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Working Paper

Europe through the crisis: Discretionary policy changes and automatic stabilisers

EUROMOD Working Paper, No. EM16/18

Provided in Cooperation with:

Institute for Social and Economic Research (ISER), University of Essex

Suggested Citation: Paulus, Alari; Tasseva, Iva Valentinova (2018) : Europe through the crisis: Discretionary policy changes and automatic stabilisers, EUROMOD Working Paper, No. EM16/18, University of Essex, Institute for Social and Economic Research (ISER), Colchester

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EUROMOD WORKING PAPER SERIES

EM 16/18

Europe Through the Crisis: Discretionary Policy Changes and Automatic Stabilisers

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October 2018



Europe Through the Crisis: Discretionary Policy Changes and Automatic Stabilisers*

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Abstract

Tax-benefit policies affect household incomes through two main channels: discretionary policy changes and automatic stabilisers. Although a large body of literature has studied the impact of tax-benefit policy changes on incomes, little is known about the link between automatic stabilisers and the income distribution. We contribute to the literature by studying in detail the contribution of automatic stabilisers and discretionary policy changes to income changes in the EU countries between 2007 and 2014. Our results show that, discretionary policy changes and the automatic stabilisation response of policies more often worked to reduce inequality of net incomes, and so helped offset the inequality-increasing impact of a growing disparity in gross (pre-tax) market incomes. Inequality reduction was achieved mainly through policy changes to benefits and benefits acting as automatic stabilisers. On the other hand, policy changes to and the automatic stabilisation response of taxes and social insurance contributions raised inequality in some countries and lowered it in others.

JEL: D31, H23, E63

Keywords: automatic stabilisers, discretionary policy changes, income distribution, decomposition

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* We would like to thank Mike Brewer, Karina Doorley and Paul Fisher for their useful comments and gratefully acknowledge all feedback received from the participants of the EUROMOD 20th anniversary conference, 6th World Congress of the International Microsimulation Association, 3rd Workshop of EC Community of Practice on Fairness and seminars in ISER, LISER, Bank of Estonia and VATT. We also thank Kostas Manios for EUROMOD-related technical support. The results presented here are based on EUROMOD version H0.13. EUROMOD is maintained, developed and managed by the Institute for Social and Economic Research (ISER) at the University of Essex, in collaboration with national teams from the EU member states. We are indebted to the many people who have contributed to the development of EUROMOD. The process of extending and updating EUROMOD is financially supported by the European Union Programme for Employment and Social Innovation 'Easi' (2014-2020). We make use of microdata from the EU Statistics on Incomes and Living Conditions (EU-SILC) made available by Eurostat (59/2013-EU-SILC-LFS); the EU-SILC for Greece together with national variables provided by the national statistical office; the national EU-SILC PDB data for Spain, Italy, Austria and Slovakia made available by respective national statistical offices; and the Family Resources Survey for the UK made available by the Department of Work and Pensions via the UK Data Service. The results and their interpretation are our own responsibility.

1 Introduction

The financial crisis of 2007-08 and the subsequent Great Recession posed serious economic challenges to Europe. Substantial increases to unemployment, losses to wages and self-employment income, increase in governments debt and fall in GDP put strain on fiscal budgets and households finances.¹ In response to such economic challenges, tax-benefit policies have important implications for household net incomes. They affect incomes through two main channels: discretionary policy changes and automatic stabilisers.

Automatic stabilisers characterise the policies' in-built flexibility to absorb shocks to earnings and people's characteristics (Pechman, 1973). They reduce, *ceteris paribus*, the need for discretionary policy actions which take time to design and implement and can be particularly important if the scope for discretionary fiscal policies is limited, e.g. in the eurozone (Mabbett and Schelkle, 2007). They are viewed as a crucial tool for reducing macroeconomic volatility (e.g. Blanchard et al. 2010). In particular, income taxes and unemployment insurance benefits in the US, Canada and Europe have received a lot of attention from the micro and macro literature as important stabilisers of fluctuations of aggregate output as well as of disposable income and household consumption (e.g. Auerbach and Feenberg, 2000; Browning and Crossley, 2001; Kniesner and Ziliak, 2002; Auerbach, 2009; Dolls et al., 2012; Fernández Salgado et al., 2014; Di Maggio and Kermani, 2016; McKay and Reis, 2016; Hsu et al., 2018).

There is less consensus on the size and direction of impact of discretionary fiscal policies on economic stability (e.g. Taylor, 2000; Feldstein, 2002; Blanchard and Perotti, 2002; Fatás and Mihov, 2003; Auerbach and Gorodnichenko, 2012; Caggiano et al., 2015; Miyamoto et al., 2018). But a large body of micro literature has shown their importance for the income distribution, for example, Clark and Leicester (2005), Sefton and Sutherland (2005), Sutherland et al. (2008) and Bargain (2012b) for the UK; Decoster et al. (2015) for Belgium; Hills et al. (2019), Matsaganis and Leventi (2014), De Agostini et al. (2016) and Bargain et al. (2017) for selected EU countries. A decomposition approach combined with a tax-benefit calculator and micro-data has enabled researchers to identify the direct (non-behavioural) impact of policy changes on the income distribution. The estimate for the policy effect has often been compared with the contribution of 'other' factors, which encompass the

¹Between 2007 and 2014, GDP fell in 10 EU countries although it increased in the EU-28 on average (+1.5%). Government debt as % of GDP increased in every EU member state and overall by a staggering 51%. The effect on households was equally severe: the share of unemployed (as a % of the population) increased in all EU countries, except Germany, and overall by 44%. Real wages and salaries, the main source of household income, fell by 4.4%, while income from self-employment dropped by nearly 10% on average. See Eurostat database.

combined effect of changes to market incomes and population characteristics, and automatic stabilisers (e.g. Bargain and Callan, 2010; Bargain et al., 2015, 2017). For the early crisis years (2007-11), the literature agrees that policy changes were broadly poverty- and inequality-reducing in most/all countries but their redistributive effect became more heterogeneous across countries between 2011 and 2014.

In contrast, there is little empirical evidence on the redistributive power of automatic stabilisers. For several Southern EU countries and Ireland, Callan et al. (2018) find that automatic stabilisers – mainly through benefits – reduced income inequality between 2007 and 2013. For Great Britain, Tasseva (2018) finds that pro-rich income gains due to education changes were mitigated by automatic stabilisers. For hypothetical earnings shocks, on the other hand, benefits and taxes are shown to stabilise mostly the incomes of households at the bottom and top of the distribution, respectively (European Commission, 2017); while Dolls et al. (2011) find that households located at the bottom of the distribution are least protected by policies against shocks.

We aim to contribute to improved understanding of the link between automatic stabilisers and the income distribution by providing an in-depth account of the relative impact of automatic stabilisers and discretionary policy changes on household incomes in the EU in recent years (2007-2014), covering the latest economic crisis and post-crisis economic developments. We seek to decompose observed changes in the income distribution into changes due to: i) discretionary tax-benefit policy changes, ii) the automatic stabilisation response of tax-benefit policies, and iii) gross market incomes and population changes. We construct counterfactual income distributions, which represent what would have happened to household incomes in the absence of changes to a certain factor – either to tax-benefit policies or to market incomes and population characteristics. Comparing the observed and counterfactual distributions allows us to quantify the contribution of each factor to the change in incomes. Our decomposition approach builds on and extends the method by Bargain and Callan (2010). We use the EU tax-benefit model EUROMOD to calculate actual and counterfactual entitlements to cash benefits and direct income taxes and social insurance contributions (SIC) for each household in the micro-data. The micro-data contain information on population characteristics and market incomes and come from the European Union Statistics on Income and Living Conditions (EU-SILC) and, for the UK, from the Family Resources Survey (FRS).

Between 2007 and 2014, market incomes became more unequally distributed in more than a third of countries. In the rest of countries, there was no statistically significant change in inequality as measured by the Gini coefficient. Our results show that, discretionary policy changes in more than two thirds of countries

lowered inequality, consistent with the existing evidence. Our decomposition by tax-benefit policy adds to the evidence by showing that the reduction was achieved mainly through increased generosity of benefit entitlements, rather than through taxes/SIC. In about a third of countries the impact of benefit changes was enhanced by inequality-reducing tax changes, while in the remaining third, benefit changes offset a rise in inequality due to tax changes (e.g. due to the introduction of a flat tax in Bulgaria and Hungary or the reduction in top marginal tax rates in Denmark). Overall, progressive policy changes were implemented not only in countries where the welfare state expanded in size but also in countries which implemented fiscal consolidation measures in the economic downturn.

Automatic stabilisers also contributed in nearly half of the countries to lower inequality. Although discretionary policies were more often inequality-reducing, the magnitude of the two types of effect was broadly similar when it comes to narrowing the gap between the rich and the poor. A further decomposition of the automatic stabilisation effect shows that the effect of benefit stabilisation was to reduce inequality in most countries, whereas taxes/SIC had a mixed effect. The impact on net income of the stabilisation response of taxes/SIC was negatively associated with changes to market incomes/population characteristics across countries. However, there was effectively no country-level correlation between the stabilisation response of benefits and market income/population changes. This suggests that – unlike taxes/SIC – benefits are overall more responsive to changes in the population structure (such as household composition changes) than changes in market income.

The rest of the paper is structured as follows: Section 2 explains the decomposition methodology and provides our refinements and extensions to it. Section 3 describes the data and the tax-benefit model EUROMOD. Section 4 presents and discusses the results and Section 5 concludes.

2 Methodology

The central question of the paper is which factors contributed to household income changes in the EU countries between 2007 and 2014. In particular, we aim to disentangle the contribution of discretionary tax-benefit policy changes, automatic stabilisers and changes to market incomes and population characteristics. Section 2.1 presents and refines the decomposition approach formalised by Bargain and Callan (2010) – BC hereafter – which allows us to identify the direct effect of policy changes (i) from all ‘other effects’. Section 2.2 extends the BC approach by splitting the ‘other effects’ into automatic stabilisers (ii) and changes to the distribution of market incomes and population characteristics (iii).

2.1 Decomposing discretionary policy changes vs other effects

We separate the direct effect of discretionary policy changes from all other factors by means of counterfactual simulations. Intuitively, we can think of it in this way: we start with the actual end-period income distribution (in 2014) and create intermediate counterfactual scenarios in which we change one factor of interest at a time, until we arrive at the actual start-period income distribution (in 2007). A comparison of the actual and counterfactual distributions unveils how much of the income change that is observed is due to policy changes and how much due to other effects. We use the decomposition approach by BC, which combines household micro-data with a tax-benefit calculator.² We refine the methodology by identifying a broader range of combinations and explicitly distinguishing between scale-variant and scale-invariant measures of the income distribution.

Following BC, denote with $I(\cdot)$ a functional of the distribution of household income, such as the Gini coefficient or mean income. Household net incomes in period t are expressed in the form of $d_t(p_t, y_t)$ of which: d is the structure of tax-benefit policies (e.g. means-tested vs universal child benefit), p are the tax-benefit parameters (e.g. €1,000 family income-test threshold), y is a matrix containing information on gross market incomes (e.g. earnings and investment income) and household/individual characteristics, and d transforms p and y into household net income. The change in the composite indicator I between two periods ($t = 0, 1$), calculated for the distribution of household net incomes, is given by

$$\Delta I = I[d_1(p_1, y_1)] - I[d_0(p_0, y_0)] \quad (1)$$

Next, we add and subtract an (intermediate) counterfactual distribution to separate the contribution of policy changes ($d_0, p_0 \rightarrow d_1, p_1$) from changes in market incomes and population characteristics ($y_0 \rightarrow y_1$). For example, such a counterfactual can be constructed using the tax-benefit structure and policy parameters from the start-period in combination with gross market incomes and population

²There is a well-established strand in the economic literature which focuses on decomposing the distribution of individual earnings, e.g. Juhn et al. (1993), DiNardo et al. (1996), Lemieux (2002), Fields (2003), Yun (2006), see Fortin et al. (2011) for an overview. However, this strand overlooks the role of taxation and ignores other income components. Bourguignon et al. (2008) take a step further by looking at household level income which includes market incomes, private transfers and retirement income but still excludes taxes and non-retirement benefits. The classical source decomposition of income inequality by Shorrocks (1982) accounts for all income components; but does not allow isolating the effects due to policy changes from effects due to market income changes, or decomposing incomes in nominal terms.

characteristics from the end-period, yielding the following identity:

$$\Delta I = \underbrace{I[d_1(p_1, y_1)] - I[d_0(p_0, y_1)]}_{\text{discretionary policy changes (nominal)}} + \underbrace{I[d_0(p_0, y_1)] - I[d_0(p_0, y_0)]}_{\text{other effects (nominal)}} \quad (2)$$

The difference between the actual distribution of the end-period ($t = 1$) and the counterfactual gives the direct effect due to *discretionary policy changes*. It gives an answer to the question: given the distribution of market incomes and population characteristics in $t = 1$, what would have been the impact on the income distribution if we were to re-introduce the tax-benefit policies from $t = 0$. If the answer is that the outcome of interest, e.g. income inequality, would have been higher (compared to the observed outcome in $t = 1$), it means that all else being equal, discretionary policy changes reduced the level of inequality.³ The difference between the counterfactual and the observed income distribution in the start-period ($t = 0$) unveils the contribution of the *other effect*, i.e. changes in market incomes and the characteristics of the population (e.g. employment) as well as the reaction to these of the tax-benefit policies from $t = 0$. The other effects also contain any changes to market incomes and population as a result of a behavioural response to the tax-benefit policy changes.^{4,5}

In equation 2, tax-benefit policy amounts such as tax income thresholds or benefit amounts from the start-period (p_0) are applied on market incomes from the end-period (y_1). To make nominal amounts from the two periods comparable, policy parameters are adjusted by a factor α , which accounts for developments in nominal levels (e.g. prices, wages) or some other relevant counterfactual benchmark. Price indices appear most appropriate when the aim is to study how people's real living standards have changed, while changes in market incomes are more relevant for understanding shifts in the fiscal balance. See Hills et al. (2019) for more discussion

³To get a better understanding of government actions, Hills et al. (2019) extend the decomposition framework by distinguishing between the effect of changing the structure of the tax-benefit system (structural effect) from adjusting the tax and benefit monetary levels (indexation effect). Their analysis for 7 EU countries between 2001 and 2011 shows that overall, the indexation effect worked to reduce poverty and inequality stressing the importance of actual indexation of tax-benefit amounts to avoid benefit erosion and fiscal drag. Structural reforms, on the other hand, worked in both ways – to reduce but also increase poverty and inequality.

