KU LEUVEN HIVA
RESEARCH INSTITUTE FOR WORK AND SOCIETY

TAX BENEFIT REFORMS AND THE ANTI-POVERTY MARGINAL BENEFIT OF PUBLIC FUNDS IN BELGIUM

Diego Collado*

August 2018

IPSWICH WORKING PAPER 4

belspo

This research received funding by the Belspo, the Belgian Scientific Policy Office, within the Brain-be program that is oriented at providing scientific support for federal policies.

All statements in this publication reflect the author's view only. Belspo is not responsible for any use that may be made of the information contained in the document.

* Herman Deleeck Centre for Social Policy, University of Antwerp
Corresponding author: diego.collado@uantwerpen.be

Publisher: KU Leuven

HIVA RESEARCH INSTITUTE FOR WORK AND SOCIETY
Parkstraat 47 box 5300, 3000 LEUVEN, Belgium
hiva@kuleuven.be
http://hiva.kuleuven.be

Abstract

During the last decades in Belgium, tax-benefit reforms that deal with the interrelated challenges of poverty, labour market participation and tighter public budgets have been implemented. At the same time, there have been changes in the environment in which policies operate. It is then relevant to evaluate tax-benefit reforms using a framework that can accommodate all these elements. We do so by estimating the poverty gap index reduction per euro of net revenue that these reforms achieved, separating their impact from the environment in which they operate and accounting for policy-driven labour supply reactions. More specifically, we study the (cash) tax-benefit reforms implemented between 2005 and 2014, focusing on households at the bottom half of the income distribution. To separate the impact of reforms on poverty and net revenue, we utilise ('no population change') counterfactual income decompositions. Without taking into account labour supply reactions, results indicate that there was a reduction of €0.09 in the poverty gap index for each euro of net revenue decline per person at the bottom half of the income distribution. This decreases to €0.05 when including labour supply reactions because policy changes reduced the probability of being in the labour market. This reduction was due to the fact that unemployment benefits grew faster than in-work compensations. These results highlight the importance of looking simultaneously at potential reforms to in- and out-of-work benefits.

Keywords: income poverty – marginal cost of public funds – labour supply – tax-benefit system

Acknowledgment

I am grateful to Tim Goedemé who has commented on previous versions of this paper. The research for this article has benefited from financial support by the Methusalem Programme and the Belspo BRAIN-be IPSWICH project. The results presented here are based on EUROMOD version H1.0+. 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 (175/2015-EU-SILC-ECHP-LFS). The results and their interpretation are the authors' responsibility.

Introduction

It has been argued that the goals of redistribution, encouraging labour market participation and limiting government costs often are in conflict with each other. This has been referred to as the 'iron triangle' of welfare reform (Adam, Brewer, & Shephard, 2006; Blundell, 2002). The idea behind this trilemma is that increasing transfers to the poorest would come at the cost of hampering financial work incentives or at a high budgetary cost (e.g. if in-work transfers were also increased). In line with this, in the last decades in Belgium and other Northwestern EU welfare states, tax-benefit reforms that deal with the challenges of poverty, labour market participation and tighter public budgets have been implemented. These budgets have been under pressure due to — among others — increasing age-related social expenditure, while in parallel 'making work pay' policies that deal simultaneously with in-work poverty and work incentives have become more widespread. At the same time, there have been changes in the environment in which policies operate. For instance, the elements of the trilemma have probably also been affected by demographic changes such as immigration, and by labour market changes such as (demand-driven) job polarisation (Buyst, Goos, & Salomons, 2018; Goos, Manning, & Salomons, 2014) or the evolution of minimum wages (Marchal & Marx, 2018). It is therefore relevant to evaluate tax-benefit reforms using a framework that can accommodate all these elements.

Previous research has described the tensions between redistribution, work incentives and net revenue in Belgium, and isolated the impact of reforms from the environment in which they operated. Nonetheless, these studies analysed each element of the trilemma separately and did not fully account for reform-driven labour supply reactions. To improve on those studies, we analyse the poverty gap index reduction per euro of net revenue achieved by the reforms, including the labour supply reactions that reforms induced. More specifically, we study the (cash) tax-benefit reforms implemented between 2005 and 2014 in Belgium, focusing on households with members available for the labour market and at the bottom half of the income distribution. The latter implies that the poverty gap index represents the average poverty gap in the population at the bottom half of the income distribution. We refer to the poverty gap index reduction per euro of net revenue as the Anti-poverty Marginal Benefit of Public Funds (AMBF). To separate the impact of reforms on poverty and net revenue from the impact of other events, we utilise ('no population change') counterfactual income decompositions. These decompositions compare poverty and revenue indicators based on the income distribution of 2005 and based on a counterfactual distribution in which the policies of 2014 are applied to the population of 2005. By utilising the same population, changes other than policy reforms are not taken into account. The counterfactual distributions are built using the tax-benefit microsimulation EUROMOD. Labour supply reactions are taken into account by estimating a reduced-form model.

Without taking into account labour supply reactions, results indicate that there was a reduction of €0.09 in the poverty gap index for each euro of net revenue decline per person at the bottom half of the income distribution. This decreases to €0.05 when including labour supply reactions because policy changes reduced the probability of being in the labour market. The decline in the likelihood of being in the labour market was due to the fact that unemployment benefits grew faster than in-work compensations. These results highlight the importance of looking simultaneously at potential reforms to in- and out-of-work benefits.

The next section reviews previous related research. Section 2 describes the main tax-benefit changes that occurred in Belgium between 2005 and 2014. Section 3 describes the data and methods that we use. Section 4 presents the results of the analysis and section 5 its conclusion.

1 Previous related research

With the advent of tax-benefit microsimulation models, several studies have analysed the mechanical (or first order) distributional effects of changes in tax-benefit systems using the decomposition framework formalised by Bargain and Callan (2010). By generating 'intermediate' counterfactual distributions which hold constant the underlying population and allow policies to change, policy effects are separated from the environment in which they operate[1]. This 'no population change' counterfactual income decomposition have been applied to Belgium to study periods that somewhat overlap with ours, finding that policies have generally reduced relative poverty (Decoster, Perelman, Vandelannoote, Vanheukelom, & Verbist, 2015; Hills, Paulus, Sutherland, & Tasseva, 2014; Paulus & Tasseva, 2017). Of these studies, only Decoster et al. (2015) included net revenue indicators, finding that policy changes have impacted negatively public budgets.

While very informative, these studies do not give a full account of the impact of policy changes on poverty and net revenue because they do not consider other policy-driven effects such as labour supply responses. Decoster et al. (2015) did studied the related issue of financial work incentives, finding that reforms weakened them and therefore reforms probably had a Marginal Cost of Public Funds (MCF) (Kleven & Kreiner, 2006) different than €1. The MCF measures the welfare cost of raising an additional euro of revenue, taking into account both the mechanical and behavioural effects of reforms. In this way, this concept connects the three elements of the aforementioned trilemma: welfare (or poverty in our case), net revenue and labour market participation. Because Decoster et al. (2015) did not translate the reform-driven changes in work incentives into behavioural changes, they could not calculate the MCF of reforms[2]. In this paper we aim to calculate a related concept that we refer to as the Anti-poverty Marginal Benefit of Public Funds (AMBF). The AMBF measures the poverty gap index reduction per euro of net revenue achieved by reforms.

To calculate the 'mechanical' AMBF of reforms separating them from the environment in which they operate, we could apply the decomposition framework of Bargain and Callan (2010) to both the evolutions of the poverty gap index and net revenue. However, as reforms tended to decrease work incentives and therefore might have reduced labour market participation, this AMBF would probably be overestimated. To include reform-driven labour supply responses, we can utilise the extension that Bargain (2012) added to his framework. This consists in, first, estimating a labour supply model exploiting cross-sectional variation in base- or end-period data. Subsequently, a distribution that holds constant the underlying population and allows policies to change is compared to a similar distribution in which the behaviour of people is also 'allowed' to respond to the reforms. We follow this framework except for the type of labour supply model suggested. Instead of using a model exploiting only static variation in budget constrains *across* people, we use one that also exploits the variation in work incentives that reforms actually generated *over time*.

With repeated cross-sectional data as we have, we could estimate a labour supply model exploiting variation over time in the following way. We could parameterise individual work incentives in a single variable (e.g. marginal tax rates) and, following Cutler and Gruber (1996), instrument this with a group-level simulated variable. This simulated instrumental variable (IV) would be built by 'freezing' the population (e.g. of the first year) and recalculating group average work incentives over time applying the respective year's policies.

[1] Here we are referring only to policy effects because it is our main focus; however, the Bargain and Callan (2010) framework also decomposes changes in distributional indices into 'other' and nominal effects. Other effects are obtained by using 'no policy change' counterfactual income distributions and allowing the underlying population to change.

[2] They did calculated a special case of the MCF. They mainly used this concept to aggregate incentives across people and margins, while the reforms and the labour supply elasticities they used to calculate the MCF did not correspond to the actual reforms they were studying. Instead they used a generic reform and stylised elasticities.

