DISCUSSION PAPER

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The distributional effects of tax-benefit policies

A reduced form approach with application to Finland

In this study we describe a procedure to account for behavioral effects in the evaluation of distributional effects of tax-benefit policy changes. Instead of applying a separate behavioral simulation module, we demonstrate how exogenously given behavioral estimates can be employed in the descriptions of distributional analysis. By employing elasticity estimates from relevant literature, behavioral effects on household incomes are assessed both on the intensive and the extensive margin. The method is demonstrated with the Finnish tax-benefit changes that came into force at the beginning of 2020.

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Abstract

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In this study we develop further methods for assessment of policy effects on income inequality with a focus on labor supply responses. Whereas the typical method to account for labor supply responses is through a structural model of discrete choices, we build on the alternative method proposed by Immervoll et al. (2007). Instead of applying a separate behavioral tax-benefit simulation module, we demonstrate how the practitioner can employ exogenously given behavioral estimates in the descriptions of distributional policy analyses. The benefits of the method include transparency and lighter data requirements. Its drawback is that the elasticities are drawn from other geographical and temporal contexts that may differ from the context of application.

Unlike Immervoll et al. (2007), we estimate the effects at the individual level rather than in subgroups. The proposed method builds on previous Finnish studies (Kärkkäinen & Tervola 2018; Kotamäki et al. 2018), but whereas these applications focused on labor supply effects on the extensive margin only (work decision), we extend the method in order to cover intensive margin responses too (labor income). The intensive margin effect on labor income is estimated by utilizing the elasticity of taxable income and the change of effective marginal tax rate. At the extensive margin we utilize the elasticity of participation and the participation tax rate. The extensive margin changes are applied by adjusting unemployment spells.

The method is demonstrated with the Finnish microsimulation model SISU and the Finnish tax-benefit changes that came into force in the beginning of 2020 before the Covid19 outbreak. The analyzed policy changes include the 50 euro increase in minimum pensions and the 10-30 increase in unemployment benefits.

The analyzed policy reforms diminished income inequality as well as incentives to work. Gini coefficient decreased by 0.3 percentage points and at-risk-of-poverty rate by 0.6 percentage points. These results remain unchanged when the estimated behavioral responses are included. Although behavioral effects on income inequality are less pronounced, we estimate that the policy changes extended unemployment spells by approximately 5,500 person-years. At the intensive margin, the changes in incentives are estimated to yield a 140 million euro decrease in gross labor income. All in all, the behavioral effects nearly doubled the negative fiscal effect of the policy changes in the baseline scenario.

Because the simulated effects are highly uncertain, we run several robustness checks regarding the operationalization of policy changes, the level and variance of elasticities as well as the income threshold for calculating the effective marginal tax rate. Overall, the policy effects on income inequality in this context are quite robust regardless of the specifications but the effects on employment and fiscal budget vary.

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Keywords: Income inequality, incentives to work, microsimulation, tax-benefit system

Tiivistelmä

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Tässä tutkimuksessa kehitämme menetelmää, jolla voidaan arvioida vero- ja etuusjärjestelmän muutosten vaikutuksia tuloeroihin huomioimalla muutosten aiheuttamia käyttäytymisvaikutuksia aiempaa monipuolisemmin. Tutkimuksessa hyödynnämme aiemmassa kirjallisuudessa arvioituja työn tarjonnan joustoja ja esittelemme, kuinka näitä voidaan hyödyntää politiikka-arvioinneissa ilman rakenteellista työn tarjonnan mallia. Tutkimuksessa käyttäytymisvaikutuksia arvioidaan sekä ekstensiivisellä (työntekopäätös) että intensiivisellä marginaalilla (työn määrä). Verrattuna rakenteellisella työn tarjonnan mallilla tehtyihin arvioihin menetelmämme etuna ovat muun muassa sen läpinäkyvyys ja kevyemmät aineistovaatimukset. Toisaalta muissa konteksteissa estimoidut joustoestimaatit voivat erota jonkin verran siitä, mitä ne olisivat tutkimuskontekstissa.

Menetelmämme pohjautuu Immervollin ym. (2007) kehikkoon sillä erotuksella, että estimoimme käyttäytymisvaikutukset yksilö- eikä ryhmätasolla. Menetelmämme rakentuu myös aiemmille suomalaistutkimuksille (Kärkkäinen & Tervola 2018; Kotamäki ym. 2018), jotka ovat keskittyneet ekstensiiviseen marginaaliin. Tässä tutkimuksessa muutokset käyttäytymisessä intensiivisellä marginaalilla huomioidaan muuttamalla bruttotyötuloja. Vaikutuksen suuruus arvioidaan hyödyntämällä aiempiin tutkimuksiin perustuvaa verotettavan tulon joustoparametria sekä simuloituja muutoksia työnteon taloudellisissa kannustimissa, joita mittaamme efektiivisellä marginaaliveroasteella.

Ekstensiivisellä marginaalilla käyttäytymisvaikutus arvioidaan käyttämällä osallistumisjoustoa ja kannustimia mittaamme työllistymisveroasteella. Ekstensiivisellä marginaalilla käyttäytymisvaikutukset arvioidaan muuttamalla työttömyysjaksojen pituutta, mikä muistuttaa Kotamäki ym. (2018) käyttämää menetelmää.

Sovellamme menetelmää SISU-mikrosimulointimallia käyttäen vuoden 2020 alussa voimaanastuneisiin politiikkamuutoksiin. Laskelma ei siten ota ollenkaan huomioon koronaepidemiaan liittyviä muutoksia työllisyystilanteessa tai lainsäädännössä. Suurimmat muutokset olivat vähimmäiseläkkeiden nosto noin 50 eurolla sekä työttömyysetuuksien korotukset 10–30 eurolla.

Politiikkamuutoksilla oli selvä tuloeroja kaventava vaikutus. Gini-kertoimella mitattuna tuloerot pienentyivät 0,3 prosenttiyksikköä ja pienituloisuusaste laski arviolta 0,6 prosenttiyksikköä. Nämä tulokset pysyvät muuttumattomina, kun huomioidaan muutosten aiheuttamat käyttäytymisvaikutukset. Vaikka käyttäytymisvaikutukset eivät näy tuloeroissa ne näkyvät pienillä muutoksilla työllisyydessä ja kokonaisbudjetissa. Politiikkamuutokset pidensivät työttömyysjaksoja arviolta noin 5 500 henkilötyövuodella. Myös intensiivisellä marginaalilla työnteon kannustimet pääosin pienentyivät ja tästä johtuen arvioimme bruttotyötulojen pienentyneen noin 140 miljoonalla eurolla. Kaiken kaikkiaan käyttäytymisvaikutukset kaksinkertaistivat negatiivisen budjettivaikutuksen.

Arvio on tehty simulointimenetelmällä, johon liittyy suuria epävarmuuksia ja tuloksiin on syytä suhtautua varoen. Siksi esitämme tutkimuksessa useita tarkistuslaskelmia eri oletuksilla: määrittelemme politiikkamuutokset eri tavoin, kokeilemme eri joustotasoja sekä perhetilanteen ja sukupuolen mukaan vaihtelevia joustoja sekä eri tuloaskelmia efektiivisen marginaaliveroasteiden laskelmissa. Vaikutukset tuloeroihin pysyvät melko muuttumattomina eri oletuksilla, joskin vaikutukset työllisyyteen ja budjettiin vaihtelevat.

Talouspolitiikan arviointineuvosto on rahoittanut tutkimuksen tekemistä. Tämä työpaperi on julkaistu myös talouspolitiikan arviointineuvoston vuoden 2020 raportin taustaraporttina.

Avainsanat: Tuloerot, sosiaaliturva, työnteon kannustimet, mikrosimulointi, vaikutusarviointi

Content

1 Introduction

Distributional analyses of tax-benefit policies are becoming a routine task of national budget announcements. The calculations are still, however, mostly non-behavioral although tax-benefit changes are known to spur behavioral changes for example in labor supply.

The present study demonstrates a way forward for the public policy analyst to apply reduced form evidence in descriptions of behavioral effects of tax policy changes. Instead of using an estimated structural model to simulate accompanying behavioral effects of tax policy changes, we show how exogenously given elasticity estimates can be applied in practical work. This evidence stems from quasi-experimental econometric work, covering both the extensive margin (decision to work) and the intensive margin (amount of work) of labor supply. There are at least two reasons for adopting this empirical strategy. First, the practitioner may prefer to employ reduced form evidence since it has been raised concern about the ability of structural models to generate robust predictions about the effects of policy changes, see for example LaLonde (1986) and Imbens (2010). As models may be too stylized or may suffer from misspecification, predictions of effects may not always be trustworthy. Second, it is acknowledged that establishing a fully structural model tool also is more demanding with respect to data and econometric work.

In this article we demonstrate a transparent way to include labor supply effects in distributional analyses that can be applied without the need for a structural labor supply model. We build on the specification proposed by Immervoll et al. (2007). We apply external elasticity estimates on labor supply responses and demonstrate how these can be combined with simulation results from a non-behavioral microsimulation model. However, unlike Immervoll et al. (2007) we apply the method at the individual level rather than on aggregated subgroups. This enables us to provide more accurate descriptions of distributional effects of tax changes.

We demonstrate the empirical framework by addressing changes in the tax-benefit policies of Finland in early 2020. Thus, this study resembles the work of the tax-benefit policy analyst, setting out to describe how one can proceed to derive information about effects of adjustments of tax-transfer schedule from one year to another. The proposed method builds on previous Finnish studies (Kärkkäinen & Tervola 2018; Kotamäki et al. 2018), but whereas these applications focused on labor supply effects on the extensive margin only, we extend the method to cover intensive margin responses too. The intensive margin changes are applied by adjusting gross labor income (Saez et al. 2012) and the extensive margin changes by adjusting unemployment spells, which resembles the method used by Kotamäki et al. (2018).

We demonstrate the method with Finnish tax-benefit changes that came in to force at the beginning of 2020. The most notable changes include increases of multiple social benefits as well as tax credits, however, without any major reform. The simulations are based on administrative micro data that represents Finnish population at the end of 2017. Therefore, COVID-19-related changes in employment structure or social benefits are excluded. Finnish national tax-benefit microsimulation model SISU (Statistics Finland 2020b) is used to calculate the non-behavioral effects. The module calculating the behavioral effects is built on the side of SISU.

The rest of the paper is constructed as follows: Section 2 describes the estimation of work incentives and employment effects. Third section presents the context of the application: SISU simulation model, the data and policy changes analyzed. Section 4 shows the results and the final section is for conclusions.

2 Evaluation of behavioral effects

Although several informative surveys have recently been produced, see Blundell & Macurdy (1999), Keane (2011), Saez et al. (2012) and Chetty et al. (2013b), it is not easy to obtain a clear and convincing picture of how taxpayers respond to economic incentives such as changes in wages and tax systems. Elasticities are derived in from static frameworks, referred to as steady-state elasticities (Chetty et al. 2013b) and from various types of life-cycle models. They are obtained from macro and micro data, and the empirical evidence may come from quasi-experimental studies and as well as from estimations based on structural models.

With respect to structural modeling it adds to the complications that there exists no clear consensus on how structural labor supply models should be built. Moreover, despite some studies employing similar modeling frameworks, the data used to estimate and test the models sometimes vary substantially. Some studies apply single cross-section micro data, others use panel data and yet some use macro data. Discrete choice models of labor supply based on stochastic utility theory have gained widespread popularity, mainly because they are much more practical than the conventional continuous approach based on marginal calculus (see the survey by Creedy & Kalb 2005).

Here we draw attention to how external estimates of the elasticities of participation and taxable income can be used in practical work. We build on the method demonstrated by Immervoll et al. (2007). Instead of estimating behavioral effects on subgroups such as income deciles, the identification strategy is based on individual-level information. For that purpose, we predict individual wage rates, which are obtained through linear wage regressions. Further, we use individual changes in work incentives both at extensive and intensive margin. Thereafter, the extensive and intensive margin behavioral responses are estimated by adjusting individual unemployment spell and gross labor incomes of the individual.

Work incentives at the extensive margin are measured with the participation tax rate (PTR) and work incentives at the intensive margin with the effective marginal tax rate (EMTR). We assume that the unemployed react to the change in PTR and the individuals with positive labor income (excluding entrepreneur income) respond to EMTR. The unemployed here include those individuals who receive unemployment or cash-for-care benefits during the data year. For individuals receiving both unemployment benefits and labor income during the year, behavioral effects are calculated at both margins independently. Individuals without labor income and not classified as unemployed are assumed to not to react to changes in work incentives.

There are a few caveats to our analysis. First, work incentives are estimated at the individual level, which requires truncation of outliers to produce sensible results. Also, it may very well be that some households make their work decisions as one unit and therefore the estimation of individual work incentives may be misleading. The individual level analysis was chosen for simplicity reasons and alternative specifications should be tested in future.

Another critical question of the present study is the time frame for the behavioral responses. The potential duration of benefits is often limited by the legislation. Unemployment insurance benefit, for example, has limited potential duration after which the benefit level decreases substantially. Some recent papers have addressed this issue. Bartels & Pestel (2016) and Jara et al. (2017) calculate the short-term and long-term PTRs and find that long-term PTRs are substantially lower than the short term PTRs, as the income support often is reduced with respect to time. Therefore the short term PTRs might overestimate the disincentives created by the tax-benefit-system. On the other hand, the employment decision affects, for instance, one's pension level and wage development in the long run. Many previous analyses of work incentives rely on a time frame of one year (e.g. Immervoll et al. 2007), but there are exceptions. Kotamäki et al. (2018), for example, estimate work incentives with two year window, which corresponds to the analyzed maximum duration for unemployment insurance benefit. In this article, we choose to analyze work incentives in one year window.

2.1. Participation tax rate and employment decision

Calculating PTR requires information on individual income level in two positions: as full-time unemployed and full-time employed. Both positions cannot be observed simultaneously and therefore simulations are needed. For that purpose individual wages are predicted through linear wage regression. Individual characteristics such as age, sex, marital status, education level, occupation, the ages of children, dwelling region, work history, months of unemployment during the year and existing debts are used to predict log-transformed wages.[4] The resulting wage predictions are used for both the employed and unemployed. To prevent unrealistically low predicted wages we use minimum wage of 1 450 euro per month.

PTR is calculated as follows:

$$PTR = 1 - \frac{c(\widehat{w}) - c(0)}{\widehat{w}} \tag{1}$$

where $w\hat{}$ is the predicted wage, $c(w\hat{})$ is the household disposable income when employed and $c(0)$ is the household disposable income when unemployed. When employed, the disposable income is a function of the predicted wage, taxes, possible income-tested in-work benefits and possible day care fees. When unemployed, the disposable income contains net unemployment benefit or cash-for-care benefit and other transfers, such as housing benefit and social assistance. The unemployed are assumed to care for their children at home and therefore no day care fees are deducted.

After calculating PTRs with the start and end point legislation, we can estimate the employment effect, ΔF on the macro-level with the following formula (see e.g. Immervoll et al. 2007):

$$\Delta F = \eta \frac{\Delta(1 - \overline{PTR})}{1 - \overline{PTR_0}} * F_0 \tag{2}$$

where $\overline{PTR_0}$ is the average PTR in the work force at the start point, $\Delta(1 - \overline{PTR})$ is the average change in the net-of-tax rate, η is an externally chosen participation elasticity parameter and F_0 is the number of the employed at the start point in person-years. In the analysis, the employment effects are calculated separately for those with decreased ($\Delta PTR < 0$) and increased ($\Delta PTR > 0$ participation tax rates according to the reform.