⁴Throughout the decomposition we are faced with an endogeneity problem: policy decisions may have been affected by the changes in the market and society and vice versa, the market and society may have been affected by policy changes. We do not estimate separately any behavioural responses to changes in the attributes, see Bargain (2012a) for estimating labour supply responses to the policy changes.

⁵Both cross-sectional and panel data allow for the decomposition of changes in aggregate income measures, e.g. average income for a particular household type. However, to decompose changes in disposable income for individual households, panel data are required. Relying on cross-sectional data only, such decomposition is limited to the discretionary policy effect (as different policy rules are applied on the same households).

on this. In our analysis, we base α on growth in prices (Consumer Price Index):

$$\begin{aligned} \Delta I = & \underbrace{I[d_1(p_1, y_1)] - I[d_0(\alpha p_0, y_1)]}_{\text{discretionary policy changes (real)}} + \underbrace{I[d_0(\alpha p_0, y_1)] - I[d_0(\alpha p_0, \alpha y_0)]}_{\text{other effect (real)}} \\ & + \underbrace{I[d_0(\alpha p_0, \alpha y_0)] - I[d_0(p_0, y_0)]}_{\text{nominal effect}} \end{aligned} \quad (3)$$

As a result, in equation 3 there are two different counterfactuals that allow us to estimate in real terms the effect due to discretionary policy changes and other effects, as well as a pure scaling effect referred to as a *nominal effect*. For scale-invariant measures, such as the Gini coefficient, the nominal effect is zero as long as the tax-benefit system is linearly homogeneous⁶, which means that changing the nominal units of market incomes and tax-benefit policy parameters simultaneously would not affect the relative position of households in the income distribution.⁷ For scale-variant measures of income, such as mean income, the nominal effect is non-zero as long as α is different from 1.⁸

The decomposition is path-dependent, meaning that the order of decomposing the effects matters and there are alternative combinations. Building on BC, we derive six strictly symmetrical combinations (permutations) for three components, whereas they suggested four combinations because of ‘pairing’ other effect with nominal effect.⁹ Similar to BC, we distinguish between two types: Type I shows the effect of discretionary policy changes conditional on **end-period** market incomes and population characteristics (P_I) and the other effect conditional on **start-period** tax-benefit policies (O_I). Type II presents the effect of discretionary policy changes conditional on **start-period** market incomes/population (P_{II}) and the other effect conditional on **end-period** policies (O_{II}). Type I/II distinction has a clear practical relevance: while full decomposition can only be carried out once household micro-data become available for the whole period (which inevitably occurs with a time

⁶That is, homogeneous of degree one: $d_0(\alpha p_0, \alpha y_0) = \alpha d_0(p_0, y_0)$.

⁷BC argue that tax-benefit systems are approximately linearly homogeneous, showing it explicitly for France and Ireland, and therefore omit the nominal effect as they focus on distributional measures rather than income changes explicitly.

⁸The nominal effect is approximately $(\alpha - 1)I[d_0(p_0, y_0)]$ or $(\alpha - 1) \cdot 100\%$ in relative terms. Notice also that the *other effect* for decomposing changes in mean disposable income is approximately zero if $\alpha = \bar{y}_1/\bar{y}_0$, i.e. α is based on changes in average market income.

⁹In principle, one could also consider first deflating I_1 (or inflating I_0) and then decomposing the real value of ΔI , as done e.g. in Herault and Azpitarte (2016), but this implies invoking the assumption of linear homogeneity from the very beginning. For example, denote an inflation factor with i and consider $d_1(p_1, y_1) - i d_0(p_0, y_0) = d_1(p_1, y_1) - d_0(ip_0, iy_0) = [d_1(p_1, y_1) - d_0(ip_0, y_1)] + [d_0(ip_0, y_1) - d_0(ip_0, iy_0)]$, which is identical to eq. 3 but without the nominal effect (if $i = \alpha$). However, linear homogeneity is assumed already in the second step here, while it was not evoked (yet) in eq. 3.

lag), Type II assessment for policy effects only requires start-period household data and hence provides the basis for ex ante policy evaluation.

As there is no obvious reason to prefer a particular combination over the others, BC suggest following the Shorrocks-Shapley line of arguments. This essentially implies averaging the marginal contribution of decomposition terms across all combinations. We hence calculate the average effect due to discretionary policy changes, other and nominal effects using all six combinations, distinguishing between scale-variant and scale-invariant measures, defined as $I[\alpha d_t(p_t, y_t)] = \alpha I[d_t(p_t, y_t)]$ and $I[\alpha d_t(p_t, y_t)] = I[d_t(p_t, y_t)]$, respectively. In the following, the observed income distributions in $t = 0, 1$ (baselines) are denoted with $B_t = I[d_t(p_t, y_t)]$ and the counterfactuals as $C_t = I[d_{1-t}(p_{1-t}, \alpha^{1-2t}y_t)]$. Assuming linear homogeneity of the tax-benefit function $d(p, y)$, the average effect due to discretionary policy changes (\bar{P}), other (\bar{O}) and nominal (\bar{N}) effects, combining Type I and Type II decompositions for *scale-variant measures* are as follows:

$$\bar{P} = \frac{1}{2}[P_I + P_{II}] = \frac{1}{6} \left[\left(\frac{1}{\alpha} + 2 \right) (B_1 - \alpha C_1) + (2 + \alpha) \left(\frac{1}{\alpha} C_0 - B_0 \right) \right] \quad (4)$$

$$\bar{O} = \frac{1}{2}[O_I + O_{II}] = \frac{1}{6} \left[(2 + \alpha)(C_1 - B_0) + \left(\frac{1}{\alpha} + 2 \right) (B_1 - C_0) \right] \quad (5)$$

$$\bar{N} = \frac{\alpha - 1}{6} \left[\frac{2}{\alpha} B_1 + 2B_0 + C_1 + \frac{1}{\alpha} C_0 \right] \quad (6)$$

For *scale-invariant measures*, these expressions simplify further and the average effect due to discretionary policy changes (\bar{P}) and the average other effect (\bar{O}) (with the nominal effect (\bar{N}) being 0) are:

$$\bar{P} = \frac{1}{2}[P_I + P_{II}] = \frac{1}{2} [B_1 - C_1 + C_0 - B_0] \quad (7)$$

$$\bar{O} = \frac{1}{2}[O_I + O_{II}] = \frac{1}{2} [C_1 - B_0 + B_1 - C_0] \quad (8)$$

For details on the derivation of the effects, see Appendix A.

2.2 Decomposing the other effects: market income/population effect vs automatic stabilisers

In addition to the direct effect of policy changes, tax-benefit policies can affect the income distribution through automatic stabilisers. They capture the extent to which changes (shocks) in the distribution of gross market income and population

characteristics (e.g. changes to earnings, varying rate of returns to human and financial capital etc.) translate into changes in the distribution of disposable income. We extend the BC decomposition method by decomposing the *other effect* and separating out the changes in market incomes/population characteristics from the automatic stabilisation effect of policies.

To show the contribution of automatic stabilisers to the changes in the income distribution, first we need to distinguish between gross and net incomes. Similar to Figari et al. (2015), we define $d_t(p_t, y_t) = y_t + f(d_t, p_t, y_t)$ where f denotes net transfers (i.e. benefits less taxes). Using the term for the *other effect* from equation 3, we can rewrite it as $I[y_1 + f(d_0, \alpha p_0, y_1)] - I[\alpha y_0 + f(d_0, \alpha p_0, \alpha y_0)]$. The automatic stabilisation effect can then be derived as the difference between the *other effect* and the contribution of market income/population changes.

To distinguish between the contribution due to market income/population changes and automatic stabilisers, the measure I needs to be additively decomposable by income source (y and f). While this is a straightforward application to some indicators (e.g. mean income), it is not for all functionals of the income distribution such as the Gini coefficient.¹⁰ Using the expression for the *other effect* from equation 3, we can rewrite it in general terms as $(I[y_1] + I[f(d_0, \alpha p_0, y_1)]) - (I[\alpha y_0] + I[f(d_0, \alpha p_0, \alpha y_0)]) + \epsilon$, where ϵ is a residual term. The value of the residual is zero for decomposing income changes but may be non-zero for decomposing other composite functions of income. Hence, our decomposition of changes to mean incomes unveils the pure contribution of market income/population changes and automatic stabilisers. When we decompose changes in income inequality our decomposition shows the joint effect of the automatic stabilisers and the residual term.

We denote as $B_t^* = I[y_t]$ the observed (baseline) distribution of gross market incomes and population characteristics in $t = 0, 1$ and as $C_t^* = I[\alpha^{1-2t}y_t]$ the counterfactual distribution. For *scale-variant* measures, the market income and population effect (M), averaged across all Type I and II combinations, equals:

$$\overline{M} = \frac{1}{2}[M_I + M_{II}] = \frac{1}{6} \left[(2 + \alpha)(C_1^* - B_0^*) + \left(\frac{1}{\alpha} + 2 \right) (B_1^* - C_0^*) \right] \quad (9)$$

The difference between the *other* and market income/population effects gives the

¹⁰Some methods for decomposing inequality measures link the contribution of a given income source to overall income inequality with the inequality of the income source itself, its share in total income and/or correlation with total income (Shorrocks, 1982; Lerman and Yitzhaki, 1985; Silber, 1993).

effect of automatic stabilisers (A):

$$\begin{aligned}\bar{A} &= \frac{1}{2}[A_I + A_{II}] = \\ &= \frac{1}{6} \left[(2 + \alpha)(C_1 - B_0 - (C_1^* - B_0^*)) + \left(\frac{1}{\alpha} + 2 \right) (B_1 - C_0 - (B_1^* - C_0^*)) \right] \quad (10)\end{aligned}$$

For *scale-invariant* measures, the average market income/population effect is:

$$\bar{M} = \frac{1}{2}[M_I + M_{II}] = \frac{1}{2}[C_1^* - B_0^* + B_1^* - C_0^*] \quad (11)$$

The effect due to automatic stabilisers is:

$$\bar{A} = \frac{1}{2}[A_I + A_{II}] = \frac{1}{2}[C_1 - B_0 - (C_1^* - B_0^*) + B_1 - C_0 - (B_1^* - C_0^*)] \quad (12)$$

For details on the derivation of the effects, see Appendix A.¹¹ Furthermore, we decompose the change in mean incomes and in inequality due to discretionary policy changes and automatic stabilisation effect by income components, i.e. benefits and taxes/SIC. Standard errors are provided for the change in mean incomes based on Taylor approximations and for the change in income inequality measured by the Gini coefficient by bootstrapping the micro-data samples 1,000 times.

3 Data and the tax-benefit model EUROMOD

The household survey data come from the European Union Statistics on Income and Living Conditions (EU-SILC) and, for the UK, from the Family Resources Survey (FRS). Both surveys are purpose-built income surveys. For most countries, we use SILC waves for 2008 and 2015 (with income reference period 2007 and 2014) and for the UK FRS waves for 2008/09 and 2014/15 incomes. Due to data availability, income reference years are 2011 and 2014 for Croatia; 2007 and 2013 for Germany; 2008 and 2014 for Malta; and 2006 and 2014 for France. The data are cross-sectional and contain rich information on household and individual incomes and characteristics for a nationally representative sample of households. The data collection and production of EU-SILC in the EU member states have been made as consistent as possible to enable cross-country comparative analysis.

For baseline (counterfactual) simulations, we apply tax-benefit policies – structure and parameters – from one period to the household data on gross market in-

¹¹Callan et al. (2018) show analytically the decomposition of the Gini coefficient (into automatic stabilisers, policy changes and market income changes), by using the property that the Reynolds-Smolensky index equals the difference between Gini based on net vs market incomes. In contrast to them, our method can be generalised to any measure that is a function of household net income.

comes and population characteristics from the same (another) period. This is done by combining the household data with the EU-wide tax-benefit model EUROMOD. Using tax-benefit routines, EUROMOD contains information on the tax-benefit rules in a specific period for a given country. The model then reads the household survey data and based on the information in the data, it identifies who should pay an income tax/SIC or receive a benefit (e.g. the family or individual), and how much needs to be paid in taxes/contributions and received in benefit entitlements. The model then combines the information on gross market incomes from the household data with the calculated tax liabilities and cash benefit entitlements to derive household net incomes. Similar to the household data, EUROMOD simulations have been made as consistent as possible across all countries for the purpose of cross-country comparative research.

EUROMOD simulation results for each policy year included in the model are validated extensively against administrative data on benefit recipients/tax payers and benefit spending/tax revenues. Simulation routines (e.g. assumptions or limitations), data imputations and validation of the results are documented in detail in Country Reports made available online.¹² In addition, summary reports containing validation and discussion of EUROMOD baseline distributional statistics are published on an annual basis.¹³ EUROMOD has been used extensively to address various economic and social policy research questions, see Sutherland and Figari (2013) and Figari et al. (2015) for literature reviews. In particular, the need for a comparative microsimulation model for decomposing changes in the income distribution has made EUROMOD an invaluable tool in the related literature.