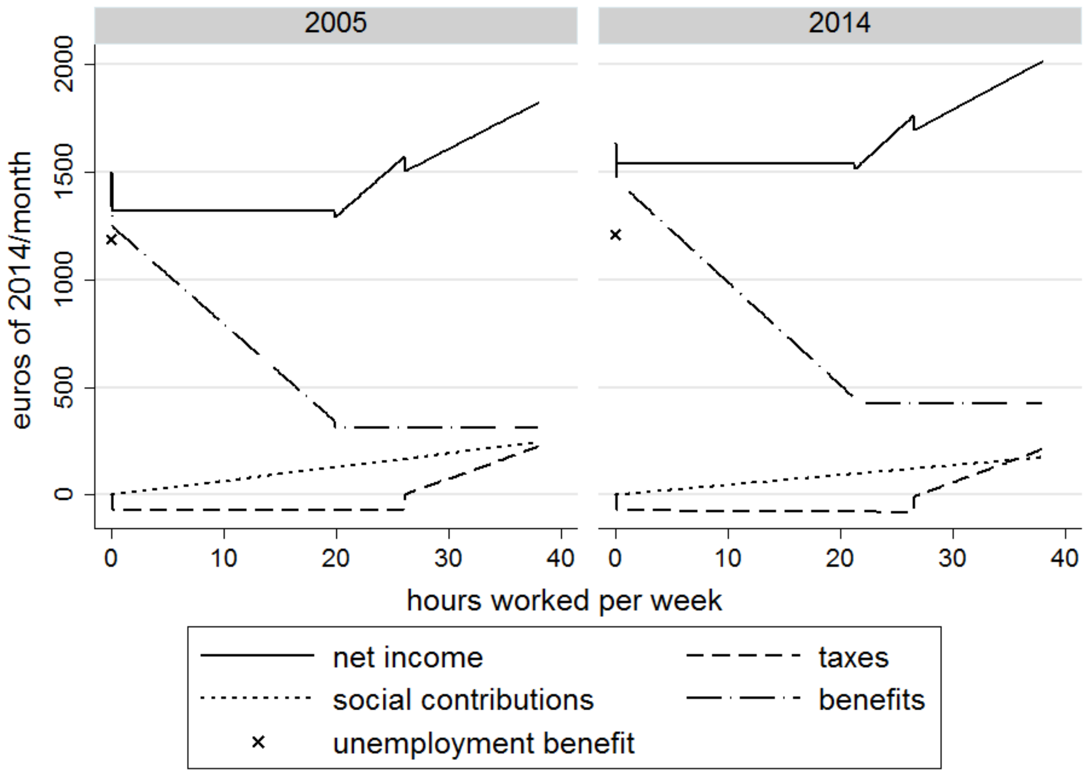
The groups are defined by differential treatments that reforms have on different people. This IV deals with the possible endogeneity between work incentives and labour supply. As Hoynes and Patel (2017) put it, the approach can be understood as a parameterised difference-in-difference framework. In our case the treatments correspond to the policy changes over the two points in time analysed. The condition for using such a framework is that tax-benefit reforms affected differently to different groups. In this regard, including more years in between would allow adding more policy variation and estimating group fixed effects more accurately. Cutler and Gruber (1996) and Hoynes and Patel (2017) used this approach to evaluate the effect of specific policies on behavioural outcomes in the US. We instead are interested in evaluating changes in work incentives provoked by *all* the (cash) tax-benefit reforms occurred in Belgium. This is closely related to Kalíšková (2015) who estimated the effect of work incentives on labour market participation in EU countries during the last decade.

It is not uncommon that important policy changes occur but that they do not affect differently (enough) to different groups (e.g. a general increase in unemployment benefits). This would violate the condition to use the previous approach. Then the approach of Blundell, Duncan, and Meghir (1998) could be an alternative. Defining groups by birth cohort and education (and adding group fixed effects), this approach exploits the differential growth in marginal net earnings between groups. This means that it exploits both the differential impact of reforms on groups as well as the differential growth in their gross earnings. In turn, this approach might lose some variation coming from policy changes as the groups are not necessarily defined by those changes, but it gains variation from differential growth in gross earnings. Originally this approach was applied to the intensive margin, and more recently Bartels and Shupe (2018) and Jäntti, Pirttilä, and Selin (2015) applied it to the extensive margin as well.

2 Most relevant policy changes

This section details the most relevant changes in the Belgian (cash) tax-benefit system that took place between 2005 and 2014. They mainly refer to households with members available for the labour market. This description complements the one in Decoster et al. (2015) which arrived until 2012. In Table A1 of the Appendix, we present the main changes in the parameters of policies, while Figure 1 exemplified some of these changes for a hypothetical single parent household with an hourly wage of €12 in 2014 prices (equivalent to around €2000 monthly if the person worked 38 hours per week). The flat net income continuous line until around 20 hours of work reflects the 100% withdrawal of social assistance (SA). This can also be seen in the declining dashed-dotted benefits line representing decreasing SA as people increase their hours of work. Benefits for this household also include child benefits (CBs).

Figure 1. Budget constraints changes, single parent with an hourly wage of €12, 2005-2014



Note: EUROMOD's wage index is used to bring amounts to euros of 2014. In this way, the evolution of policy parameters is contrasted to the evolution of wages.

Source: EUROMOD's Hypothetical Households Tool (HHoT)

The main policy change affecting distributional outcomes and participation incentives were increases in unemployment benefits (UBs). The main rises occurred in 2009 and 2014. Increases were generally the same for the three types of recipients defined by the rules of UBs[3]. An exception to this was in 2009 when the 55% replacement rate for cohabitants was equalised with the ones for singles and head of households at 60%, and when the limit to the earnings of partners was increased. The other across the board changes corresponded to an increase in replacement rates from 60% to 65% for the three first months of a spell in 2014, and important increases in the maximum and minimum limits of UBs in 2009 and 2014 (only slightly noticeable in Figure 1 due to the specific characteristics of this household). It is relevant to mention here a limitation of our analysis. Due to data limitations, it is not possible to identify people according to the length of their unemployment spells. For this reason, UBs are simulated as if everybody were in their first year of unemployment, while there have also been reductions of these benefits for the long-term unemployed. In consequence, the effect of UBs on poverty and spending is probably overestimated, and on work incentives underestimated[4].

Other policies that went through some changes were social contribution (SC) reductions and SA. SC rebates were significantly expanded in 2006, while in 2009 there was also an important increase in the base reduction – although few workers are entitled to the full base reduction (for a description of SC rebates see Appendix 1). This can be noticed in the decline in the steepness of the SC dotted line in Figure 1. With respect to SA,

[3] Heads of households are defined as people not living alone and whose partners or dependent children contribute nothing or very little to household income. Singles correspond to people who live alone or dependent children earning above a threshold.

[4] If we were able to identify people according to the length of their unemployment spells, the approach of Bartels and Pestel (2016) including the present value of future benefits could be used to account for changes in generosity over time.

though not many jobless households receive this benefit, in some years it grew considerably faster than average wages.

There were also other smaller changes to CBs and special SCs for employees. With respect to child benefits, in 2007 two supplements were implemented. A 'back-to-school' premium was gradually introduced, while a special means-tested supplement for single-parents was implemented. This can be noticed in Figure 1 by the rise of the dashed-dotted benefits line. In relation to special SCs, their brackets were not uprated during the whole period. This might have increased payments for people who were just below the lower bound of a bracket and whose earnings grew (e.g. above the bound exempting this payment).

3 Data and method

3.1 Data

We utilise data from the tax-benefit microsimulation model EUROMOD H1.0+ (Figari, Paulus, & Sutherland, 2015; Sutherland & Figari, 2013) which is mostly based on the EU-SILC survey[5]. With EUROMOD it is possible to calculate net incomes, given gross incomes and personal/household characteristics. We use this model to obtain the counterfactual net income distributions in which policies from one year are applied to another year, and also to obtain the observed distributions to make them comparable. We also utilise EUROMOD to calculate financial incentive measures since for each person we need to know how much would be her household income if she worked different amounts of hours (including zero hours). Our analysis goes from the first to the most recent year with available data, that is, from 2005 to 2014. We do some modifications to the default simulation of out-of-work benefits in EUROMOD which are specified in Appendix 1.

We study people living in households that contain persons available for the labour market, that is, employed or unemployed[6]. We only consider households composed by either couples or singles, with or without (non-working) children. We concentrate on the bottom half of the income distribution. We do so to focus on the effect of policies targeted at low-income households. For the decomposition analysis we also exclude households with negative equivalised disposable incomes that are below -1.5 times median equivalised disposable income (following Paulus & Tasseva, 2017), and to calculate work incentives we exclude people above and below the first and last percentile of the incentives distribution.

3.2 The AMBF and the decomposition framework

Kleven and Kreiner (2006) defined the Social Marginal Cost of Public Funds (SMCF) as the weighted welfare cost of raising one euro of revenue with a reform. We instead calculate what we refer to as the Anti-poverty Marginal Benefit of Public Funds (AMBF). This is the poverty gap index reduction per euro of net revenue achieved by reforms. The AMBF can be seen as a special case of the SMCF in which instead of a social welfare function, we utilise a non-welfarist[7] approach (as in the optimal taxation work of Kanbur,

[5] Standard errors take into account the sample design of EU-SILC following the Stata files of Zardo Trindade and Goedemé (2016) and Goedemé (2011). EUROMOD uses other EU-SILC versions than these files, which means that some sample design variables are missing: in 2008 primary sampling units (PSU) are missing so we use instead household identifiers as PSU, and in 2012 the strata is missing so we use a single strata instead.

[6] Available for the labour market means people aged between 18 and 65 years old excluding self-employed (due to the limited quality of their income data (Immervoll, 2004)), (early) retired, students, disabled, or other inactive.

[7] In this context non-welfarist refers to not taking into account utility but just income.

Keen, & Tuomala, 1994), namely, poverty gap reduction. In addition, instead of deriving analytical formulas and calibrate them as, for example, Kleven and Kreiner (2006) did in their application, we estimate the AMBF completely empirically.

To obtain the AMBF at the bottom half of the income distribution (of our subsample), we need to estimate the effect of reforms on both the poverty gap index and net revenue, and subsequently calculate the ratio between them. The poverty gap index is defined as the mean poverty gap across the whole population (Ravallion, 2017). This indicator then reflects both the depth of poverty and how widespread is among the population. To make this index more comparable to our revenue indicators, we divide the sum of the gaps by the population at the bottom half of the income distribution instead of by the whole population. We use the at-risk-of-poverty threshold which is defined as 60% of median equivalised household income. We anchor this relative poverty line on the first year analysed to not include possible 'poverty line effects' (and uprate it by a wage index explained below). In relation to net revenue, we obtain it for each household by summing taxes and social contributions and subtracting social benefits, and later we calculate the average per person at the bottom half of the income distribution. Then as poverty is driven by a smaller segment of people than revenue, the AMBF without taking into account labour supply reactions reflects how targeted to the poor are tax-benefit changes.

