exceed 10,000 individuals, corresponding to just under 5000 households in each year.

The demographic, cyclical, and structural changes discussed previously are visible in the EU-SILC data. Table 2 shows several population socioeconomic characteristics for each of the 3 years based on the samples in our database, as well as changes in these characteristics from 2007 to 2011 and from 2011 to 2015.

TABLE 2
Population Socioeconomic Characteristics (Shares of Total Population)

| | 2007 | 2011 | 2015 | 2007–2011 | 2011–2015 |
|---|---|---|---|---|---|
| *Demographic* | | | | | |
| Tertiary education | 0.287 | 0.332 | 0.358 | 0.045 (0.014) | 0.026 (0.015) |
| People 16–65 | 0.684 | 0.670 | 0.665 | −0.014 (0.008) | −0.005 (0.008) |
| People >65 | 0.148 | 0.173 | 0.179 | 0.024 (0.007) | 0.006 (0.008) |
| Child 0–3 | 0.038 | 0.037 | 0.039 | −0.001 (0.005) | 0.002 (0.005) |
| Child 4–11 | 0.080 | 0.073 | 0.081 | −0.007 (0.006) | 0.008 (0.006) |
| Child 12–15 | 0.049 | 0.047 | 0.036 | −0.002 (0.004) | −0.011 (0.004) |
| Married | 0.578 | 0.530 | 0.469 | −0.048 (0.011) | −0.061 (0.012) |
| Citizen | 0.995 | 0.995 | 0.992 | 0.000 (0.002) | −0.002 (0.002) |
| Male | 0.444 | 0.450 | 0.451 | 0.006 (0.007) | 0.000 (0.007) |
| Household size | 3.316 | 3.091 | 2.991 | −0.225 (0.074) | −0.101 (0.068) |
| *Labour market structure* | | | | | |
| Months worked | 6.629 | 5.903 | 6.479 | −0.726 (0.121) | 0.576 (0.124) |
| Employee/Self-employed | 0.897 | 0.942 | 0.910 | 0.045 (0.007) | −0.032 (0.007) |
| Occupation | | | | | |
| Managers | 0.139 | 0.115 | 0.115 | −0.024 (0.009) | 0.000 (0.009) |
| Professionals | 0.168 | 0.233 | 0.229 | 0.064 (0.012) | −0.003 (0.013) |
| Associate Prof. | 0.104 | 0.084 | 0.071 | −0.021 (0.008) | −0.013 (0.007) |
| Clerks | 0.041 | 0.038 | 0.043 | −0.003 (0.005) | 0.005 (0.005) |
| Service | 0.118 | 0.125 | 0.122 | 0.007 (0.010) | −0.003 (0.009) |
| Craft | 0.204 | 0.193 | 0.189 | −0.011 (0.011) | −0.003 (0.011) |
| Plant | 0.112 | 0.103 | 0.103 | −0.009 (0.008) | −0.001 (0.008) |
| Unskilled | 0.113 | 0.110 | 0.129 | −0.003 (0.008) | 0.018 (0.009) |
| Industry | | | | | |
| Agriculture | 0.078 | 0.058 | 0.052 | −0.020 (0.007) | −0.006 (0.006) |
| Industry | 0.246 | 0.155 | 0.151 | −0.091 (0.012) | −0.003 (0.010) |
| Services | 0.676 | 0.788 | 0.797 | 0.111 (0.013) | 0.009 (0.012) |
| Business certificate | 0.262 | 0.191 | 0.215 | −0.071 (0.040) | 0.024 (0.038) |
| *Price and returns* | | | | | |
| With wage income | 0.615 | 0.606 | 0.653 | −0.009 (0.011) | 0.047 (0.011) |
| Wages | 4.263 | 3.750 | 4.624 | −0.513 (0.097) | 0.874 (0.105) |
| With capital income | 0.085 | 0.075 | 0.164 | −0.010 (0.007) | 0.089 (0.008) |
| Capital income | 9.004 | 4.883 | 9.174 | −4.122 (2.620) | 4.291 (2.035) |
| 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 to 80; for citizen to the entire sample; for buisness sertificates to self-employed. The shares for capital refer to age ≥ 16. Wages and capital income deflated by the harmonized index of consumer prices. Standard errors in parenthesis.

*Source*: Author calculation based on EU-SILC EUROMOD input data.