We deal with cash household net incomes which comprise the sum of gross market incomes (earnings, self-employment income, investment income, income from rent and private transfers), pensions, means-tested and non-means-tested benefits net of personal income taxes and employee and self-employed SIC. Means-tested, universal and some contributory insurance-based benefits as well as direct income taxes and contributions are calculated by EUROMOD while information on the rest of incomes is taken from the household data. Although public pensions are not simulated (due to insufficient information on contributory history in the data), the policy change is approximated through the official indexation factor used by governments to adjust nominally pension amounts over time. In absence of large compositional changes in the population (the period we consider is relatively short), the indexation factor serves as a good proxy for the policy change. In our analysis of distributional changes, the remaining change in pension amounts – not captured

¹²<https://www.euromod.ac.uk/using-euromod/country-reports>

¹³For the latest issues, see Tammik (2018) and EUROMOD (2018). The latter report relies on a EUROMOD tool, which was developed as part of this paper.

through indexation – is included in the component of ‘market income/population effect’.

In cases where there is evidence for benefit non take-up or tax non-compliance, the simulation results are adjusted to account for it. Adjustments are done for benefit non-take-up in Belgium, France, Ireland, Latvia, Romania and the UK; and for tax non-compliance in Bulgaria, Greece, Italy and Romania.

The analysis is based on household equivalised incomes. Incomes are equivalised based on the assumptions that individuals share resources equally with other household members and economies of scale occur within the household. Incomes are adjusted by the modified OECD equivalence scale, assigning a value of 1 to the head, 0.5 for each individual aged ≥ 14 and 0.3 for each individual aged < 14 .

4 Results

4.1 Changes in mean incomes

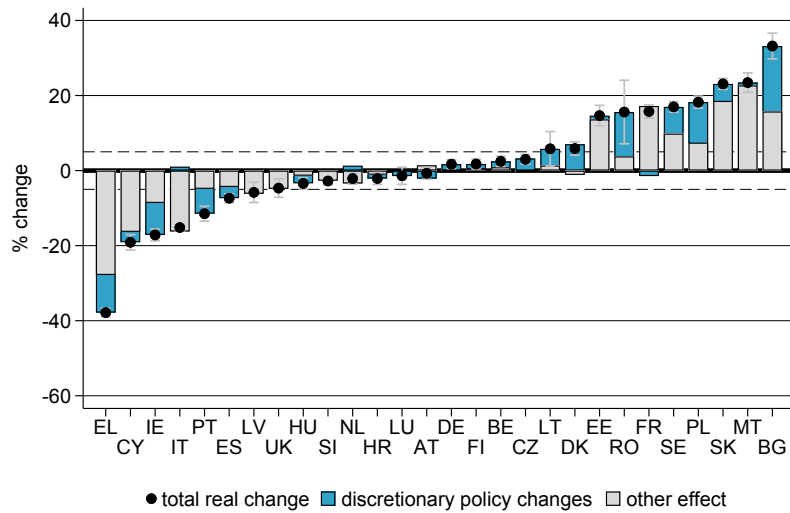
The changes to net incomes between 2007 and 2014 are decomposed into the changes due to discretionary policies, automatic stabilisers, changes to gross market incomes and population characteristics as well as the nominal effect. Using the CPI-based benchmark indexation factor, the latter component reflects how prices developed and allows other components to be interpreted in real terms. In the first step, we present the combined effect of automatic stabilisers and changes to gross market incomes and population characteristics as in Bargain and Callan (2010), labelled ‘other effect’. We then extend the standard decomposition approach by distinguishing between the two sub-components.

While average net incomes increased in nominal terms in the majority of countries, real incomes fell in half of countries and rose in the other half, with the change ranging from -37.8% (Greece) to +33.2% (Bulgaria). Figure 1 ranks countries by the real change in mean household net incomes (black circle); the nominal effect is not shown here as it corresponds closely to the CPI reported in Table 1.¹⁴ Some of these changes are very substantial and it is remarkable that the extremes occurred in neighbouring countries. Among the countries experiencing a drop in real income were the ones hit badly by the crisis in the late 2000s such as Southern European countries, Ireland and Latvia, while the countries with the highest real income growth include some Eastern European countries as well as Malta, France and Sweden.

¹⁴The sum of all components together with the nominal effect corresponds to the total nominal change in incomes.

Similarly, countries are roughly split by whether changes in market incomes and population characteristics (without separating automatic stabilisers) and discretionary policy effects made a positive or negative contribution to household incomes on average. What is striking is that the two effects went in the same direction in almost all countries, in other words, discretionary policies largely reinforced market and population dynamics. The positive relationship between the two components at the country level suggests that in the cases where economic conditions were favourable – i.e. incomes growing due to ‘other effects’ – governments’ tax-benefit policies boosted household disposable incomes as well. In contrast, countries experiencing economic contraction implemented fiscal consolidation measures, which squeezed further household budgets. Of course, such a positive correlation is expected at least in the long-term as governments ought to balance their budgets over the business cycle. We return to this point below.

Figure 1: Decomposing the change in mean net income: discretionary policy changes vs other effects



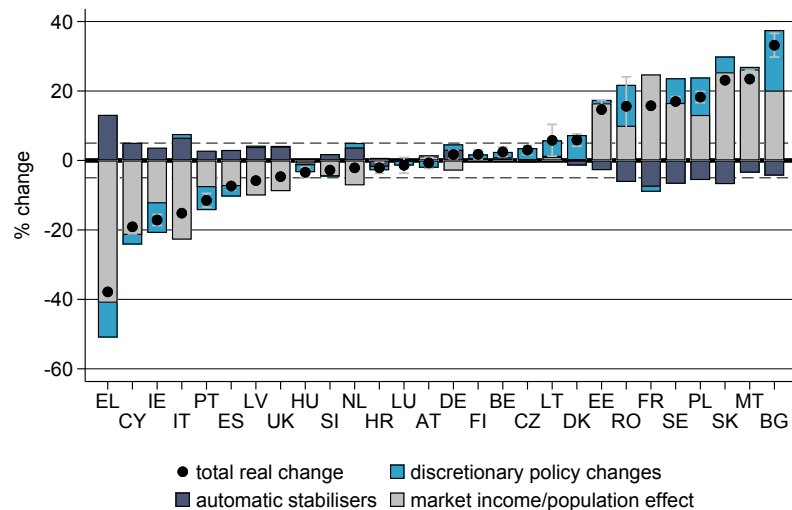
Source: Own calculations with EUROMOD and EU-SILC/FRS. *Notes:* Countries are ranked by the total real change in equivalised household net incomes. Income changes are estimated in real terms.

Focusing on discretionary policy changes only, De Agostini et al. (2016) show that Southern European countries implemented fiscal consolidation measures in both the crisis period (2008-11) as well as in the aftermath (2011-14), reinforcing the drop in mean incomes. On the other hand, they show that the large rise in incomes due to discretionary policy changes in Bulgaria, Sweden, Poland and Denmark was due to fiscal stimulus measures being implemented in both periods.

Next, to unveil the effect of automatic stabilisers, we apply our extension to BC method and decompose in Figure 2 the ‘other effect’ into the components due to

changes in market incomes and population characteristics (grey bars) and automatic stabilisation response of policies (dark blue bars). Our decomposition clearly reveals that changes in average incomes in this period have been driven by market incomes and population changes. In progressive tax-benefit systems, such as the ones in EU countries, a shock to gross market incomes should be smoothed by fiscal policies. Confirming this, in all countries automatic stabilisers worked in the opposite direction to the market income/population effect. Thus, in countries where average gross market incomes fell, part of the negative shock was offset by automatic increases in benefit entitlements and reductions in tax liabilities and social insurance contributions (SIC); conversely, gains in gross market incomes were lowered through automatic reductions to benefits and increases in taxes/SIC. This can be seen more clearly in Figure 3, plotting automatic stabilisation effect and discretionary policy changes against market income and population effect. More than half of countries are situated in the left upper section of the left panel in Figure 3, highlighting the importance of the tax-benefit system to cushion the adverse income shocks households endured in the crisis. We estimate a correlation of -0.95 between the effect of automatic stabilisers and the market income/population effect across countries.

Figure 2: Decomposing the change in mean net income: discretionary policy changes vs automatic stabilisers

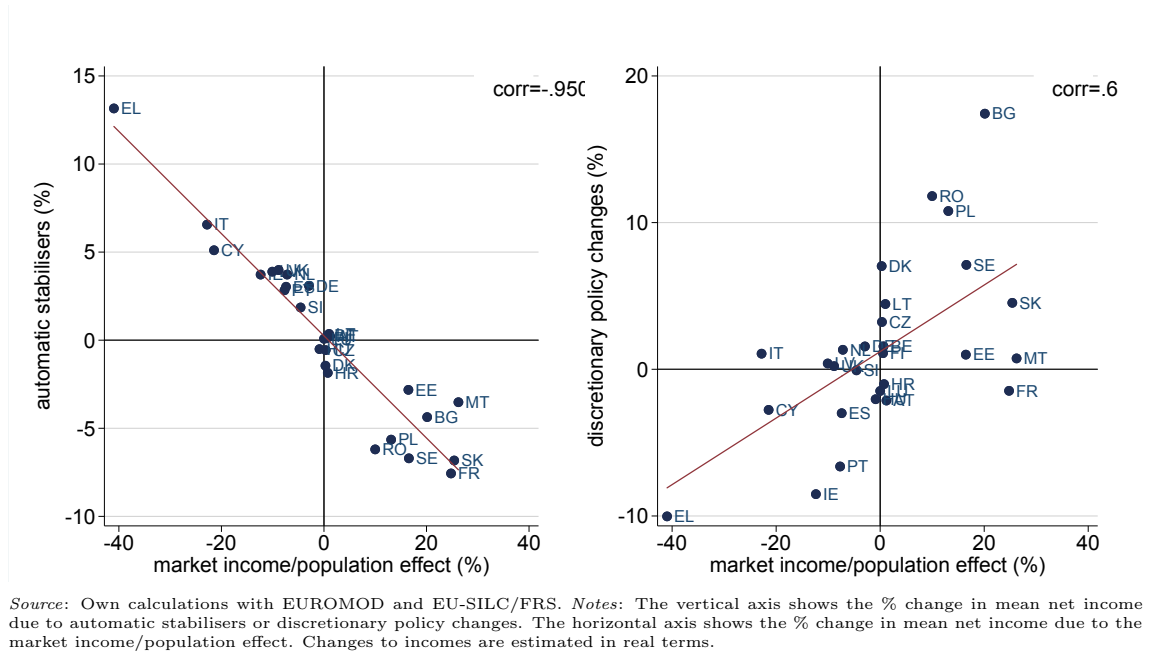


Source: Own calculations with EUROMOD and EU-SILC/FRS. *Notes:* Countries are ranked by the total real change in equivalised household net incomes. Income changes are estimated in real terms.

The correlation between discretionary policy changes and changes in gross market income and population characteristics is 0.59 (right panel of Figure 3). This reflects governments' resource constraints in broad terms (as already briefly discussed above). However, the result only relates to cash benefits and taxes/SIC

affecting household disposable incomes directly. It is conceivable that governments may have counterbalanced these effects through other means, in particular, through adjusting spending on social protection in-kind and public services like health and education as well as changes to indirect taxation. To check that, we have plotted our measure of discretionary (cash) policy changes against these four items (Figure 8 in Appendix B). We use Eurostat data available on total government spending on social protection in-kind, health and education and calculate changes in spending per capita between 2007 and 2014 in 2007 incomes (as a percentage of per capita disposable income estimated with EUROMOD). The effects of changes to indirect taxation are limited to changes in standard VAT rate, which we approximate by assuming that all income is spent on goods and services subject to the standard rate of VAT. We find that the correlation with all four items is positive (stronger in the case of spending measures), suggesting that across countries these policy measures complemented rather than offset the effects of discretionary cash policies.

Figure 3: Correlation of automatic stabilisers and discretionary policy changes against the market income/population effect



It is important to be clear that the right panel of Figure 3 cannot be interpreted in terms of how discretionary policies affected the structural balance of governments' finance, as the latter is also determined by changes in market incomes. To understand how discretionary policy actions contributed to the fiscal balance, we have estimated the policy effects using another counterfactual scenario with a benchmark equal to the growth in mean gross market incomes (labelled as Market Income Index or MII). For policy actions to be fiscally neutral towards household dispos-

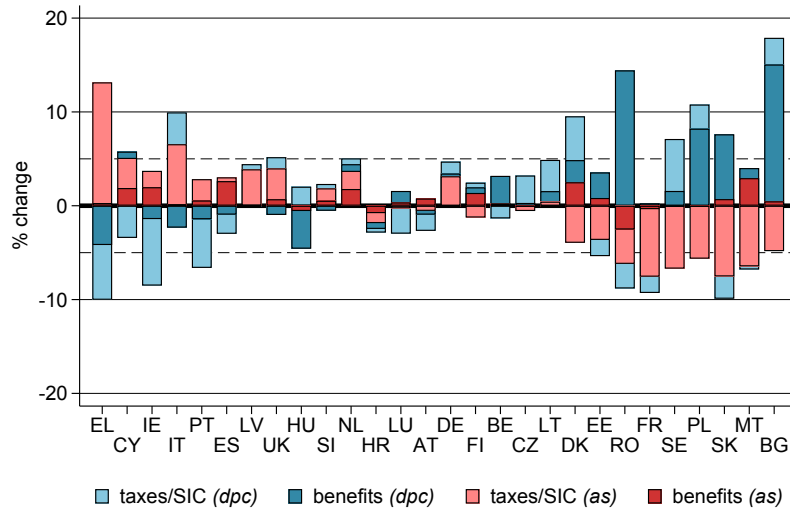
able incomes, the net contribution of benefits and taxes to household disposable incomes on average should remain constant over time (as a share of total income). A raising share of benefits would mean that policies have become more generous, while a declining share would reflect fiscal tightening. Figure 9 in Appendix B plots discretionary policy changes (assessed with MII) against changes in gross market incomes (assessed with CPI), revealing a weak negative correlation. This suggests that structural changes in fiscal balances due to direct taxes and cash benefits were, if anything, counter-cyclical.