To isolate the poverty and revenue effects of reforms from the environment in which they operate, we decompose these two dimensions using the counterfactual decomposition framework of Bargain (2012). Based on 'intermediate' counterfactual distributions, changes in distributional indices are decomposed into policy, (policy-driven) behavioural and other effects[8]. We are mainly interested in the first two components. The decomposition framework is shown in equation 1 where the difference between the values of an index I (e.g. poverty or net revenue) is decomposed between 2005 and 2014. d refers to the 'tax-benefit function' that transforms household gross incomes into net ones, p to the monetary parameters of policies, y to the gross income distribution (including all the characteristics of people), and α to an uprating factor. Superscripts refer to the year of the item, whereas the gross income distribution of 2005 with a subscript indicates that people's responses to the policies of 2014 are taken into account. The change in an index is decomposed into the three effects by adding and subtracting indices based on income distributions in which the policies of 2014 are applied to the population of 2005, simulating and not simulating people's responses to policies. First, at the bottom of equation 1 we see that by applying different policies to the same population we obtain the policy effect. Here we compare, for instance, poverty under the 2014 policies, to what would have happened if the 2005 policies had not changed except for their parameters following α. Second, by comparing the counterfactual distributions simulating and not simulating labour supply responses we obtain the policy-driven behavioural effect. Lastly, applying the same policies to different populations (already including policy responses) 'other effects' are obtained[9]. Complementary we will also present results of decompositions not including the counterfactual distribution allowing for labour supply responses. In that case the 'other effects' contain the behavioural effects.

[8] It is possible that changes in revenue from personal taxes and benefits are counterbalanced by increases in other fiscal sources not considered among our policies (e.g. VAT). Another limitation of this approach is that, besides considering labour supply reactions, our counterfactual scenarios are partial equilibriums and therefore do not allow studying other potential effects of policies.

[9] It is relevant to mention that this decomposition is path dependent. We chose this path combination based on base-period data because it looks at the impact of policy changes in prospect.

$$\Delta = I[d^{14}(p^{14},\ y^{14})] - I[d^{05}(\alpha p^{05}, \alpha y^{05})]\ =$$

$$\{I[d^{14}(p^{14},\ y^{14})] - I[d^{14}(\ p^{14}, \alpha y^{05}_{14})]\} + \quad \text{other effects}$$

$$\{I[d^{14}(p^{14}, \alpha y^{05}_{14})] - I[d^{14}(\ p^{14}, \alpha y^{05})]\} + \quad \text{behavioural effect} \qquad (1)$$

$$\{I[d^{14}(p^{14}, \alpha y^{05})] - I[d^{05}(\alpha p^{05}, \alpha y^{05})]\} \quad \text{policy effect}$$

The selection of the uprating factor α has a normative interpretation. This is because tax-benefit parameters growing differently than α contribute to policy effects (this can be seen by comparing p^{14} and αp^{05} in the policy effect). Two common alternatives for α are market income index (MII) and consumer price index (CPI). We choose MII for the following reasons. First, whether parameters follow market incomes also affects work incentive indicators (e.g. tax bracket creep can make a person jump to a next bracket). Second, although 'other effects' are not our main focus, uprating gross incomes of 2005 by CPI to make them comparable to those of 2014, yields a less realistic 'neutral distribution' to apportion the 'other effects'. The caveat of using MII is that for policy effects it also makes sense comparing policy parameter evolutions to CPI. As MII we utilise EUROMOD's average annual wages index.

3.3 Labour supply responses

For the decomposition analysis we need a model relating changes in work incentives to labour supply. Since there were not many policy changes affecting the intensive margin and elasticities in this margin tend to be small (e.g. Bargain, Orsini, & Peichl, 2014; Collado, 2018), we only estimate models for the extensive margin. We then try estimating two types of models: one exploiting variation in Participation Tax Rates (PTRs) (as Kalíšková, 2015), and another exploiting Net-of-PTR earnings (NPTRE) (as Bartels & Shupe, 2018; Jäntti et al., 2015). Before detailing each model, we describe the definition of financial work incentives in each margin.

We utilise Participation Tax Rates (PTRs) and Effective Marginal Tax Rates (EMTRs) to measure the 'distortion' of taxes and benefits on financial incentives to work at all and to work more hours, respectively. Although we do not estimate labour supply models based on EMTRs, we do present descriptive evidence of their evolution. Due to data limitations, we focus on changes in taxes and benefits in cash. First in relation to PTRs, they measure the proportion of household earnings taken in (effective) tax and withdrawn (net) benefits when a household member moves from unemployment to employment. This is depicted in equation 2 where i corresponds to the person for whom the PTR is being calculated, j to all household earners, w_j to hourly wages, h_j to hours of work, I to household non-labour income, Z to other household characteristics, and $t(.)$ to a function returning household taxes (including social contributions) minus household benefits. $w_i 0$ corresponds to the situation in which individual i is unemployed. Note that $t(.)$ is negative every time benefits are higher than taxes paid[10]. With respect to EMTRs, they follow the same logic as PTRs: they measure the proportion of household earnings taken in tax and withdrawn benefits when a household member increases her hours of work by 5%.

[10] Benefits in relation to earnings represent replacement rates, and taxes in relation to earnings represent tax rates. Then for a person who only receives a benefit when unemployed and only pays taxes when employed, the PTR can be understood as the sum of her benefit's replacement rate and her tax rate. An equivalent formula for the PTR is one minus the difference between in- and out-of-work household net incomes, in relation to individual gross earnings, i.e. $PTR_i = 1 - (d(\sum_j (w_j h_j) + I) - d(\sum_{j \neq i} (w_j h_j) + I))/w_i h_i$.

$$PTR_i = \frac{t\left(\sum_j (w_j h_j) + I, Z\right) - t\left(\sum_{j\neq i}(w_j h_j) + w_i 0 + I, Z\right)}{\sum_j (w_j h_j) - \left(\sum_{j\neq i}(w_j h_j) + w_i 0\right)} = \frac{t\left(\sum_j (w_j h_j) + I, Z\right) - t\left(\sum_{j\neq i}(w_j h_j) + I, Z\right)}{w_i h_i} \quad (2)$$

Work incentive measures require a few extra assumptions. In the numerator of equation 2 we see the difference between $t(.)$ when a household member is employed and unemployed, while people is observed only in one state. In the non-observed state, household net incomes are simulated changing individual i into this state and running EUROMOD assuming other household members do not change their behaviour. To predict gross wages for unemployed people we utilise a Heckman selection equation, while we impute the most likely hours option they might work (see Appendix 1). Incomes in the in- and out-of-work states are made comparable by estimating earnings and out-of-work benefits in a full-year basis. In equation 2 we see that the difference between household $t(.)$ when in- and out-of-work is expressed in relation to the earnings of individual i. In this way, PTRs take into account household incomes but represent an individual measure. This implies that we calculate them separately for each (available) partner in a couple: one time modifying the earnings of one partner, keeping constant the income sources of the other partner, and then vice versa.

After having described the definition of PTRs, we can now detail the two labour supply models we attempt estimating. To identify the relationship between reform-driven changes in budget constraints and labour participation, the first model regresses the probability of being employed on individual PTRs, year fixed effects α_t and other controls included in vector $\boldsymbol{X}$. To do so we use cross-sectional data from several years (in addition to 2005 and 2014 we include 2006, 2007, 2009 and 2011). To account for possible omitted variable bias we instrument individual PTRs with a group–level simulated instrumental variable (IV) (Cutler & Gruber, 1996). This is expressed in equations 3 and 4 where E_{it} represents an indicator of whether person i in year t is in or out of work[11]. Being in and out of work is defined by being eight or more months in the respective state[12]. The instrumental variable IV_PTR_{gt} is built in the following way. First we define groups g based on the main policy changes: family types in the case of unemployment benefits and FTE earnings (decile group) in the case of social contribution rebates. Then, using the population of the first year we calculate the average PTR for these groups in each year following the respective year's policies. In this way, those group-averages reflect exclusively mechanical policy changes. We also calculate PTRs using predicted earnings both for people in and out of work to solely utilise the variation we are interested in. In addition, we include group fixed effects α_g to exploit only *within-group* variation.

$$\text{1st stage: } PTR_{it} = \beta_{IV\_PTR} * IV\_PTR_{gt} + \boldsymbol{\beta'} * \boldsymbol{X} \quad (3)$$

$$\text{2nd stage: } Pr(E_{it} = 1) = \Lambda(\beta_{PTR} * \widehat{PTR_{it}} + \alpha_t + \alpha_g + \boldsymbol{\beta'} * \boldsymbol{X}) \quad (4)$$

[11] This assumes no income effects which has been the common practice in some studies (e.g. Bartels & Pestel, 2016; Jäntti et al., 2015; Kalíšková, 2015; Shupe & Bartels, 2016) or have been found to be not statistically significant, very small or have given mixed results in others studies (e.g. Bargain et al., 2014; Collado, 2018: for transitions in Belgium; Selin, 2014).

[12] People working 12 months or unemployed 12 months represent most of our sample (more than 90%). The very few people less than eight months in either state are not consider in the regression analysis but we do include their predicted incomes in the decomposition analysis. Results are very similar if we consider half a year as the division point, if we compare only those 12 months in each state, or if we compare those unemployed 12 months to those who worked at least one month.

