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Labour force participation elasticities and the move away from a flat tax: the case of Slovakia

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Abstract

This paper provides a microeconometric analysis of labour force participation elasticities in Slovakia where we study the elasticity with respect to a unique tax reform whereby the flat tax was backtracked and replaced by a progressive tax. By estimating a probability model for labour force participation, we show that the low-skilled and females are groups that are particularly responsive to changes in income taxes and transfers. We perform a microsimulation analysis of two scenarios of flat-tax regime abolishment. We find that the recent departure from the flat-tax system in Slovakia in 2013, which introduced two tax brackets in personal income taxation, only negligibly reduced the average probability of being economically active at the extensive margin. A more significant average effect has been found in a hypothetical scenario with a similar fiscal revenue impact, simulating a departure from the flat-tax system by reintroducing five tax brackets. We show the different impacts of the two distinct scenarios of abolishing the flat tax on selected subgroups of the population.

JEL Classification: H31, H53, I38, J21

Keywords: Labour force participation elasticity, Extensive margin, Microsimulation, Flat tax

1 Introduction

This paper examines the link between labour force participation and changes in the tax system. As argued by Meghir and Phillips (2010), the impact of taxation on work incentives is one of the principal sources of inefficiency that may arise in a tax system. The fundamental issue is to assess how sensitive individuals' work incentives are to changes in taxes and benefits. An analysis of labour supply behaviour is therefore a key element when evaluating the reforms of tax and transfer systems and the impact of different policies on changes in tax revenues, employment, and wealth redistribution.

The way how labour force participation responds to the work incentive/disincentive effects of taxation and welfare programmes has attracted a lot of interest in both labour and public economics, and extensive research has resulted in numerous empirical results. For an overview of the literature that connects labour supply to income taxes and social benefits, see, among others, surveys by Meghir and Phillips (2010), Moffitt (2002), and Blundell and MaCurdy (1999).

In this paper, a case study of the recent moving away from the flat-tax system in Slovakia is performed. The idea of introducing a flat-tax regime was widespread among Central and Eastern European (CEE) countries, including Slovakia, at the beginning of the 2000s. Effective from 2004, the system of graduated personal income tax rates in Slovakia was simplified to a flat-tax rate of 19%. Only a few EU countries abandoned the flat tax and returned to the more progressive system by reintroducing tax brackets. These countries currently include Slovakia and the Czech Republic. Using the detailed microsimulation model and estimates of participation decisions (labour supply elasticities at the extensive margin), we quantify the effects of the tax system reform valid from 2013 that resulted in a marginal move away from the flat tax and to a positive first-round fiscal effect leading to an increase in revenues by 0.4% of GDP. This reform has been characterized by the re-introduction of two tax brackets and the unification (and increase) of the assessment basis for different social and health insurance contributions. In addition, we perform a simulation of the counterfactual scenario abolishing the flat-tax regime by introducing five tax brackets. In broad terms, this scenario simulates the personal income tax system valid in Slovakia before the flat-tax reform in 2004. By simulating these two scenarios with the same simulated first-round revenue effect, we show that the departure from a flat tax can have a different impact on selected population subgroups.

The literature on the microeconometric estimations of labour supply elasticities is vast. A comprehensive overview in relation to the progress in the field of microsimulation models focused on labour supply, and methodological approaches can be found in Aaberge and Colombino (2014), who identify three main methodologies that have been adopted for modelling labour supply. A so-called reduced form approach embodies the hypothesis that labour supply (namely the observed hours of work) is a function of an exogenous net wage and net income. In general, it is not a precise representation of dependence, mainly due to the non-linearities of budget constraint. Moreover, corner solutions are usually ignored. The structural "marginalist" approach works with the conditions for a constrained maximum of the utility function; see, among others, a presentation of the methodology by Hausman (1981). The solution is obvious when convex budget sets and a consumption-leisure setup in the utility function are assumed. However, the method tends to be cumbersome if more complicated non-convex budget constraints are formulated. As a response, a discrete choice framework based on the concept of a "random utility maximization" presents an often-used alternative. This approach, introduced originally by van Soest (1995), has become rather standard in recent years. The utility maximization problem of individuals is reduced to a choice among a discrete set of options (yielding different utilities) such as working full time, working part time, or not working at all. Being inactive thus presents one of the alternatives, and the extensive and intensive margins could be directly estimated so that labour supply decisions could be evaluated even in the presence of non-convexities in budget constraints.