To obtain distributional employment effects the macro-level effect must be transferred to individuals. For that purpose, we determine those individuals who become employed or unemployed. In economic literature the effect of benefit level on unemployment is typically represented by unemployment duration (see Tatsiramos & van Ours (2014) for a survey). Immervoll et al. (2007) use heterogeneous elasticities by income deciles and demographic groups to target the employment effect on the unemployed that are concentrated on low-income groups. However, at least in Finland, there are many unemployed also in high-income deciles (Statistics Finland 2020a). In addition, long-term unemployed in lower deciles are actually observed to have lower elasticities (Lalive et al. 2006; Uusitalo & Verho 2010). Therefore, we argue that a more accurate way to target the employment effect at the extensive margin is to adjust the observed unemployment spells (or more accurately, the number of unemployment days during the year). In other words, if one's participation tax rate increases, his/her unemployment spell is extended and vice versa.

The changes in incentives can vary substantially at the individual level which can be expected cause variation in behavioral effect. Therefore, to get more precise distributional effects we weight each individual according to their individual incentive change. Formally the weight of an individual i is defined as:

$$w_i = \frac{\Delta\,(1 - PTR_i)}{1 - PTR_{i0}} \Big/ \frac{1}{n} \sum \frac{\Delta(1 - PTR_i)}{1 - PTR_{i0}} \tag{3}$$

[4] See Appendix A for the model specification and the estimated coefficients.

The individual extended (or shortened) unemployment spell is then calculated with the following formula:

$$U_{1i} = \left(1 - \frac{\Delta \mathrm{F}}{\sum U_0}\right) * w_i * U_{0i} \quad (4)$$

where U_{0i} is the observed unemployment spell of individual i in the data and $\sum U_0$ is the "reserve" of unemployment spells in the sub-population where the unemployment effect is calculated. Because of the restriction to one year time frame, all new unemployment spells U_{1i} are restricted to the maximum of one year. Therefore, an iterative loop is applied that extends employment spells up to one year until the macro-level employment effect ΔF is reached. This is in line with Lalive et al. (2006) and Uusitalo & Verho (2010), where the behavioral effect is observed to be stronger among short-term employed.

2.2. Effective marginal tax rate and labor income

We measure the financial incentives to work at the intensive margin with the effective marginal tax rate (EMTR). It is defined as the percentage of extra income is lost due to tax increase and benefit withdrawal. Formally, it is defined as:

$$EMTR = 1 - \frac{c(I+s) - c(I)}{s} \quad (5)$$

where $c(I)$ is the disposable household income with gross labor income I and s denotes the extra unit added to the earnings.

We calculate the EMTRs for individuals aged between 18 and 68, who receive labor income. Again, as we calculate incentives at the individual level, the calculation of $c(I+s)$, is done separately for household head and his/her partner. The extra unit of income, s, is set to 1 200 euro per year, but we run robustness checks with the higher unit of 6 000 euro per year.

After obtaining the EMTRs with both base and end year legislation, we can estimate the effect on taxable income, ΔTI, on the individual level. We follow Saez et al. (2012) and estimate the change in taxable income as:

$$\Delta TI_i = \varepsilon \frac{\Delta(1 - EMTR_i)}{1 - EMTR_{0i}} TI_i \quad (6)$$

where ε is the elasticity of taxable income, TI_i is the individual's taxable income which in our specification is restricted to gross labor income (excluding benefits and capital income). $EMTR_{0i}$ is the effective marginal tax rate with the base year legislation and $\Delta(1 - EMTR_i)$ is the change in net-of-tax rate for individual.

Finally, we add the calculated change in taxable income to individual's original taxable income and simulate once again the taxes and benefits to obtain the net effect on disposable income.

2.3. Labor supply elasticity estimates

The elasticities of participation (extensive margin) and taxable income (intensive margin) are the key parameters of our study. We do not estimate these parameters but use elasticities obtained in the literature, which is shortly reviewed in this section. The next subsection provides an overview of the earlier literature, whereas the last two subsections discuss the literature of each margin separately.

2.3.1. Earlier literature

One important avenue of research is based on structural steady-state approaches, which neglect the intertemporal aspects of optimization. In this approach the individual agent is assumed to have preferences over total consumption and leisure and to maximize utility under the economic budget constraint determined by the wage, non-labor income and the tax system. The so-called Hausman approach (Burtless & Hausman 1978; Hausman 1981) departs from a linear labor supply function to handle piece-wise linear budget constraints. Estimations are carried out both with positive and zero working hours, which means that estimates for both intensive and extensive margin can be obtained. Moreover, the extensive margin of labor supply was theoretically strengthened by the introduction of the fixed cost of work by Cogan (1981).

Estimation of structural labor supply model associated with the Hausman approach is often complicated, in particular when departing from the linear specification. The post-Hausman literature includes two lines of research which can be considered as replies to the complexities of the Hausman model. First, discrete choice models of labor supply based on stochastic utility theory have gained widespread popularity, mainly because they are much more practical than the conventional continuous approach based on marginal calculus (van Soest 1995; Creedy & Kalb 2005; Dagsvik et al. 2014). The discrete approach differs from the corresponding continuous one (as in the model by Hausman) because the set of feasible hours of work is approximated by a suitable finite discrete set. With the discrete choice approach, it is easy to deal with non-linear and non-convex economic budget constraints, and to apply rather general functional forms of the utility representation. From a theoretical perspective, however, the conventional discrete choice model is similar to the standard textbook approach to labor supply in that it is essentially a version of the theory of consumer behavior. With particular distributional assumptions about the stochastic disturbances in the utility function one can derive tractable expressions for the distribution of hours of work, such as the multinomial or the nested multinomial logit model. Elasticity estimates are conventionally obtained by simulations, for example measuring working hours when all before-tax wages are increased by 1 percent or 10 percent.

The second branch of literature utilizes tax reforms in order to identify labor supply responses. In particular, after an initial contribution by Feldstein (1995), a large literature has developed estimating the elasticity of taxable income (ETI) with respect to marginal tax rates using tax return data before and after a major change in the tax schedule (tax reform) in the identification of effects. Saez et al. (2012) survey this literature which has two main differences compared to the earlier literature. First, instead of using working hours, it uses taxable income as an outcome. Therefore, it has been argued that results seize all the policy relevant behavioral adjustments of a tax change at the intensive margin. Second, econometric identification is often based on a simple difference estimation method comparing reported incomes before and after a tax reform, attributing the change in reported incomes to the changes in tax rates and exploiting the fact that tax reforms often affect subgroups differently. The latter means that one can use difference-in-differences estimator by having the group less (or not at all) affected by the tax change as a control and proxy unobserved income changes in the affected group (absent the tax reform) with changes in reported income in the control group. This framework has also been utilized to obtain tax responses from reforms in a number of countries. However, compared to the structural approach, results are to larger extent dependent on the data used in the estimation; they are “history dependent” in the sense that responses reflect the actual tax reform used to obtain identification. This means that the external validity, i.e. the relevance of estimates for the development of new policies, can be limited.

Finally, some argue that tax elasticity estimates should preferably be derived from macro data instead of micro data, see for example Mertens & Montiel Olea (2018). With reference to the quasi-experimental literature, surveyed in Saez et al. (2012), they obtain both short-run (steady-state) and long-term elasticity estimates. Crucially, results are derived from macro data (aggregate data) over a number of tax reforms in post-war U.S. and macro econometric techniques are used in the identification. The elasticity estimates are clearly larger than most estimates of the conventional ETI literature based on micro data, which is explained by additional efforts to control for dynamics, such as expectations and endogeneity of tax policies.

2.3.2. Elasticity of participation

The empirical literature of extensive margin elasticities has shown that the behavioral labor supply responses differ between population groups (see Meghir & Phillips 2010 for a review). Women and individuals with lower incomes or lower level of education have higher elasticities compared to men and individuals with high incomes or higher level of education. Elasticities also differ with respect to having children and cohabiting status with varying implications by gender. However, the literature is not unanimous regarding the actual level of the participation elasticity.

In a recent survey, Lundberg & Norell (2020) conclude that the population-level participation elasticity is likely to be below 0.36 and their preferred estimate lies between 0.1 and 0.2. This is somewhat in line with earlier literature reviews based on micro evidence (see Chetty et al. 2011b; 2013b), which conclude of using Hicksian elasticity of 0.25 for extensive margin and 0.3 for the intensive margin. However, evidence from macro data suggests larger elasticities. For instance, Keane & Rogerson (2012) argues that the total labor supply elasticity is between 1 and 2. Similarly, some studies analysing the 1993 EITC reform in the USA find significant labor supply reactions (see Hotz 2003, Eissa & Hoynes 2006 and Nichols & Rothstein 2015 for reviews) but these estimates have been recently questioned by Kleven (2019). Kleven finds that the large labor supply reactions are mostly due to confounding factors occurring at the same time with the reform. Respectively, Chetty et al. (2013a) finds that taking into account the differences in awareness of EITC the elasticity is diminished to 0.2. Fairly low values of elasticity have been estimated in recent European studies as well. Bastani et al. (2020), for instance, utilises the 1997 housing allowance reform in Sweden and estimates an average participation elasticity of 0.13 for married women. Similarly, Martinez et al. (2018) analyses tax reform in Switzerland and does not find any labor supply reactions at the extensive margin.

There are also few studies situated in Finland. Jäntti et al. (2015) estimates an average participation elasticity of 0.17 with very similar estimates for males (0.173) and females (0.163). Evidence from the Finnish basic income experiment (Kangas et al. 2020) supports low elasticity even though the study could not produce exact estimate. Also, Uusitalo & Laine (2001), Bargain & Orsini (2006) and Bargain et al. (2014) estimate rather small elasticities of participation. Depending on marital status their elasticity estimates range from 0.12 to 0.26 for women and from 0.10 to 0.34 for men. However, Kosonen (2014) estimates a large participation elasticity of 0.8 for mothers with small children.

Based on the literature reviewed above, we decide to use participation elasticity of 0.2. It is also in line with the recent survey by Lundberg & Norell (2020) and very close to the estimated elasticity for Finland in Jäntti et al. (2015). In addition, it is consistent with the elasticity estimate in intensive margin, which allows easier comparisons. However, we run robustness checks with the participation elasticities of 0.1 and 0.3. Finally, we add heterogeneity in participation elasticity by gender and the age of the youngest child to test the robustness of our finding (see Appendix B.4 for full details).

2.3.3. Elasticity of taxable income

In a recent meta-analysis, Neisser (2017) finds that most of the estimates for ETI vary from 0 to 1 with a high concentration around 0.3. Similarly, Saez et al. (2012) conclude that the best available estimates of the long-run elasticity range from 0.12 to 0.4, which is likely smaller than in the short-term. Elasticities estimated using macro data are usually higher than those obtained with micro data. Mertens & Montiel Olea (2018), for instance, obtain short-run elasticities of around 1.2 based on time series from 1946 to 2012.

In the Finnish context, Matikka (2018) ends up in an elasticity of 0.21 by exploiting the variation in municipal taxation. Results from other Nordic countries are somewhat similar to Matikka's findings. Kleven & Schultz (2014) studies several Danish tax reforms and finds an average estimate of 0.12. Chetty et al. (2011a) also uses Danish data and does not find strong labor supply responses. With a Norwegian data, Thoresen & Vattø (2015) estimates elasticity less than 0.1. Blomquist & Selin (2010) studies Swedish tax reforms and their estimates for the elasticity ranges between 0.19 and 0.21 for males and for females between 0.96 and 1.44.

Our choice for the elasticity of taxable income is 0.2, which is very close to the estimate obtained by Matikka (2018). Again, we also use elasticities of 0.1 and 0.3 to check the robustness of our results but unlike for the elasticity of participation, we do not add variation by subgroups in ETI. Our choice for the intensive margin elasticity is also partly driven by our choice for the extensive margin elasticity.

3 The context of application

The method presented in Chapter 2 is applied to the context of Finland and its policy changes that came into force in the beginning of 2020. The data, microsimulation model and policy changes are depicted below in more detail.

3.1. SISU data and microsimulation model

The policy effects are estimated with the tax-benefit microsimulation model of Finland, SISU (Statistics Finland 2020b). The model is maintained by Statistics Finland and it is used widely by ministries, universities and governmental research institutes.

The model is based on extensive register data that is compiled for a random population sample of approximately 800,000 individuals i.e. 15% of the Finnish population at the end of 2017. The model itself is a standard non-behavioral microsimulation model. However, extensions to behavioral estimation have been made by individual research groups (Kotamäki et al. 2018; Kärkkäinen & Tervola 2018).

3.2. Studied policy changes

We demonstrate the method with tax-benefit policy changes that took force in Finland from the beginning of 2020. The changes can be summarized as modest increases in social benefits and both increasing and decreasing changes in taxation. The changes are listed in more detail below.

3.2.1. Changes in social benefits

The most notable changes in benefits from incentive-perspective were the increases of unemployment benefits. Basic unemployment benefit and labor market subsidy was increased by 20 euro per month (+4%) and earnings-related unemployment benefits by 10-30 euro per month. The higher benefit amounts (after a certain threshold) were increased by 30 euro and lower amounts by 10 euro per month.

The so called activation model of unemployment benefits was abolished. Having been in force only since 2018 its purpose was to activate the unemployed by cutting the unemployment benefits of passive individuals by 4.65 percent, which accounts one working day per month. The activity condition could be fulfilled, not only by working (more than 18 hours a month), but also by participating in ALMP measures. Therefore the effect of the activation model on work incentives is ambiguous. In addition, its effect on employment could not be estimated (Kyyrä et al. 2019). Consequently, the activation model is ignored in this study when calculating PTR and EMTR changes but it is accounted for in the non-behavioral simulations. Because activation model legislation is not included in the SISU model, it has been added manually. The incidence of benefit reduction is calibrated to equal unemployment benefit statistics in 2019 (FIN-FSA 2020) with the same individual targeting method that Tervola (2019) uses.

There were also changes which hardly altered work incentives but had non-behavioral distributional effects. Most importantly the minimum pension benefits, i.e. guarantee pension and national pension, were increased by max. 50 euro per month. The housing benefit for pensioners was also increased respectively and the minimum levels of sickness and parental benefits were increased by 20 euro per month. However, the increase in the minimum sickness benefit is not taken into account in the simulation because of data restrictions.

The child benefit for the 4th and 5th child and for single parents was increased and the social assistance for single parents was increased respectively. Finally, study grants were tied to the national pension index and they were increased accordingly. In addition to the changes listed above, most social benefits were increased according to automatic index adjustments.

3.2.2. Changes in taxation

There were several changes in taxation causing a tax increase for some and a decrease for others. Among the tax cuts were the increases of tax credits, such as the earned income tax credit and the low income tax allowance. In addition, income limits for the earned income tax schedule were increased approximately by 3 percent. There were also several tax increases. Most notably, the (income-weighted) average municipal tax rate increased by 0.09 percentage points from 19.88 to 19.97 percent. In addition, the amount of domestic help credit and the tax deduction of mortgage interest payments were decreased.

Some of the contribution payments were increased and some were decreased. The mandatory pension contribution payment was increased by 0.4 percentage points and medical care contribution of wage earners by 0.68 percentage points. On the other hand, unemployment insurance contribution was decreased by 0.25 percentage points and daily allowance contribution for wage earners by 0.36 percentage points.

3.2.3. Operationalization of policy changes

Measuring the level of a policy change is not a straightforward issue and it can be carried out in multiple ways. The central challenge is that different policies are implemented at different temporal contexts. Crucial dimensions such as population structure, price levels or wage levels may have changed simultaneously with the policies. How much these exogenous changes should be taken into account, is under dispute.

The contextual changes can be taken account by nowcasting the data or by adjusting the monetary legislation parameters such as benefit levels and tax schedules. Generally three adjustment methods have been used: 1) adjustment with wage index, 2) adjustment with customer price index, 3) no adjustments at all but analysis of the effects of juridical changes in contrast to ’no juridical changes’.

Perhaps the most popular way has been 1) adjustment with wage index (see e.g. Bargain & Callan 2010; Honkanen & Tervola 2014). In this option benefit levels and tax schedules are adjusted by the development in the average wage. This means that if benefit levels do not follow the average wage level, they are interpreted as decreasing. In Finland, most benefit levels are juridically tied to price index, so they automatically tend to fall behind wage index, given that wages grow faster than prices. Tax schedule in turn is not juridically tied to any index but adjusted "manually", typically according to the predicted increases in wages. Therefore, option 1) may exaggerate the deterioration of benefit levels but option 2) may exaggerate the effects of index adjustments of tax cuts. The choice between consumer price and wage indexation has been examined e.g. in Paulus et al. (2020).