The second model we attempt estimating also regresses the probability of being employed but on Net-of-PTR earnings (NPTRE). NPTRE represent the net gain in euros of moving to employment. The rest of the model is similar to the previous one (see equations 5 and 6) except for the way of dealing with endogeneity. Because we also exploit changes in gross earnings (e_{it}), to deal with endogeneity we cannot use the previous approach of 'freezing' the population and recalculating policies. Instead, we define groups based on education, birth cohort and gender, and utilise the averages of those groups as IV (Blundell et al., 1998). This and the fact that we include group fixed effects implies that the model exploits differential growth between groups. Although this model exploits within-group variation in both gross earnings and PTRs, later for the decomposition analysis we will predict employment probabilities modifying only PTRs.

$$\text{1st stage: } e_{it} * (1 - PTR_{it}) = NPTRE_{it} = \beta_{IV\_NPTRE} * IV\_NPTRE_{gt} + \boldsymbol{\beta}' * \boldsymbol{X} \quad (5)$$

$$\text{2nd stage: } Pr(E_{it} = 1) = \Lambda(\beta_{NPTRE} * \widehat{NPTRE}_{it} + \alpha_t + \alpha_g + \boldsymbol{\beta}' * \boldsymbol{X}) \quad (6)$$

Once we have identified the relationship between PTRs and labour participation, we can generate a prediction of the probability of being employed (and non-employed) under the policies of a given year. In parallel, for the decomposition analysis we need to predict for the households of 2005 what would be their likely net *incomes* — including behavioural responses — under the policies of 2014. To calculate these likely incomes we follow the expected value approach described in equation 7: combining predicted probabilities of employment and non-employment from our models with the incomes in each of those states, we can obtain an expected household income d_{it} for each (available) person (Creedy and Kalb (2005) proposed a similar approach for the multinomial case). In the same way we can obtain expected taxes (including social contributions) and benefits. More precisely, we do the following procedure to obtain the expected incomes for the term $I\left[d^{14}\left(p^{14}, \alpha y_{14}^{05}\right)\right]$ in equation 1 in which policies of 2014 are simulated and responses to those policies should be taken into account as well. In this case we calculate expected incomes using the in- and out-of-work incomes that the policies of 2014 mechanically generate on households of 2005. Regarding probabilities, we use the predicted probabilities that policies (or PTRs) of 2014 generate on households of 2005. To make these outcomes more comparable, we use the same approach for the other terms of the decomposition. For instance, for the counterfactual term $I[d^{14}(p^{14}, \alpha y^{05})]$ in which responses should not be taken into account, we also use the in- and out-of-work incomes generated by the policies of 2014 but combined with the predicted probabilities generated by the 'non-changed' policies of 2005.

$$E(d_{it}) = E(Pr(E_{it} = 1)) * d_{it}^{in\ work} + E(Pr(E_{it} = 0)) * d_{it}^{out\ of\ work} \quad (7)$$

Since predictions from the types of models we use are far from the binary behaviour observed, this approach tends to overestimate incomes for unemployed people (by multiplying their potential in-work incomes by a positive prediction), and vice versa for employed people. For a measure such as poverty which is not fully based on averages, these misestimations are not cancelled out. For this reason, for decompositions including behavioural effects we recalculate the poverty line using expected incomes[13] (for our subsample in the base-period year).

[13] Other constants misestimations are cancelled out because we study *changes*. An alternative approach would be to assign people to employment and unemployment following their predicted values and random draws from a suitable distribution, then calculate poverty, and repeat this procedure many times to obtain a distribution of likely poverty.

4 Results

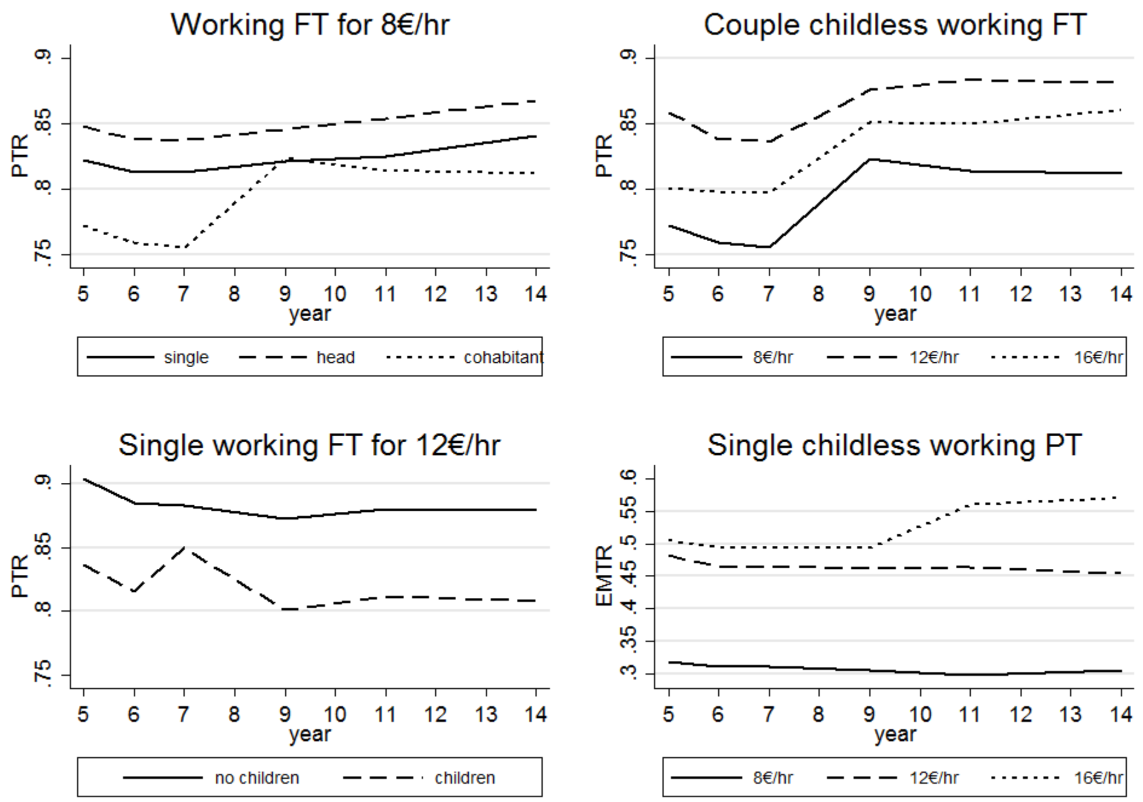
4.1 Mechanical policy effects on distributional outcomes and work incentives

We start this results section by analysing what were the specific policies that drove changes in distributional outcomes and work incentives. In relation to distributional outcomes, we first decompose the change in the poverty gap index and net revenue into policy and 'other' effects (Figure A1 of the Appendix). We do so using the decomposition framework of equation 1 without including labour supply responses (therefore without the expected income approach). Consistent with previous research, policy effects have decreased net revenue as well as poverty. The decreases were €30 and €5 per person per month respectively (or €13 if we consider poverty gaps among the poor only). 'Other effects' — which for now include behavioural effects as well — have also decreased net revenue, while contrary to policy effects, they have increased poverty. This means that while the tax-benefit system is running harder, other factors are putting extra pressure on it[14]. To know which specific tax-benefit components drove policy effects, we assign to each tax-benefit component its proportional contribution to these effects (Figure A2). Because tax-benefit components can correspond to different employment states, we separate their contributions by the household work intensity (WI) declared at the moment of the interview. By doing this we discover that policy effects were stronger for households with jobless members. In terms of the specific tax-benefit components, policy effects have been mainly driven by unemployment benefits (UBs). This was the case for 'working' household as well because people in these households might have been receiving UBs in other moments than the interview. Taxes seem important; however, this is mainly the response to more generous UBs as they are partially taxable. Social contribution (SC) reductions and child benefits (CBs) somewhat contributed as well to poverty reduction and higher expenditure.

To analyse the effect of policies on the evolution of work incentives we utilise two approaches. First, we do this on a selection of hypothetical households to remove compositional effects, and break down the evolutions by the categories that the main policy changes define. Second, we analyse the evolution of the average incentive of groups defined by those categories. With respect to the first approach, we present some selected results in Figure 2. At the top left corner we observe the evolution of Participation Tax Rates (PTRs) by UB recipient type. We see that the evolution of PTRs was similar for singles and head of households, while PTRs increased importantly in 2009 for cohabitants due to the large increase in UBs for this category. At the top right corner of the figure we see that PTRs have evolved somewhat similarly for people working for different levels of hourly wages, except in 2006. This household correspond to a cohabitant and therefore the curves are generally driven by increases in UBs. The somewhat different evolutions in 2006 are due to the expansion of SC rebates which made work pay more at medium and low FTE earnings. Moving to the bottom left corner of the figure, we do not see many differences between a single person with or without children, except in 2007. This was due to the the introduction of the special mean-tested supplement for single-parents which for specific earnings levels could affect how much work paid. Lastly, at the bottom right corner we see the evolution of Effective Marginal Tax Rates (EMTRs). We see that the increase in SC reductions in 2006 had an effect on them but not a large one. The increase in EMTRs for people with high hourly wages in 2011 was caused by special SCs based on taxable income. The brackets for these contribution were not uprated during the whole period and this hypothetical household happened to cross the exemption limit in this year.

[14] For 'other effects', the sub-sample under analysis of the second year is re-weighed to match the size of the sub-sample of the first year. This is done to remove the effect of changes in the size of the sub-sample on net revenue (e.g. due to a larger portion of people leaving the labour market).

Figure 2. Policy effects on work incentives of hypothetical households, 2005-2014



Note: we analysed hypothetical household formed by singles and couples, with and without children, with different hourly wages, and here present some selected results. Full-time (FT) means working 38 hours per week, while part-time (PT) 30. Families with children have two children of 7 and 14 years old. The analysed cohabitants have working partners.

Source: EUROMOD's Hypothetical Households Tool (HHoT)

The second approach to explore the effect of policies on work incentives consists in analysing the evolution of mean incentives of groups defined by the aforementioned policy changes (Figure A3 in the Appendix). Accordingly, at the extensive margin we define groups for PTR evolutions using UB type, FTE decile group (which affect SC reductions), and having or not children (which affects CBs). To define groups for EMTRs we use FTE earnings decile groups as well, and taxable income decile groups (which affect special SCs). From the evolutions of EMTRs we exclude people working full-time or more hours because the design of the SC rebates creates a discontinuity at this point[15]. Results show that PTRs have increased for most groups, while the differences between EMTRs in 2005 and 2014 are negligible[16]. At the same time, although there were important PTR increases, they were not very different across groups. This might difficult the usage of a model only exploiting this type of variation. We explore this in the next sub-section.