4.2 Changes in mean incomes by policy instruments and income deciles

The impact on incomes due to discretionary policy changes and automatic stabilisers is further decomposed by benefits and taxes/SIC policies (Figure 4). It clearly shows that automatic responses were mainly realised through taxes and SIC and, on average, benefits played only a modest part. Furthermore, changes to net income due to taxes/SIC as automatic stabilisers were negatively associated with changes to market incomes/population characteristics (correlation of -0.96), while there was effectively no correlation between the stabilisation response of benefits and market income/population changes (-0.14) (Figure 10 in Appendix B). This suggests that overall changes in benefits are driven by changes to population characteristics (such as household composition changes) rather than to market incomes. On the other hand, the composition of discretionary policy actions was more balanced and most of the income gains were due to benefits (Figure 4). Unlike with automatic stabilisers, the correlation between discretionary policy changes and market income/population effect was stronger in the case of benefits compared to taxes/SIC (cf. Figure 11 in Appendix B). Detailed results on the decomposition of changes to mean incomes can be found in Table 2.

We also examine how similar are the impacts of fiscal policies and shocks to the economy on household incomes across the income distribution. We find that the patterns of total change in incomes varied greatly and were neither continuously progressive nor regressive in majority of cases (Figure 12 in Appendix B). We repeat the decomposition by income decile and by country. The effect of discretionary policy changes was pro-poor in most countries, with Hungary and Denmark as the main exceptions (Figure 13 in Appendix B). In these two countries, households in the richest decile groups benefited relatively more than households in the rest of the distribution through the introduction of a flat income tax (Hungary) and a reduction in tax rates (Denmark). Overall, changes to taxes and SIC had a mixed effect on

Figure 4: Decomposing the *change* in mean net income by type of policy



Source: Own calculations with EUROMOD and EU-SILC/FRS. Notes: dpc=discretionary policy changes; as=automatic stabilisers. The total change and market income/population effect are omitted. Changes to incomes are estimated in real terms.

the income distribution. On the other hand, policy changes to benefits tended to be pro-poor and resulted mainly in income gains across the distribution. There were exceptions where benefit cuts and/or deterioration in the real value of benefits led to income losses, mostly born by the poorer (in Croatia, Germany, Hungary, Ireland, Portugal and the UK). With the exception of Greece, the indexation of public pensions – generally higher than price inflation – was clearly pro-poor across countries, leading to larger relative income gains at the bottom than at the top of the distribution. In Greece, pension cuts led to larger income losses at the bottom and middle than the top of the distribution.

Benefits as automatic stabilisers responded to market income and population changes primarily at the bottom part of the distribution (Figure 14 in Appendix B). This is not surprising as many benefits in EU countries are means-tested and are targeted by design at lower-income households. Insurance-based unemployment benefits are also designed to respond to losses in earnings and the latter could push individuals towards the bottom of the distribution. As in many countries households at the bottom saw their market incomes falling, benefits automatically cushioned part of the income loss making their contribution to income changes mostly progressive. Although the impact on the population-mean income of benefits was small in most countries, they contributed to substantial income gains among poorer households (e.g. of more than 5% for the bottom decile in Belgium, Bulgaria, Cyprus, Germany, Estonia, Greece, Finland, France, Lithuania, Latvia, Malta, Portugal and Slovakia). Nevertheless, across all decile groups we estimate a weak correlation

between changes in gross market incomes and the stabilisation response of benefits.¹⁵ This result supports our hypothesis that benefits are more responsive than taxes/SIC to changes in the population characteristics, which may not be fully visible in changes to market incomes. For instance, universal benefits would not provide any stabilisation towards income shocks per se but they could reduce income fluctuations which result from changes to household characteristics. An example is the entitlement to universal child benefits in the presence of a child in the household.

In the middle and top of the distribution, income taxes had the biggest stabilisation response, which was regressive in some and progressive in other countries. Where market incomes fell throughout most of the income distribution, the automatic stabilisation response was regressive as households from the middle/top benefited more than the bottom from the reductions in taxes (in Germany, Greece, Ireland, Italy, Latvia, the Netherlands, Portugal and the UK). In other countries, increases in gross market incomes at the top of the distribution were mitigated by increases in taxes, making their contribution progressive (in Bulgaria, Denmark, Estonia, Spain, France, Malta and Sweden) (Figure 14 in Appendix B).

Across all decile groups, with the exception of the bottom one, market income and population changes were strongly and negatively correlated with the stabilisation response of income taxes.¹⁶ As the income tax schedule – whether progressive or flat – includes a tax free allowance in all EU countries, households from the bottom decile group pay no or very little taxes as a share of their income.¹⁷ Therefore, income taxes are less responsive to changes in market incomes at the bottom than middle or top of the distribution.

Similarly, we find that SIC as automatic stabilisers are less strongly correlated with changes in market incomes in the bottom decile (estimate of -0.43).¹⁸ Furthermore, we estimate a weaker correlation (of -0.69) for the top decile group than for the preceding eight deciles which is (at least partly) due to the presence of the upper limit on the contribution base in most countries. That is if earnings are above the maximum threshold, SIC are levied on the maximum instead of actual earnings, making them non-responsive to changes in earnings in this income range. In the rest of the income distribution, the automatic response of SIC to market income changes

¹⁵Our estimates vary between 0 and -0.27 for all decile groups, apart from the fourth decile where the correlation is estimated at -0.49.

¹⁶Our estimate is -0.33 for the first decile group, -0.72 for the second and varies between -0.78 and -0.91 for the rest of the distribution.

¹⁷After the flat tax reform of 2008, only in Bulgaria individuals start paying income taxes from the first unit of income they earn. However, there are several tax deductions (e.g. for families with children) that act as a tax free allowance for certain household types. Furthermore, our decomposition results show the stabilisation response averaged over the 2007 and 2014 policies and thus they reflect the combined response of the progressive (2007) and flat (2014) tax schedule.

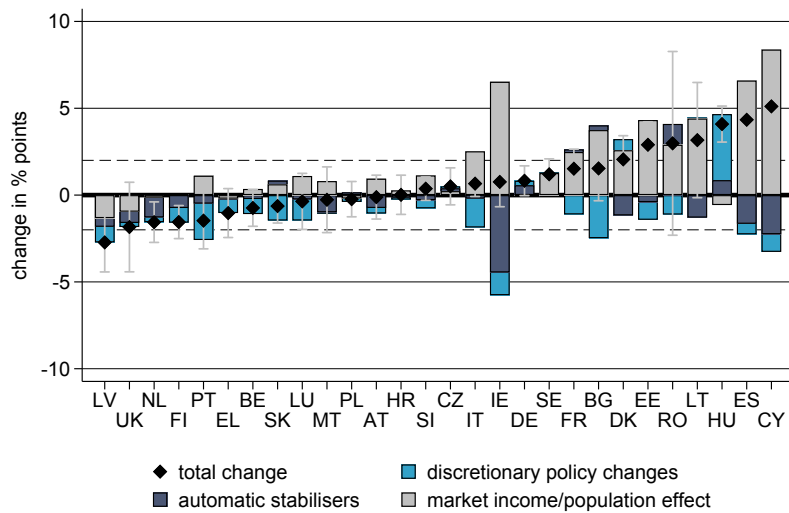
¹⁸For deciles 2-9, we estimate a correlation between -0.71 and -0.88.

was similar in relative terms as SIC are usually levied as a flat rate on earnings (Figure 14 in Appendix B). The distributional changes are further summarised in the next section.

4.3 Changes in income inequality

After studying changes along the income distribution, we turn to income inequality measured by the Gini coefficient. Figure 5 ranks the EU-28 countries by the inequality change between 2007 and 2014 and decomposes it into the same components as previously. Inequality changes ranged from -2.7 percentage points (Latvia) to +5.1 percentage points (Cyprus), increasing roughly in about half of the countries and decreasing in the rest, though the overall changes in inequality are relatively small and not statistically significant in many cases.

Figure 5: Decomposing the *change* in Gini



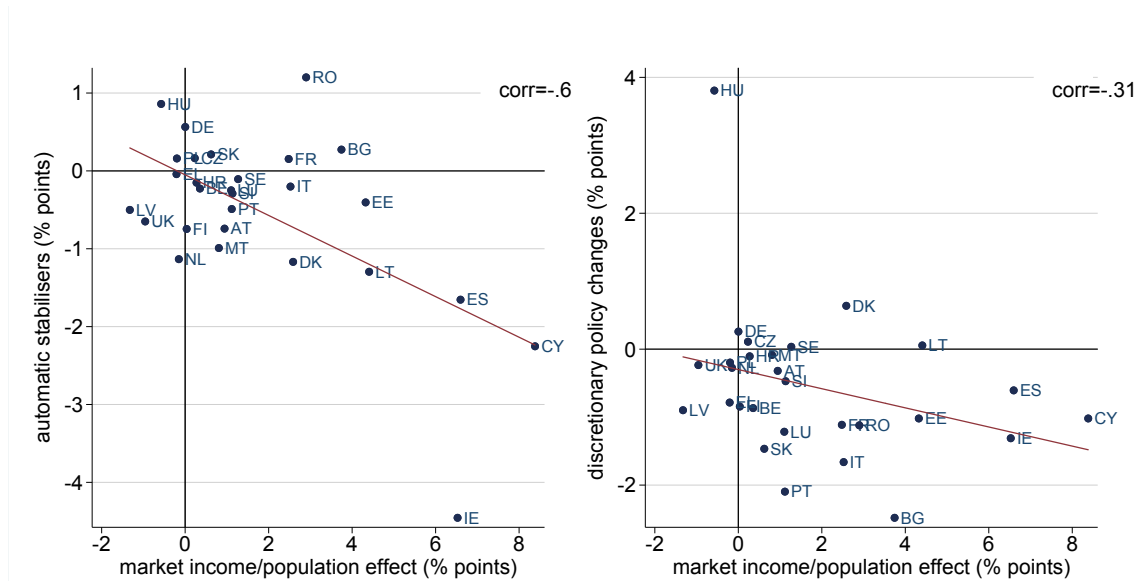
Source: Own calculations with EUROMOD and EU-SILC/FRS. *Notes:* Countries are ranked by the total change in Gini. Changes to incomes are estimated in real terms.

However, the way different factors contributed to the total change in Gini was remarkably similar across countries. First, changes to the distribution of market incomes and population characteristics raised income inequality in nearly all countries (and were statistically significant in more than a third), with the change reaching 8.4 percentage points in Cyprus. Second, our results show that what helped to offset (part of) these increases was the tax-benefit system. Consistent with the previous literature on discretionary policy changes (e.g. Hills et al., 2019; De Agostini et al., 2016; Bargain et al., 2017), we find that, albeit small in size, they lowered inequality in almost all countries. De Agostini et al. (2016) show that in most EU countries

inequality fell due to discretionary policy changes in the crisis years (2008-11) as well as in its aftermath (2011-14). In addition, our results show that countries where inequality fell (Figure 5) were not only those where the welfare state expanded but also included those which implemented fiscal consolidation (Figure 2).

Moving to the effect of automatic stabilisers, we can establish that they had a statistically significant impact in about half of the countries, lowering inequality in most of them (Figure 5). We find a negative correlation between automatic stabilisers and the gross market income/population effect (see the left graph of Figure 6). However, this correlation is not as strong as with changes in mean incomes. This is expected as automatic stabilisers are foremost a tool for *income stabilisation* and not designed to directly react to changes in the *distribution* of incomes but income changes at the individual level. Hence, the sign of the relationship between automatic stabilisers and income inequality is ambiguous. In a few countries, the direction of inequality change due to automatic stabilisers was the same as for the change due to the market income/population effect (Latvia, UK, Slovakia, France, Bulgaria and Romania).

Figure 6: Correlation of automatic stabilisers and discretionary policy changes against the market income/population effect

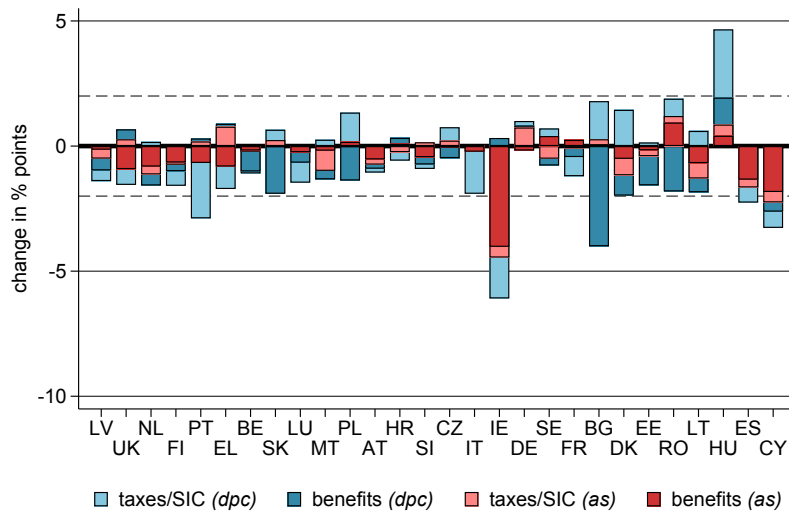


Source: Own calculations with EUROMOD and EU-SILC/FRS. Notes: The vertical axis shows the % points change in Gini due to automatic stabilisers or discretionary policy changes. The horizontal axis shows the % points change in Gini due to the market income/population effect. Changes to incomes are estimated in real terms.