Currently, a number of empirical studies conclude that an extensive margin is much more important than an intensive one. Existing studies usually evaluate labour supply elasticities of some special demographic subgroups (e.g. single individuals, married women, and couples). They usually find that wage elasticities are larger for women than for men. Looking at the magnitude of the estimated elasticities, the variation of the results found in the literature is sizeable. As noted by Bargain et al. (2014), differences across studies arise due to the distinct methodologies applied, including the underlying datasets used (administrative versus survey data) as well as the periods of study. An overview of recent estimates of labour supply elasticities in the US economy can be found in Chetty et al. (2013) and in McClelland and Mok (2012). For an overview of recent empirical evidence on labour supply elasticities in Europe and the USA, see Bargain et al. (2014). A brief survey and critique of different methods of the estimation of labour force participation elasticities can also be found in Heim (2008). However, despite the multitude of methodologies and information covered by existing studies, analyses focusing on CEE countries are rather scarce, and the case of Slovakia has been covered only in one paper so far. Chase (1995) compared labour force participation and wage elasticities between the communist and post-communist regimes in Slovakia and the Czech Republic. He showed that women's participation in the labour market was higher under communism and concluded that the effects of changes in earnings are smaller in Slovakia compared to the Czech Republic. This is probably a result of the slower transformation of the Slovak economy.

Looking at countries bordering Slovakia, Benczur et al. (2014) studied the labour supply at the extensive margin in Hungary. They modified an existing structural approach originally proposed by Hausman (1981) by taking the effects of the tax and benefit system directly into account. As regards the participation decision, they showed that wages, taxes, and transfers have a stronger influence on the participation decision of individuals that are older, low-skilled, married women, or women of child-bearing age. Galuscak and Katay (2014) followed the same methodology and provided empirical estimates for the Czech Republic, which are close to those reported for Hungary. Another analysis focused on the Czech Republic was performed by Bicakova et al. (2011), who provided estimates of participation probabilities separately for males and females by using a probit model. Compared to the study by Galuscak and Katay (2014), the estimated wage semi-elasticities of labour supply are substantially smaller, even though they are larger for women compared to men.

Our estimates of participation elasticities are based on a model of labour supply where both taxes and social transfers are simultaneously taken into account. We estimate a labour supply model following the methodological approach introduced by Benczur et al. (2014). The behavioural response is based on the rationale of utility maximization, and using the classification provided by Aaberge and Colombino (2014), it can be seen as a "marginalist" approach. The model covers in minute detail the joint effects of tax and benefit systems on individuals' net income. Using this modelling strategy, individual participation probabilities are determined by comparing incomes in two states: being in the labour force and being out of it. A key component of this approach is to precisely evaluate the disposable income of an individual, including non-labour income and social transfers received by a household in both states. In order to do so, the concept of the gains to work of an individual is introduced and defined as the difference between the net wage and the amount of welfare benefits lost due to taking up a full-time job.

Employing this microeconometric method allows us to evaluate how the Slovak tax-benefit system can affect work incentives at the extensive margin. We document that participation probabilities are generally dependent on the level of net income and non-labour income, including social transfers. We find that a 1% increase in gains to work increases the probability of economic activity by 0.08 percentage points for males and 0.12 percentage points for females. Our findings are broadly in line with the results usually reported in the literature that frequently demonstrate that elasticities are large for women and very small for men. Taking into account tax and transfer system details valid from 2010 to 2012, a 1% increase in non-labour income decreases the probability of labour force participation by 0.04 percentage points for both genders. Policy initiatives likely to increase financial incentives to work should result in higher participation rates. Our results also show that, in line with findings for other countries, the low-skilled and females are the groups that are particularly responsive to changes in taxes and transfers.

A major advantage of this method is that it allows an ex ante assessment of the counterfactual tax and transfer system reforms and permits an evaluation of specific government interventions and policies. The essential part of this modelling approach is the SIMTASK module, a microsimulation model of the Slovak tax and transfer system described in detail in Siebertova et al. (2016). This tool enables us to simulate individual tax liabilities and benefit entitlements in detail according to valid legislation or hypothetical reform.