Option 3) defines policy changes from different angle than the previous two. It focuses on the actual legislative changes and ignores automatic index adjustments or the lack of them. Therefore, it considers changes from purely juridical perspective without any deflation parameters. Counterfactual is defined as the policies and benefit levels that would have took place without any legislative changes. Because the Finnish tax schedule is not juridically tied to any index but benefit levels are, index adjustment of tax schedule is considered as a policy change whereas index adjustments of benefit levels are not. This likely yields more positive results from an incentive-perspective than the options 1) and 2). Previous applications of option 3) can be found in Kärkkäinen & Tervola (2018) and Browne & Elming (2015).

Economic theory does not to give a unequivocal answer to which operationalization is better than another. We will, therefore, present the main results with adjusted by the consumer price index, which is the middle option of these all. However, we also show sensitivity analysis with the other two specifications.

4 Results

First we provide the results on work incentives and consecutive employment effects. Thereafter, we present the effects on income distribution. Unless stated otherwise, all calculations are conducted with the baseline specification: Monetary parameters are adjusted according to the consumer price index, elasticities are set to a constant value of 0.2 for both the extensive and intensive margins and EMTR is calculated by an increase of 1200 euro per year. Results of various robustness checks are discussed throughout the section and the full details are presented in Appendix B.

4.1. Changes in financial incentives to work

4.1.1. Extensive margin

Figure 1 shows the distribution of simulated participation tax rates with the legislations of 2019 and 2020. For both years the majority of PTRs are concentrated around the 70% mark, which is little larger than the mean of all observation (66%). Moreover, the changes in tax-benefit-legislation have mainly increased PTRs from 2019 to 2020, i.e. decreased the financial incentives to work. On average the change is 0.5 percentage point and it is rather uniformly distributed across the different levels of the PTRs.

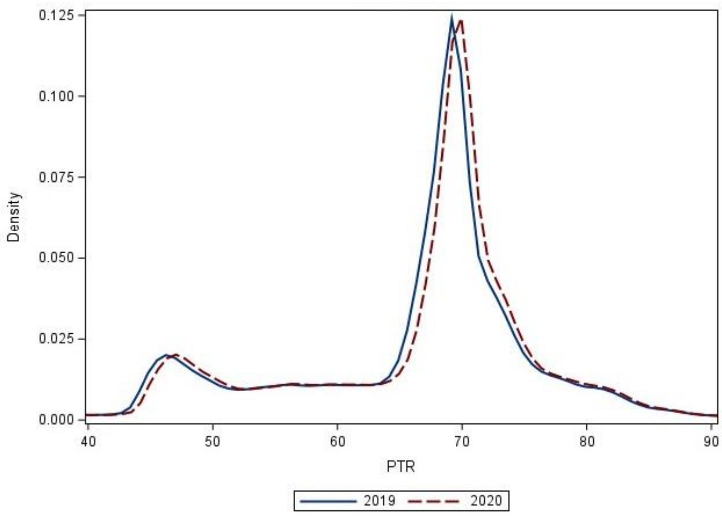

Figure 1. Kernel density distributions of participation tax rates simulated with the legislations of 2019 and 2020.

Variation in PTRs is mainly caused by variation in the level of potential benefit package when unemployed. Therefore, Table 1 shows the mean PTRs in 2019 and 2020 by receipt of different benefits or being employed. Not surprisingly, individuals receiving earnings-related unemployment benefit face highest PTRs (69.3% in 2019) and the lowest ones are for individuals receiving home care allowance (54.8% in 2019). Recipients of flat rate unemployment benefit have average PTR of 62.7% (in 2019) and the employed have PTRs of 66.6% (in 2019).

Table 1. Average participation tax rates by legislation year and benefit receipt.

	Frequency	PTR 2019, %	PTR 2020, %	Change, pp
Flat-rate UB	280 000	62.7	62.9	+0.1
Earnings-related UB	270 000	69.3	69.7	+0.4
Home care allowance	100 000	54.8	54.7	-0.1
Employed	1 890 000	66.6	67.2	+0.5
Total	2 540 000	66.0	66.5	+0.5

Note: If individual have several income sources within a year the following prioritization is used: 1. Home care allowance, 2. Earnings-related UB and 3. Flat-rate UB. Employed are individuals with positive labor income and not received home care allowance or any unemployment benefit within a year.

Figure 2 shows how the participation tax rates vary by the predicted participation wage. Overall the mean of PTR does not seem to vary much by predicted wage. Also, the change between the legislation years is rather constant across the participation wages. However, especially the upper part of the PTR distribution seems to narrow down with higher predicted wages. This may be due to the fact that individuals with low predicted wages are heterogeneous by their characteristics. Also, as predicted wage is the denominator in PTR calculation, higher wage levels may suppress the variation. However, lower part of PTR distribution stays quite constant across predicted wages.

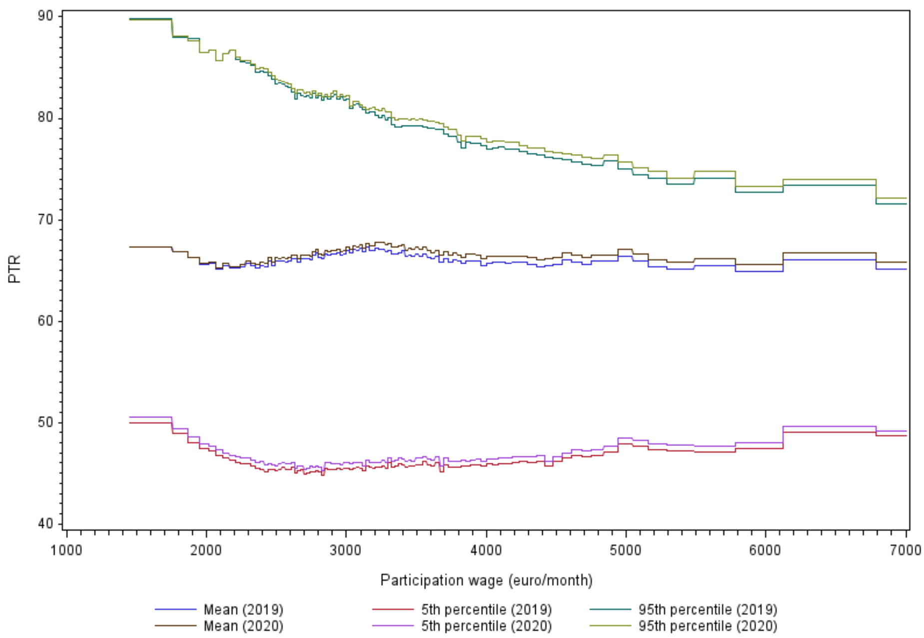

Figure 2. Participation tax rates by predicted participation wages with the legislations of 2019 and 2020.

Table 2 summarizes the incentive changes and the employment effects at the extensive margin. The results are calculated separately for those whose incentives to work became better and for those whose incentives worsened. The results are shown for five cases: 1) baseline case, 2) with heterogeneous participation elasticity, 3) with the wage index, 4) with active policy changes and 5) with the elasticities of 0.1 and 0.3 (values in brackets).

For more than 2.2 million individuals the work incentives weakened whereas for around 300 000 individuals' work incentives became stronger. The average increase in PTRs was 0.5 percentage points and the average decrease was 0.3 percentage points. As expected, active policy changes accentuate the increase of work incentives.

The estimated effect on employment depends largely on the elasticity of participation and other specifications. Therefore, giving one exact number of the effect on employment might be misleading and thus we display the employment changes with five different specifications. Our baseline estimation yields a net decrease of around 5 700 person-years. The estimated net effects on employment are smaller with the other two indexation strategies and with the heterogeneous elasticity. Most notably, the active policy changes yield a net decrease for only about 3 900 person-years. Despite the differences in the estimates, all of them indicate that the changes in tax-benefit legislation had negative effect on employment and the actual decrease in employment lies somewhere between 3 000 and 9 000 person-years.

Table 2. Changes in incentives and employment in extensive margin with various specifications.

	Baseline	Heterogeneous elasticity	Wage index	Active policy changes
Change of average PTR if increased, pp	+0.5	+0.5	+0.5	+0.4
Population with an increase	2 260 000	2 260 000	2 230 000	2 100 000
Change of average PTR if decreased, pp	-0.3	-0.3	-0.3	-0.4
Population with a decrease	270 000	270 000	310 000	440 000
Increase in employment, person-years	+200 (100 – 300)	+200	+200	+400
Decrease in employment, person-years	-5 800 (-3 000 – -8 800)	-5 700	-5 300	-4 300
Net change, person-years	-5 700 (-2 800 – -8 500)	-5 500	-5 100	-3 900

Note: All columns are calculated using the average aggregate participation elasticity of 0.2. For the heterogeneous elasticity, the aggregate participation elasticity varies by gender and the age of the youngest in the household (see Appendix B.4). The values in brackets are calculated using elasticities of 0.1 and 0.3.

4.1.2. Intensive margin

As depicted in Figure 3, a large majority of the EMTRs falls between 30% and 55%. In addition, the policy effects of 2020 are rather modest, average EMTR increasing from 44.5% to 44.8%.

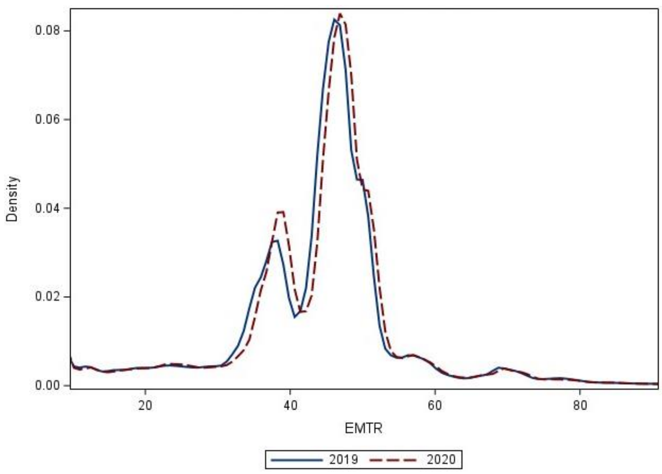

Figure 3. Kernel density distributions of effective marginal tax rates simulated with the legislations of 2019 and 2020.

Figure 4 displays the mean and variation of EMTRs across earned income distribution with two legislation years. The average EMTR is slightly higher among high-income individuals although with few exceptions in the trend. Most notably, the variation in EMTRs is very strong among low-earning individuals but decreases sharply and remains rather stable, before it increases somewhat for high earnings levels. High variation is due to last-resort social assistance and relating earnings disregards. If the extra income unit does not exceed the earnings disregard, estimated EMTR can be close to zero. Otherwise, households eligible to social assistance have EMTRs close to 100% which equals the withdrawal rate of social assistance.

The above findings are fairly robust and the choice of the indexation does not influence the results much (see Appendix B). The overall pattern and levels of EMTRs are nearly identical when policy changes are operationalized with wage index or as active policy changes. Increasing the extra income unit in turn has more visible effect. It smoothens the lines and increases EMTRs among low-earning individuals. This is not surprising since means-tested benefits and related earnings disregards react more strongly to higher increases in earnings.

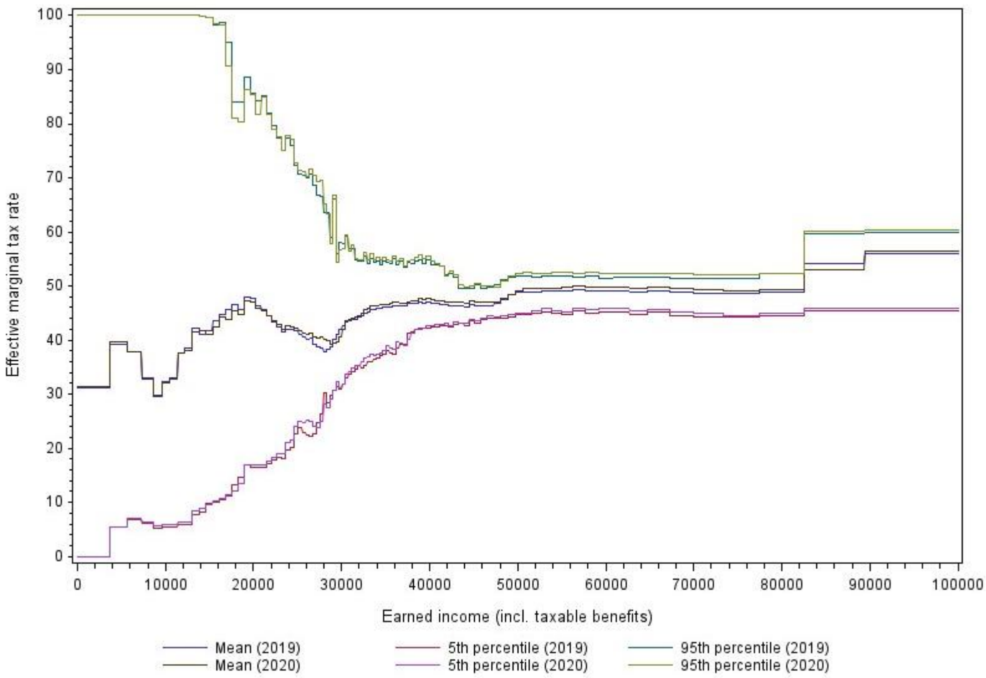

Figure 4. Effective marginal tax rates (%) by annual earned income with the legislations of 2019 and 2020.

Figure 5 presents change in the on simulated EMTR with 100 equally sized income bins.[5] It illustrates how the recent policy changes have mainly increased EMTRs for higher-earning individuals with few exceptions. This is mainly due to an increase in the contribution payments. The three steep gaps reflect the income limits of the tax schedule. Because the index adjustments of the tax schedule are larger than the increase in consumer price index used to deflate the parameters, they are interpreted here as tax cuts. For those earning less than 22 000 euro/year marginal tax rates have mainly decreased, which is likely due to increases in tax credits.

As shown in the Appendix B, the patterns of the changes are similar regardless the choice of indexation or the amount of extra income. With the wage index the change in EMTRs is larger, whereas with the extra income of 6 000 euro/year the changes are closer to zero.

[5] The number of bins does not affect the results since the analysis is conducted at the individual level. The number of bins only affects our graphical illustration (see Appendix C for illustrations with higher number of bins).

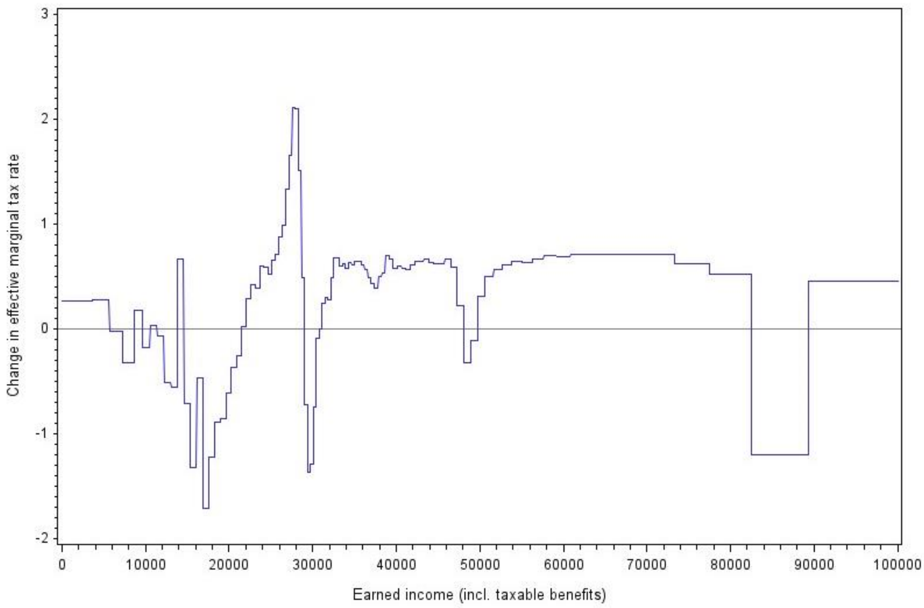

Figure 5. The change (pp) of average effective marginal tax rates during 2019-2020 by annual earned income.