Standard errors of the changes are in parenthesis, and we label the changes as significant if $t$ values exceed 1.96.

In terms of demographics characteristics, we see a relative increase in education attainment and life expectancy, both of which increased significantly in the 2007–2011 period. We also see a decline in the presence of children, especially those aged 12–15 in the 2011–2015 period and a significant relative decline in (legal) marriage rates (from 58 percent in 2007 to 47 percent in 2015).

Changes in the labor market structure are more nuanced. In 2007, an average respondent worked for 6.6 months during the year; this significantly fell to 5.9 in 2011. This constitutes a greater than 10 percent 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 the share of people with tertiary education: a larger share of high-skilled workers were able to take more qualified jobs. There was also a large shift toward the service sector, especially during 2007–2011, at the expense of the agricultural and industry sectors, as expected.

Finally, looking at the participation and returns in the labor and capital markets, we can see that the share of people with capital income has doubled since 2007. The increase is highly significant in the 2011–2015 period. Average capital income increased by about 87 percent after accounting for inflation, while it decreased by 46 percent during the first subperiod. We observe similar dynamics in the labor market: wages have fallen by 12 percent and increased by 23 percent during the first and second subperiods, respectively. We take this as evidence of significant changes in the returns of investments in both the labor and the capital markets.

## 4. Changes in the Income Distribution and Redistribution Between 2007 and 2015 in Lithuania

### 4.1. *Changes in Disposable Income Inequality*

We start by characterizing the changes in the distribution of equivalized household disposable incomes in Lithuania between 2007 and 2015, considering both the period 2007–2015 as a whole and two subperiods: 2007–2011 and 2011–2015.

Table 3 shows the mean and median monthly disposable incomes and the Gini index associated with each of these periods. We present both nominal and uprated values to assess the evolution of incomes relative to price developments (the harmonized index of consumer prices, HICP). Nominal values do not differ a lot between 2007 and 2011, but there is a rapid increase in 2015. The HICP uprated mean and median income values, however, were significantly lower in 2011 as compared to 2007. Therefore, we observe a decline in purchasing power during the economic crisis period. In contrast, the mean and median income has increased

TABLE 3
Summary Statistics of Monthly Household Disposable Income (in EUR)

| | Nominal | | HICP Adjusted | | |
|---|---|---|---|---|---|
| | Mean | Median | Mean | Median | Gini |
| 2007 | 433 | 369 | 549 | 467 | 0.339 |
| | (4.34) | (3.84) | (5.50) | (4.87) | (0.0041) |
| 2011 | 438 | 364 | 455 | 378 | 0.331 |
| | (3.59) | (3.89) | (3.73) | (5.63) | (0.003) |
| 2015 | 611 | 508 | 611 | 508 | 0.360 |
| | (6.66) | (5.82) | (6.66) | (5.82) | (0.0039) |

*Notes*: HICP adjusted values are given in 2015 prices. Standard errors in parenthesis.
*Source*: Author calculation based on EU-SILC EUROMOD input data.