[15] Beyond FT or 38 hours of work, FTE earnings are calculated under the assumption that the person still works 38 hours. If worked hours go beyond FT and therefore actual earnings increase, that assumption implies that FTE increase (since one earns more while still working FT). After a plateau-area limit, social contribution rebates are withdrawn when FTE increase (see Appendix 1 for a description of SC rebates). This implies that after 38 hours the slope of the budget constraint decreases, creating a discontinuity. In other words, the incentive to work overtime is lower than the incentive to arrive at FT hours. When SC rebates are increased, some people working FT become eligible and start having this distortion. Then their EMTRs sharply increase. On the contrary, if they had been working slightly less than FT, their EMTRs would have decreased as they had become entitled to the rebate. In addition, there were changes in the rates at which FTE are withdrawn, which also affects the incentive to work overtime. For all these reasons, EMTRs for this group do not reflect well the incentive to change hours worked. Furthermore, people working FT probably have other type of restrictions to work overtime.

[16] The peak in EMTRs in 2007 was due to a tax credit that included civil servants only in this year and which was strongly targeted at low earnings.

4.2 Participation responses

For the two types of labour supply models we try to estimate,

Table 1 presents results of statistical tests of the relevance of instrumental variables (IVs) and of the exogeneity of the variables being instrumented. The first-stage relevance tests are formal tests of whether there are different evolutions across groups. As suspected, in the first row we see that the conditional relationship between the simulated group-average PTRs and individual PTRs is very low. Though there were important policy changes affecting PTRs, they tended to be common across groups and therefore this variation is absorbed by the year fixed effects. Fortunately, the relevance of the group-average Net of PTR earnings (NPTRE) is somewhat higher. The corresponding exogeneity test shows that results are not very different if we use or not this instrument. Using the instrument would come at the cost of very high standard errors because its variation is much lower than the one of the instrumented variable. For these reasons, we use the model without the instrument.

Table 1. Relevance and exogeneity test results

Instrumental variable	Relevance		Test of exogeneity
	Partial R-sq.	F	p-value
Mean group PTR	0.00	24	-
Mean group NPTRE	0.02	547	0.88

Note: To estimate relevance we use the Stata command *ivregress* since the reduced form for the endogenous explanatory variable is linear. To test exogeneity we use the Stata command *ivprobit*. These commands are able to accommodate the survey's sample design except the strata. Results were obtained using all control variables (without interactions).

Source: EUROMOD

Table 2 shows the results of the selected model. To later simulate more heterogeneous effects, we include in the model interactions that the literature traditionally studies: gender, education, having children and age. Column 1 shows the results in odds. Column 2 shows the Average Marginal Effects (AME) of the variables and of the *difference* between the categories of the interactions. Column 3 shows the *level* of the AME of the categories of the interactions. Results for NPTREs are presented for an increase in €100 per month. All monetary amounts are in monthly euros of 2014. That being said, in column 2 we see that for an increase in €100 in the monthly income difference between working and not working, the probability of being in the labour market increases in 0.7%. This AME is equivalent to an elasticity of 0.05, with the employment rate in our sub-sample being 89% and the average NPTRE around €780. Our elasticity is between the ones that Jäntti et al. (2015) and Bartels and Shupe (2018) found, which are 0.01 and 0.08 respectively. Among the interactions, elderly people seem less sensitive to changes in their marginal net earnings, while males and more educated people somewhat more sensitive. The results of this model are the ones that we will utilise in the next subsection to simulate reform-driven labour supply effects.

Table 2. Labour supply model results

VARIABLES	(1) DV: Emp. logit odds	(2) DV: Emp. logit AME (contrasts)	(3) DV: Emp. logit AME (levels)
NPTRE (100 euro 2014)	1.059***	0.007***	
	[1.026 - 1.092]	[0.005 - 0.008]	
NPTRE * Male = 0	1.000		0.005***
	[1.000 - 1.000]		[0.004,0.007]
NPTRE * Male = 1	1.054***	0.003***	0.009***
	[1.029 - 1.080]	[0.002,0.005]	[0.007,0.010]
NPTRE * High Edu. = 0	1.000		0.006***
	[1.000 - 1.000]		[0.005,0.008]
NPTRE * High Edu. = 1	1.029*	0.002*	0.008***
	[1.004 - 1.056]	[0.000,0.003]	[0.007,0.009]
Children = 1	1.043	0.018***	
	[0.903 - 1.206]	[0.010 - 0.027]	
NPTRE * Children = 0	1.000		0.006***
	[1.000 - 1.000]		[0.005,0.008]
NPTRE * Children = 1	1.027**	0.001	0.008***
	[1.008 - 1.046]	[-0.000,0.003]	[0.006,0.009]
NPTRE * 18-34	1.000		0.008***
	[1.000 - 1.000]		[0.006,0.010]
NPTRE * 35-49	1.007	0.000	0.008***
	[0.982 - 1.032]	[-0.001,0.001]	[0.007,0.010]
NPTRE * 50-64	0.925***	-0.005***	0.003**
	[0.900 - 0.950]	[-0.007,-0.004]	[0.001,0.005]
Group FE	Yes		
Year Fe	Yes		
Pseudo-R2	0.100		
Log likelihood	-5.893e+06		
AIC	1.180e+07		
N_sub	25281	25281	25281

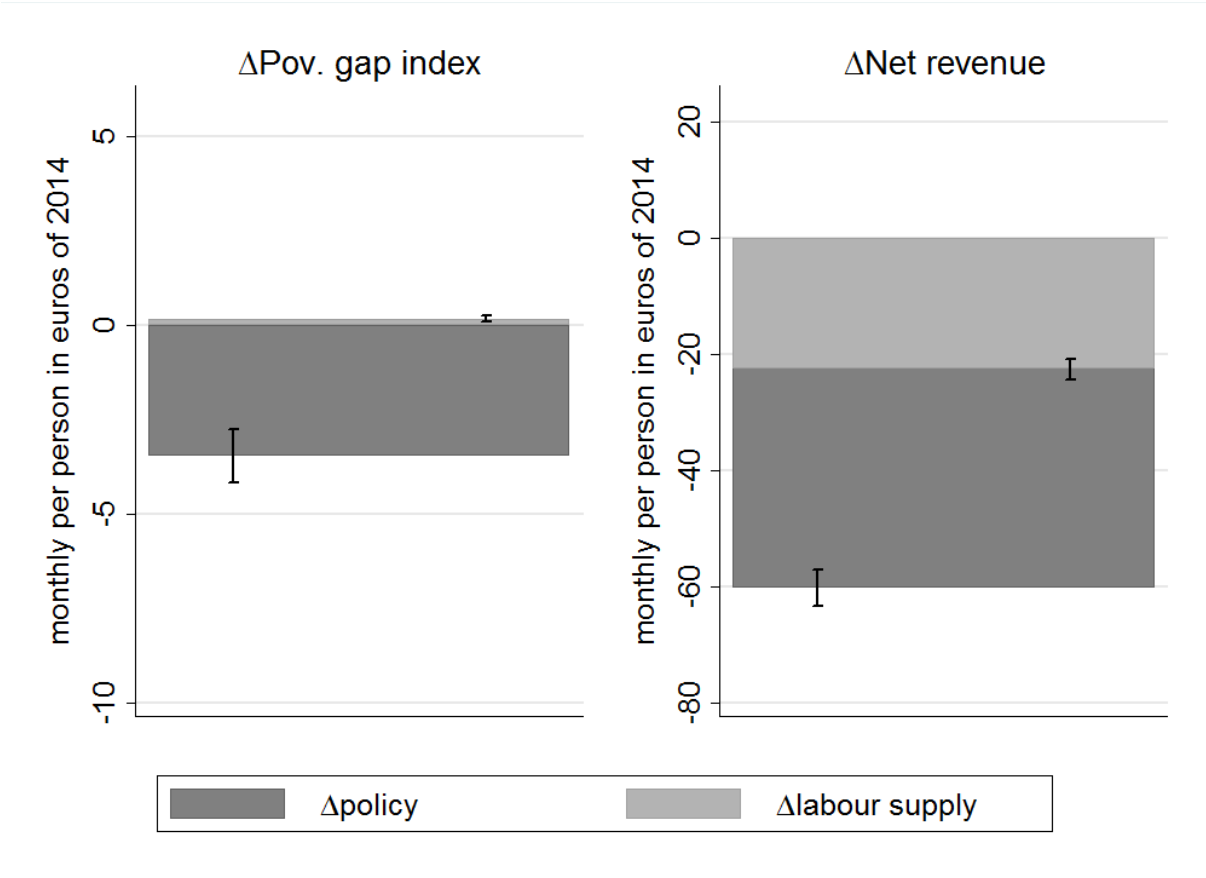
Note: *** p<0.01 ** p<0.05 * p<0.1, 90% confidence intervals in brackets. AME=average marginal effects. In column 2 AMEs refer to *contrasting* between the categories of the interacted variables the effect of increasing the NPTRE in €100 per month. In column 3 AMEs refer to the *level* of the effect of increasing the NPTRE in €100 for the categories of the interacted variables. Groups are defined by UB type, FTE decile group and having or not children. The smallest group size in a given year is 20 (and the second smallest 59). Information criteria are able to accommodate the survey's sample design except the strata.

Source: EUROMOD

4.3 The Anti-Poverty Marginal Benefit of public Funds

With the results of the labour supply model we are able to make the decomposition described in equation 1. Figure 3 presents the results of this decomposition for the policy and the policy-driven labour supply effects. In relation to the policy effect, as we already discussed, we see that reforms have reduced the poverty gap index as well as decreased net revenue. Results go in the same direction as in Figure A1 but are not exactly the same because for the decomposition of Figure 3 we utilise the expected income approach of equation 7. Looking solely at the mechanical policy effects, results indicate that policies reduced the poverty gap index and net revenue in €3.5 and €38 per person per month. This means that the poverty gap index decreased in €0.09 for each euro of net revenue decline per person at the bottom half of the income distribution. We refer to this measure as the Anti-Poverty Marginal Benefit of public Funds (AMBF).

Figure 3. Decomposition of policy and policy-driven labour supply effects on the poverty gap index and net revenue, 2005-2014



Note: 90% confidence intervals.