Table 3 shows the mean changes in EMTR and consecutive behavioral effect on earnings. As for the extensive margin, the large majority of individuals face decreased incentives in intensive margin. About 1.9 million individuals face diminished work incentives due to the legislation changes, whereas only around 350 000 individuals see increase in incentives at the intensive margin. However, the average decrease in EMTR (3.0 pp) is much larger than average increase (1.0 pp).

Table 3. Changes in incentives and employment in intensive margin with various specifications.

	Baseline	Wage index	Active policy changes	Extra income of 6000 euros/year
Change of average EMTR if increased, pp	+1.0	+1.0	+0.9	+0.6
Population with increase	1 920 000	1 970 000	1 870 000	1 920 000
Change of average EMTR if decreased, pp	-3.0	-2.4	-3.3	-1.2
Population with decrease	350 000	310 000	410 000	390 000
Increase in earnings, million euro	+120 (60 – 180)	+90	+150	+40
Decrease in earnings, million euro	-250 (-130 – -380)	-260	-230	-190
Net change, million euro	-140 (-70 – -200)	-160	-70	-150

Note: Values in brackets are formed using elasticities of 0.1 and 0.3.

The net effect on gross earnings varies depending on the assumptions. Our baseline estimate for the net change (-140 Me) is close to the estimates calculated with wage index (-160 Me). Again, active policy changes yield most positive result for incentives and consecutive effect on gross earnings (-70 Me). Depending on the elasticity of taxable income the estimated net effect varies from -70 million euro (elasticity of 0.1) to -200 million euro (elasticity of 0.3). All estimation results indicate that the behavioral effect in intensive margin had a negative average impact on individuals' gross earnings.

4.2. Effects on income inequality

Policy changes in January 2020 decreased income inequality in Finland. According to the table 4, the policy changes decreased Gini coefficient by 0.3 percentage points, which is solely driven by the non-behavioral effect. Estimated behavioral effects in extensive and intensive margins responses have negligible effects on Gini coefficient. The result is robust with different elasticity specifications (see Appendix B).

Table 4. Policy effects of 2019-2020 on inequality and poverty indicators.

	Base level in 2019	Non-behavioral	Extensive margin	Intensive margin	Both margins	Total effect
Gini coefficient	28	-0.3	0.0	0.0	0.0	-0.3
Eq. median income, €/y	24 335	+54	-29	-17	-47	+7
At risk of poverty						
Total population, %	13.4	-0.6	0.0	0.0	0.0	-0.6
Total population, N	738 000	-32 500	+2 000	-200	1 600	-30 900
Children, %	12.6	-0.4	+0.1	0.0	+0.1	-0.4
Children, N	133 600	-4 600	+600	+100	+600	-3 900
Elderly, %	12.7	-1.4	0.0	0.0	0.0	-1.4
Elderly, N	150 100	-16 200	0	0	0	-16 200
Fiscal changes						
Taxes, Me	35 700	+130	-40	-70	-110	+20
Benefits, Me	13 600	+360	+90	0	+90	+450
Total, Me	22 100	-230	-140	-70	-210	-430

Note: Poverty line used is set to 60% of median income and it is fixed to the level of 2019. Children are defined as individuals aged less than 18 years. Elderly are defined as individuals aged 65 or more.

The at-risk-poverty indicators, based on a fixed poverty line of 60% of equivalent median income, produce similar results. Policy changes decreased the risk of poverty especially among elderly (-1.4 pp) but also among children (-0.4 pp) and total population (-0.6 pp). Behavioral effects on at-risk-of-poverty rates are minor. The estimated increase in unemployment in the extensive margin yields 2 000 new individuals in poverty, which however does not change the poverty rates visibly. The changes in intensive margin have even smaller effect. The insignificance of behavioral effects is partly due to the fact that policy changes concentrated on the pensions and retired population.

Lower part of the table 4 focuses on the fiscal changes. It shows that due to the non-behavioral effects taxes and payments collected by the government increased by 130 million euro and the relative increase in benefits paid was larger being 360 million euro. The fiscal non-behavioral net effect of the change was -230 million euro. Extensive margin responses clearly increased the total benefits paid (90 million euro), but the intensive margin responses had no effect on the total benefits paid, whereas for taxes both margins mildly decrease the amount collected. The total effect, therefore, on taxes and payments were almost zero (20 million euro), whereas the benefits paid increased by 450 million euro in total. Together the total net fiscal effect of the government was -430 million euro.

Figure 6 shows the changes in disposable income by household income decile with the baseline specification. The overall pattern of the effect on disposable income is clear – the lowest deciles have benefited whereas the higher deciles have lost on average. The lowest decile got a 1.2% increase in their disposable incomes and the top decile got a decrease of around 0.4% in their incomes. It should be noted that the relative figures accentuate the changes in low-end of income distribution and changes in absolute levels are more flat across deciles (see Appendix C). Again, we see that behavioral effects produce only minor changes. Changes in labor supply in intensive and extensive margin decrease disposable incomes in most deciles.

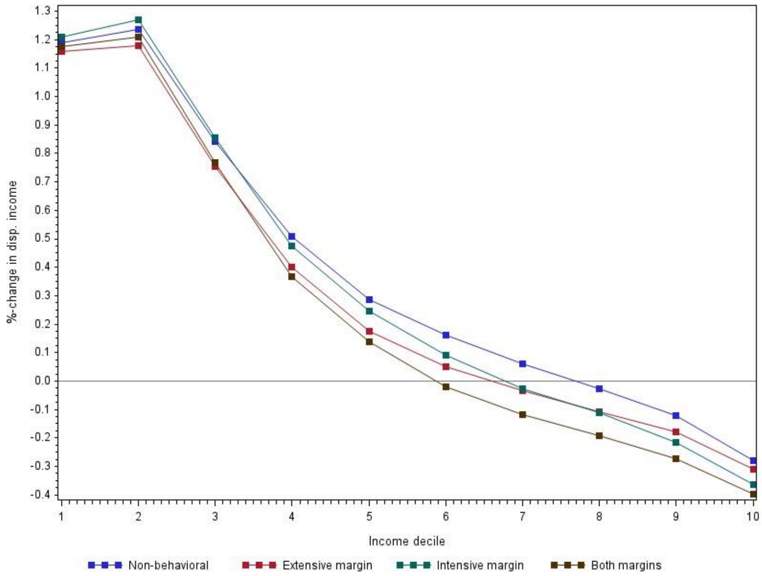

Figure 6. The policy effects (%) on disposable income by income decile.

Note: All lines include also non-behavioral effects.

The overall pattern of the changes is nearly identical with all the specification used (see Appendix B). The actual levels of the changes, however, vary between the specification and with higher elasticity there are larger differences between the lines.

The differences between non-behavioral and behavioral simulations are illustrated in Figure 7 in more detail. The extensive margin responses (blue line) have a U-shaped effect and it is negative for all deciles. Concentrating symmetrically on both ends of the income distribution, it is not surprising that changes in extensive margin did not yield changes in Gini coefficient. The U-shape is mostly caused by the specification where the macro effect is allocated by adjusting unemployment spells.

The effect in intensive margins responses (red line) is concentrated differently. The behavioral effect is income-increasing at the bottom three deciles whereas slightly income-decreasing for the rest of deciles. These results reflect the changes in EMTR (see Figure 5). The increase in incomes is likely to be due to the increase in tax credits. Whereas the behavioral effect in extensive margin is more significant for the most deciles, for the top three deciles the intensive margin responses are larger than the extensive margin responses. The total behavioral effect (green line) is also somewhat U-shaped, being the smallest at the lowest deciles and the largest at the sixth decile.

Figure 8 summarizes the results of the robustness checks compared to the baseline specification (see Appendix B.5 for more detailed results). Positive values indicate larger increase or smaller decrease in disposable incomes compared to baseline results and vice versa for the negative values.

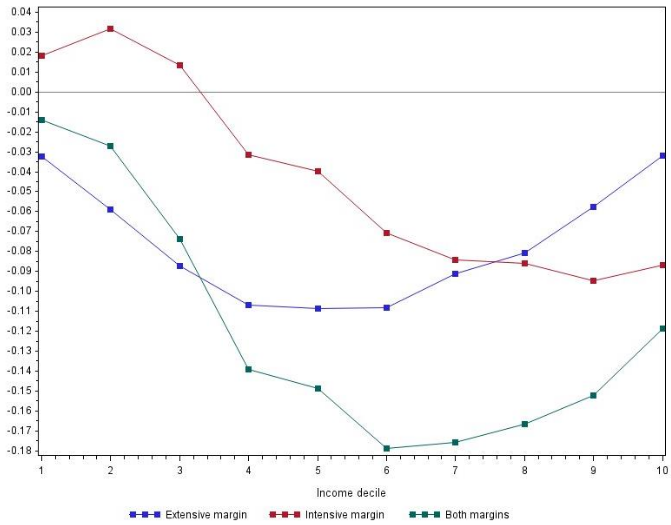

Figure 7. The differences (pp) between behavioral and non-behavioral effects by income decile.

The largest differences are found between the different indexation strategies, where the active policy changes yield larger gains (or smaller losses) in incomes whereas the wage indexation yields the opposite results. It is not surprising that these two yield the greatest differences in this context since the indexation strategy affects also the non-behavioral effect which mainly drives the results. The reason for the larger decrease in disposable incomes with the wage index is the fact that benefit levels are adjusted according to the consumer price index. The active policy changes yield greater gains, especially in the highest deciles, because the increases of tax brackets are taken into account without any deflation.

The second largest differences are found in the choice of the elasticities and the smallest differences are found with heterogeneous participation elasticity and extra income of 6 000 euro/year. These results, however, depend greatly on the analyzed policy changes and the differences in signification cannot be generalized.

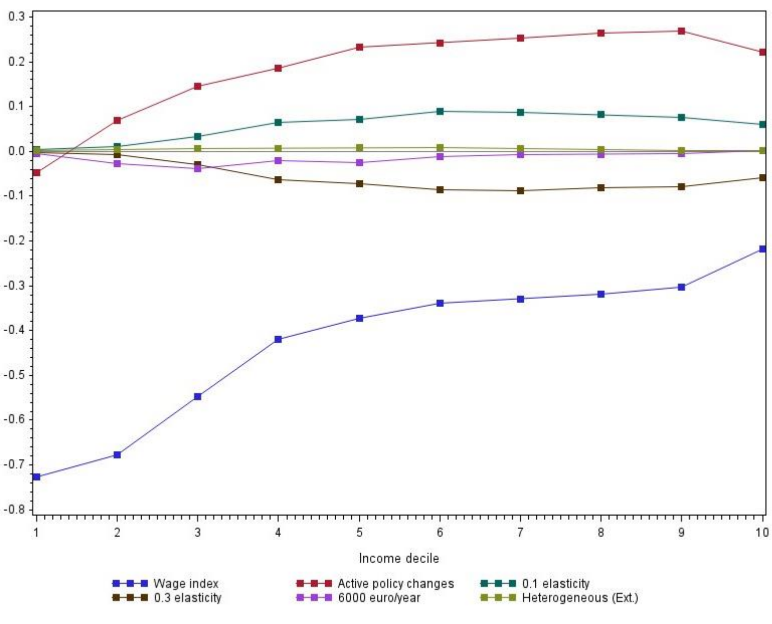

Figure 8. The differences (pp) of various specifications in relation to the baseline specification (=0) by income decile.

5 Conclusions

In this article, we developed further methods for assessing policy effects on income inequality with a special focus on labor supply responses. Whereas the somewhat typical method to account for labor supply responses is through a structural model of discrete choices, we built on the alternative method proposed by Immervoll et al. (2007). Its benefits include transparency and lighter data requirements. Its drawback is that the elasticities are drawn from other contexts.

Unlike Immervoll et al. (2007), we continued the Finnish tradition to estimate the effects at the individual level rather than in subgroups. However, as a novelty to previous Finnish applications (Kärkkäinen & Tervola 2018; Kotamäki et al. 2018) we incorporated labor supply responses in intensive margin. In addition, we developed further the application in extensive margin by allocating the macro effect in existing unemployment spells.

The method was applied to the policy changes in Finland 2019-2020 before the Covid19-outbreak. Therefore our calculation do not take into account any Covid19 related changes in employment structure or tax-benefit-legislation.

The policy changes analyzed were relatively modest, the most notable being the 10 to 50 euro increases in minimum pensions and unemployment benefits. The changes clearly diminished income inequality. Gini coefficient decreased by 0.3 percentage points and at-risk-poverty rate by 0.6 percentage points. The results on the indicators stay the same when behavioral responses were included in the analysis. Still, we find that policy changes extended unemployment spells (increase of roughly 5,500 person-years). At the intensive margin, the incentives to earn more were mostly decreased and this yielded around of 140 million euro decrease in gross labor income. All in all, the behavioral effects nearly doubled the negative fiscal effect of the policy changes.

We also provided an exhausting set of robustness checks by different levels of elasticities, variation of elasticities by subgroups, different operationalization of policy changes and by different income units used to calculate EMTRs. Overall, it seems that the behavioral effect is mostly driven by the general level of elasticity, not by its variation by subgroups or by income unit of EMTR. However, in this case the behavioral effect in total was minor, and the overall result was dominated by the choice of policy change operationalization. It should be noted that the empirical results are naturally bound to the context and do not allow much to be externalized.

It should be emphasized that the results are based on simulations rather than observed effects. The simulation of behavioral responses was based on empirical literature based on different contexts. The elasticity of taxable income, for example, was based on a study that exploited changes in municipal tax rates (Matikka 2018). In this study, the elasticity was applied on changes in effective marginal tax rate which was driven, not by municipal tax rates, but by several tax deductions and contributory payments. It may be that these mechanisms are more unclear to taxpayers and therefore spur smaller effects than municipal tax rates.

Finally, the presented results on income inequality cannot be interpreted in welfare dimension in any way. It may very well be for example that lower incomes due to longer unemployment spells may yield higher welfare in some situations when, for example, having more time to search better quality jobs or high preference for leisure. One possible avenue for the future development is to assess inequality aversions of different politics in a way that Christiansen et al. (2018) has proposed.

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Appendices

A Regression results for wage prediction

Table A.1. Regression coefficients for males.