Labour supply models are extensively used in the literature to assess the effects of proposed tax system reforms. In such studies, the (hypothetical) introduction of a flat income tax and its impact on the supply of labour is frequently analysed, for example, Decoster et al. (2010) studied the introduction of a flat tax in Belgium and found that a flat-tax system could potentially increase labour supply. The introduction of linear taxation in Germany was examined in Beninger et al. (2006) and Fuest et al. (2008). Beninger et al. compared the effects in a computed manner by using a unitary and collective labour supply model. Fuest et al. used a behavioural microsimulation model and concluded that flat-tax reform could potentially increase employment although the magnitude of the increase was very small. Duncan and Sabirianova Peter (2010) analysed the Russian flat-tax reform of 2001 by using the difference-in-difference regression approach. As a reaction to tax changes, they identified an increase in the distribution of hours worked and that the reform increased the probability of finding a job. Compared to the studies mentioned above, we perform a kind of “reverse” analysis where we study the effects of departure from the flat-tax system. In our setup, the baseline is the flat-tax system valid in 2012 in Slovakia and we study the effects of reintroducing the tax brackets. By performing a microsimulation analysis of two scenarios, we show that a different way of moving away from the flat-tax system may have a different impact on labour supply decisions. We find that the recent departure from the flat-tax system in Slovakia effective from 2013 slightly reduced the average probability of being economically active. Although the hypothetical scenario of the abolition of the flat-tax system would have a higher average impact on the probability of being economically active, we show that the impact on participation probabilities in the two scenarios differs for selected population subgroups.

In our analysis, we investigate the immediate or “day-after” effects of two reforms. A long-run general equilibrium analysis will be performed in a separate paper, since the discussion and execution of these issues is beyond the scope of the present study.

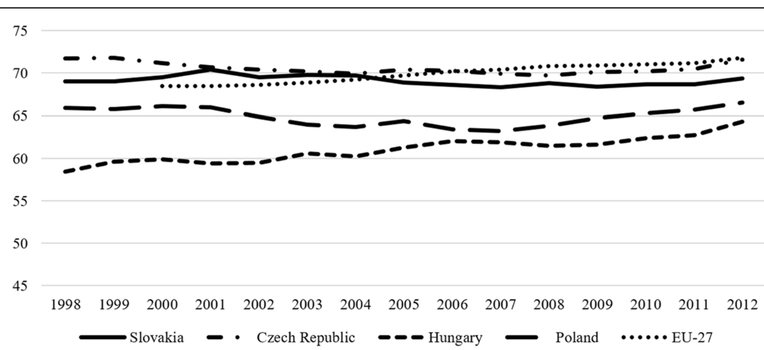
The rest of the paper is organized as follows: the next section provides an overview of the developments in the Slovak labour market and briefly describes the reforms to the tax-benefit system; Section 3 presents the modelling approach that was employed in this article; Section 4 follows with a data description and definition of variables used in the model; Section 5 depicts a short introduction of the Slovak tax and benefit system; Section 6 discusses the main results on estimated labour supply elasticities and provides tax reform simulations; and Section 7 offers a conclusion. In the Appendix, we list the definitions of the main variables and present the detailed results of our estimations.

2 Labour market outcomes and policies in Slovakia

The empirical evidence on labour supply behaviour in transition and post-transition countries is limited. From the historical point of view, labour force participation was obligatory in the CEE countries that experienced communist regimes. In general, after the change of regimes at the beginning of the 1990s and during the transition period, when national economies changed from planned to market-based ones, a continual withdrawal from the labour force was detected in labour markets in all CEE countries.

Participation and employment rates in Slovakia reached their lowest in the early 2000s. Later, in the period of economic growth, an increase in both rates was observed; they started to decline again in 2009 as a consequence of the global economic crisis. The situation in post-transition Slovakia to 2012 can be characterized by participation rates (see Fig. 1) being permanently below the EU-27 average but still somewhat high compared to Hungary and Poland. Low activity rates in Slovakia persist, especially for labour market entrants and for individuals with low qualifications. Participation rates of the youth and low-skilled (low-educated) workers are excessively low, even compared to neighbouring countries (see Fig. 2).

The Slovak tax-benefit system experienced major changes over the last decade. Both tax and social transfer systems were considerably modified[1] in 2004, when Slovakia became the first among Central European countries to implement a flat income tax scheme. It followed the cases of the Baltic States, where the flat tax was introduced in the mid-1990s and Russia in 2001. Afterwards, other CEE countries also followed this flat-tax track, among them Ukraine (in 2004); Georgia and Romania (in 2005); Albania, Bulgaria, and the Czech Republic (in 2008); Bosnia and Herzegovina (in 2009); and Hungary (in 2011). As in most of the mentioned countries, the implementation of the 19% flat income tax (both personal and corporate) in Slovakia was supplemented by additional reform changes, including the modified definition of the tax base, social and



Note: population from 15 to 64 years. Source: Eurostat.