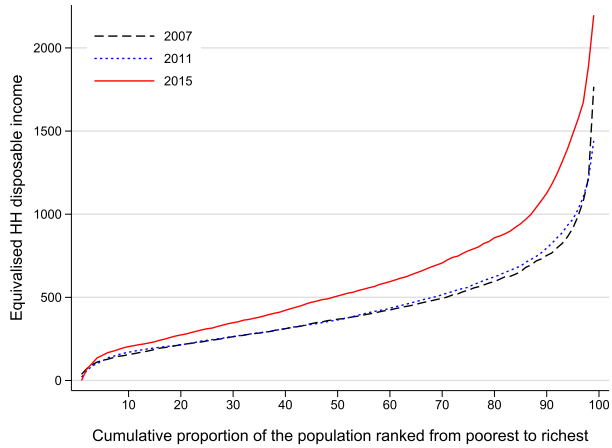


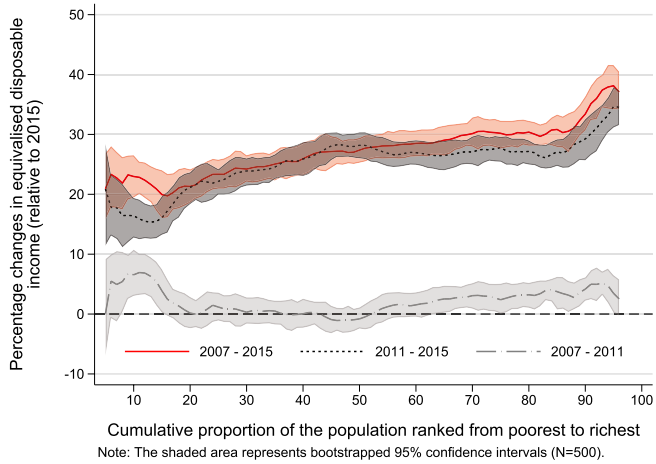

Figure 5. Distribution of Equivalized Household Disposable Income (Nominal Values)
*Source*: Authors' calculation based on EU-SILC EUROMOD input data. [Colour figure can be viewed at wileyonlinelibrary.com]

roughly by 34 percent since 2011. The Gini moved in tandem with real incomes. It slightly fell between 2007 and 2011, but then increased by 2.9 Gini points in 2015.

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, we can see 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 two panels of Figure 6. Panel 6a 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

(a) Nominal values




(b) HICP adjusted to 2015 prices

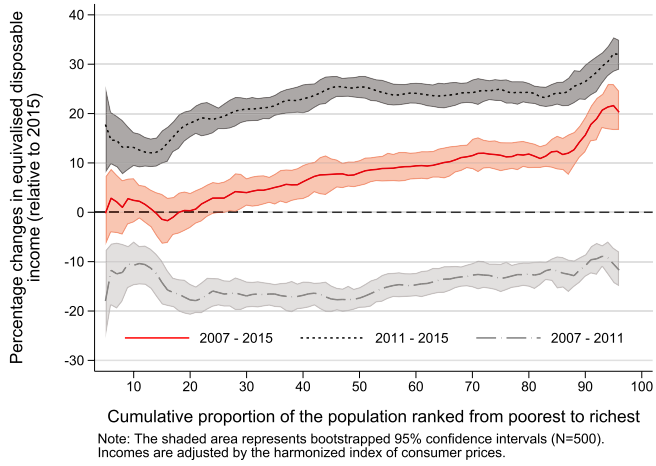



Figure 6. Relative Changes in the Distribution of Equivalized Household Disposable Income
*Source*: Authors' calculation based on EU-SILC EUROMOD input data. [Colour figure can be viewed at wileyonlinelibrary.com]

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 subperiods. The 2007–2015 period comprised two very distinct subperiods 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 percent and the 40–50 percent actually lost income. This contrasts with the period 2011–2015, where income of the entire distribution rose. However, the rise in income in 2011–2015 period differs along the distribution: it

rose by around 20 percent for the bottom 20 percent of the population and around 30 percent for the top of the population. The top 10 percent of the distribution gained even more than 30 percent in their disposable income. Therefore, the economic upturn increased inequality between the tails of the distribution. Panel 6b contains the HICP deflated quantile differences. Therefore, it captures the drop in purchasing power from 2007 to 2011 across the income distribution. Even though this was followed by a rapid recovery, incomes at the bottom of the income distribution increased by far less than those at the top. As a result, the purchasing power of those at the bottom of 25 percent of income distribution was the same in 2015 as in 2007.

### 4.2. *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 market income and the Gini of disposable income. Next, the effectiveness of each component of redistribution, that is, 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) progressivity/regressivity effect, measured by the Kakwani index.[9]

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 inequality in Lithuania. In each of the 3 years considered, the net redistributive effect was around 15 Gini points, or about 30 percent 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 percent, from 0.134 to 0.182. The effect was large enough to dominate the increase in market income inequality by more than 13 percent: 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.

The increase in net redistribution in 2011 was determined by an increase in benefit redistribution (more generous transfer rates and more regressive benefits), whereas the drop in 2015 compared to 2011 was determined by a decrease in both benefit (smaller transfer rates and less regressive transfers) and tax redistribution (drop in tax progressivity).

[9]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.