Males (y=log monthly wage)	Lone dwellers		Couples		Single parents		Two parent families		Others	
	coeff	p-value	coeff	p-value	coeff	p-value	coeff	p-value	coeff	p-value
Intercept	7.455	0.000	7.200	0.000	7.710	0.000	6.863	0.000	7.642	0.000
Age	0.027	0.000	0.024	0.000	0.018	0.000	0.035	0.000	0.016	0.000
Age^2	0.000	0.000	0.000	0.000	0.000	0.003	0.000	0.000	0.000	0.000
Field of education (ref. unknown or other)										
Generic programmes	0.129	0.019	0.392	0.000	0.001	0.997	0.477	0.000	0.285	0.000
Education	-0.097	0.104	0.077	0.203	-0.252	0.453	0.029	0.575	0.036	0.677
Humanities and arts	-0.087	0.119	0.047	0.421	-0.219	0.506	0.059	0.246	0.112	0.160
Business and social sciences	0.058	0.291	0.260	0.000	-0.067	0.838	0.362	0.000	0.238	0.002
Natural sciences, mathematics	0.018	0.747	0.194	0.001	-0.074	0.821	0.218	0.000	0.184	0.022
Engineering and manufacturing	0.115	0.034	0.308	0.000	0.018	0.957	0.368	0.000	0.284	0.000
Agriculture and forestry	0.033	0.558	0.183	0.002	-0.028	0.931	0.254	0.000	0.174	0.028
Health and welfare	0.069	0.209	0.237	0.000	-0.066	0.840	0.266	0.000	0.269	0.001
Services	0.056	0.307	0.254	0.000	-0.042	0.897	0.300	0.000	0.242	0.002
Level of education (ref. doctoral or equivalent)										
Unknown or primary	-0.404	0.000	-0.289	0.000	-0.645	0.051	-0.207	0.000	-0.333	0.000
Secondary	-0.471	0.000	-0.533	0.000	-0.619	0.000	-0.527	0.000	-0.547	0.000
Post-secondary non-tertiary	-0.339	0.000	-0.431	0.000	-0.430	0.000	-0.419	0.000	-0.491	0.000
Short-cycle tertiary	-0.306	0.000	-0.312	0.000	-0.373	0.000	-0.295	0.000	-0.350	0.000
Master's or equivalent	-0.087	0.000	-0.062	0.001	-0.058	0.302	-0.017	0.210	-0.138	0.001
Ages of children										
Less than 3 years (0/1)					-0.003	0.964	-0.002	0.797	-0.012	0.480
3-6 years (0/1)					0.020	0.525	0.004	0.421	-0.042	0.006
7-18 years (0/1)					-0.041	0.321	-0.018	0.002	-0.010	0.359
Region (ref. Lapland)										
Uusimaa	0.041	0.001	0.094	0.000	0.132	0.000	0.121	0.000	0.067	0.007
Etelä-Savo	-0.076	0.000	-0.069	0.000	-0.059	0.168	-0.059	0.000	0.007	0.859
Pohjois-Savo	-0.056	0.000	-0.040	0.005	0.011	0.770	-0.042	0.001	0.020	0.549
Pohjois-Karjala	-0.085	0.000	-0.058	0.000	-0.046	0.262	-0.071	0.000	-0.031	0.417
Keski-Suomi	-0.044	0.003	-0.028	0.045	0.003	0.941	-0.017	0.162	-0.012	0.709
Etelä-Pohjanmaa	-0.084	0.000	-0.072	0.000	-0.030	0.455	-0.089	0.000	-0.067	0.067
Pohjanmaa	-0.062	0.000	-0.007	0.661	0.004	0.925	-0.029	0.028	-0.038	0.288
Keski-Pohjanmaa	-0.048	0.035	-0.033	0.120	-0.008	0.884	-0.033	0.058	-0.053	0.276
Pohjois-Pohjanmaa	-0.031	0.023	-0.030	0.024	-0.001	0.982	-0.011	0.320	0.009	0.771
Kainuu	-0.067	0.001	-0.055	0.007	0.009	0.857	-0.052	0.004	0.006	0.918
Varsinais-Suomi	-0.042	0.002	-0.012	0.344	-0.015	0.648	-0.016	0.151	-0.030	0.289
Satakunta	-0.012	0.425	0.009	0.524	0.054	0.132	0.003	0.790	0.023	0.490
Kanta-Häme	-0.016	0.297	-0.003	0.841	0.038	0.315	0.004	0.750	0.007	0.839
Pirkanmaa	-0.049	0.000	-0.005	0.703	0.032	0.319	0.004	0.731	-0.024	0.404
Päijät-Häme	-0.025	0.108	-0.011	0.466	0.071	0.073	-0.009	0.475	-0.008	0.807
Kymenlaakso	0.022	0.164	0.051	0.001	0.077	0.057	0.017	0.209	-0.009	0.805
Etelä-Karjala	-0.013	0.451	0.013	0.415	0.082	0.066	-0.008	0.617	0.003	0.945
Months in unemployment during the year (ref. more than 8)										
Less than 3	0.192	0.000	0.164	0.000	0.293	0.018	0.160	0.000	0.131	0.012
3-5	0.105	0.002	0.081	0.064	0.225	0.073	0.054	0.187	0.063	0.252
6-8	0.033	0.417	-0.108	0.031	0.185	0.165	0.012	0.806	0.008	0.901
Employment days (100) in previous year	0.063	0.000	0.076	0.000	0.074	0.000	0.076	0.000	0.052	0.000
Existing debt (0/1)	0.113	0.000	0.082	0.000	0.135	0.000	0.096	0.000	0.121	0.000
Married (0/1)	0.066	0.000	0.027	0.000	0.081	0.000	0.045	0.000	0.060	0.000
Income of other hh members (log €)			0.007	0.000	-0.005	0.001	0.018	0.000	0.002	0.049

Table A.2. Regression coefficients for females.

Females (y=log monthly wage)	Lone dwellers		Couples		Single parents		Two parent families		Others	
	coeff	p-value	coeff	p-value	coeff	p-value	coeff	p-value	coeff	p-value
Intercept	7.522	0.000	7.385	0.000	7.459	0.000	7.130	0.000	7.591	0.000
Age	0.016	0.000	0.016	0.000	0.015	0.000	0.022	0.000	0.008	0.000
Age^2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.113
Field of education (ref. unknown or other)										
Generic programmes	0.372	0.000	0.338	0.000	0.259	0.000	0.399	0.000	0.408	0.000
Education	0.216	0.002	0.172	0.002	0.024	0.733	0.117	0.008	0.272	0.000
Humanities and arts	0.201	0.004	0.157	0.004	0.046	0.520	0.143	0.001	0.261	0.000
Business and social sciences	0.325	0.000	0.282	0.000	0.192	0.006	0.295	0.000	0.372	0.000
Natural sciences, mathematics	0.286	0.000	0.257	0.000	0.164	0.026	0.232	0.000	0.359	0.000
Engineering and manufacturing	0.349	0.000	0.313	0.000	0.234	0.001	0.346	0.000	0.366	0.000
Agriculture and forestry	0.257	0.000	0.247	0.000	0.115	0.115	0.222	0.000	0.288	0.000
Health and welfare	0.339	0.000	0.275	0.000	0.170	0.016	0.253	0.000	0.383	0.000
Services	0.249	0.000	0.192	0.000	0.104	0.141	0.195	0.000	0.301	0.000
Level of education (ref. doctoral or equivalent)										
Unknown or primary	-0.338	0.000	-0.435	0.000	-0.481	0.000	-0.400	0.000	-0.398	0.000
Secondary	-0.607	0.000	-0.669	0.000	-0.593	0.000	-0.639	0.000	-0.695	0.000
Post-secondary non-tertiary	-0.503	0.000	-0.556	0.000	-0.499	0.000	-0.532	0.000	-0.568	0.000
Short-cycle tertiary	-0.448	0.000	-0.500	0.000	-0.416	0.000	-0.477	0.000	-0.540	0.000
Master's or equivalent	-0.162	0.000	-0.192	0.000	-0.091	0.001	-0.147	0.000	-0.240	0.000
Ages of children										
Less than 3 years (0/1)					0.064	0.001	0.072	0.000	-0.021	0.264
3-6 years (0/1)					0.021	0.044	0.023	0.000	0.005	0.729
7-18 years (0/1)					0.011	0.433	0.016	0.005	-0.012	0.242
Region (ref. Lapland)										
Uusimaa	0.085	0.000	0.116	0.000	0.142	0.000	0.108	0.000	0.097	0.000
Etelä-Savo	-0.017	0.320	-0.029	0.022	0.014	0.575	-0.022	0.085	-0.001	0.987
Pohjois-Savo	-0.027	0.075	-0.006	0.560	0.030	0.170	0.007	0.546	-0.002	0.940
Pohjois-Karjala	-0.044	0.013	-0.019	0.120	0.017	0.491	-0.014	0.262	-0.007	0.819
Keski-Suomi	-0.040	0.008	-0.014	0.190	0.005	0.810	-0.024	0.025	0.009	0.749
Etelä-Pohjanmaa	-0.026	0.117	-0.019	0.121	0.009	0.698	-0.031	0.006	-0.009	0.767
Pohjanmaa	-0.053	0.002	-0.022	0.070	0.043	0.080	-0.046	0.000	-0.054	0.070
Keski-Pohjanmaa	-0.032	0.174	-0.024	0.146	0.005	0.864	-0.049	0.002	0.015	0.713
Pohjois-Pohjanmaa	-0.040	0.004	0.000	0.999	0.009	0.641	-0.004	0.659	0.016	0.537
Kainuu	-0.044	0.045	-0.023	0.134	0.030	0.363	0.001	0.936	-0.109	0.014
Varsinais-Suomi	-0.011	0.380	0.018	0.074	0.034	0.074	0.012	0.198	0.012	0.612
Satakunta	-0.023	0.134	-0.006	0.604	0.017	0.429	-0.003	0.772	-0.026	0.378
Kanta-Häme	0.007	0.663	0.030	0.009	0.065	0.004	0.029	0.011	0.018	0.552
Pirkanmaa	-0.012	0.364	0.017	0.082	0.053	0.005	-0.004	0.648	-0.009	0.701
Päijät-Häme	-0.013	0.379	0.014	0.228	0.050	0.023	-0.003	0.770	0.005	0.856
Kymenlaakso	-0.007	0.643	0.002	0.852	0.023	0.316	0.004	0.750	0.002	0.948
Etelä-Karjala	-0.013	0.460	0.001	0.960	0.019	0.452	-0.013	0.306	-0.013	0.730
Months in unemployment during the year (ref. more than 8)										
Less than 3	0.013	0.796	0.042	0.462	0.059	0.418	0.038	0.509	0.109	0.207
3-5	-0.043	0.402	-0.007	0.901	-0.034	0.646	-0.028	0.628	0.084	0.348
6-8	-0.129	0.039	-0.116	0.088	-0.081	0.397	-0.109	0.124	-0.089	0.390
Employment days (100) in prev. year	0.062	0.000	0.058	0.000	0.053	0.000	0.048	0.000	0.057	0.000
Existing debt (0/1)	0.079	0.000	0.062	0.000	0.103	0.000	0.068	0.000	0.075	0.000
Married (0/1)	0.023	0.015	0.007	0.048	-0.009	0.386	-0.002	0.572	-0.014	0.102
Income of other hh members (log €)			0.015	0.000	-0.003	0.000	0.016	0.000	0.000	0.964

B Robustness checks

We conduct several additional analyses to examine the robustness of our results. First, we test the effect of alternative income threshold when calculating EMTRs. In the second part, we show how the different operationalization strategies of policy changes affect the results. Finally we test different levels of elasticities.

B.1 Increase in extra incomes

In this section, we use an alternative 500 euro/month (i.e. 6000 euro/year) increase in wages in the calculation of EMTRs. The amount is five times the amount we used in our main specification. According to equation (5), the increase of the threshold will increase EMTRs in two ways. First, the increase in s increases the denominator. Second, the net gains are likely to be smaller due to progressive taxation and income tested benefits with earning disregards. The change in EMTR between the different legislation years, on the other hand, becomes smaller in absolute terms. This is due the fact that with the larger increase in incomes, the roles of tax-brackets and income-tested s become smaller.

Our results illustrate these features. Figure B.1 shows EMTRs by annual earned income in both legislation years using the higher 6000 euro/year addition to wages. The shape of the curve is similar, but the levels of EMTRs are larger. The differences to the baseline specification (Figure 4) are much larger with low income levels. This is not surprising because of means-tested benefits with earnings disregards ranging between 150 and 300 euros per month.

As shown in Figure B.2, individual changes in EMTRs are also smaller than in Figure 5. The shape, however, is fairly similar in both figures. With the larger increase in additional incomes the policy changes have more clearly benefited individuals with low incomes. Despite these differences, the total effect on income inequality (Table B.1) and on disposable incomes (figures B.3 and B.4) are almost identical compared to baseline results. This is due to the fact that majority of the total effect is caused by the non-behavioral effect.

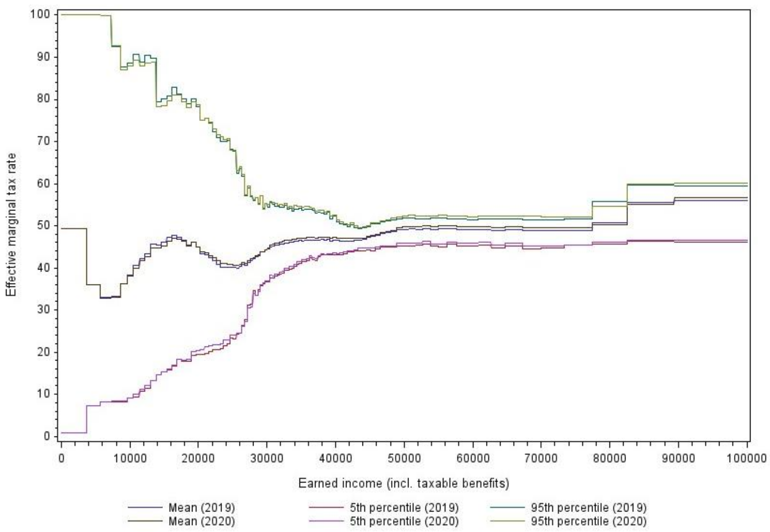


Figure B.1. EMTRs by annual earned income with 6000 euro increase.

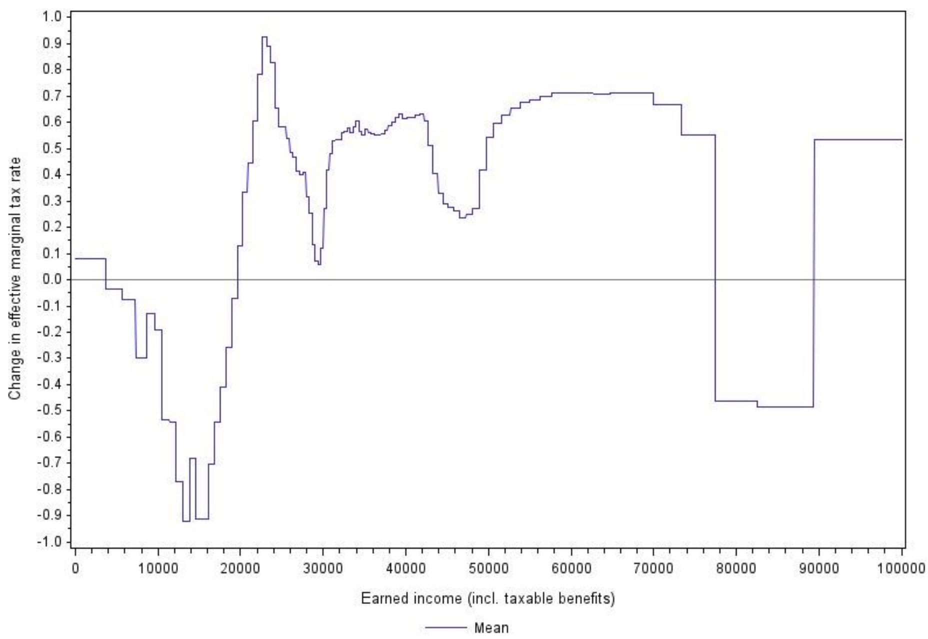


Figure B.2. Change (pp) in EMTRs using 6000 euro/year increase in wages.

Table B.1. Changes in incomes and inequality with 6 000 euro/year extra income.

	Benchmark	Non-behavioral	Extensive margin	Intensive margin	Both margins	Total effect
Gini coefficient	28	-0.3	0.0	0.0	0.0	-0.3
Equalized income						
Median	24 335	54	-29	-20	-49	5
At risk of poverty						
Whole population (%)	13.4	-0.6	0.0	0.0	0.0	-0.6
Whole population (N)	738 000	-32 500	2 000	- 500	1 500	-31 100
Children (%)	12.6	-0.4	0.1	0.0	0.1	-0.4
Children (N)	133 600	-4 600	600	0	600	-4 000
Elderly (%)	12.7	-1.4	0.0	0.0	0.0	-1.4
Elderly (N)	150 100	-16 200	0	0	0	-16 200
Fiscal changes						
Taxes (Me)	35 700	130	-40	-70	-110	20
Benefits (Me)	13 600	360	90	0	90	450
Total fiscal (Me)	22 100	-230	-140	-70	-210	-430

Note: Results are calculated with consumer price index, elasticity of 0.2 and extra income of 6 000 euro/year. Benchmark refers to results obtained with 2019 legislation. Total effect is the sum of non-behavioral and behavioral effects. Extensive margin, intensive margin and both margins are calculated compared to the 2020 non-behavioral simulation. Non-behavioral and total effects are calculated compared to the benchmark results. Poverty line used in the calculations is 60% of median income and it is fixed according to benchmark calculation.