Fig. 1 Participation rates in Slovakia and selected countries, 1998–2012

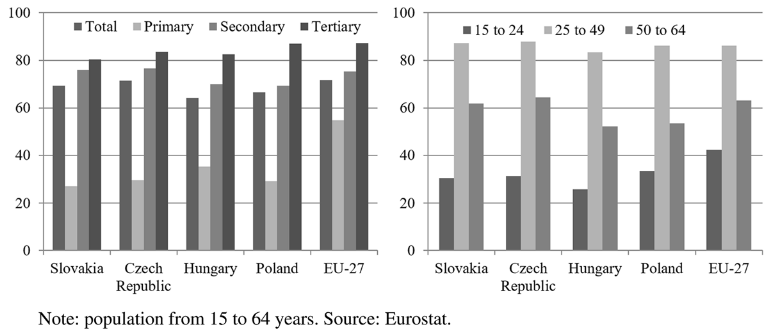


Fig. 2 Participation rates by education and age in 2012

health insurance contributions, indirect taxation (the VAT rate was unified at 19%), and tax administration. In countries with established market economies (like those in Western Europe), there was not such a strong requirement for overall reforms as there was in transition countries, and as a consequence, the demand for the introduction of the flat tax has not been so appealing. As pointed out by Fuest et al. (2008), flat-tax reform is unlikely to take place in Germany due to its questionable distributional impact and limited efficiency effects. After the economic crisis, most countries needed to increase their revenues due to growing deficits, and increasing taxes, whether income or indirect, looked like an appealing tool. Currently, most of the CEE countries that introduced flat-tax regimes still use them. However, Ukraine abandoned the flat tax in 2011. Slovakia, the Czech Republic, and Montenegro returned back to the progressive system in 2013 by introducing a second tax bracket in the personal income tax scheme. It is noteworthy that the threshold for the higher tax rate in both Slovakia and the Czech Republic is sufficiently high and only applies to a small fraction of taxpayers in both countries.

In Slovakia, the levels of social transfers were also effectively significantly cut from 2004 in order to increase work incentives. A report conducted by the World Bank (2012) has shown that these reforms have considerably improved work incentives for low-income workers. However, this improvement has mainly been achieved due to a reduction in transfer levels. The tax-benefit system currently valid in Slovakia seems to encourage work more than the system valid before reforms in 2004. On the other hand, low-wage part-time work is still not sufficiently attractive for those who are eligible to receive the material needs benefit. The Slovak transfer system is restrictive especially for labour market entrants and low-skilled workers employed in low-paid jobs. Structural changes both in the tax and transfer systems that followed from 2005 to 2012 were minor and are well documented in Porubsky et al. (2013).

3 Methodology

In this section, we set up the microeconometric model of labour supply behaviour. We present an approach where taxes and transfers are explicitly taken into account. This extension of the standard labour supply model leads to the specification of a probit model that relates labour participation probabilities to the gains to work from working full time, non-labour income, and other individual characteristics. Finally, we show that participation elasticities can be derived analytically when using this methodology.

3.1 A specification of the model of participation decision

The labour supply decision of individuals is usually modelled as a utility maximization problem formulated as a consumption-leisure trade-off[2]:

$$\max_{c,l} u(c, 1-l) \tag{1}$$

subject to the budget constraint

$$c + w(1-l) = w + \mathrm{NY}, \tag{2}$$

where c stands for consumption, w is wage, l is labour, and NY is other non-labour income, including the income of other household members and government transfers. Note that the budget constraint includes the disposable income of the whole household; thus, the income of other members also affects the labour supply decision of an individual. The total time endowment between work and leisure is normalized to 1, so $(1 - l)$ denotes leisure. Using this modelling framework, taxes regulate the decision to supply labour through their impact on net market wages and non-labour net income. When employing the standard utility function[3] characterized by strictly positive marginal utilities, the optimality condition is determined by first-order conditions: $wu_c^{'}(c, 1-l) = u_{1-l}^{'}(c, 1-l)$. An individual will participate if the utility from working will exceed the utility from not working. In this theoretical framework, non-participation in work results from the corner solution of the model (Hausman, 1981). Note that if an individual does not work, the optimal consumption equals $c = \mathrm{NY}$. The reservation wage is the lowest wage rate at which the worker will be willing to accept a particular job, i.e. working non-zero hours, and in this setup, it can be expressed as

$$w_{\mathrm{res}} = \frac{u_{1-l}^{'}(\mathrm{NY}, 1)}{u_c^{'}(\mathrm{NY}, 1)} = \mathrm{NY}^{\psi}\chi. \tag{3}$$

An individual takes up a job if the offered wage exceeds his reservation wage $w \geq w_{\mathrm{res}}$, or put differently, $\log w \geq \psi \log \mathrm{NY} + \log \chi$. Assume that individuals differ in their preferences so that relation $\log \chi_i = Z_i^{'}\alpha + \varepsilon_i$ holds. Z_i is a vector of observable preferences that affect an individual decision to work, and $\varepsilon_i \sim N(0, \sigma_\varepsilon^2)$ is the error term independently and normally distributed among individuals. Given the assumption of the normality of the error term, the probability that an individual supplies labour can be estimated using the standard probit specification

$$\Pr(\mathrm{activity}_i = 1) = \Phi\left(\gamma \log w_i + Z_i^{'}\alpha - \psi \log NY_i\right), \tag{4}$$

where $\Phi(\cdot)$ stands for the standard normal cumulative distribution function.