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 |
| | [0.463 to 0.483] | [0.505 to 0.521] | [0.505 to 0.525] | [0.028 to 0.053] | [−0.011 to 0.015] | [0.028 to 0.056] |
| Gini disposable income (2) | 0.339 | 0.331 | 0.360 | −0.008 | 0.029 | 0.021 |
| | [0.33 to 0.349] | [0.325 to 0.338] | [0.352 to 0.368] | [−0.020 to 0.002]] | [0.017 to 0.038] | [0.008 to 0.032] |
| Net redistribution (1)–(2) | 0.134 | 0.182 | 0.155 | 0.048 | −0.026 | 0.021 |
| | [0.128 to 0.139] | [0.175 to 0.188] | [0.149 to 0.161] | [0.039 to 0.057] | [−0.036 to −0.018] | [0.012 to 0.029] |
| Gini market income | 0.369 | 0.364 | 0.391 | −0.005 | 0.026 | 0.021 |
| (+ transfers) (3) | [0.36 to 0.379] | [0.358 to 0.371] | [0.383 to 0.399] | [−0.017 to 0.005] | [0.015 to 0.037] | [0.009 to 0.034] |
| Average transfer rate | 0.186 | 0.252 | 0.223 | 0.066 | −0.029 | 0.037 |
| | [0.178 to 0.195] | [0.241 to 0.263] | [0.213 to 0.233] | [0.053 to 0.081] | [0.016 to 0.046] | [−0.052 to −0.024] |
| Transfer regressivity | 0.768 | 0.845 | 0.801 | 0.078 | −0.044 | 0.034 |
| | [0.745 to 0.791] | [0.832 to 0.860] | [0.782 to 0.820] | [0.05 to 0.104] | [−0.066 to 0.021] | [0.003 to 0.062] |
| Transfer redistribution (RS) | 0.104 | 0.148 | 0.124 | 0.045 | −0.024 | 0.021 |
| (1)–(3) | [0.099 to 0.108] | [0.142 to 0.154] | [0.119 to 0.129] | [0.037 to 0.053] | [−0.032 to −0.016] | [0.013 to 0.028] |
| Gini market income | 0.341 | 0.343 | 0.372 | 0.002 | 0.030 | 0.032 |
| (+ transfers − taxes) (4) | [0.332 to 0.350] | [0.337 to 0.349] | [0.364 to 0.381] | [−0.01 to 0.012] | [0.018 to 0.040] | [0.02 to 0.043] |
| Average tax rate | 0.177 | 0.100 | 0.107 | −0.077 | 0.007 | −0.070 |
| | [0.175 to 0.179] | [0.099 to 0.101] | [0.105 to 0.108] | [−0.08 to −0.075] | [0.005 to 0.008] | [−0.073 to −0.068] |
| Tax progressivity (K) | 0.144 | 0.199 | 0.161 | 0.055 | −0.038 | 0.017 |
| | [0.139 to 0.149] | [0.193 to 0.205] | [0.154 to 0.165] | [0.047 to 0.063] | [−0.047 to −0.032] | [0.009 to 0.024] |
| Tax redistribution (RS) (3)–(4) | 0.029 | 0.022 | 0.019 | −0.007 | −0.003 | −0.010 |
| | [0.028 to 0.03] | [0.021 to 0.022] | [0.018 to 0.019] | [−0.009 to −0.006] | [−0.004 to −0.002] | [−0.012 to −0.009] |

*Notes*: K = Kakwani; RS = Reynolds-Smolensky. Bootstrapped 95% confidence intervals ($N = 500$) are reported in squared brackets.
*Source*: Author calculation based on EU-SILC EUROMOD input data.

## 5. Drivers of Changes in the Income Distribution Between 2007 and 2015

This section decomposes the changes in total income inequality presented in Section 4 into the contributions of the main factors considered in our model, as described in Section 3.3. This helps us understand why income inequality changed.

### 5.1. *Decomposing Changes in Incomes*

Figure 7 shows the contribution of each factor to the total changes in income distributions (i.e., the decomposition of the total changes in income distribution that were depicted in Figure 6b). Analogous 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 interaction effects and the residuals. The joint effect of the latter two can be found in Figure A1 in the Appendix.