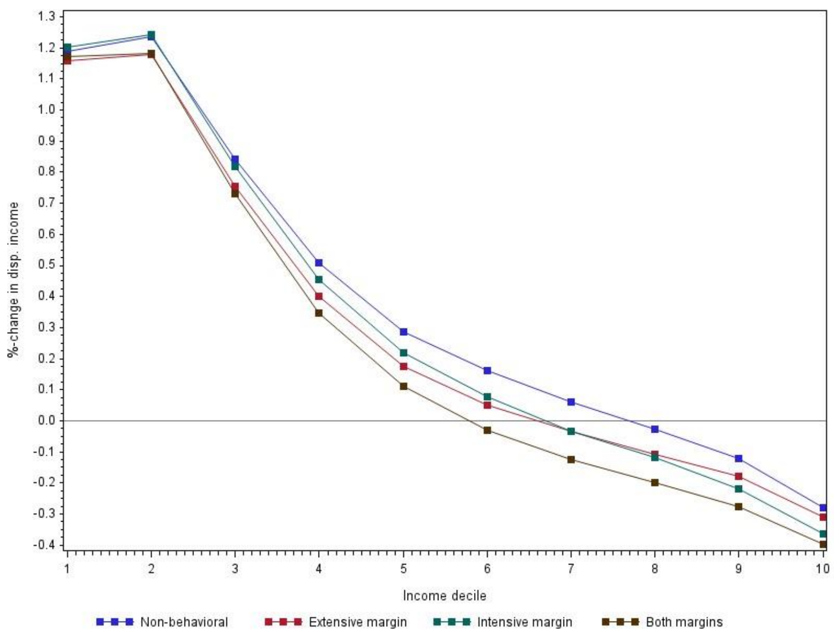


Figure B.3. Change in disposable income with CPI and 6000 euro/year addition to wages.

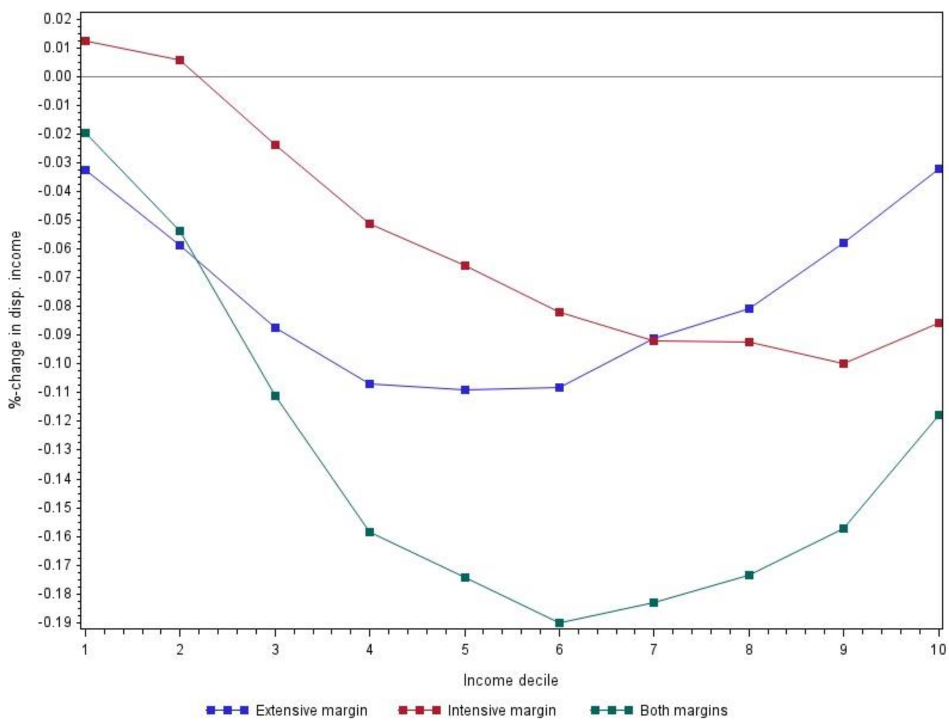


Figure B.4. The differences (pp) between behavioral and non-behavioral effects by income decile when income threshold is 6000 euro/year.

B.2 Different operationalizations of policy changes

B.2.1 Wage index

This section shows how using wage index instead of consumer price index as the baseline for policies alters the results. Wage indexation yields some small differences compared to our baseline modelling, but overall the results are very similar. With the wage indexation the increase in disposable incomes is smaller in all income deciles but especially in the lowest ones. Consequently, the decrease in Gini coefficient and AROP-rates are slightly smaller than when adjusting with consumer price index.

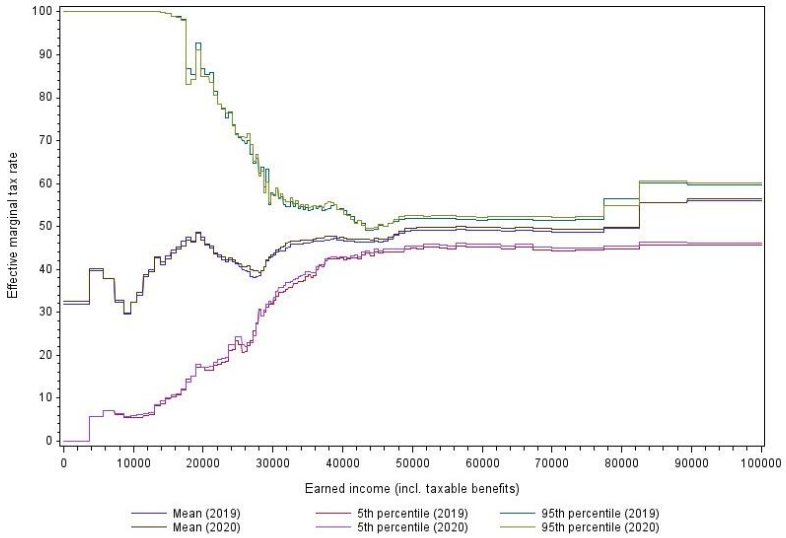


Figure B.5. EMTRs by annual earned income with wage index.

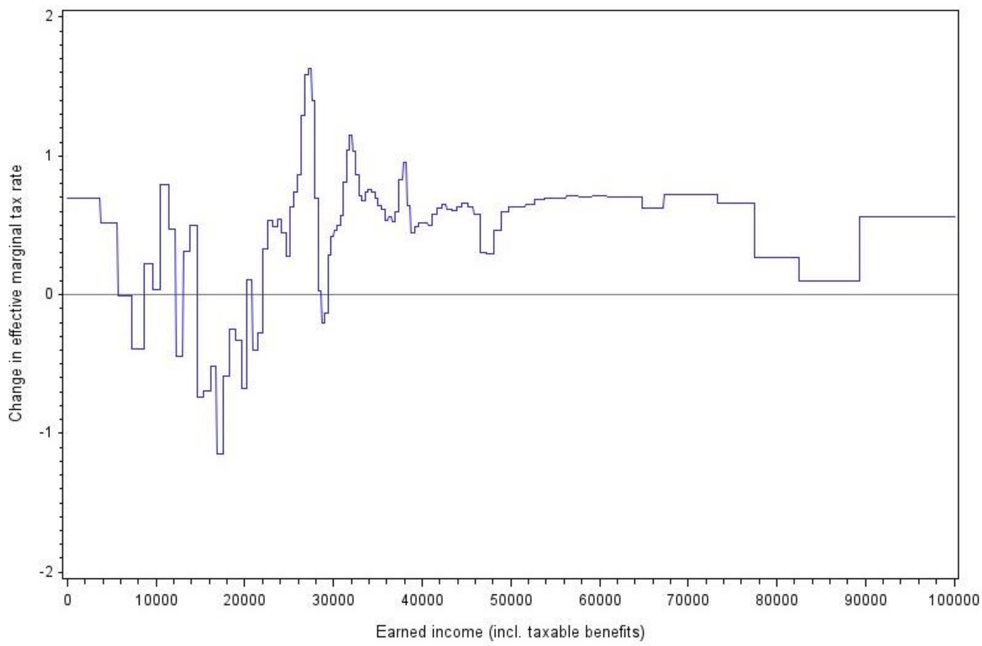


Figure B.6. Change (pp) in EMTRs using wage index.

Table B.2. Changes in incomes and inequality with wage index.

	Benchmark	Non-behavioral	Extensive margin	Intensive margin	Both margins	Total effect
Gini coefficient	28.1	-0.2	0.0	0.0	0.0	-0.2
Equalized income						
Median	24 204	-35	-25	-18	-44	-79
At risk of poverty						
Whole population (%)	13.7	-0.3	0	0	0	-0.3
Whole population (N)	753 900	- 15 200	1 700	- 400	1 300	- 13 900
Children (%)	12.8	-0.1	0.1	0	0	0
Children (N)	136 700	-700	700	-300	400	-300
Elderly (%)	13.2	-0.9	0	0	0	-0.9
Elderly (N)	155 500	- 10 400	0	0	0	- 10 400
Fiscal changes						
Taxes (Me)	36 100	360	-40	-80	-120	240
Benefits (Me)	13 400	190	80	0	80	270
Taxes-benefits (Me)	22 800	170	-120	-80	-200	-30

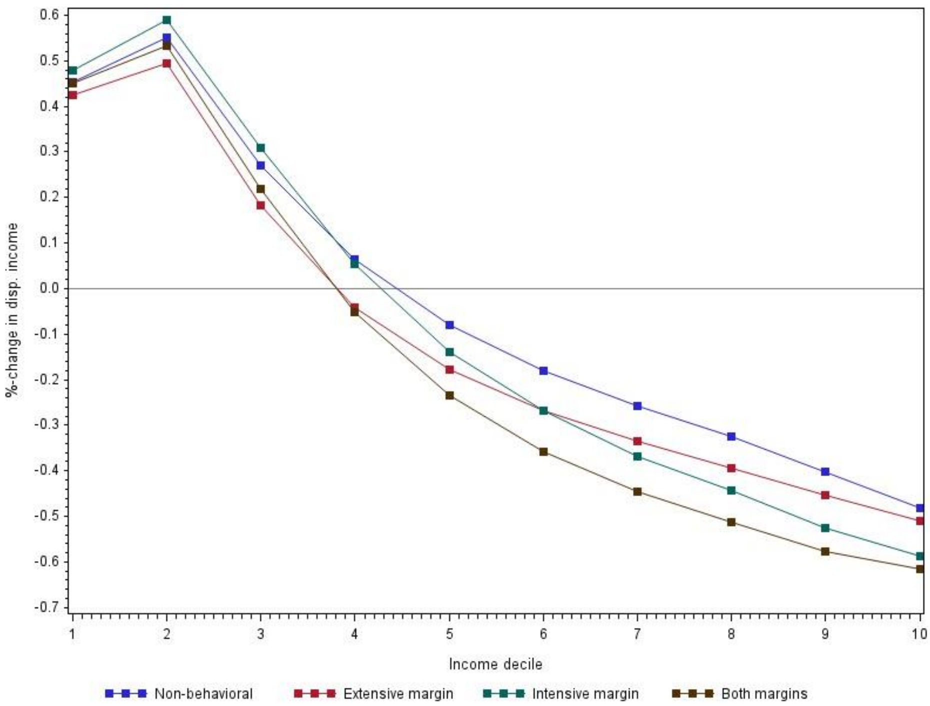


Figure B.7. Change in disposable income with wage index.

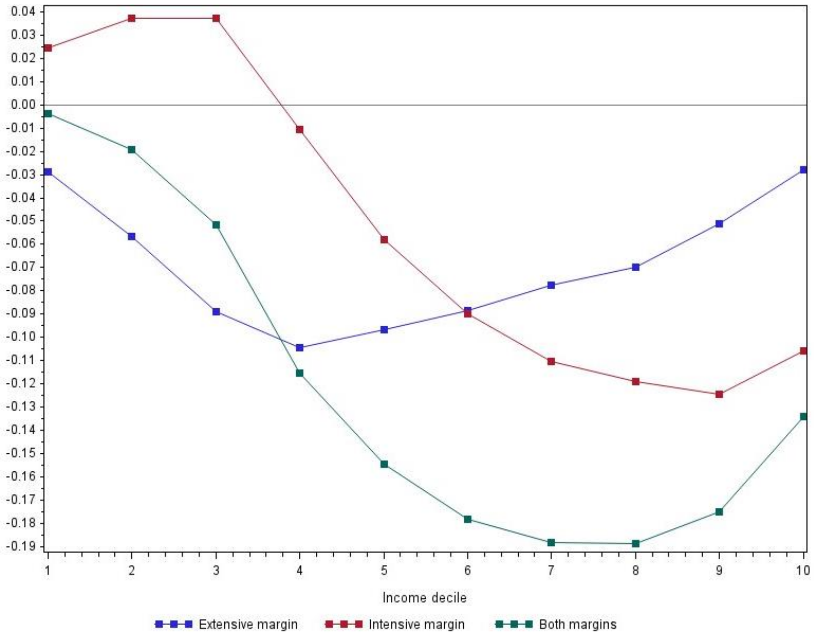


Figure B.8. The differences (pp) between behavioral and non-behavioral effects by income decile when using wage index.

B.2.2 Active policy changes

In this section we define policy changes from a juridical perspective and include only those policy changes that occurred due to legislative changes. This means we exclude ignore the changes in municipal tax rates as well as automatic index adjustments of benefit levels. Most benefit levels are juridically tied to national pension index, but the tax schedule in turn is not tied to any index. Therefore, in this specification we ignore typical index adjustments of benefits, but include all changes in tax schedule and other changes in benefit levels. The changes are measured in relation to the benefit levels that had been in force in 2020 without legislative changes.

According to the results below, this specification yields larger gains in disposable incomes in each income decile and especially in the highest deciles. Results are also reflected in slightly smaller decrease in Gini coefficient and the larger decrease in the poverty head count.

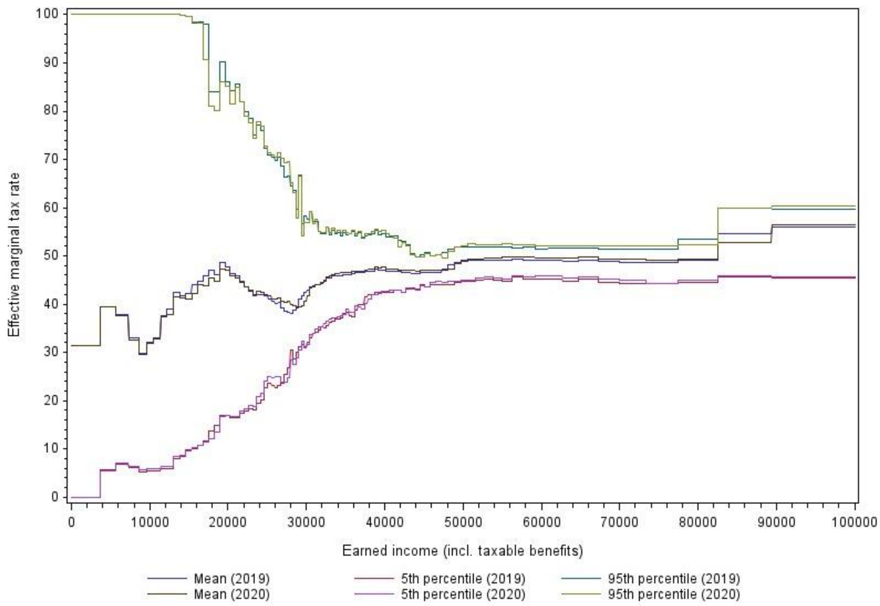


Figure B.9. EMTRs by annual earned income with active policy changes.