The early generation of static models of labour supply, represented essentially by the approach of Hausman (1981), were capable of only partially representing the effects of tax and transfer policies on household budget sets. Relying on tangency conditions, the Hausman model is restricted to the case of (piecewise) linear and convex budget sets. As argued by Benczur et al. (2014), this assumption is particularly restrictive if certain benefits expire immediately after taking up a job and the wage earned for the first few hours does not reward this discrete downward jump in transfers.

In the next step, we methodologically follow the approach presented in Benczur et al. (2014). Adding taxes and social transfers to the model leads to a redefinition of the reservation wage at the cost of the participation decision of an individual needing to be constrained to a full-time job. The participation decision is defined by comparing the utility derived from working full time and the utility from being inactive and receiving full social transfers. Taking into account the corresponding budget constraints, estimating the probability of being economically active yields a probit equation.

Considering the binomial probit can be supported by the fact that in Slovakia the most typical form of employment is full-time employment. As is shown by statistics from Eurostat, Slovakia is a country with one of the lowest shares of workers in Europe who are employed part time. In 2012, the share of part-time workers was only 4% as opposed to 20% in the EU-27 on average.[4] A similar situation has been documented in Hungary and the Czech Republic.

To derive formal expressions, we first introduce the concept of the gains to work (or effective net wage) variable GTW_i of the individual i, defined as the annual net wage w_i minus the difference between social benefits if not working and social benefits if working:

$$\mathrm{GTW}_i = \widehat{w}_i - \left(\mathrm{SB}^{\mathrm{NW}} - \mathrm{SB}^{W}\right) = \widehat{w}_i - \Delta\mathrm{SB}, \tag{5}$$

where the term in parentheses expresses the amount of social benefits lost when working and the net wage $\widehat{w}_i$ is computed from the predicted gross wage. Since income from employment is naturally unobservable for those who are unemployed or inactive, we use Heckman's sample selection methodology (Heckman, 1979) to predict gross wages.[5] In order to obtain a consistent vector of gains to work GTW and reduce the division bias, we use the predicted values of gross wages for every individual in our sample (also for the employed), as this is common in the labour supply literature: see, for example, Bargain et al. (2014) and Breunig and Mercante (2010). To construct the vector GTW, a microsimulation tool is needed. The SIMTASK tax and benefit calculator is used to compute net wages from gross wages and simulate the amount of social benefits an individual is entitled to when working (SB^{W}) and when not working ($\mathrm{SB}^{\mathrm{NW}}$), taking into account the individual's characteristics as well as the characteristics of the corresponding household. In our implementation, considering the details of the tax and transfer system, social benefits that enter the variable GTW include the means-tested material needs benefit and its supplements allocated at the household level.[6]

The second variable of principal interest to us is the non-labour income NY_i of the individual i, which is defined as a sum of three components, namely the social benefits that an individual is entitled to when not working, the non-labour income of all household members (including individual i), and the net labour income of other members of the household. Non-labour income covers pensions, income from property, dividend payments, and family-related benefits (eligibility does not depend on whether a parent works or not) and the unemployment benefit (we assume that this transfer does not affect the decision to work—it is a contributory benefit and expires after 6 months). Note that the construction of the variable NY_i also needs a microsimulation tool.

Using the notation of the standard labour supply model presented above, the budget constraint of an individual that does not work can be written as follows: $c = \mathrm{NY}$, $1 - l = 1$, and the utility is given as $u(\mathrm{NY}, 1)$. When working full time (l^*), the budget constraint can be expressed as $c = wl^* - \Delta\text{SB} + \text{NY},\ 1 - l = 1 - l^*$ and the corresponding utility as $u(\text{GTW} + \text{NY},\ 1 - l^*)$.