Source: EUROMOD

When looking at the labour supply behavioural effect, we see an extra effect on budget deficits. This happened because unemployment benefits grew faster than in-work compensations, which increases PTR and therefore decreases NPTRE. This is translated into a reduction in the probability of being in the labour market according to our labour supply model. Applying the policies of 2014 to the population of 2005 reduces NPTRE in €128 per month on average, which our model's elasticity translates into a 1.2% decrease in employment. Then the probability of being a tax-payer decreases and of receiving out-of-work benefits increases. Labour supply effects on the poverty gap index are much less noticeable than on net revenue. This is because benefits cushion income drops when unemployed. In other words, from the perspective of income maintenance there are not many changes. However, from the perspective of revenue it does make a difference whether people pay taxes or receives benefits. For this reason, the effect is much more visible on net revenue (-€22.5). Accordingly, when including labour supply reactions the AMBF decreases to €0.05.

To show complementary indicators, we also calculate the AMBF using the average poverty gap among the poor only, and including people at the top half of the income distribution. Although the poverty gap among the poor has the caveat of not considering how widespread is poverty, it is a more graspable indicator. That being said, the average poverty gap among the poor decreased in €18. This implies that for each euro of net revenue decline per person at the bottom half of the income distribution, the average poverty gap among the poor diminished in €0.29. If we also include people at the top half of the distribution, this raises to €0.44 as there were less negative policy and behavioural effects in that part of the distribution.

Lastly, as a comparison for the AMBF of the reforms between 2005 and 2014, we calculate the AMBF between 2005 and 2009. Up to 2009 most of the large policy changes had already been implemented, except for the additional increase in UBs in 2014. Without considering labour supply reactions, the AMBF up to 2009 was €0.07 (compared to €0.09 up to 2014). This reflects the fact that until that period there was less poverty reduction with respect to the loss in net revenue. When including labour supply reactions, the AMBF up to 2009 only decreases to €0.06 (compared to €0.05 up to 2014). This reflects the fact that policy changes until 2009 increased PTRs less than changes up to 2014 (Figure A3).

5 Conclusion

In this paper we estimated the poverty gap index reduction per euro of net revenue that the reforms implemented in Belgium between 2005 and 2014 achieved. Through counterfactual income decompositions we separated the impact of reform from the environment in which they operated. Without taking into account labour supply reactions, results indicate that reforms reduced the poverty gap index in 0.09€ for each euro of net revenue decline per person at the bottom half of the income distribution. We referred to this measure as the Anti-poverty Marginal Benefit of Public Funds (AMBF). This reduction in poverty with a concomitant increase in budget deficit was mainly due to large increases in unemployment benefits, and secondarily, to augmentations in social contribution reductions and child benefits. The AMBF decreases to 0.05€ when including labour supply reactions because policy changes reduced the probability of being in the labour market. This means that the probability of being a tax-payer decreased and of receiving out-of-work benefits increased. The decline in the probability of being in the labour market was due to the fact that unemployment benefits grew faster than in-work compensations, which weakened participation incentives. These results highlight the importance of looking simultaneously at potential reforms to in- and out-of-work benefits.

At a broader level, results show the difficulty of dealing with a social trilemma: reducing poverty, while not discouraging work nor running large public deficits. Furthermore, we found that 'other effects' are also decreasing net revenue and are running against the pro-poor effects of policies. This implies that anti-poverty strategies inevitably have to also address other drivers of rising income inequality.

There are several avenues for further research. For example, combining our labour supply elasticities with labour demand elasticities from the literature could allow obtaining possible changes in equilibrium wages (as e.g. in Dolls et al., 2017) and thus more realistic counterfactual scenarios. Another avenue would be to further decompose the 'other effects' to understand what factors are counteracting the poverty-reducing policy effects. This further decomposition could be done, for example, using the parametric and nonparametric generalisation of the Oaxaca-Blinder decomposition of Bourguignon, Ferreira, and Leite (2008). To estimate so many different factors and in general, larger and more accurate data would be ideal.

References

Adam, S., Brewer, M., & Shephard, A. (2006). *The poverty trade-off: Work incentives and income redistribution in Britain*. Retrieved from Bristol, UK: https://www.ifs.org.uk/publications/3739

Bargain, O. (2012). Decomposition analysis of distributive policies using behavioural simulations. *International Tax and Public Finance, 19*(5), 708-731.

Bargain, O., & Callan, T. (2010). Analysing the effects of tax-benefit reforms on income distribution: a decomposition approach. *The Journal of Economic Inequality, 8*(1), 1-21.

Bargain, O., Orsini, K., & Peichl, A. (2014). Comparing labor supply elasticities in europe and the united states new results. *Journal of human Resources, 49*(3), 723-838.

Bartels, C., & Pestel, N. (2016). Short- and long-term participation tax rates and their impact on labor supply. *International Tax and Public Finance, 23*(6), 1126-1159. doi:10.1007/s10797-016-9400-9

Bartels, C., & Shupe, C. (2018). Drivers of participation elasticities across Europe: gender or earner role within the household? *EUROMOD Working Paper Series.* Retrieved from https://www.iser.essex.ac.uk/research/publications/working-papers/euromod/em7-18.pdf

Blundell, R. (2002). Welfare-to-Work: Which Policies Work and Why? *Keynes Lecture in Economics: Proceedings of the British Academy, 117*, 477-524.

Blundell, R., Duncan, A., & Meghir, C. (1998). Estimating labor supply responses using tax reforms. *Econometrica*, 827-861.

Bourguignon, F., Ferreira, F. H., & Leite, P. G. (2008). Beyond Oaxaca–Blinder: Accounting for differences in household income distributions. *The Journal of Economic Inequality, 6*(2), 117-148.

Buyst, E., Goos, M., & Salomons, A. (2018). Job polarization: an historical perspective. *Oxford Review of Economic Policy, 34*(3), 461-474.

Collado, D. (2018). Financial work incentives and the longterm unemployed: the case of Belgium. *EUROMOD Working Paper Series.* Retrieved from https://www.iser.essex.ac.uk/research/publications/working-papers/euromod/em1-18.pdf

Creedy, J., & Kalb, G. (2005). Discrete hours labour supply modelling: specification, estimation and simulation. *Journal of Economic Surveys, 19*(5), 697-734.

Cutler, D. M., & Gruber, J. (1996). Does public insurance crowd out private insurance? *The Quarterly Journal of Economics, 111*(2), 391-430.

Decoster, A., Perelman, S., Vandelannoote, D., Vanheukelom, T., & Verbist, G. (2015). A bird's eye view on 20 years of tax-benefit reforms in Belgium. *EUROMOD Working Paper Series*, 47. Retrieved from https://www.euromod.ac.uk/sites/default/files/working-papers/em10-15.pdf

Dolls, M., Doorley, K., Paulus, A., Schneider, H., Siegloch, S., & Sommer, E. (2017). Fiscal sustainability and demographic change: a micro-approach for 27 EU countries. *International Tax and Public Finance, 24*(4), 575-615.

Figari, F., Paulus, A., & Sutherland, H. (2015). Chapter 24 - Microsimulation and Policy Analysis. In B. A. Anthony & B. François (Eds.), *Handbook of Income Distribution* (Vol. Volume 2, pp. 2141-2221): Elsevier.

Goedemé, T. (2011). How much Confidence can we have in EU-SILC? Complex Sample Designs and the Standard Error of the Europe 2020 Poverty Indicators. *Social Indicators Research, 110*(1), 89-110. doi:10.1007/s11205-011-9918-2

Goos, M., Manning, A., & Salomons, A. (2014). Explaining job polarization: Routine-biased technological change and offshoring. *American Economic Review, 104*(8), 2509-2526.

Hills, J., Paulus, A., Sutherland, H., & Tasseva, I. (2014). A lost decade? Decomposing the effect of 2001-11 tax-benefit policy changes on the income distribution in EU countries. *ImPRovE Working Papers*. Retrieved from https://EconPapers.repec.org/RePEc:hdl:improv:1403

Hoynes, H. W., & Patel, A. J. (2017). Effective Policy for Reducing Poverty and Inequality? The Earned Income Tax Credit and the Distribution of Income. *Journal of human Resources*, 1115-7494R1111.

Immervoll, H. (2004). *Average and Marginal Effective Tax Rates Facing Workers in the EU: A Micro-Level Analysis of Levels, Distributions and Driving Factors*. Retrieved from http://www.oecd-ilibrary.org/social-issues-migration-health/average-and-marginal-effective-tax-rates-facing-workers-in-the-eu_652730151886

Jäntti, M., Pirttilä, J., & Selin, H. (2015). Estimating labour supply elasticities based on cross-country micro data: A bridge between micro and macro estimates? *Journal of Public Economics, 127*, 87-99.

Kalíšková, K. (2015). Tax and Transfer Policies and the Female Labor Supply in the EU. *IZA Discussion Paper Series*, 30. Retrieved from http://ftp.iza.org/dp8949.pdf

Kanbur, R., Keen, M., & Tuomala, M. (1994). Optimal non-linear income taxation for the alleviation of income-poverty. *European Economic Review, 38*(8), 1613-1632.

Kleven, H. J., & Kreiner, C. T. (2006). The marginal cost of public funds: Hours of work versus labor force participation. *Journal of Public Economics, 90*(10-11), 1955-1973.

Marchal, S., & Marx, I. (2018). Stemming the tide: What have European Union countries done to support low-wage workers in an era of downward wage pressures? *Journal of European Social Policy, 28*(1), 18-33.

OECD. (2014). OECD.Stat (database) (Publication no. http://dx.doi.org/10.1787/data-00285-en).

Paulus, A., & Tasseva, I. (2017). Decomposition of changes in the EU income distribution in 2007-2011. *EUROMOD Working Paper Series*. Retrieved from https://www.iser.essex.ac.uk/research/publications/working-papers/euromod/em9-17.pdf

Ravallion, M. (2017). *Poverty comparisons*. New York: Routledge.

Selin, H. (2014). The rise in female employment and the role of tax incentives. An empirical analysis of the Swedish individual tax reform of 1971. *International Tax and Public Finance, 21*(5), 894-922.