All four factors contributed to changing household disposable income distribution in Lithuania. The biggest effect was due to the price and returns effect, as

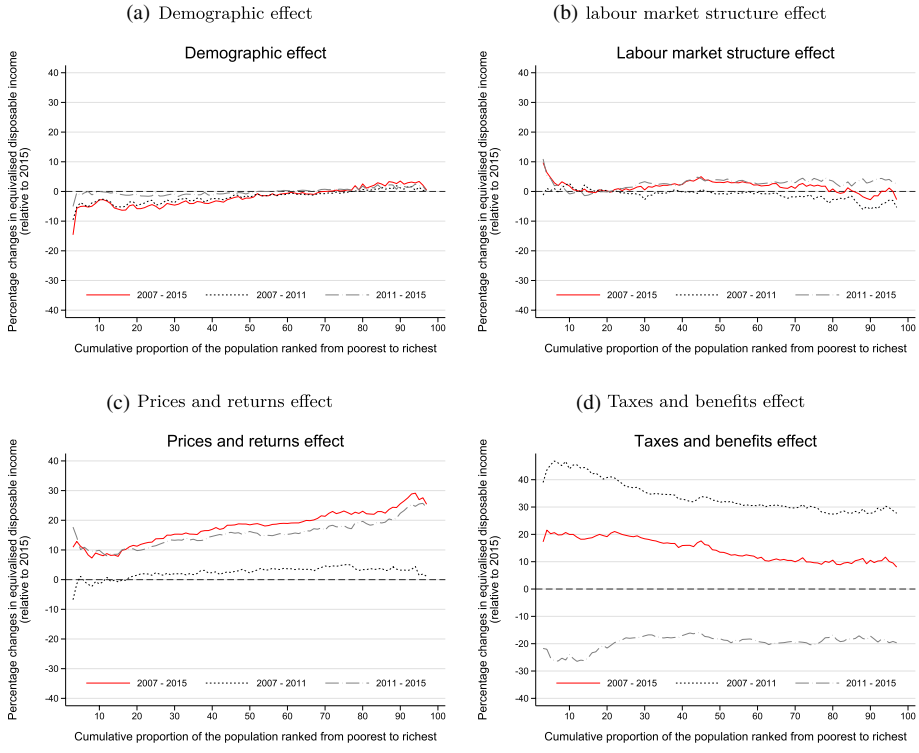



Figure 7. Decomposition of Changes in the Distribution of Equivalized Household Disposable Income

*Source*: Authors' calculation based on EU-SILC EUROMOD input data. [Colour figure can be viewed at wileyonlinelibrary.com]

well as changes in the generosity of the tax and benefit system. Changes in price and returns increased disposable income of the median household by about 20 percent during the whole period, whereas changes in the tax and benefit system generosity contributed another 12 percent. Changes in labor market structure increased income by 5 percent 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 varies, 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 had a smaller impact on the level of disposable income, its effect on inequality appears to be very significant over the analyzed period. This is because changes in the demographics of the population affect the bottom and the top of the income distribution unequally: because of the demographic effect, the income of the bottom 30 percent of the population was 5 percent lower in 2015, whereas the income of the top has increased by 5 percent. The size of the contribution of the demographic effect to increasing income inequality is comparable to the size of the tax and benefit effect acting in the opposite direction.

Looking at the two subperiods, we can see that 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. This was partly because benefits were substantially raised in this period, as well as because market incomes have dropped. In contrast, the tax and benefit became much less generous during the upturn, because benefits increased less or not at all, while market incomes rose rapidly. Furthermore, benefits that target the bottom of the income distribution, such as social assistance, actually decreased during the 2011–2015 period and as a result the bottom 20 percent benefited less than the rest of the distribution. In contrast, the price and returns played a modest role in 2007–2011; most of the effect came 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, that is, 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 subperiods, likely because of the secular nature of the demographic shifts.

Finally, the effect of changes in the labor market structure appears to be mostly concentrated at the bottom of the income distribution. There is a positive effect on the bottom 5 percent of households: their income increased by almost 10 percent 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 labor market structure.

### 5.2. *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 A3 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 A3 discloses that declining (legal) marriage rates contributed the most while increasing rates of education, defined as tertiary level education versus all lower education levels, 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 A2d, explains the totality of the demographic effect. Interestingly, the aging 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 means that as a smaller share of population becomes married, income inequality increases. This finding is consistent with Burtless (1999), who found a similar result for the US 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 nonmarried households (which are largely also single-person households) do not have. Alternatively, marriage can be a "luxury" into which higher income earners self-select. In addition, our results show that fewer married households are linked to lower household disposable income. While our decompositions are not causal, other studies do tend to suggest that this link may be causal: as summarized by Lundberg *et al*. (2016), married men tend to work longer hours and get higher earnings. This is related to changing behavior (reducing risky activities such as drug use or drinking and increasing preferences for work). As such, falling marriage rates among the poorest households maybe especially problematic, as this pushes them into even deeper poverty.