An individual will decide to work if the utility from working exceeds the utility from not working:

$$u(\text{GTW} + \text{NY},\ 1 - l^*) \geq u(\text{NY},\ 1) \tag{6}$$

Benczur et al. (2014) show that by linearizing the left-hand-side expression in Eq. (6), one obtains

$$\text{GTW} \geq \frac{u(\text{NY}, 1) - u(\text{NY},\ 1 - l^*)}{u'_c(\text{NY}, 1 - l^*)} \tag{7}$$

Applying the additively separable utility function and taking the logarithm in the previous expression leads to the inequality that describes an individual's decision to work as

$$\log\text{GTW} - \psi\log\text{NY} - \log\chi \geq \varepsilon. \tag{8}$$

Conditional on the assumption of the normally distributed error terms, the probability that an individual is economically active (and works full time) can be estimated using the probit specification, which is a modified version of Eq. (4):

$$\Pr\left(\text{activity}_i = 1\right) = \Phi\left(\gamma\log\text{GTW}_i + Z'_i\alpha - \psi\log\text{NY}_i\right). \tag{9}$$

As noted by Galuscak and Katay (2014), this specification can be understood as a discretized version of the standard Hausman (1981) approach.

3.2 Participation (semi-)elasticities

Being an advantage of this approach, income elasticities in the presented labour supply model can be derived analytically. Notice that since the probit model is non-linear, the point estimates of the coefficients do not indicate the marginal effects of a unit change in the corresponding variables. To compute the marginal impact of a percentage change in gains to work, the probit function given by (9) should be evaluated at certain vectors Z and log NY.

Since we evaluate the probability of economic activity, and our wage measure gains to work is given in a natural logarithm, note that we are actually evaluating semi-elasticities.[7] To calculate the corresponding income elasticities, one has to divide the computed semi-elasticities by the predicted probability of economic activity.[8]

In the probit model of labour force participation, the effect of gains to work is directly evaluated. The separate impact of change in the net wage (w) that represents an own-wage semi-elasticity can be derived as follows:

$$\frac{\partial\log\text{GTW}}{\partial\log w} = \frac{\partial\log(w - \Delta\text{SB})}{\partial\log w} = \frac{\partial\log\left(e^{\log(w - \Delta\text{SB})}\right)}{\partial\log w} = \frac{e^{\log w}}{e^{\log w} - \Delta\text{SB}} = \frac{w}{w - \Delta\text{SB}} \tag{10}$$

Using the previous relationship, we find that the net wage semi-elasticity of the probability of supplying labour can be expressed as

$$\frac{\partial \Pr(\text{activity} = 1)}{\partial \log w} = \frac{\partial \Phi}{\partial \log w} = \frac{\partial \Phi(\cdot)}{\partial \text{logGTW}} \frac{\partial \text{logGTW}}{\partial \log w} = \hat{\gamma}\varphi(\cdot)\frac{w}{w - \Delta \text{SB}} \tag{11}$$

where $\varphi(\cdot)$ denotes the standard normal density function.

4 Data

The following part describes the datasets used for econometric estimation. We define the setup of the estimation sample and the construction of variables that are of interest.

4.1 Statistics on Income and Living Conditions

The data used for the microeconometric analysis come from three waves (2010–2012) of the SK-SILC (Statistics on Income and Living Conditions), the national version of the EU-SILC. Data have been collected on an annual basis since 2004 by the Statistical Office of the Slovak Republic on behalf of Eurostat. We have decided to limit the time span of our analysis to the period after 2009, when the global economic crisis spread to Slovakia. In 2010, the economy recovered and the period of stable economic growth (2.8% on average) and slightly negative output gap (−0.8% on average) began. In this period, no structural change or major shift in the labour market's functioning was observed. The dataset contains cross-sectional data on household and individual level and provides information on income, living conditions, social exclusion, and poverty. The original datasets contain information on more than 15,000 individuals and 5200 households annually. We combined these three datasets into a pooled cross-section, and we estimated probit models of participation decisions as a pooled regression.

The SK-SILC comprises detailed information describing the personal characteristics of individuals. These include age, gender, education, region of permanent residency, and marital status. The dataset also reports detailed information related to labour market status—whether individuals were employed (full time, part time), self-employed, or unemployed in the reference period. Information on the length of working history (in years) is also available. Furthermore, extensive information on the structure of individual income is available. Survey participants were asked to declare their yearly gross earnings from employment (self-employment), fringe benefits, and transfers from the state: including family-related benefits, unemployment benefits, and pensions (for old age or disability). A further description and a summary of statistics of variables can be found in Tables 7 and 8 in the Appendix.