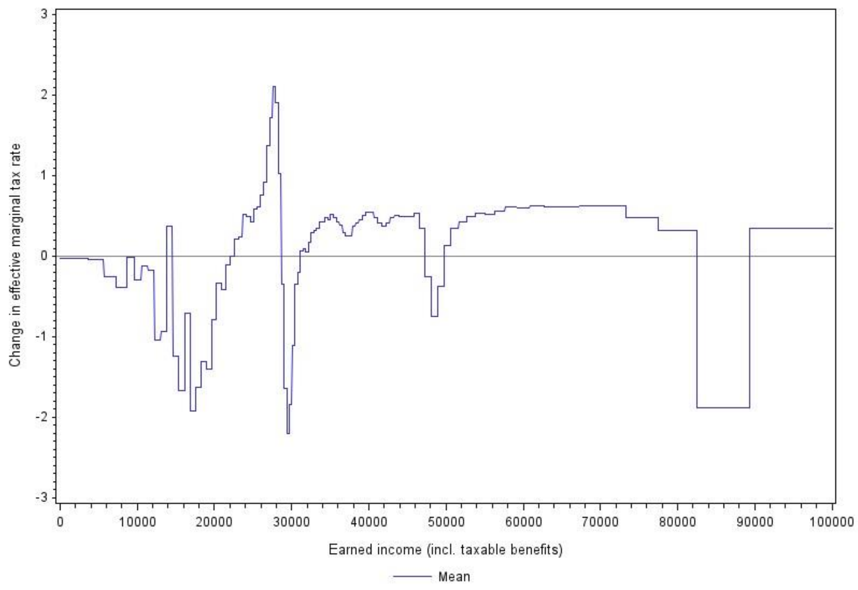


Figure B.10. Change (pp) in EMTRs using active policy changes.

Table B.3. Changes in incomes and inequality measures with active policy changes.

	Benchmark	Non-behavioral	Extensive margin	Intensive margin	Both margins	Total effect
Gini coefficient	28.0	-0.2	0.0	0.0	0.0	-0.2
Equalized income						
Median	24 314	95	-21	-7	-29	66
At risk of poverty						
Whole population (%)	13.3	-0.6	0.0	0.0	0.0	-0.6
Whole population (N)	735 000	- 32 700	800	- 700	0	- 32 700
Children (%)	12.5	-0.5	0.0	0.0	0.0	-0.4
Children (N)	133 400	- 5 100	300	0	300	- 4 800
Elderly (%)	12.6	-1.3	0.0	0.0	0.0	-1.3
Elderly (N)	148 500	- 15 600	0	0	0	- 15 500
Fiscal changes						
Taxes (Me)	35 800	-60	-30	-40	-70	-130
Benefits (Me)	13 600	340	70	0	70	400
Taxes-benefits (Me)	22 200	-400	-100	-40	-140	-540

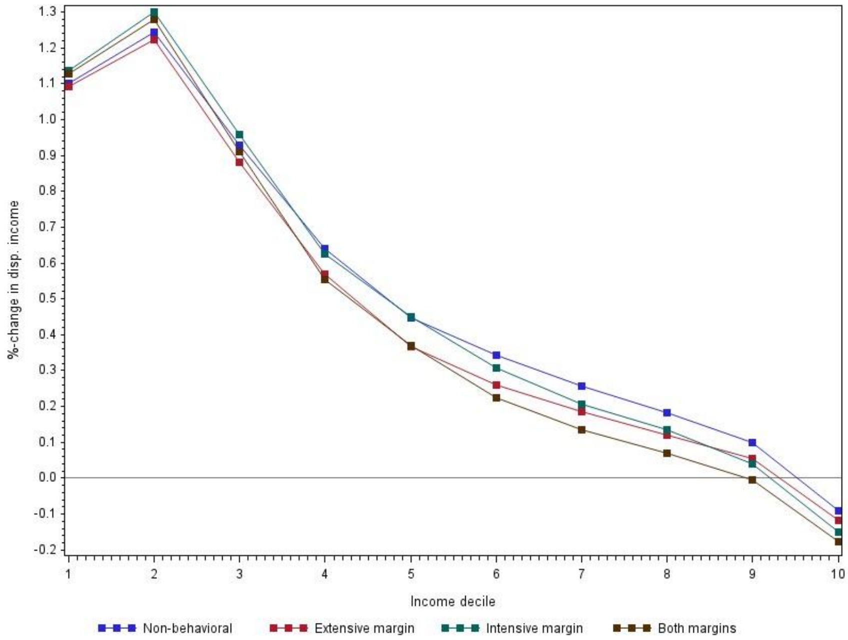


Figure B.11. Change in disposable income with active policy changes.

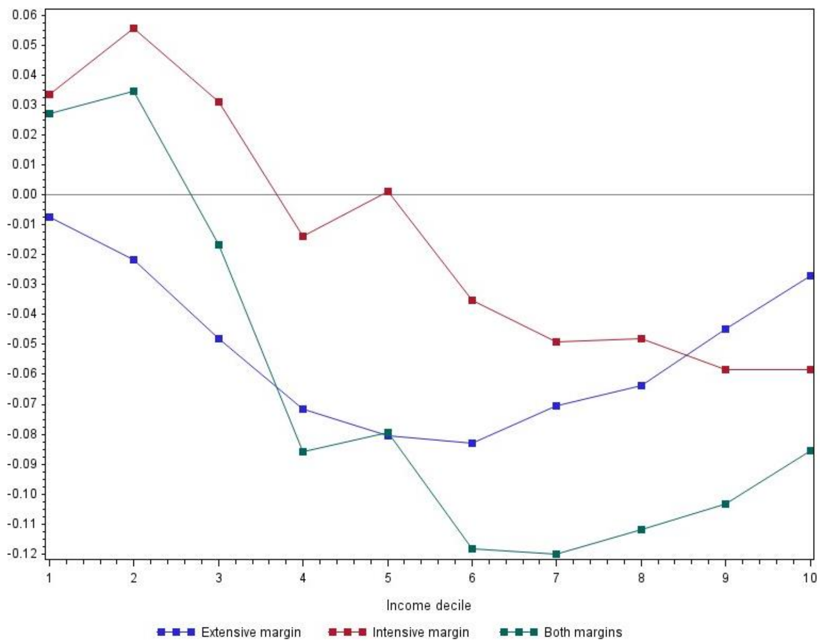
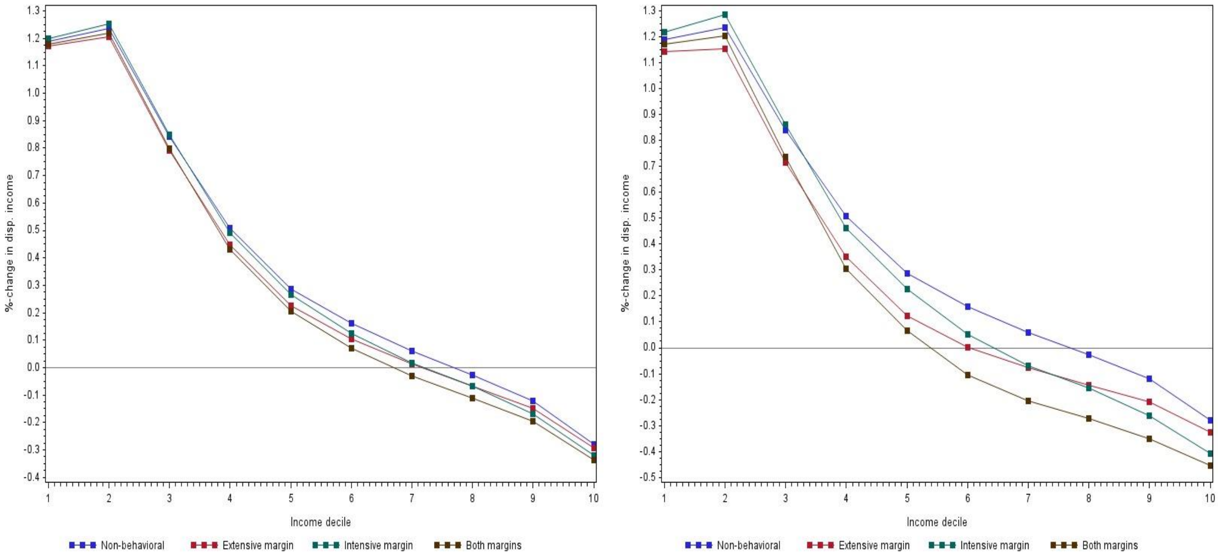


Figure B.12. The differences (pp) between behavioral and non-behavioral effects by income decile when measuring active policy changes.

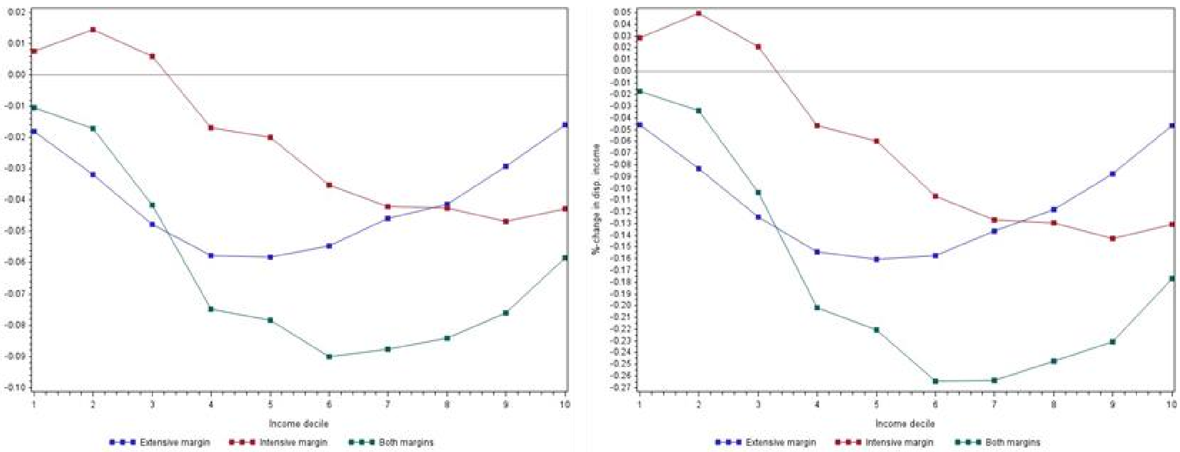
B.3 Different elasticity levels

The elasticity parameter used in baseline estimation was 0.2 for both margins but here we test two alternative levels: 0.1 and 0.3. As depicted in the results below, changing the elasticity level alters the results rather mildly, which is mostly due to fact that the clear majority of the total inequality effect is driven by the non-behavioral effect. Not surprisingly, the effects of behavioral responses are larger with the higher elasticity.



(a) Elasticities of 0.1 (b) Elasticities of 0.3

Figure B.13. Relative change in disposable incomes with different elasticities.



(a) Elasticities of 0.1 (b) Elasticities of 0.3

Figure B.14. The differences (pp) between behavioral and non-behavioral effects by income decile with different elasticities.

Table B.4: Change in incomes and inequality measure with different elasticities

	Benchmark	Non-behavioral	Extensive margin	Intensive margin	Both margins	Total effect
			Elasticities of 0.1			
Gini coefficient	28.0	-0.3	0.0	0.0	0.0	-0.3
Equalized income						
Median	24 335	54	-14	-7	-22	32
At risk of poverty						
Whole population (%)	13.4	-0.6	0.0	0.0	0.0	-0.6
Whole population (N)	738 000	- 32 500	1 000	0	900	- 31 600
Children (%)	12.6	-0.4	0.0	0.0	0.0	-0.4
Children (N)	133 600	- 4 600	300	200	400	- 4 200
Elderly (%)	12.7	-1.4	0	0.0	0.0	-1.4
Elderly (N)	150 100	- 16 200	0	0	0	- 16 200
Fiscal changes						
Taxes (Me)	35 700	130	-20	-40	-60	80
Benefits (Me)	13 600	360	50	0	50	410
Taxes-benefits (Me)	22 100	-230	-70	-40	-110	-330
			Elasticities of 0.3			
Gini coefficient	28.0	-0.3	0.0	0.0	0.0	-0.3
Equalized income						
Median	24 335	54	-41	-24	-65	-11
At risk of poverty						
Whole population (%)	13.4	-0.6	0.0	0.0	0.0	-0.6
Whole population (N)	738 000	- 32 500	2 900	- 100	2 400	- 30 100
Children (%)	12.6	-0.4	0.1	0.0	0.1	-0.3
Children (N)	133 600	- 4 600	900	300	1 000	- 3 600
Elderly (%)	12.7	-1.4	0.0	0.0	0.0	-1.4
Elderly (N)	150 100	16 200	0	0	0	- 16 200
Fiscal changes						
Taxes (Me)	35 700	130	-60	-100	-160	-30
Benefits (Me)	13 600	360	140	0	140	500
Taxes-benefits (Me)	22 100	-230	-200	-110	-310	-530

B.4 Heterogeneous participation elasticity

In the baseline scenario we incorporated constant elasticity parameter, which may not be realistic. Here we test participation elasticities that vary according to the gender of individual and the age of the youngest child in household. We add variation by incorporating eight different subgroups. The groups and respective elasticity weights, shown in table B.5, are based on Kotamäki & Kärkkäinen (2018). In the calculations, the baseline elasticity of participation (0.2) is weighted according to these weights. We, however, make also an ad-hoc adjustment to the heterogeneous elasticities since with our data these do not sum up exactly to aggregate participation elasticity. All of the elasticities are multiplied by 0.986 to correct the inaccuracy.

Table B.5. Heterogeneous elasticity weights for participation elasticity.

Age of youngest children	Women	Men
More than 17 years or no children	1.28	0.92
Less than 3 years old	1.32	0.92
From 3 to 7 years old	1	0.68
From 8 to 17 years old	0.84	0.56

Source: Own calculations based on Kotamäki & Kärkkäinen (2018)

Table B.6. Changes in incomes and inequality with heterogeneous participation elasticity.

	Benchmark	Non- behavioral	Extensive margin	Intensive margin	Both margins	Total effect
Gini coefficient	28.0	-0.3	0.0	0.0	0.0	-0.3
Equalized income Median	24 335	54	-27	-17	-44	10
At risk of poverty Whole population (%)	13.4	-0.6	0.0	0.0	0.0	-0.6
Whole population (N)	738 000	- 32 500	1 900	- 200	1 400	- 31 100
Children (%)	12.6	-0.4	0.1	0.0	0.1	-0.4
Children (N)	133 600	- 4 600	500	100	600	- 4 000
Elderly (%)	12.7	-1.4	0.0	0.0	0.0	-1.4
Elderly (N)	150 100	- 16 200	0	0	0	- 16 200
Fiscal changes Taxes (Me)	35 700	130	-40	-70	-110	30
Benefits (Me)	13 600	360	90	0	90	450
Taxes-benefits (Me)	22 100	-230	-130	-70	-200	-420

Note: Results are calculated with consumer price index, aggregate elasticities of 0.2 and extra income of 1200 euro/year. Extensive margin elasticity is weighted according to table B.7. Benchmark refers to results obtained with 2019 legislation. Total effect is the sum of non-behavioral and behavioral effects. Extensive margin, intensive margin and both margins are calculated compared to the 2020 non-behavioral simulation. Non-behavioral and total effect are calculated compared to the benchmark results. Poverty line used in the calculations is 60% of median income and it is fixed according to benchmark calculation.