Next, we break down discretionary policy changes and automatic stabilisers by benefits and taxes/SIC (Figure 7). We find that the inequality reduction due to policy changes was achieved mainly with benefits. In comparison, Callan et al. (2018) analysing the Southern EU countries (Greece, Italy, Portugal and Spain) and Ireland, find small or no changes to Gini due to benefit changes, which is also

consistent with our results for these countries. In about a third of the EU countries, the inequality-reducing impact of benefit changes was enhanced by tax/SIC changes. In the remaining third, it offset the rise in inequality due to tax changes, e.g. due to the introduction of a flat tax in Bulgaria and Hungary or reduction in top marginal tax rates in Denmark. Moreover, in a separate analysis we find that in the countries where benefit changes raised income inequality this was (at least partly) the result of erosion in the real value of benefits as their growth lagged behind growth in prices (e.g. in Germany, Hungary, Ireland and the UK).¹⁹

Figure 7: Decomposing the *change* in Gini by type of policy



Source: Own calculations with EUROMOD and EU-SILC/FRS. Notes: dpc=discretionary policy changes; as=automatic stabilisers. The total change and market income/population effect are omitted. Changes to incomes are estimated in real terms.

In their role as automatic stabilisers, benefits also reduced inequality in more countries than taxes/SIC did. They were the main stabilising source among the Southern EU countries and Ireland, consistent with the analysis by Callan et al. (2018) for these countries. At times when market incomes of the poor fall, means-tested benefits, at least partly, mitigate their losses. Increases in the unemployment rate, which are linked to an increase in the share of low-income households, triggers a similar response from insurance-based unemployment benefits. Such provision of pro-poor income stabilisation contributes towards narrowing the gap between the rich and the poor. However, it also means that when market incomes of the poor grow, benefit withdrawals would lower these gains, increasing the disparity between the bottom and the top of the distribution. How the response of benefits to changes in population characteristics impacts the income distribution is convoluted

¹⁹We checked the nominal and real change in benefit and tax amounts for the policies we analyse with EUROMOD.

and depends on the type of population changes and where they occur along the distribution.

For income taxes, their distributional impact as automatic stabilisers generally depends on the size and direction of the income shock across the distribution, the progressivity of the tax schedule and the concentration of people across the tax schedule. Finally, the distributional impact of SIC as automatic stabilisers is more limited as in most countries a flat rate is applied on labour earnings.²⁰ Detailed results on the decomposition of changes to Gini can be found in Table 3.

5 Conclusions

Tax-benefit policies can affect the income distribution through two main channels: discretionary policy changes and automatic stabilisers. Although a large body of literature analyses the impact of tax-benefit policy changes on household incomes, little is known about the link between automatic stabilisers and the income distribution. We contribute to the literature by studying in detail the contribution of automatic stabilisers and discretionary policy changes to income changes in the EU countries between 2007 and 2014.

We find that, first, discretionary policy changes raised incomes on average in about two thirds of countries and lowered them in the remaining third. In comparison, on average automatic stabilisers – responding to changes to market incomes and population characteristics – led to income gains in about a third, losses in another third of countries and no statistically significant changes in the remaining third. In terms of income inequality, discretionary policy changes lowered it in more than two thirds of countries. Progressive policy changes were implemented not only in countries where the welfare state expanded in size but also in countries, which implemented fiscal consolidation measures in the economic downturn. Automatic stabilisers, on the other hand, had a statistically significant impact on inequality in about half of countries, lowering inequality in most of them.

Second, discretionary policy changes to benefits – by increasing their level – and the automatic stabilisation response of benefits – mostly to income losses at the bottom of the distribution – were the main instruments raising the incomes of low-income households and narrowing the gap between rich and poor. Policy changes to and the automatic stabilisation response of taxes/SIC had a mixed effect on the income distribution of EU countries. While we find that changes in net

²⁰We estimate a weak and positive correlation of +0.1 between the impact of SIC as automatic stabilisers and the market income/population effect, on the Gini. In comparison, for the automatic stabilisation effect of taxes and benefits on the Gini, our estimates yield a correlation of -0.48 and -0.53, respectively, with the market income and population effect.

income due to the stabilisation response of taxes/SIC were negatively associated with changes to market incomes and population characteristics, the correlation between the stabilisation response of benefits and market income/population changes was much weaker. This suggests that benefits are more responsive than taxes/SIC to changes in the population structure such as household composition changes.

Third, in terms of prevalence, discretionary policy changes lowered inequality in more countries than automatic stabilisers. But in terms of the size of the effects, we cannot conclude that policy changes contributed to inequality reduction more than automatic stabilisers, and vice versa. Thus, our findings show the importance of both discretionary policy changes and automatic stabilisers to redistribute incomes.

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6 Tables

Table 1: *Change (%) in prices (CPI) and market incomes (MII)*

	CPI	MII
AT	15.983	16.696
BE	15.376	13.954
BG	23.700	53.029
CY	14.548	-11.593
CZ	16.461	17.292
DE	10.726	9.174
DK	13.409	14.887
EE	29.263	43.178
EL	12.660	-33.578
ES	13.388	.658
FI	18.429	13.597
FR	13.407	39.665
HR	5.480	9.132
HU	29.035	36.329
IE	3.693	-8.655
IT	14.430	-5.299
LT	27.553	29.080
LU	16.957	12.783
LV	26.169	10.599
MT	11.902	42.110
NL	12.757	6.024
PL	21.037	39.144
PT	10.079	-1.830
RO	38.332	47.440
SE	10.562	24.279
SI	16.684	12.109
SK	15.608	46.576
UK	17.119	7.431

Notes: The value of the Consumer Price Index (CPI) is in fact equal to % change in prices based on the Harmonised Index of Consumer Prices. The value of the Market Incomes Index (MII) equals the growth in average unequivalised gross market incomes.

Source: For HICP, Eurostat database (indicator prc_hicp_aind). For MII, authors' calculations using EU-SILC and FRS data.

Table 2: Decomposing the (%) change in mean household net income

	total change	mipe	discretionary policy changes				automatic stabilisers				
			benefits	pensions	taxes	SIC	total	benefits	taxes	SIC	total
AT	-705 (.8)	1.206 (1.5)	-1.120*** (.0)	-2.281*** (.0)	-1.185*** (.0)	-5.444*** (.0)	-2.130*** (.0)	.769*** (.2)	-.682 (.6)	.131 (.2)	.219 (.7)
BE	2.471*** (.7)	.637 (1.4)	.354*** (.0)	2.563*** (.0)	-1.074*** (.0)	-2.279*** (.0)	1.565*** (.0)	.154 (.1)	.367 (.6)	-.251 (.2)	.270 (.7)
BG	33.188*** (1.7)	20.127*** (2.1)	2.295*** (.1)	12.286*** (.2)	3.370*** (.1)	-5.524*** (.0)	17.427*** (.2)	.474*** (.1)	-3.266*** (.3)	-1.574*** (.3)	-4.366*** (.5)
CY	-19.106*** (1.0)	-21.445*** (1.4)	-.357*** (.0)	1.021*** (.0)	-1.967*** (.0)	-1.464*** (.0)	-2.767*** (.1)	1.890*** (.1)	1.768*** (.3)	1.448*** (.1)	5.106*** (.4)
CZ	3.006*** (.7)	.343 (1.0)	-1.066*** (.0)	1.366*** (.0)	1.682*** (.0)	1.244*** (.0)	3.226*** (.0)	-.122 (.1)	-.090 (.2)	-.351* (.2)	-.563 (.4)
DE	1.718** (.6)	-2.929** (1.1)	-.038* (.0)	.321*** (.0)	.848*** (.0)	.428*** (.0)	1.559*** (.0)	-.060 (.1)	2.236*** (.4)	.913*** (.2)	3.088*** (.5)
DK	5.876*** (.9)	.289 (2.0)	.914*** (.0)	1.448*** (.0)	4.734*** (.0)	-.061*** (.0)	7.035*** (.0)	2.506*** (.4)	-4.020*** (.1)	.067 (.0)	-1.447 (1.2)
EE	14.648*** (1.4)	16.468*** (1.8)	.254*** (.0)	2.474*** (.0)	.004 (.0)	-1.734*** (.0)	.997*** (.0)	.827*** (.1)	-2.839*** (.4)	-.806*** (.1)	-2.818*** (.4)
EL	-37.844*** (.6)	-40.971*** (.9)	.767*** (.0)	-4.956*** (.0)	-4.903*** (.0)	-.935*** (.0)	-10.028*** (.1)	.293*** (.1)	7.300*** (.2)	5.563*** (.1)	13.155*** (.3)
ES	-7.358*** (.6)	-7.399*** (.9)	.020 (.0)	-.969*** (.0)	-1.966*** (.0)	-.079*** (.0)	-2.993*** (.0)	2.627*** (.1)	-.598* (.2)	1.004*** (.1)	3.033*** (.3)
FI	1.753** (.7)	.546 (1.1)	.525*** (.0)	.076*** (.0)	2.054*** (.0)	-1.556*** (.0)	1.098*** (.0)	1.366*** (.1)	-1.728*** (.4)	.472*** (.2)	.110 (.3)
FR	15.750*** (.9)	24.782*** (1.5)	.648*** (.0)	-.381*** (.0)	-1.236*** (.0)	-.499*** (.0)	-1.469*** (.0)	-.366 (.2)	-5.599*** (.4)	-1.599*** (.2)	-7.563*** (.7)
HR	-2.115** (.8)	.749 (1.3)	-.345*** (.0)	-.273*** (.0)	-.325*** (.0)	-.068*** (.0)	-1.010*** (.0)	-.790*** (.2)	-.235 (.2)	-.829** (.3)	-1.853*** (.5)
HU	-3.413*** (.8)	-.867 (1.3)	-4.660*** (.1)	.642*** (.0)	2.842*** (.1)	-.863*** (.1)	-2.039*** (.1)	-.562*** (.2)	-.021 (.3)	.077 (.4)	-.507 (.7)
IE	-17.145*** (.8)	-12.355*** (1.6)	-1.798*** (.0)	.373*** (.0)	-6.617*** (.1)	-.471*** (.0)	-8.512*** (.1)	1.980*** (.3)	1.332* (.6)	.410*** (.1)	3.723*** (.8)
IT	-15.179*** (.5)	-22.803*** (.8)	-.049*** (.0)	-2.283*** (.0)	3.808*** (.1)	-.413*** (.0)	1.063*** (.1)	.135*** (.0)	4.935*** (.3)	1.492*** (.1)	6.561*** (.3)
LT	5.802* (2.3)	.997 (3.1)	-.105 (.1)	1.228*** (.0)	9.147*** (.2)	-5.821*** (.1)	4.449*** (.1)	-.083 (.3)	.843 (.6)	-.403 (.2)	.357 (.6)
LU	-1.393 (1.2)	.006 (2.0)	.506*** (.0)	.720*** (.0)	-2.906*** (.0)	.202*** (.0)	-1.479*** (.0)	.354 (.2)	-.746 (.7)	.472* (.2)	.080 (.9)
LV	-5.795*** (1.4)	-10.080*** (1.8)	.248*** (.0)	-.399*** (.0)	2.320*** (.1)	-1.773*** (.0)	.396*** (.1)	.079 (.2)	2.296*** (.4)	1.515*** (.1)	3.889*** (.5)
MT	23.448*** (1.3)	26.226*** (1.9)	.676*** (.0)	.399*** (.0)	.435*** (.0)	-.768*** (.0)	.743*** (.1)	2.942*** (.4)	-4.993*** (.5)	-1.469*** (.1)	-3.520*** (.7)
NL	-2.123** (.8)	-7.176*** (1.3)	.565*** (.0)	.141*** (.0)	-.615*** (.0)	1.237*** (.0)	1.328*** (.0)	1.787*** (.2)	2.734*** (.4)	-.796*** (.2)	3.725*** (.6)

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	total change	mipe	discretionary policy changes				automatic stabilisers				
			benefits	pensions	taxes	SIC	total	benefits	taxes	SIC	total
PT	-11.489*** (1.0)	-7.699*** (1.6)	-.308*** (.0)	-1.134*** (.0)	-4.902*** (.0)	-.283*** (.0)	-6.627*** (.1)	.563*** (.1)	.626 (.5)	1.648*** (.2)	2.837*** (.6)
RO	15.603*** (4.3)	9.993* (4.8)	1.364*** (.0)	13.065*** (.8)	-2.504*** (.1)	-.117*** (.0)	11.807*** (.7)	-2.536*** (.2)	-1.829* (.8)	-1.833 (.4)	-6.198*** (1.1)
SE	16.980*** (.7)	16.566*** (1.2)	.184*** (.0)	1.395*** (.0)	5.693*** (.0)	-.155*** (.0)	7.117*** (.0)	-.104 (.1)	-6.243*** (.5)	-.356*** (.1)	-6.703*** (.6)
SI	-2.774*** (.5)	-4.560*** (.9)	.202*** (.0)	-.739*** (.0)	.907*** (.0)	-.441*** (.0)	-.071** (.0)	.536*** (.1)	.466* (.2)	.856*** (.2)	1.857*** (.4)
SK	23.103*** (.7)	25.401*** (1.1)	1.591*** (.0)	5.318*** (.1)	1.021*** (.0)	-3.400*** (.1)	4.530*** (.1)	.708*** (.1)	-3.073*** (.2)	-4.463*** (.2)	-6.828*** (.4)
UK	-4.658*** (1.3)	-8.859*** (2.1)	-1.396*** (.0)	.415*** (.0)	1.273*** (.1)	-.077*** (.0)	.215** (.1)	.698*** (.1)	2.737** (.9)	.550*** (.1)	3.986*** (.9)

Notes: mipe=market income/population effect. Standard errors are calculated based on Taylor approximations. Significance levels indicated as * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.
Source: Own calculations with EUROMOD and EU-SILC/FRS.