Education has an overall positive effect for incomes, although the effect is slightly stronger in the upper tail of the income distribution. This means that the rise in the number of people with tertiary education is associated with higher income overall, even though the richest individuals benefit more. This result is in line with Magda *et al*. (2021), who show that education contributed to wage inequality in Lithuania in the similar period because of the composition effect (more educated people).

Importantly, the demographic effect only captures a part of the overall education effect. This is because the demographic effect only considers the share of people with tertiary education, but does not consider the returns to education. Magda *et al*. (2021) finds that returns to education in terms of wages indeed declined in Lithuania in a similar period, and that this decline was strong enough to offset

the composition effect (more people getting tertiary education). As a result, more education also means more equal wages and subsequently more equal incomes. In addition, those with higher education tend to receive more equal incomes than those who do not have it (Černiauskas and Čiginas, 2020). Therefore, even if between-group inequality increases (i.e., the income gap between those with a tertiary degree and those without rises), the higher share of educated results in lower within-group inequality in Lithuania. This finding contrasts Lemieux (2006) results obtained for the US, where the more educated (albeit defined at a more disaggregated level) tended to be more unequal than those who were educated, in which case more education means less equality. One possible explanation for different levels of within inequality could relate to more homogeneous universities in Lithuania than in the US, resulting in more equal outcomes. For example, all but one university in Lithuania are public, and the government (now and in Soviet times) provides heavy subsidies to enter. However, this should be explored further. Similarly, the stronger effect for the top of income distribution could be examined further. This would be problematic if higher-income families have certain privileges of obtaining education. Contemporary reports do not suggest unequal access to higher education per se, but there are signs that supply of early education is unequal, which could allow wealthier families to access it, and then subsequently find it easier to enroll into higher education (OECD, 2017).

### 5.3. *Decomposing Changes in Inequality and Redistribution*

Here we quantify the contributions of the four factors as well as their interactions to the changes in income inequality and net redistribution. That is, we decompose Table 4, found in Section 4.2. Table 5 shows the contributions to the changes in Gini of disposable income and the Gini of market income. The contributions to the changes of the net redistribution, which is the difference between Gini of market income and the Gini of disposable income, is found in Table 6. All decompositions are based on direct effects, as shown in Section 3.3. As a robustness check, the decompositions based on the Shapley value can be found in Table A3 in the Appendix.

Starting with the contributions to the changes in disposable income inequality, we can see that the effects of the four factors were heterogeneous. In terms of the size of the effect, the contribution of the prices and returns factor 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 because of 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 were 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 growing income inequality because of the returns and the

TABLE 5
DECOMPOSITION OF CHANGES IN EQUIVALIZED INCOME INEQUALITY

| | Gini Disposable Income | | | Gini Market Income | | |
|---|---|---|---|---|---|---|
| | | 2007–2011 | 2011–2015 | 2007–2015 | 2007–2011 | 2007–2015 |
| **Total change** | **0.021** | **−0.008** | **0.029** | **0.042** | **0.04** | **0.002** |
| Demographics | | 0.008 | 0.006 | 0.020 | 0.017 | 0.013 |
| Labour market structure | | −0.017 | 0.005 | −0.015 | −0.015 | −0.012 |
| Prices and returns | | −0.002 | 0.032 | 0.006 | −0.007 | 0.030 |
| Taxes and benefits | | −0.021 | 0.000 | 0.002 | 0.004 | −0.020 |
| Interactions | | 0.002 | 0.016 | 0.003 | 0.009 | 0.017 |
| Unexplained | | 0.022 | −0.030 | 0.026 | 0.033 | −0.008 |

*Notes*: Columns indicate the time period over which statistics where calculated (e.g. 2007–2011 refers to the change from 2007 to 2011).
*Source*: Author calculation based on EU-SILC EUROMOD input data.