Because the non-behavioral effect and intensive margin responses remain unchanged, we show only the changes on extensive margin. As shown in figure B.15. As was shown in table 2 the decrease in employment is smaller with heterogeneous elasticity. Therefore, not surprisingly, the extensive margin effects on disposable income are also closer to zero with the heterogeneous elasticity. In this context, heterogeneous elasticities do not change the shape of extensive margin effects and therefore effects on income inequality are identical when using constant elasticity parameter.

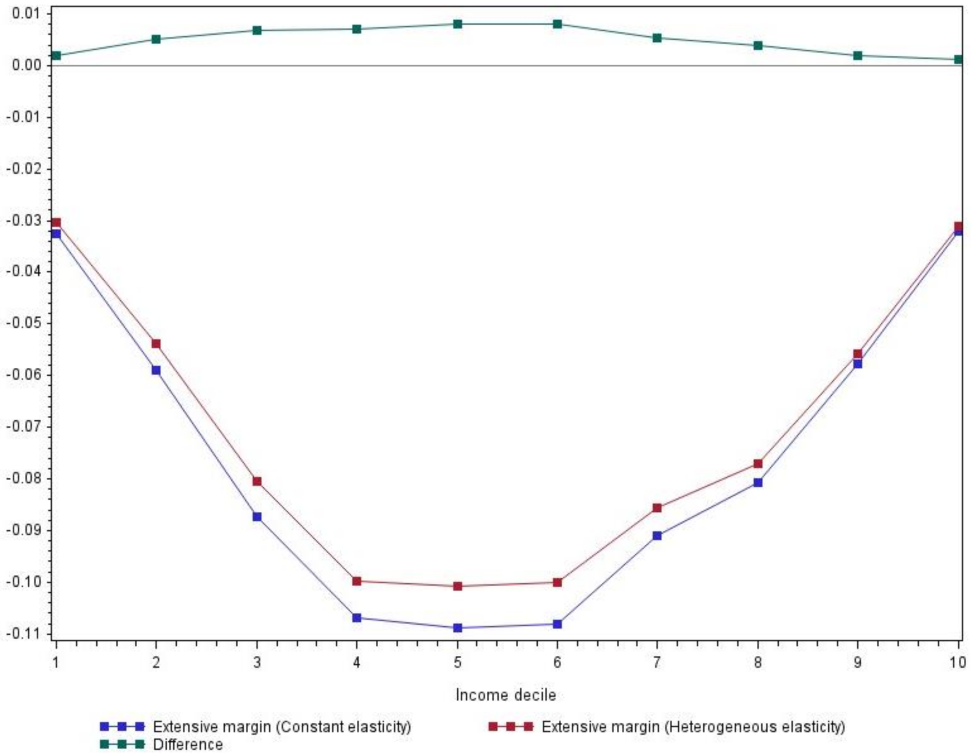


Figure B.15. The differences (pp) in income effects when using constant and heterogeneous elasticities.

B.5 Differences between specifications

Here we present a summary on how different empirical specifications alter the results on income inequality. The differences are shown separately for each type of the effect i.e. for: 1) the non-behavioral effect (Figure B.16), 2) the extensive margin effect (Figure B.17), 3) the intensive margin effect (Figure B.18) and 4) the total behavioral effect (Figure B.19).

All of the figures below show the difference compared to baseline effect. In total six different specification is used in the following figures: 1) with wage index, 2) with active policy changes, 3) with the elasticities of 0.1, 4) with the elasticities of 0.3, 5) with extra income of 6 000 euro per year and 6) with heterogeneous participation elasticity. However, all of the specifications are not displayed in every figure, since some of them affect only some types of effects. Positive values indicate larger increase or smaller decrease in disposable incomes compared to baseline results and vice versa for the negative values.

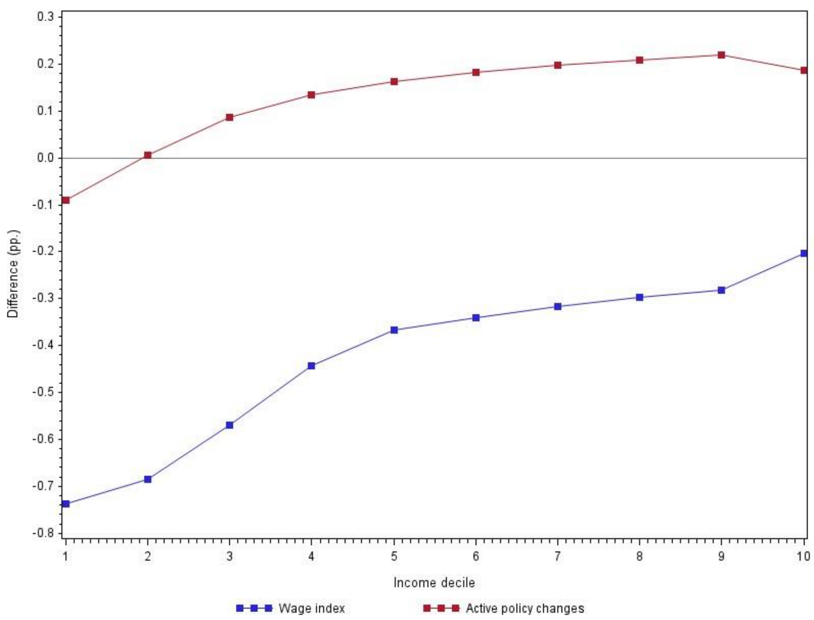


Figure B.16. Differences (pp) in non-behavioral effect on disposable income by income deciles.

Note: Difference is calculated comparing the non-behavioral effects of different indexation strategies to our baseline estimation. Positive values indicate larger increase or smaller decrease in disposable income compared to the baseline results and vice versa for negative values.

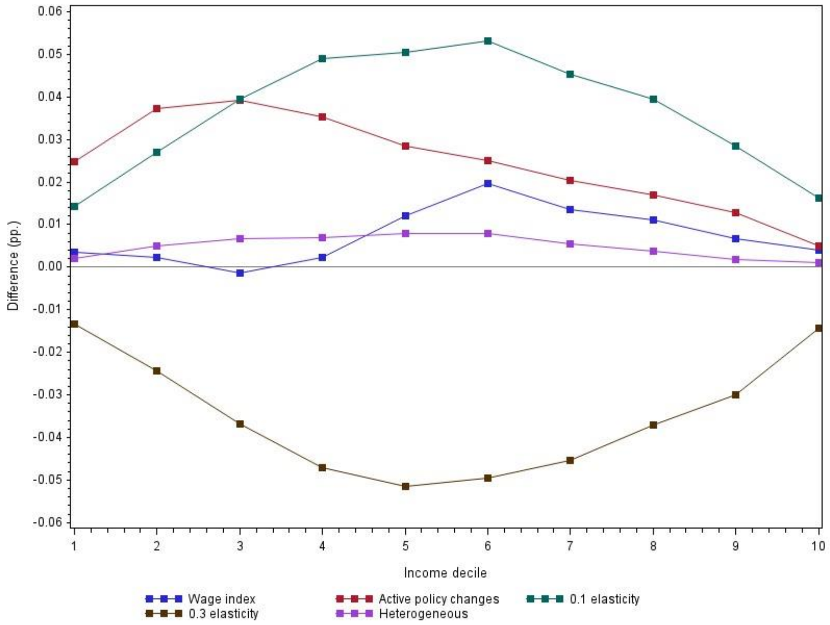


Figure B.17. Differences (pp) in the effect of extensive margin responses on disposable income by income decile.

Note: Difference is calculated comparing the effects of extensive margin responses to our baseline estimation. Positive values indicate larger increase or smaller decrease in disposable income compared to the baseline results and vice versa for negative values. Heterogeneous refers to heterogeneous participation elasticity.

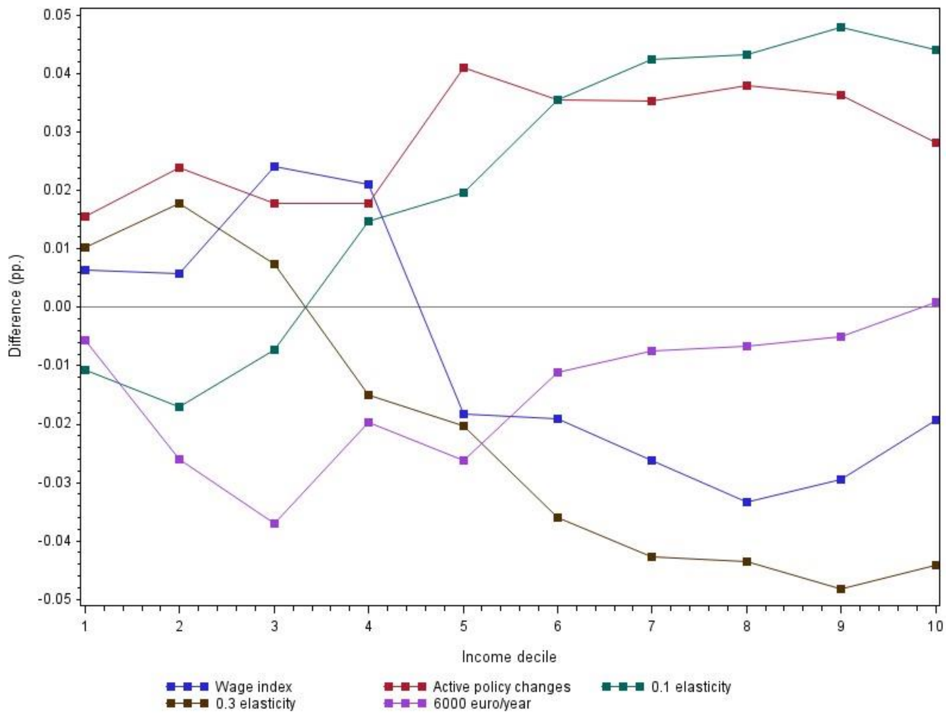


Figure B.18. Differences (pp) in the effect of intensive margin responses on disposable income by income decile.

Note: Difference is calculated comparing the effects of intensive margin responses to our baseline estimation. Positive values indicate larger increase or smaller decrease in disposable income compared to the baseline results and vice versa for negative values. 6 000 euro/year refers to extra income.

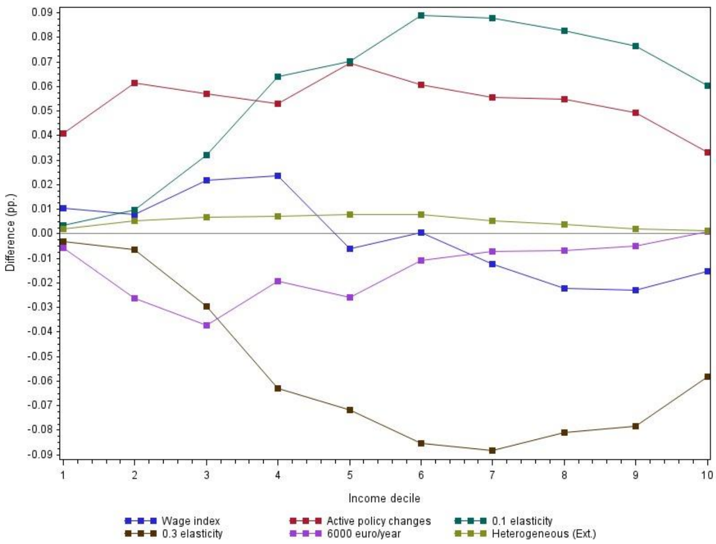


Figure B.19. Differences (pp) in the effect of behavioral responses on disposable income by income decile.

Note: Difference is calculated comparing the effects of responses on both margins to our baseline estimation. Positive values indicate larger increase or smaller decrease in disposable income compared to the baseline results and vice versa for negative values. Heterogeneous refers to heterogeneous participation elasticity and 6 000 euro/year refers to extra income.

C Additional tables and figures

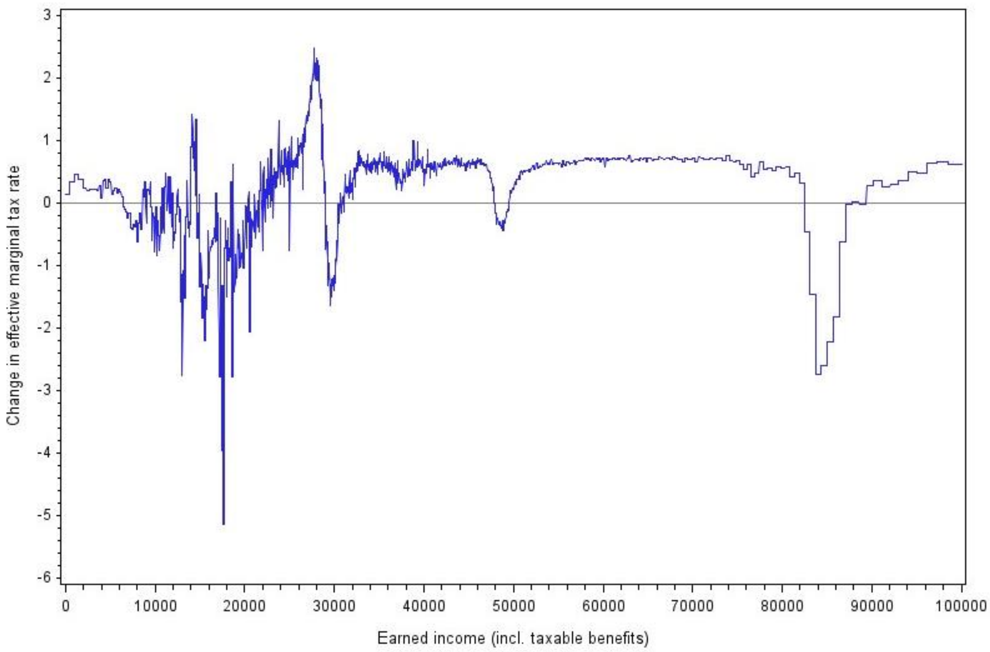


Figure C.1. Change (pp) in EMTRs with respect to earned income using 1000 income bins.

Table C.1. Changes in disposable incomes by income decile.

Income decile	Non-behavioral	Extensive margin	Intensive margin	Both margins
1.	1.19%	1.16%	1.21%	1.18%
2.	1.24%	1.18%	1.27%	1.21%
3.	0.84%	0.75%	0.85%	0.77%
4.	0.51%	0.39%	0.48%	0.36%
5.	0.29%	0.17%	0.25%	0.13%
6.	0.16%	0.05%	0.09%	-0.02%
7.	0.06%	-0.04%	-0.03%	-0.12%
8.	-0.03%	-0.11%	-0.11%	-0.20%
9.	-0.12%	-0.18%	-0.22%	-0.28%
10.	-0.28%	-0.31%	-0.37%	-0.40%

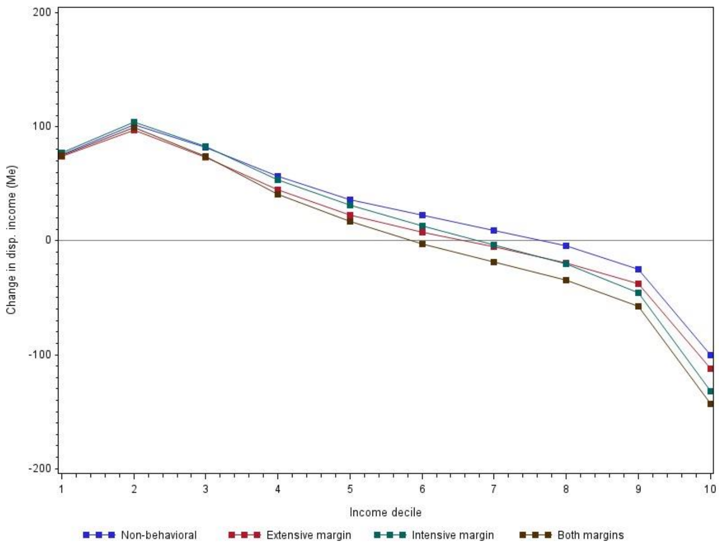


Figure C.2. Absolute change in disposable incomes by income decile.