The dataset we use in the econometric estimation is restricted by age to people older than 15 to exclude children in compulsory education. The average retirement age was 61 in Slovakia in 2012; those receiving old-age pensions may still participate in paid work, but the majority of individuals older than 75 do not receive a paid income and do not participate in the labour market. Thus, we restricted the sample to persons younger than 75 years of age. However, when computing the household income and household social benefits, the whole dataset is considered. We do not exclude the self-employed from the estimation sample, although they are not usually considered in the majority of analyses due to data unrepresentativeness. Our decision not to exclude those declaring income from self-employment is based on two perspectives. Firstly, a number of individuals declare income from both employment and self-employment, and we take this into account in our microsimulation model when simulating the amount of tax due. Secondly, in our model of labour force participation, we explicitly model decision-making at the household level; if the declared income from self-employment is not considered, this may lead to bias in results. We left out of the estimation sample those individuals whose prevailing economic activity in the income reference period could not be defined. By applying these adjustments, the original sample is reduced by almost 18% and we are left with nearly 38,000 individual observations in the pooled sample.

4.2 A definition of variables in the model

We first focus on the definition of economic activity that serves as a dependent variable in the probit model. For the definition of labour market status, we use the SILC variable of "prevailing activity in the income reference period", which comprises the categories of the employed, the unemployed, children, pensioners, and those who are otherwise inactive. Economically active people encompass those who declared themselves as employed or unemployed (in terms of the ILO definition of economic activity); the category of inactive people consists of children, pensioners, and those who are otherwise inactive. However, those pensioners and students who have declared a positive labour income are considered in our model to be employed, and their influence on labour force participation probability is controlled by using dummy variables.

Income variables are necessary to generate gains to work; those which are collected on the individual level are listed in gross terms on a yearly basis in SK-SILC. The only exception is the net profit (loss) from self-employment. Information on disposable income, income taxes, and social security contributions are only available in the SK-SILC database as an aggregate at the household level. Therefore, all income variables are used in gross terms and the net income is simulated.

Actually, we distinguish between three different types of income: labour income, non-labour income, and transfers from the government. Labour income includes gross wages from a main and second job, income from self-employment, income from company shares, and income from agreement contracts (temporary employment contracts). Information on fringe benefits, severance and termination payments, and a company car is also available. Non-labour income covers income from the rental of property or land, interest, dividends, and profit from capital investments. Transfers involve pensions (old age and disability), means-tested benefits (such as the material needs benefit), contributory benefits (unemployment and maternity), and family-related benefits.

5 A microsimulation model of the tax-benefit system

In short, we describe the tax and benefit system valid in Slovakia. As the system is highly complex, we focus on substantial parts and discuss its major attributes. In addition, we present a newly developed microsimulation tax and benefit module.

5.1 The Slovak tax and benefit system

The Slovak tax and benefit system is largely unified, and all important components are set at the central level. Individuals are subject to personal income tax (PIT), and the joint taxation of couples is not permitted. Tax is levied on gross income from different sources including wages from employment, self-employment income, fringe benefits, capital income (dividends excluded), rental income, and interest income. Social and health insurance contributions are exempt from the tax base, which is given as the gross earnings net of paid social and health insurance contributions. The tax law allows for deductions from the tax base, and these include a basic tax allowance, spouse tax allowance, employee tax credit, and child tax credit. Every individual can apply for the basic tax allowance—the amount is based on the legally defined minimum subsistence level, and a progressive reduction in its amount applies when earnings exceed the threshold value. If the earnings of a spouse are under a certain level, the taxpayer may be entitled to a spouse tax allowance. An employee tax credit is targeted at low-income groups who pay health and social insurance contributions. One spouse may claim a child tax credit, which is an allowance for every child in the household. Income tax is calculated by applying the appropriate tax rate schedule to the tax base. From 2004 to 2012, the PIT was set at a 19% flat rate; from 2013, tax brackets were re-introduced and a 25% rate was applied to incomes exceeding the threshold. However, this threshold is sufficiently high; thus, the higher tax rate affects less than 2% of employees.

Social and health insurance payments are split between employers and employees. From 2013, the assessment bases for the social and health insurance contributions of employees were unified; before then, they differed based on the type of insurance and employment contract. The assessment base for contributions differs from the base for the computation of the PIT and has a maximum level (i.e. there is a ceiling in paid contributions). Social insurance payments by employers and employees consist of unemployment, sickness, disability, and old-age insurance, but the two categories pay different percentages from the social insurance assessment base. Besides this, employers contribute to a reserve solidarity fund, accident insurance, and guarantee insurance.

The Slovak benefits system comprises three components, and every component consists of several programmes. Contributory benefits cover various pensions (e.g. for senior citizens, the disabled, the bereaved, and orphans), the sickness benefit, maternity benefit, and unemployment insurance benefit. The social assistance programme includes the material needs benefit, which is a means-tested transfer provided to families to provide them with a basic living standard if their income is below the minimum subsistence level. The third component is the state social support programme, which includes several family-related benefits (e.g. a child-birth grant, child benefit, and parental allowance). Eligibility for these transfers does not depend on the contribution history and is not means-tested.