Table 3: *Decomposing the (% points) change in the Gini coefficient*

	total change	mipe	discretionary policy changes			automatic stabilisers		
			benefits	taxes & SIC	total	benefits	taxes & SIC	total
AT	-.117 (.6)	.943 (.9)	-.163*** (.0)	-.156*** (.0)	-.319*** (.0)	-.533* (.2)	-.208 (.2)	-.742* (.3)
BE	-.739 (.5)	.354 (.7)	-.787*** (.0)	-.080*** (.0)	-.867*** (.0)	-.177 (.1)	-.050 (.2)	-.227 (.2)
BG	1.535 (.9)	3.744*** (1.0)	-4.004*** (.1)	1.523*** (.0)	-2.481*** (.1)	.073 (.1)	.200 (.1)	.273 (.2)
CY	5.110*** (1.1)	8.382*** (1.3)	-.368*** (.1)	-.651*** (.0)	-1.019*** (.1)	-1.837*** (.2)	-.416 (.3)	-2.253*** (.3)
CZ	.503 (.5)	.231 (.7)	-.426*** (.0)	.536*** (.0)	.110** (.0)	-.055 (.2)	.218 (.1)	.163 (.2)
DE	.826 (.4)	.003 (.6)	.077*** (.0)	.182*** (.0)	.259*** (.0)	-.179 (.2)	.743*** (.1)	.564* (.2)
DK	2.056** (.7)	2.586* (1.0)	-.811*** (.0)	1.449*** (.0)	.638*** (.0)	-.510 (.4)	-.658** (.1)	-1.168* (.5)
EE	2.899*** (.7)	4.323*** (.7)	-1.164*** (.0)	.145*** (.0)	-1.019*** (.0)	-.169 (.1)	-.236** (.1)	-.405** (.1)
EL	-1.035 (.7)	-.208 (.8)	.114* (.0)	-.900*** (.1)	-.785*** (.1)	-.817*** (.1)	.775*** (.1)	-.042 (.2)
ES	4.337*** (.4)	6.597*** (.5)	-.004 (.0)	-.603*** (.0)	-.606*** (.0)	-1.342*** (.1)	-.312** (.1)	-1.654*** (.2)
FI	-1.554** (.5)	.036 (.5)	-.258*** (.0)	-.586*** (.0)	-.844*** (.0)	-.656*** (.2)	-.090 (.1)	-.746*** (.2)
FR	1.520** (.6)	2.480** (.8)	-.347*** (.0)	-.766*** (.0)	-1.113*** (.0)	.246 (.2)	-.093 (.2)	.153 (.3)
HR	.016 (.6)	.273 (.8)	.235*** (.0)	-.340*** (.0)	-.105*** (.0)	.092 (.3)	-.243 (.2)	-.151 (.3)
HU	4.090*** (.5)	-.575 (.7)	1.077*** (.1)	2.728*** (.1)	3.805*** (.1)	.412* (.2)	.448 (.3)	.860* (.4)
IE	.760 (.7)	6.526*** (1.1)	.324*** (.0)	-1.634*** (.0)	-1.310*** (.1)	-4.028*** (.6)	-.428 (.3)	-4.456*** (.7)
IT	.660 (.4)	2.523*** (.4)	.022 (.0)	-1.683*** (.1)	-1.662*** (.1)	-.224*** (.0)	.023 (.1)	-.202 (.1)
LT	3.167 (1.7)	4.408* (1.7)	-.550*** (.1)	.605*** (.0)	.055 (.1)	-.682** (.2)	-.614*** (.2)	-1.296*** (.3)
LU	-.363 (.8)	1.101 (1.1)	-.415*** (.0)	-.800*** (.0)	-1.215*** (.0)	-.247 (.3)	-.003 (.2)	-.250 (.4)
LV	-2.724** (.9)	-1.325 (.9)	-.472*** (.0)	-.426*** (.0)	-.898*** (.0)	-.146 (.1)	-.355* (.1)	-.501* (.2)
MT	-.269 (1.0)	.807 (1.2)	-.338*** (.0)	.253*** (.0)	-.085 (.0)	-.185 (.4)	-.806*** (.2)	-.991 (.5)
NL	-1.559** (.6)	-.151 (.7)	-.441*** (.0)	.166*** (.0)	-.274*** (.0)	-.819*** (.2)	-.315 (.2)	-1.134*** (.3)
PL	-.235 (.5)	-.197 (.6)	-1.369*** (.0)	1.173*** (.0)	-.197*** (.0)	.166** (.1)	-.007 (.1)	.160 (.1)
PT	-1.471 (.8)	1.116 (1.0)	.117** (.0)	-2.214*** (.0)	-2.097*** (.1)	-.675*** (.2)	.185 (.2)	-.490 (.3)
RO	2.979 (2.7)	2.898 (2.3)	-1.813*** (.3)	.692*** (.0)	-1.121*** (.3)	.939*** (.2)	.262 (.2)	1.201*** (.3)
SE	1.198** (.5)	1.269* (.6)	-.269*** (.0)	.305*** (.0)	.035 (.0)	.400** (.1)	-.506** (.2)	-.106 (.3)
SI	.371 (.3)	1.133* (.5)	-.292*** (.0)	-.179*** (.0)	-.471*** (.0)	-.444*** (.1)	.153 (.2)	-.291 (.2)
SK	-.632 (.5)	.622 (.7)	-1.879*** (.0)	.413*** (.1)	-1.466*** (.1)	-.029 (.2)	.240 (.2)	.212 (.2)
UK	-1.840 (1.3)	-.956 (1.5)	.397*** (.0)	-.631*** (.1)	-.234*** (.1)	-.922*** (.2)	.272 (.3)	-.650* (.3)

Notes: mipe=market income/population effect. Bootstrapped standard errors after 1,000 replications. Significance levels indicated as * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Source: Own calculations with EUROMOD and EU-SILC/FRS.

Supplementary materials

A Type I and Type II decompositions

A.1 Type I

Under *Type I* decomposition, the effect due to discretionary policy changes is derived based on gross market incomes from end-period (y_1) while the other effect is based on policies from start-period (d_0, p_0). In addition to equation 3 (decomposing discretionary policy changes, other and nominal effects in that order) which falls under *Type I*, due to symmetry the total change in I can be also decomposed in this order: discretionary policy changes, nominal effect, other effect (equation 13) as well as nominal effect, discretionary policy changes, other effect (equation 14):

$$\begin{aligned} \Delta I = & \underbrace{I[d_1(p_1, y_1)] - I[d_0(\alpha p_0, y_1)]}_{\text{discretionary policy changes}} + \underbrace{I[d_0(\alpha p_0, y_1)] - I\left[d_0\left(p_0, \frac{1}{\alpha}y_1\right)\right]}_{\text{nominal effect}} \\ & + \underbrace{I\left[d_0\left(p_0, \frac{1}{\alpha}y_1\right)\right] - I[d_0(p_0, y_0)]}_{\text{other effect}} \end{aligned} \quad (13)$$

$$\begin{aligned} \Delta I = & \underbrace{I[d_1(p_1, y_1)] - I\left[d_1\left(\frac{1}{\alpha}p_1, \frac{1}{\alpha}y_1\right)\right]}_{\text{nominal effect}} + \underbrace{I\left[d_1\left(\frac{1}{\alpha}p_1, \frac{1}{\alpha}y_1\right)\right] - I\left[d_0\left(p_0, \frac{1}{\alpha}y_1\right)\right]}_{\text{discretionary policy changes}} \\ & + \underbrace{I\left[d_0\left(p_0, \frac{1}{\alpha}y_1\right)\right] - I[d_0(p_0, y_0)]}_{\text{other effect}} \end{aligned} \quad (14)$$

Following on this, we can derive the effect due to discretionary policy changes, other and nominal effects averaged over equations 3, 13 and 14. Thus, the average effect of discretionary policy changes conditional on end-period gross market incomes is:

$$\frac{2}{3} \left[I[d_1(p_1, y_1)] - I\left[\alpha d_0(p_0, \frac{1}{\alpha}y_1)\right] \right] + \frac{1}{3} \left[I\left[\frac{1}{\alpha}d_1(p_1, y_1)\right] - I\left[d_0(p_0, \frac{1}{\alpha}y_1)\right] \right] \quad (15)$$

The other effect conditional on start-period policies becomes:

$$\frac{1}{3} \left[I\left[\alpha d_0(p_0, \frac{1}{\alpha}y_1)\right] - I[\alpha d_0(p_0, y_0)] \right] + \frac{2}{3} \left[I\left[d_0\left(p_0, \frac{1}{\alpha}y_1\right)\right] - I[d_0(p_0, y_0)] \right] \quad (16)$$

Finally, the nominal effect is:

$$\begin{aligned} & \frac{1}{3} [I[\alpha d_0(p_0, y_0)] - I[d_0(p_0, y_0)]] + \frac{1}{3} \left[I \left[\alpha d_0 \left(p_0, \frac{1}{\alpha} y_1 \right) \right] - I \left[d_0 \left(p_0, \frac{1}{\alpha} y_1 \right) \right] \right] \\ & + \frac{1}{3} \left[I[d_1(p_1, y_1)] - I \left[\frac{1}{\alpha} d_1(p_1, y_1) \right] \right] \end{aligned} \quad (17)$$

A.2 Type II

Under *Type II* decomposition, the effect of discretionary policy changes is conditional on gross market incomes from start-period (y_0) while the other effect is conditional on policies from end-period (d_1, p_1). Under *Type II* decomposition (as with Type I) there are three ways to decompose the total change: nominal effect, other effect, discretionary policy changes (equation 18); other effect, nominal effect, discretionary policy changes (equation 19); and other effect, discretionary policy changes, nominal effects (equation 20):²¹

$$\begin{aligned} \Delta I = & \underbrace{I[d_1(p_1, y_1)] - I \left[d_1 \left(\frac{1}{\alpha} p_1, \frac{1}{\alpha} y_1 \right) \right]}_{\text{nominal effect}} + \underbrace{I \left[d_1 \left(\frac{1}{\alpha} p_1, \frac{1}{\alpha} y_1 \right) \right] - I \left[d_1 \left(\frac{1}{\alpha} p_1, y_0 \right) \right]}_{\text{other effect}} \\ & + \underbrace{I \left[d_1 \left(\frac{1}{\alpha} p_1, y_0 \right) \right] - I[d_0(p_0, y_0)]}_{\text{discretionary policy changes}} \end{aligned} \quad (18)$$

$$\begin{aligned} \Delta I = & \underbrace{I[d_1(p_1, y_1)] - I[d_1(p_1, \alpha y_0)]}_{\text{other effect}} + \underbrace{I[d_1(p_1, \alpha y_0)] - I \left[d_1 \left(\frac{1}{\alpha} p_1, y_0 \right) \right]}_{\text{nominal effect}} \\ & + \underbrace{I \left[d_1 \left(\frac{1}{\alpha} p_1, y_0 \right) \right] - I[d_0(p_0, y_0)]}_{\text{discretionary policy changes}} \end{aligned} \quad (19)$$

²¹A special Policy Effects Tool was developed in the tax-benefit model EUROMOD that generates all counterfactual permutations and allows the estimation of discretionary policy changes and other effects on the income distribution. At the time of writing, a simplified version of the tool is publicly available for research and policy uses.

$$\begin{aligned} \Delta I = & \underbrace{I[d_1(p_1, y_1)] - I[d_1(p_1, \alpha y_0)]}_{\text{other effect}} + \underbrace{I[d_1(p_1, \alpha y_0)] - I[d_1(\alpha p_0, \alpha y_0)]}_{\text{discretionary policy changes}} \\ & + \underbrace{I[d_1(\alpha p_0, \alpha y_0)] - I[d_0(p_0, y_0)]}_{\text{nominal effect}} \end{aligned} \quad (20)$$

To derive the average effect of discretionary policy changes, other and nominal effects for *Type II* decomposition, we take the arithmetic average over equations 18–20. As a result, the average effect of discretionary policy changes conditional on start-period gross market incomes becomes:

$$\frac{2}{3} \left[I \left[\frac{1}{\alpha} d_1(p_1, \alpha y_0) \right] - I[d_0(p_0, y_0)] \right] + \frac{1}{3} [I[d_1(p_1, \alpha y_0)] - I[\alpha d_0(p_0, y_0)]] \quad (21)$$

The average other effect conditional on end-period policies equals:

$$\frac{1}{3} \left[I \left[\frac{1}{\alpha} d_1(p_1, y_1) \right] - I \left[\frac{1}{\alpha} d_1(p_1, \alpha y_0) \right] \right] + \frac{2}{3} [I[d_1(p_1, y_1)] - I[d_1(p_1, \alpha y_0)]] \quad (22)$$

Finally, the average nominal effect is:

$$\begin{aligned} \frac{1}{3} \left[I[d_1(p_1, y_1)] - I \left[\frac{1}{\alpha} d_1(p_1, y_1) \right] \right] + \frac{1}{3} \left[I[d_1(p_1, \alpha y_0)] - I \left[\frac{1}{\alpha} d_1(p_1, \alpha y_0) \right] \right] \\ + \frac{1}{3} [I[\alpha d_0(p_0, y_0)] - I[d_0(p_0, y_0)]] \end{aligned} \quad (23)$$

A.3 Average effects for scale-variant and scale-invariant measures

In this subsection, we use the linear homogeneity property to derive the average effect of discretionary policy changes, other and nominal effects as well as the effect of automatic stabilisers and market income/population effects. We do this first for *scale-variant* and then for *scale-invariant* measures.