TABLE 6
DECOMPOSITION OF THE CHANGES IN REDISTRIBUTION

(a) Net redistribution, benefit redistribution, and tax redistribution

| | Net redistribution | | | Benefit redistribution | | | Tax redistribution | | |
|---|---|---|---|---|---|---|---|---|---|
| | 2007–2015 | 2007–2011 | 2011–2015 | 2007–2015 | 2007–2011 | 2011–2015 | 2007–2015 | 2007–2011 | 2011–2015 |
| **Total** | **0.021** | **0.048** | **-0.026** | **0.021** | **0.045** | **−0.024** | **−0.010** | **−0.007** | **−0.003** |
| Taxes and Benefits | 0.023 | 0.024 | −0.001 | 0.027 | 0.028 | −0.002 | −0.008 | −0.008 | 0.000 |
| Market incomes | −0.001 | 0.024 | −0.025 | −0.006 | 0.017 | −0.022 | −0.002 | 0.001 | −0.003 |

(b) Detailed tax and benefit redistribution

| | Benefit regressivity | | | Average benefit rate | | | Tax progressivity | | | Average tax rate | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2007–2015 | 2007–2011 | 2011–2015 | 2007–2015 | 2007–2011 | 2011–2015 | 2007–2015 | 2007–2011 | 2011–2015 | 2007–2015 | 2007–2011 | 2011–2015 |
| **Total** | **0.034** | **0.078** | **−0.044** | **0.037** | **0.066** | **−0.029** | **0.017** | **0.055** | **−0.038** | **−0.070** | **−0.077** | **0.007** |
| Taxes and Benefits | −0.017 | 0.015 | −0.032 | 0.070 | 0.060 | 0.010 | 0.029 | 0.033 | −0.004 | −0.071 | −0.071 | 0.000 |
| Market incomes | 0.051 | 0.062 | −0.012 | −0.033 | 0.006 | −0.039 | −0.012 | 0.022 | −0.035 | 0.000 | −0.006 | 0.006 |

Notes: (a) Columns indicate the time period over which statistics where calculated (e.g. 2007–2011 refers to the change from 2007 to 2011).
*Source*: Author calculation based on EU-SILC EUROMOD input data.
(b) Columns indicate the time period over which statistics where calculated (e.g. 2007–2011 refers to the change from 2007 to 2011).
*Source*: Author calculation based on EU-SILC EUROMOD input data.
The bolded values "Total" is the sum of the values below.

demographic effects. Specifically, changes in 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 2.0 pp, and the effect is concentrated in the period of financial crisis. As discussed in Section 2, no additional measures were implemented during the years of economic expansion, as most of the transfers, such as pensions, were frozen. This means 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 labor market structure is shown to make a smaller but also significant contribution to lowering income inequality, which occurred during the first subperiod.

Moving to 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 percent of the growth concentrated in the first subperiod.[10] 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 labor and capital markets on 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, we can see that the two phases cancel each other out, and the total effect is only 0.6 pp. Changes in labor market structure appear to be the only factor that has reduced market income inequality substantially, and the effect is mainly concentrated in the first subperiod. It is important to note that the component unexplained by our methodology amounts to a significant share of the total change, especially so during the first subperiod. This implies that factors not modeled by our methodology (e.g., regional composition of workers and jobs) also played a role.

Next, we examine net redistribution to assess whether the changes in the income distribution were due to changes in policy design or changes in the distribution of market incomes. Here, market incomes refer to all factors (except the tax and benefit factor) plus interactions and the unexplained residual. We decompose the changes in the redistributive indices marking the transition from market to disposable income. Specifically, we decompose redistributive indexes into total (a) net redistribution, (b) benefit redistribution (benefit regressivity and average benefit rate), and (c) tax redistribution (tax progressivity and average tax rate). Our infrastructure allows us to assess to what extent the observed changes in these indices are due to changes in policy design over time, as captured by the tax–benefit effect in Table 6. Controlling for changes in market income distributions between 2007 and 2015, we find that net redistribution increased. The increase was driven by an increase in benefit redistribution, as seen in Table 6a, where all the increase

[10]The small effect of the tax–benefit transformation on market income inequality is due to adjustments to minimum wages, which are included in the taxes and benefit transformation. Regarding the compliance rules implemented in EUROMOD, we are not bringing in second-order non-compliance and we are not assuming differential compliance. We assume, thus, no tax-evasion, compliance in benefit take-up, and compliance with minimum wage regulations.

took place in the period 2007–2011. In contrast, changes to the tax system reduced income redistribution. Again, the policy changes predominantly took place in 2007–2011.