Shupe, C., & Bartels, C. (2016, 5 Sep). *Work Incentives in Europe*. Paper presented at the EUROMOD 20th Anniversary Conference, University of Essex, Colchester.

Sutherland, H., & Figari, F. (2013). EUROMOD: the European Union tax-benefit microsimulation model. *International Journal of Microsimulation, 6*(1), 4-26.

Zardo Trindade, L., & Goedemé, T. (2016). Notes on updating the EU-SILC UDB sample design variables, 2012 and 2013. *CSB Working Paper*. Retrieved from http://www.centrumvoorsociaalbeleid.be/index.php?q=publicaties/workingpapers/en

Appendix

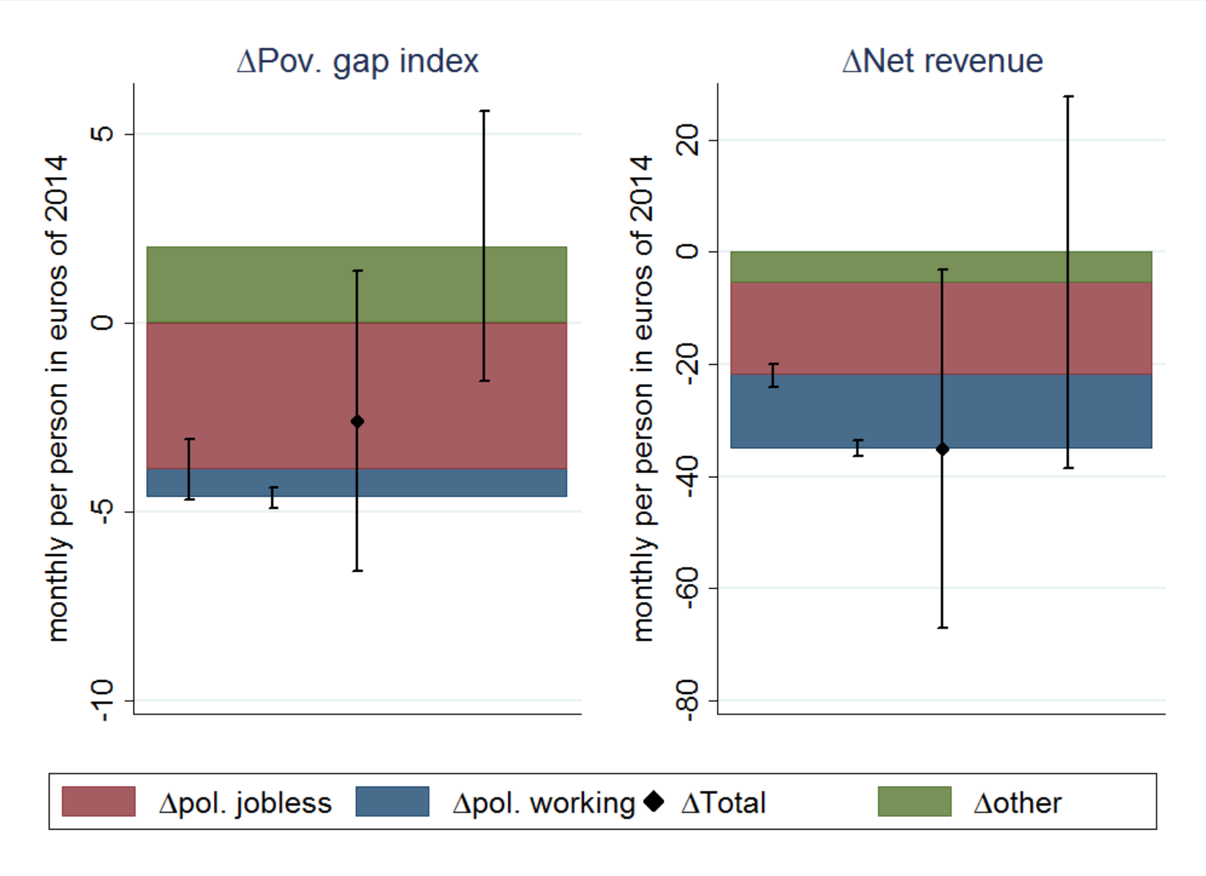
Table A1. Main changes in the parameters of policies

	2005	2006-2005	2007-2006	2009-2007	2011-2009	2014-2011
			Year-year growth			
Wage index	100	3.65	2.47	3.98	4.65	5.91
		Year-year growth in relation to wage index growth				
Unemployment benefits						
Wage limit partner	€384.27	-1.85	-0.64	49.66	13.29	-1.87
Replacement rate single and head months 1 to 6/3	60%	0.00	0.00	0.00	0.00	8.83
Replacement rate cohabitating months 1 to 6/3	55%	0.00	0.00	9.45	0.00	8.83
Max UB months 1 to 6	€2,054.56	-1.65	-0.46	20.06	0.70	9.04
Min UB*	€1,106.70	-1.64	-0.46	4.29	1.43	2.33
Max UB months 6 to 12	€2,054.56	-1.65	-0.46	11.63	0.69	0.21
Social Insurance Contributions						
Base reduction	€125.00	8.35	-0.33	18.39	-4.65	-0.78
Plateau-area limit of reduction	€1,234.23	-3.65	1.56	4.08	-0.61	-1.87
Phase-out area limit of reduction	€1,703.42	15.87	-0.47	2.14	-0.61	-1.86
Exemption from special contribution	€1,549.34	-3.65	-2.47	-3.98	-4.65	-5.91
Social Assistance						
Max social assistance*	€817.77	-1.65	0.55	8.63	-0.61	2.34
Child benefits						
Special supplement for single-parents's first child			€20.00	108.32	-0.62	-1.86
Back-to-school premium 0-5 years old				€25.50	-0.61	-1.88
Back-to-school premium 6-11 years old			€51.00	2.13	-0.60	-1.86
Back-to-school premium 12-17 years old			€71.40	2.14	-0.61	-1.86
Back-to-school premium 18-24 years old				€50.00	54.53	32.83
Income limit for single-parents's social supplements	€1,672.38	-1.65	-2.47	16.83	-0.61	1.81

Note: In the first row, the year-to-year wage index growth is displayed. In the rest of the rows, the growth of each parameter with respect to the growth of the wage index is displayed (e.g. from 2007 to 2009, the upper limit of UBs grew 20.06 percentage points more than the wage index). For replacement rates, we present the difference that changes would have caused to an average wage. In the first column are presented the 2005 monthly parameters (in prices of that year for monetary values). In the rows marked with an asterisk, the monthly parameter corresponds to the minimum and maximum across the categories defined by the policies (for other rows involving categories the growth was the same across them). When policies were implemented in a year after 2005, their initial value is presented in the respective column. Replacement rates with allusion to 3/6 months refer to 6 months except in 2014 when they refer to 3.

Source: EUROMOD

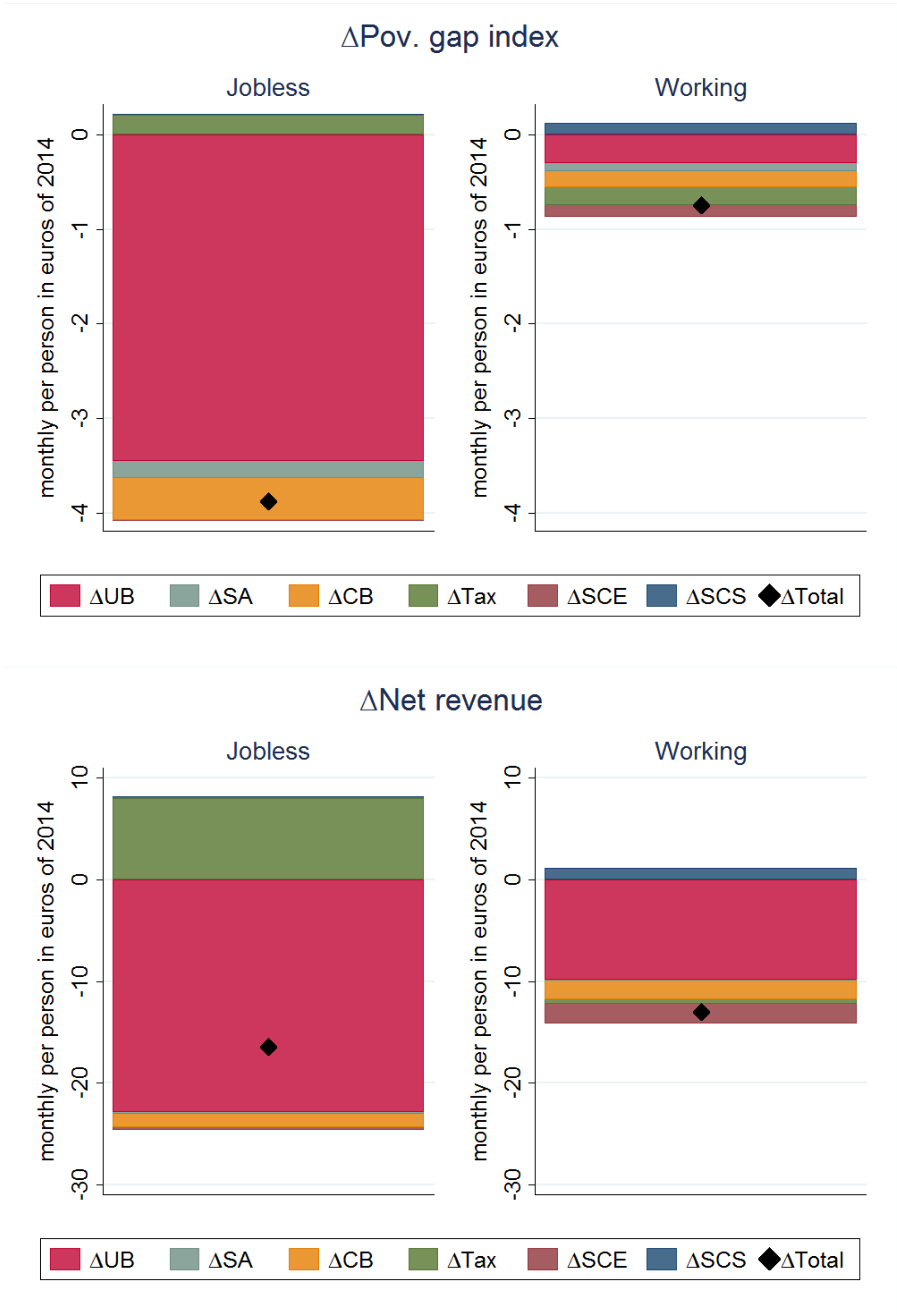
Figure A1. Decomposition of policy and other effects on the poverty gap index and net revenue, 2005-2014



Note: We separate households into the ones with jobless members and the ones where everybody available for the labour market works. 90% confidence intervals. The larger standard errors of the other effects are due to the fact that they are estimated using different survey years.