Scale-variant measures

The baselines (the observed) income distributions in $t = 0, 1$ are denoted with $B_t = I[d_t(p_t, y_t)]$; the counterfactuals are denoted with $C_t = I[d_{1-t}(p_{1-t}, \alpha^{1-2t} y_t)]$. Beginning with scale-variant measures, for *Type I* decomposition, we can simplify equation 15 to present the average effect of discretionary policy changes conditional on end-period gross market incomes as:

$$P_I = \frac{1}{3} \left(\frac{1}{\alpha} + 2 \right) I[d_1(p_1, y_1)] - (2\alpha + 1) I \left[d_0 \left(p_0, \frac{1}{\alpha} y_1 \right) \right] = \frac{1}{3} \left(\frac{1}{\alpha} + 2 \right) (B_1 - \alpha C_1) \quad (24)$$

Similarly, equation 16 can be simplified to show the average other effects conditional on start-period policies as:

$$O_I = \frac{2+\alpha}{3} \left(I \left[d_0 \left(p_0, \frac{1}{\alpha} y_1 \right) \right] - I [d_0(p_0, y_0)] \right) = \frac{2+\alpha}{3} (C_1 - B_0) \quad (25)$$

Simplifying equation 17 gives the average nominal effect:

$$N_I = \left(\frac{\alpha-1}{3} \right) \left(B_0 + C_1 + \frac{1}{\alpha} B_1 \right) \quad (26)$$

Let us denote as $B_t^* = I[y_t]$ the baseline (the observed) distribution of gross market incomes and population characteristics in $t = 0, 1$ and as $C_t^* = I[\alpha^{1-2t} y_t]$ the counterfactual distribution of gross incomes. We can then present the effect of automatic stabilisers as the difference between the other effects and the market income/population effect. The market income/population effect is:

$$M_I = \frac{2+\alpha}{3} \left(I \left[\frac{1}{\alpha} y_1 \right] - I[y_0] \right) = \frac{2+\alpha}{3} (C_1^* - B_0^*) \quad (27)$$

Thus, the effect of automatic stabilisers equals:

$$\begin{aligned} A_I &= \frac{2+\alpha}{3} \left(I \left[d_0 \left(p_0, \frac{1}{\alpha} y_1 \right) \right] - I [d_0(p_0, y_0)] - \left(I \left[\frac{1}{\alpha} y_1 \right] - I[y_0] \right) \right) = \\ &= \frac{2+\alpha}{3} (C_1 - B_0 - (C_1^* - B_0^*)) \end{aligned} \quad (28)$$

For *Type II* decomposition, the average effect of discretionary policy changes conditional on start-period gross market incomes becomes based on equation 21:

$$P_{II} = \frac{1}{3} \left(\frac{2}{\alpha} + 1 \right) I[d_1(p_1, \alpha y_0)] - (2\alpha + 1) I[d_0(p_0, y_0)] = \frac{2+\alpha}{3} \left(\frac{1}{\alpha} C_0 - B_0 \right) \quad (29)$$

Simplifying equation 22 shows the average other effect conditional on end-period policies as:

$$O_{II} = \frac{1}{3} \left(\frac{1}{\alpha} + 2 \right) (I[d_1(p_1, y_1)] - I[d_1(p_1, \alpha y_0)]) = \frac{1}{3} \left(\frac{1}{\alpha} + 2 \right) (B_1 - C_0) \quad (30)$$

By simplifying equation 23, the average nominal effect becomes:

$$N_{II} = \left(\frac{\alpha-1}{3} \right) \left(\frac{1}{\alpha} B_1 + \frac{1}{\alpha} C_0 + B_0 \right) \quad (31)$$

Decomposing the other effects into the market income/population and automatic

stabilisation effects yields the following identities:

$$M_{II} = \frac{2+\alpha}{3} \left(I \left[\frac{1}{\alpha} y_1 \right] - I[y_0] \right) = \frac{2+\alpha}{3} (C_1^* - B_0^*) \quad (32)$$

$$\begin{aligned} A_{II} = \frac{1}{3} \left(\frac{1}{\alpha} + 2 \right) (I[d_1(p_1, y_1)] - I[d_1(p_1, \alpha y_0)] - (I[y_1] - I[\alpha y_0])) = \\ \frac{1}{3} \left(\frac{1}{\alpha} + 2 \right) (B_1 - C_0 - (B_1^* - C_0^*)) \end{aligned} \quad (33)$$

Scale-invariant measures

For scale-invariant measures, the nominal effect is zero. The average effect of discretionary policy changes, other effect, market income/population effect and effect of automatic stabilisers – first for *Type I* and then *Type II* decomposition – can be presented as follows:

$$P_I = I[d_1(p_1, y_1)] - I \left[d_0 \left(p_0, \frac{1}{\alpha} y_1 \right) \right] = B_1 - C_1 \quad (34)$$

$$O_I = I \left[d_0 \left(p_0, \frac{1}{\alpha} y_1 \right) \right] - I[d_0(p_0, y_0)] = C_1 - B_0 \quad (35)$$

$$M_I = I \left[\frac{1}{\alpha} y_1 \right] - I[y_0] = C_1^* - B_0^* \quad (36)$$

$$A_I = I \left[d_0 \left(p_0, \frac{1}{\alpha} y_1 \right) \right] - I[d_0(p_0, y_0)] - \left(I \left[\frac{1}{\alpha} y_1 \right] - I[y_0] \right) = C_1 - B_0 - (C_1^* - B_0^*) \quad (37)$$

$$P_{II} = I[d_1(p_1, \alpha y_0)] - I[d_0(p_0, y_0)] = C_0 - B_0 \quad (38)$$

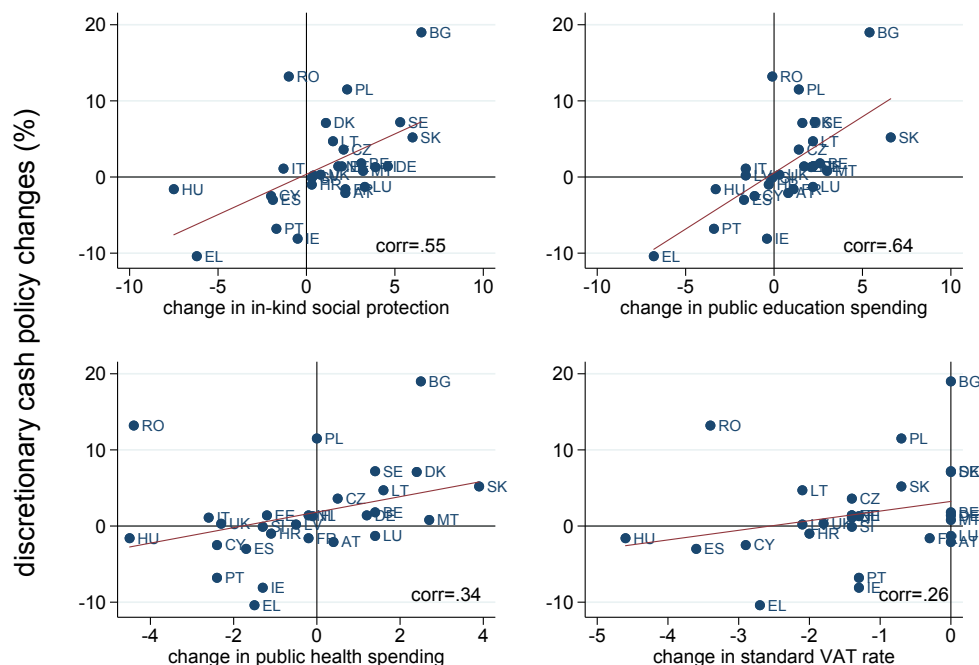
$$O_{II} = I[d_1(p_1, y_1)] - I[d_1(p_1, \alpha y_0)] = B_1 - C_0 \quad (39)$$

$$M_{II} = I[y_1] - I[\alpha y_0] = B_1^* - C_0^* \quad (40)$$

$$A_{II} = I[d_1(p_1, y_1)] - I[d_1(p_1, \alpha y_0)] - (I[y_1] - I[\alpha y_0]) = B_1 - C_0 - (B_1^* - C_0^*) \quad (41)$$

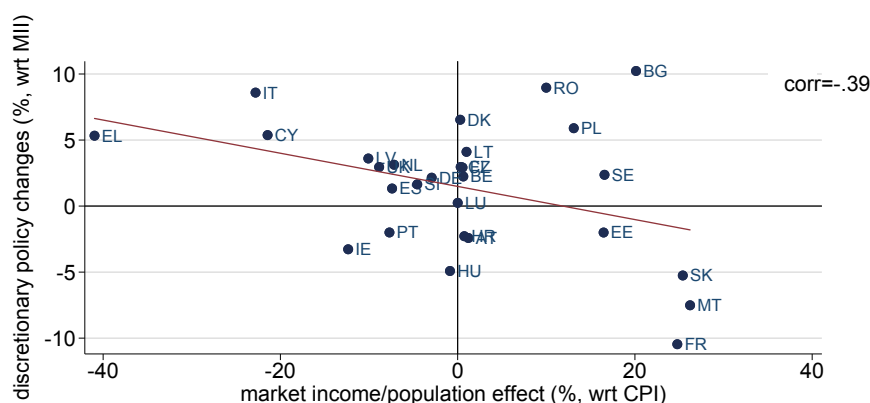
B Decomposing income changes

Figure 8: Correlation of discretionary cash policy changes against changes to expenditure on in-kind benefits and VAT



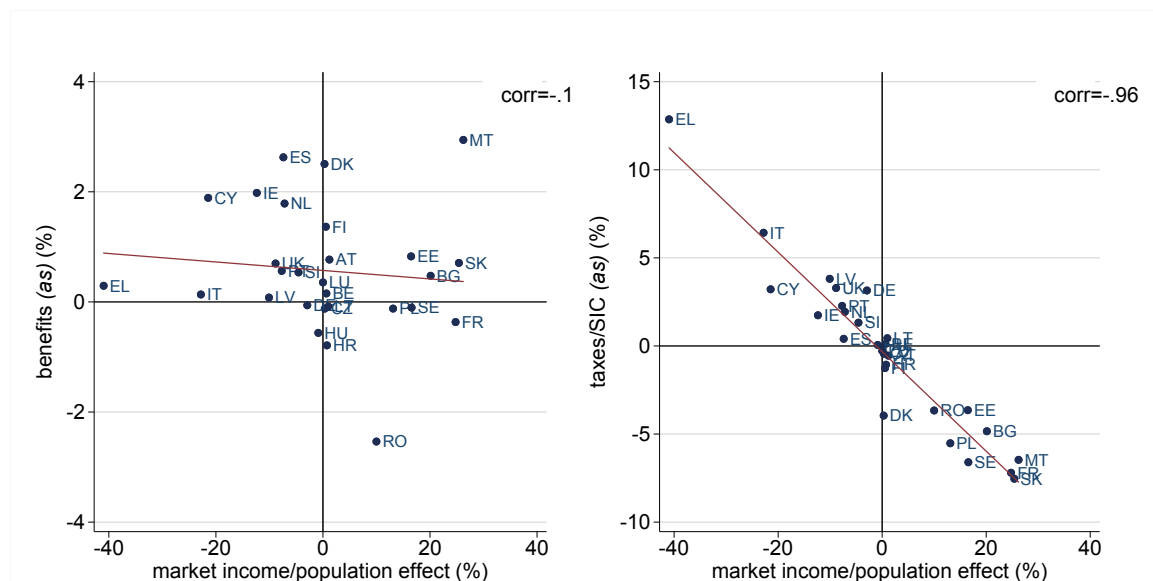
Source: Eurostat data on government spending on social protection (in-kind benefits) (indicator spr_exp_eur); health and education (indicator gov_10a_exp); population size for the respective country (indicator demo_pjan). The % change in mean income due to discretionary policy changes are based on authors' calculations using EUROMOD and EU-SILC and FRS data. Notes: Change in expenditures are presented in real terms per capita and as % of disposable income. The effect of the change in standard VAT rate is calculated assuming all income is spent on goods and services subject to the standard rate of VAT. The data on health and education includes both cash and in-kind payments. To calculate the change in per capita spending, total spending is divided by the population size for the respective country and year. The change in mean income due to discretionary policy changes is based on per capita income. Changes to incomes are estimated in real terms.

Figure 9: Correlation of discretionary policy changes (assessed against MII-benchmark) against the market income/population effect (assessed against CPI-benchmark)



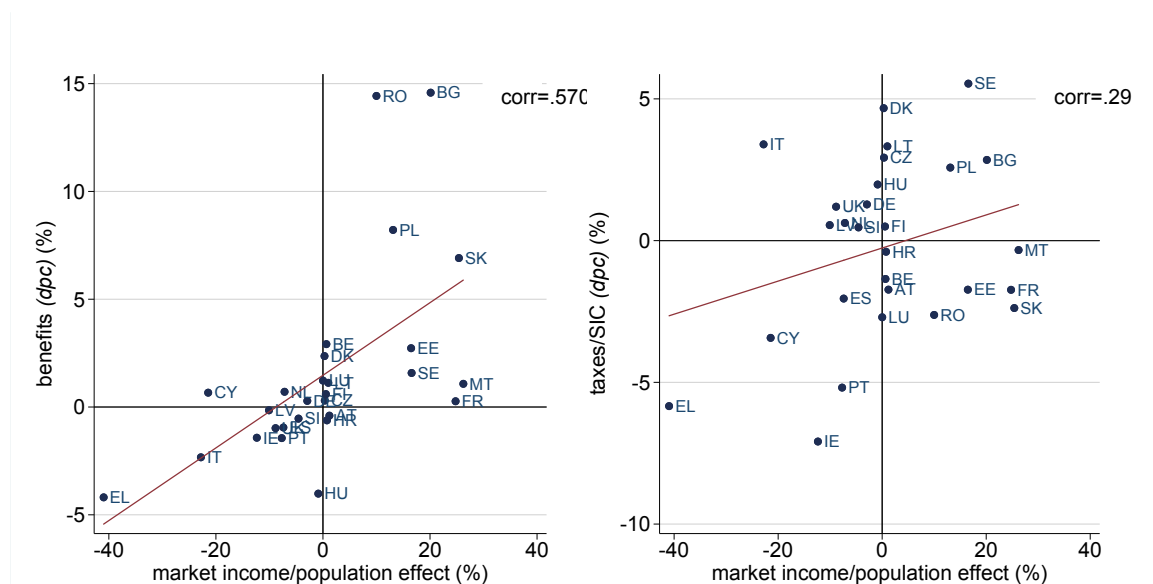
Source: Own calculations with EUROMOD and EU-SILC/FRS. Notes: The vertical axis shows the % change in mean net income due to discretionary policy changes. The horizontal axis shows the % change in mean net income due to the market income/population effect. Changes to incomes are estimated in real terms. Discretionary policy changes are assessed against MII (growth in average market incomes). The market income/population effect is assessed against CPI.