We then split the benefit and tax redistribution further into average tax/benefit rate effect and a progressivity effect with the help of the STATA package compiled by Peichl and Van Kerm (2007). The results are found in Table 6b. From this, we see that the benefit redistribution increased because of higher benefit generosity. Higher benefits were paid out, particularly in the period of 2007–2011. Had market incomes not risen in that period also, inequality would have been even lower. Although benefits became less regressive, benefit redistribution increased. As shown in Černiauskas and Čiginas (2020), this is because it is more effective to change benefit level than benefit regressivity, as benefits are already regressive. Although tax rates did become more progressive (partly because of rising tax-exempt amount of income), the level of taxes decreased substantially because of lower tax rates. As a result, taxes became less redistributive.

The tax–benefit system during the period from 2011 to 2015 did not generate sufficient redistribution for prevention of income inequality, which resulted from rapid increases in market incomes. Comparatively low levels of benefits and reluctance to introduce an increasingly progressive income tax were the main factors of rising income inequality.

## 6. Concluding Remarks

This paper studies the drivers of changes in the income distribution in Lithuania from 2007 to 2015 by adapting a methodology developed by Sologon *et al*. (2021). We assess the role played by changes in the labor market structure, the economic returns in labor and capital markets, the demographics, and the economic policy related to tax and benefit rules. The case of Lithuania is especially interesting, given the country's recent transition from a planned economy to a market one, its ongoing convergence to the EU-15, and large fluctuations in disposable income over the business cycle. During the period under discussion, the Lithuanian economy experienced a global financial crisis that 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 labor 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 overall, but only during the period 2007–2011. In particular, the benefit system became more redistributive because of larger benefit payouts that were increased in this period. 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. However, benefits only slightly increased thereafter, while in some cases (e.g., because of increasing pension age) fewer

benefits have been handed out altogether. Tax rates were lowered in 2007–2011 and were not raised in the later period. As a consequence, disposable income inequality increased sharply over the next period. Although the returns effect was the main contributor to increasing income inequality, especially during the period 2011–2015, other important factors played a significant role as well. 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.

Several lessons can be drawn from the analysis of the Lithuanian economy during 2007–2015. First, implementing fiscal consolidation by reducing the generosity of the benefits system can have important negative distributional consequences. Falling regressivity of benefits during the economic expansion in the aftermath of the financial crisis was one of the main contributors to increasing disposable income inequality in Lithuania. Second, the Lithuanian tax system is designed in such a way that its progressivity declines in response to unequal growth in income distribution. As the economy continues to converge toward EU-15, we can expect this mechanism to continue unless the tax system is reconsidered. Third, changing demographic composition of the population can have important consequences on the income inequality as well. As marriage rates continue to decline (most likely because of a change in the preferences with respect to the size of the household), we can expect to see rising income inequality in the future.

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## Supporting Information

Additional supporting information may be found in the online version of this article at the publisher's web site:

**Figure A1**: Interactions and Unexplained Effect *Source*: Authors' calculation based on EU-SILC EUROMOD input data.

**Figure A2**: Decomposition of the Demographic Effect *Source*: Authors' calculation based on EU-SILC EUROMOD input data.

**Table A1**: Definition of Income Components and Summary Modelling Information

**Table A2**: Demographic and Labour Market Variables

**Table A3**: Comparison of Direct Effects and Shapley Value Effects

**Table A4**: Employment

**Table A5**: Average Wage Rate- Females

**Table A6**: Average Wage Rate - Male

**Table A7**: Number of Hours Worked

**Table A8**: Self-Employment Income (Receipt, Amount)

**Table A9**: Investment Income (Receipt, Amount)

**Table A10**: Property Income (Receipt, Amount)

**Table A11**: Other Incomes (Receipt, Amount)

**Table A12**: State Old Age Benefits (Receipt and Amount)

**Table A13**: Occupation (1-Digit ISCO); for Working Individuals Only

**Table A14**: Industry Sector (Primary - Control, Secondary or Tertiary); for Working Individuals Only

**Table A15**: Retired

**Table A16**: Unemployed

**Table A17**: Owner of Enterprise with Employees (Sub-Group of Self-Employed)

**Table A18**: Has Business Certificate (Sub-Group of Self-Employed)

**Table A19**: Engaged in Individual Activities (Sub-Group of Self-Employed)