Source: EUROMOD

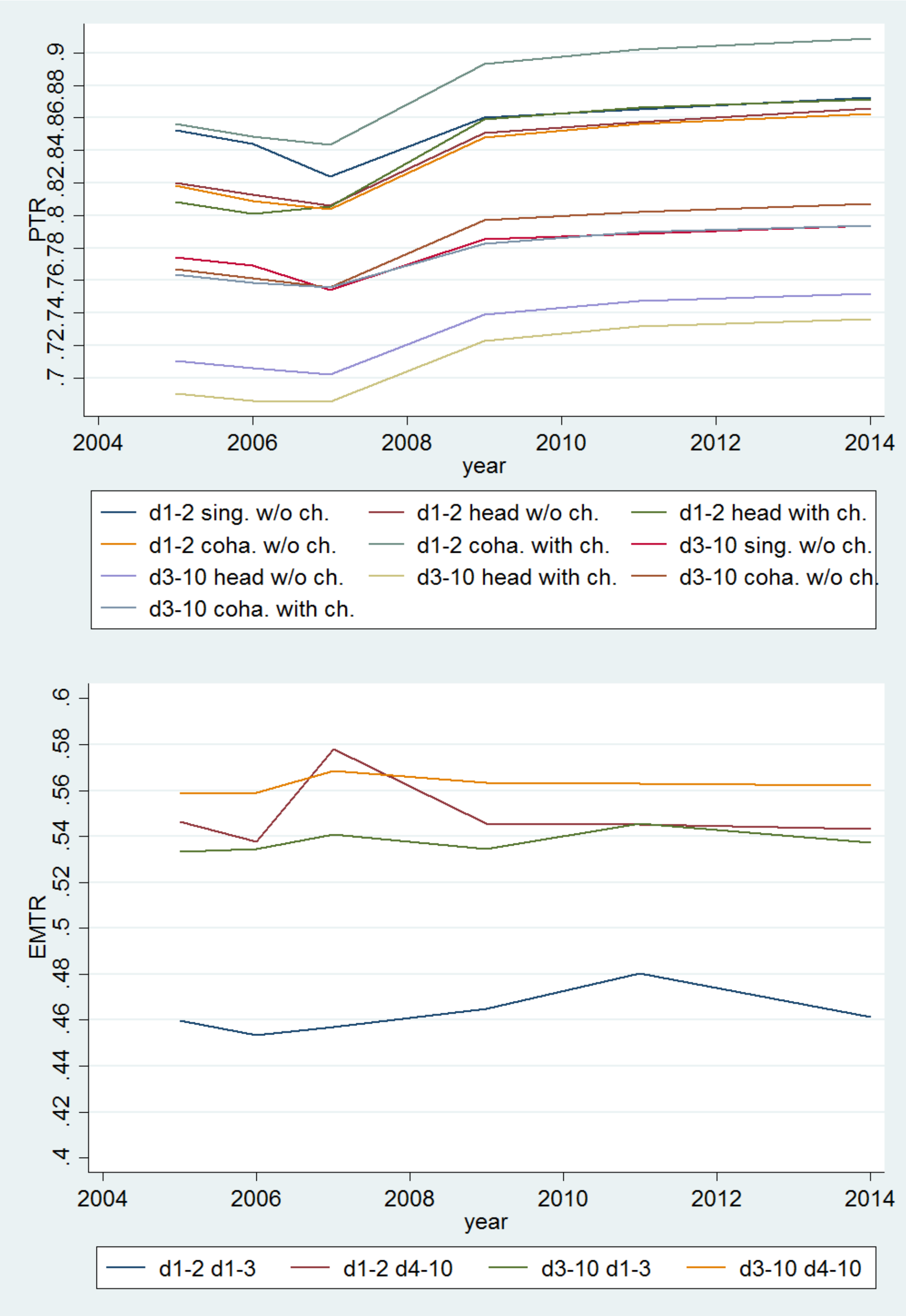
Figure A2. Policy effects on distributional outcomes by tax-benefit component, 2005-2014



Note: UB=unemployment benefit, SA=social assistance, CB=child benefit, SCE=social contribution employee, SCS=social contribution self-employed. We separate households into the ones with jobless members and the ones where everybody available for the labour market works. Although we do not focus on the behaviour of self-employed, we do include some of them as partners of employed people.

Source: EUROMOD

Figure A3. Mean work incentives by groups defined by main policy changes, 2005-2014



Note: FTE earning deciles are divided from 1 to 2 and 3 to 10, while taxable income deciles from 1 to 3 and 4 to 10. sing=single, coha=cohabitant, head=head of household, w/o=without, ch.=children. For EMTRs, people working full-time or more are excluded because the design of SC rebates creates a discontinuity at this point.

Source: EUROMOD

Appendix 1 – Policy descriptions and earnings estimation

Social contribution reductions

SCs generally correspond to 13.07% of gross earnings (so if the person of Figure 1 works 38 hours earning €2000, SC are approximately €260). Reductions to these contributions are calculated based on full-time equivalent (FTE) gross earnings and, given an hourly wage, they are proportional to hours worked up to full-time hours[17]. Below a plateau-area limit workers are entitled to the full base reduction from their SCs. The plateau-area limit was around €1500 in 2014, which is quite close to the minimum wage, while the base reduction was around €183. Above the plateau-area limit, FTE earnings are withdrawn from the base reduction at a given rate until a phase-out-area limit. The withdrawal rate was around 20% in 2014 and the phase-out-area limit around €2395 (this implied a SC reduction of around €85 at 38 hours for the person in Figure 1).

Simulating out-of-work benefits

Unemployment benefits (UBs) are not ready to be simulated in EUROMOD's baseline. And even when activated, they are programmed only for people observed in unemployment and not for 'new unemployed'[18]. We implement a few modifications in both cases. To check the eligibility of new unemployed, we extrapolate the observed months in work, to the previous two years. For UBs amounts, we utilise observed wages (e.g. to apply the replacement rates) when possible and suitable, and otherwise we predict them with models explained below. For work incentive measures and the labour supply model in the extensive margin, UBs in the out-of-work state are calculated using predicted earnings both for employed and unemployed people. This is consistent with the earnings we utilise in the corresponding in-work state. When estimating work incentives in the intensive margin, the UBs of unemployed partners are estimated using observed wages if these partners happened to be employed at the moment of the interview and therefore declared those wages, and otherwise they are predicted. We do the same when estimating the unemployment benefits of people observed in unemployment when generating the distributions for the mechanical decomposition analysis.

By default, social assistance (SA) is simulated for every entitled household assuming a given amount of random non-take up. We do not apply the random non-take up and instead do the following:

- For people observed in unemployment: we only simulate SA if their households are actually taking it up. We make one exception for the counterfactual situation in which an unemployed person works: if when not working she is not receiving SA but UB, when we assume she works we allow her household to take up SA if they are entitled to it.
- For people observed in employment: we only simulate SA in the counterfactual situation in which they work if their households are actually taking it up. In the counterfactual situation in which these people do not work, we assume their households would take up social assistance if entitled to it.

---

[17] This means that SC reductions do not distort financial incentives to work more hours but do distort incentives to work more than full-time (as the rebate does not increase beyond that) and incentives to increase hourly wages.

[18] The following special UBs are not simulated either and instead regular UBs are used. First, if people work involuntarily part-time they can receive an income guarantee connected to their UBs (though instead EUROMOD allows combining earnings and SA). As a reference, the EUROMOD country report shows that part-time employees with income guarantee only amounted to around 6% among the categories that we should simulate. Second, those working part-time voluntarily should receive a 'halved' UB as well. According to our own calculations based on EU-SILC, only around ¼ of people working less than 30 hours did so because they did "not want to work more". Third, the category "temporary unemployed" for people still bounded by a contract while work is temporarily suspended (e.g. because of economic circumstances). Replacement rates are slightly higher and do not decrease over time. According to the EUROMOD country report, among the categories that we should simulate temporary unemployed represented around 20%. Lastly, seniority supplements and UBs after studies. While all these special UBs affect the level of benefits, some constants misestimations are cancelled out when studying *changes*.

Estimating earnings

- We predict log hourly wages using a Heckman selection model. This model controls for sample selection bias given that those currently in work might have unobserved characteristics different from those currently out of work. We partially follow Bargain et al. (2014) in estimating separate wage equations for men and women containing age and experience (including squared terms), education, number of children and number of children below three years old. The extra exclusion variables in the selection equation are other household incomes and the number of children younger than three years old, between four and six, between seven and 12, and between 13 and 17. To improve our estimations, we do not include in the model people with too high/low hours (below 30 and above 70 for full-timers, and more than 36 for part-timers) and with a second job. In EU-SILC, income and employment information refer to the year before the interview, while weekly hours worked to the year of the interview. For this reason we also exclude from the model employed people who changed their job or were not in the same full/part-time regime during the whole year. We impute wages for these excluded employed people based on the same model but using an OLS regression. We also bottom code wages using minimum wages from OECD (2014).
- In relation to hours of work, we assign people to their most likely option among the most common options by gender. Thus, we assume that unemployed and employed men excluded from the previous model work 39 hours. For this type of women we assign them to either 20, 30 or 38 hours of work according to their highest predicted probability using a multinomial logistic model. This model contains the same variables as the selection equation of the Heckman model.