Figure 10: Correlation of automatic stabilisers by benefits and taxes/SIC against the market income/population effect



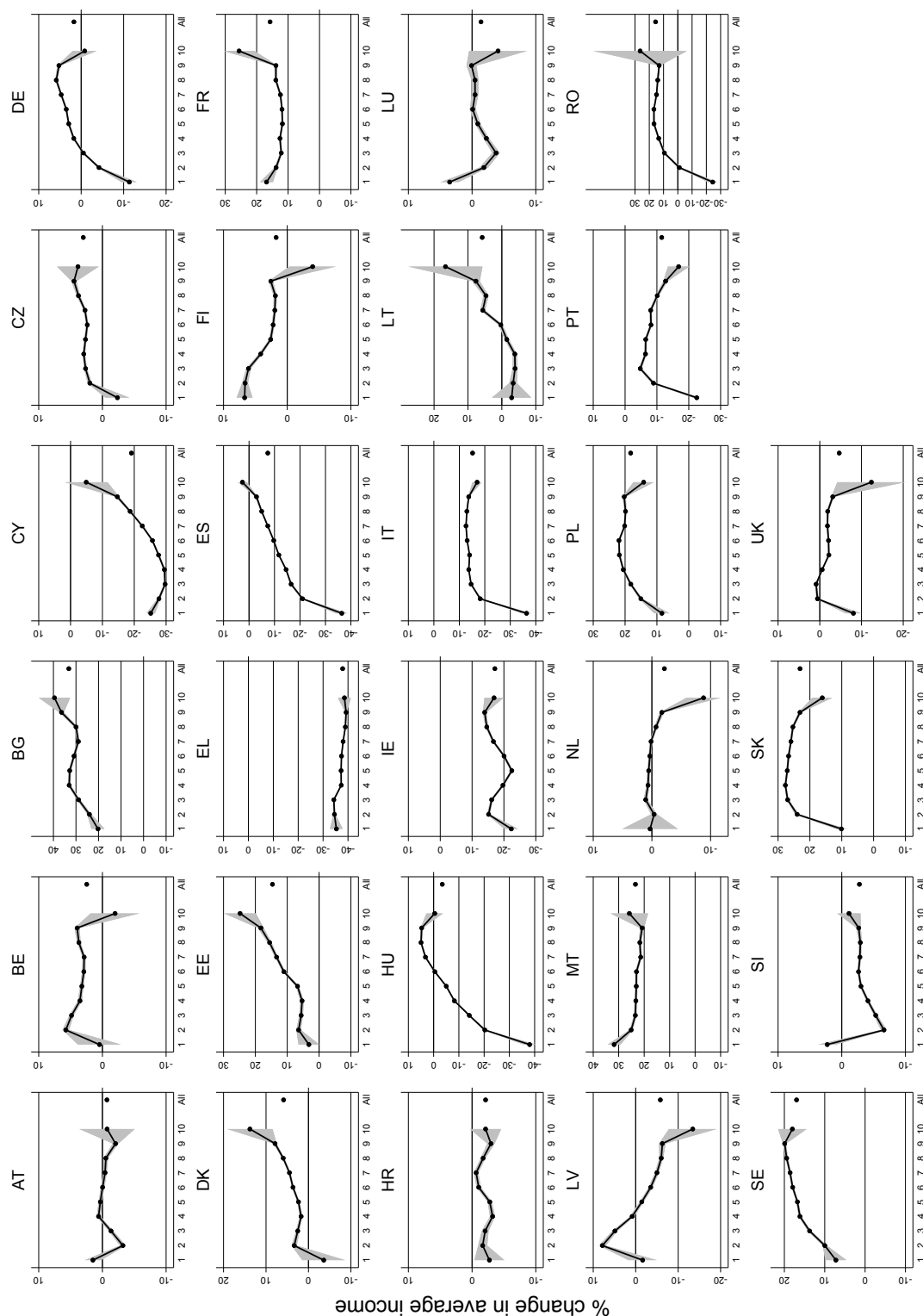
Source: Own calculations with EUROMOD and EU-SILC/FRS. Notes: as=automatic stabilisers. The vertical axis shows the % change in mean net income due to automatic stabilisers. The horizontal axis shows the % change in mean net income due to the market income/population effect. Changes to incomes are estimated in real terms.

Figure 11: Correlation of discretionary policy changes to benefits and taxes/SIC against the market income/population effect



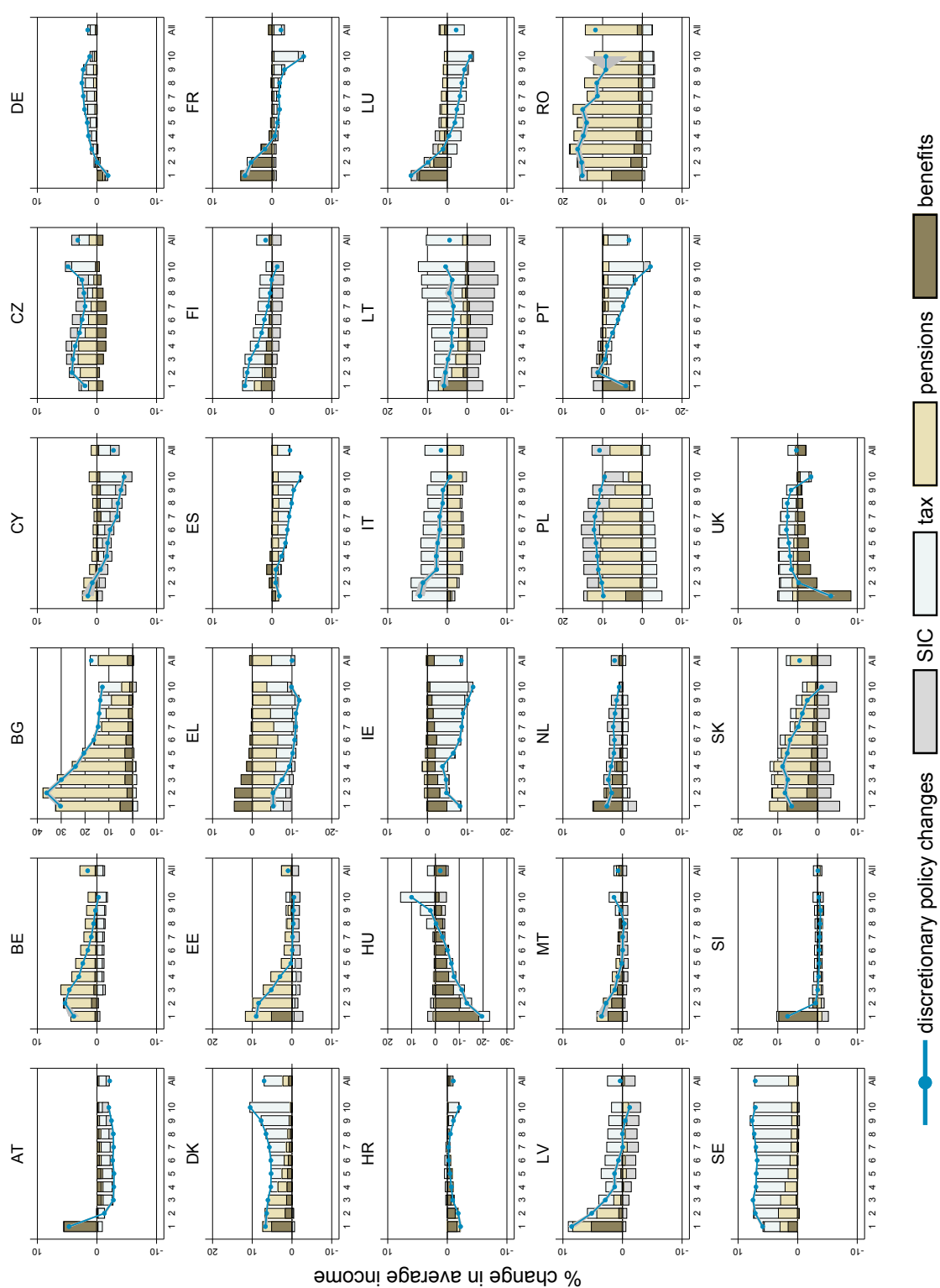
Source: Own calculations with EUROMOD and EU-SILC/FRS. Notes: dpc=discretionary policy changes. The vertical axis shows the % change in mean net income due to discretionary policy changes. The horizontal axis shows the % change in mean net income due to the market income/population effect. Changes to incomes are estimated in real terms.

Figure 12: Change in mean incomes by decile groups and country



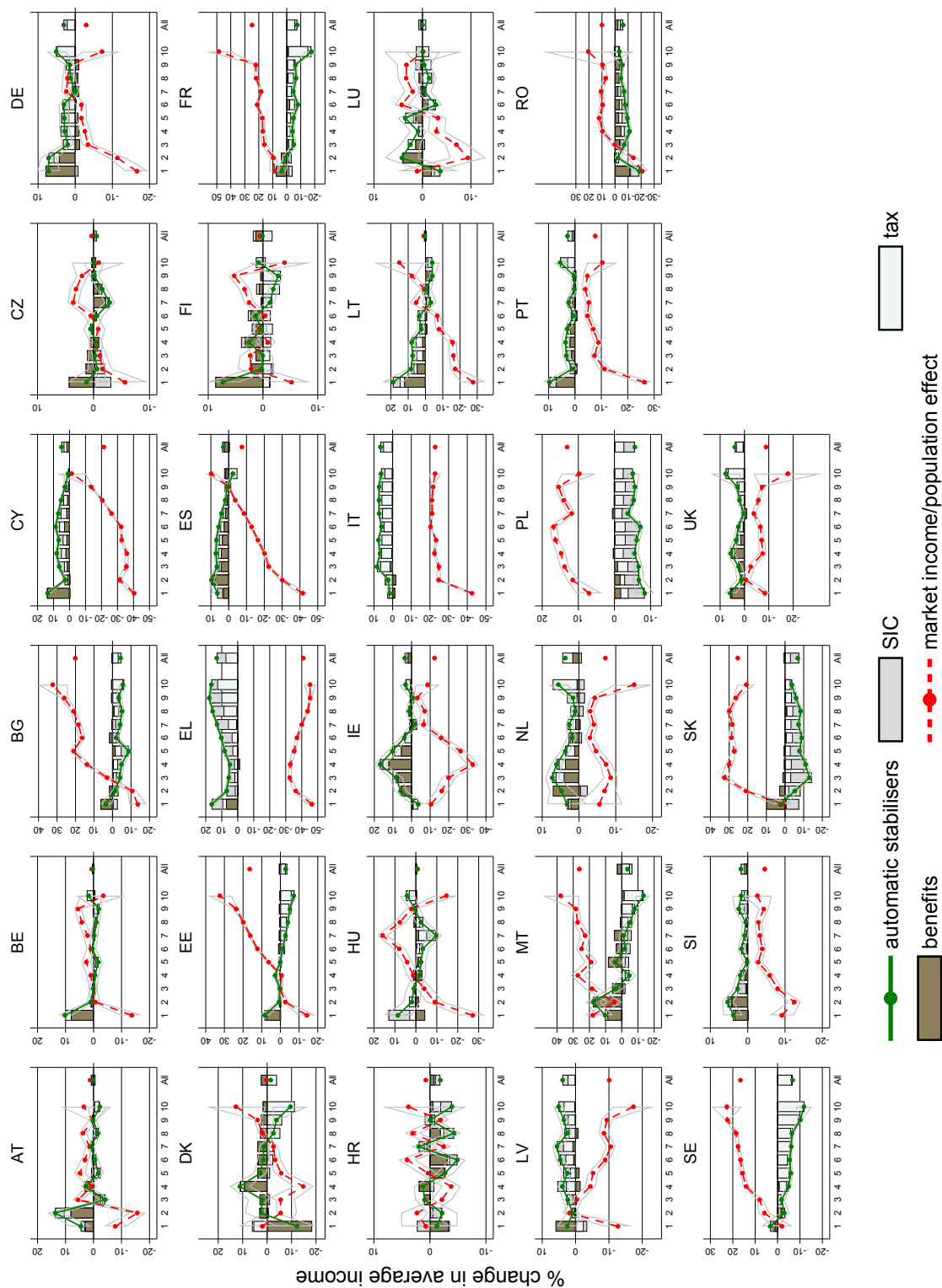
Source: Own calculations with EUROMOD and EU-SILC/FRS. Notes: Changes to incomes are estimated in real terms. Household ranking is not fixed and is based on the respective (2007/2014 actual) distribution of equivalised household net incomes.

Figure 13: Decomposing the effect on mean income of discretionary policy changes, by type of policy and decile group



Source: Own calculations with EUROMOD and EU-SILC/FRS. Notes: Changes to incomes are estimated in real terms. Household ranking is not fixed and is based on the respective (2007/2014 actual or counterfactual) distribution of equivalised household net incomes.

Figure 14: Decomposing the automatic stabilisation effect on mean income, by type of policy and decile group



Source: Own calculations with EUROMOD and EU-SILC/FRS. Notes: Changes to incomes are estimated in real terms. Household ranking is not fixed and is based on the respective (2007/2014 actual or counterfactual) distribution of equivalised household net incomes.