5.2 SIMTASK: a microsimulation model of the Slovak tax-benefit system

The SIMTASK microsimulation model is a tool that can simulate individual tax liabilities and benefit entitlements according to policy rules. It has been built on the existing Slovak tax and transfer microsimulation model developed and maintained by the EUROMOD team at the Institute for Social and Economic Research at the University of Essex. In SIMTASK, several modules of the baseline EUROMOD model were customized and enlarged in order to achieve the highest precision in policy simulation. The development of the model and validation tests of the simulations are comprehensively documented in a related paper by Siebertova et al. (2016). Simulations cover direct taxes (namely labour and capital income taxes) and health and social insurance contributions paid by employees, employers, and the self-employed. Selected transfers—the unemployment benefit, material needs benefit, and family-related transfers (the child-birth grant, child benefit, and parental allowance)—are also simulated.

6 Findings

In this section, we present the labour force participation elasticities estimated for the small and open Slovak economy. The results are shown for different educational, age, and income groups as well as for the full sample. On top of that, we make use of the estimated models to carry out simulations of two tax reform scenarios.

6.1 Labour force participation elasticities

Equipped with the vectors of gains to work logGTW and non-labour income logNY that are constructed using a microsimulation model, we estimate the probit model of labour force participation decision given by Eq. (9). The estimation sample is a pooled dataset over 3 years (2010–2012) constructed with the intention to include only the post-crisis waves of the SILC survey. The model is estimated separately for males and females. The point estimates and the goodness-of-fit measure pseudo R^2 are listed in Table 9 in the Appendix. Reported standard errors are bootstrapped (5000 replications).

In general, the estimates of parameters are in line with the usual findings; the significance and direction of dependencies is similar to those described for the selection equation of the Heckman model that we have used for the prediction of gross wages. Having a higher education and living with an economically active partner increases the probability of economic activity. In order to capture the effect of parenthood, two dummy variables corresponding to child-age categories are included (up to 3 years and over 3 years of age). The age of a child up to 3 years should catch the effect of paid parental allowance. It turns out that being a mother of a small child younger than 3 years of age significantly decreases the probability of being economically active; when having a child older than 3 years of age, the effect becomes positive. However, being the father of a small child of an arbitrary age significantly increases activity. Reporting chronic illness, being a student, or being a pensioner proved to have a significant negative effect on the probability of activity.

In Table 1, we report our main results: the average marginal effects from the probit model of labour force participation. Since our income measures of gains to work and

Table 1 Average marginal effects—the main specification

	Females		Males	
	dy/dx	Std err	dy/dx	Std err
Gains to work (logGTW)	0.118	0.011	0.081	0.009
Non-labour income (logNY)	−0.039	0.004	−0.036	0.003
Net wage (*w*)	0.129	0.013	0.087	0.011

Note: Bootstrapped standard errors, 5000 replications non-labour income are given in natural logarithms, note that in fact we are evaluating semi-elasticities.

Looking at both specifications, the computed results are statistically significant and have the expected sign; in other words, an increase in gains to work increases the probability of participation both for males and females, while the opposite is true for non-labour income. The key estimate of interest—the income semi-elasticity of a labour force participation decision—is significantly larger for females than for males. A 1% rise in gains to work increases individuals' probability of economic activity by 0.12 and 0.08 percentage points for females and males, respectively. This effect is more pronounced for net wages (see Eq. (11) for the analytical derivation). Our results show that the own-wage semi-elasticity of the probability of participation yields 0.13 for females and 0.09 for males. Corresponding income elasticities[9] can be obtained by dividing the semi-elasticities by the average predicted probability of activity—these estimates yield 0.2 for females and 0.11 for males.

On the contrary, the effect of non-labour income on participation probability is comparable for both genders; a 1% increase in non-labour income leads to a decrease of 0.04 percentage points for both genders in supplying labour. Expressed in terms of elasticities, these estimates provide −0.07 and −0.05 for females and males, respectively.

Next, we focused on selected subgroups of individuals and explored how estimated semi-elasticities vary in magnitude. In Table 2, we present a comparison of marginal effects computed for the three educational subgroups (elementary [or less], secondary, and tertiary education) on the prime-age subsample (25–49 years) and separately for females and males. The estimated semi-elasticities are substantially different in terms of educational subgroups: the highest responsiveness was observed in the low-educated group with an elementary education (these individuals are often highly transfer dependent). Our results suggest that participation semi-elasticities substantially decrease with the educational level for both genders. When comparing males and females, the responsiveness of females in higher educated groups is two times higher compared to that of males. Note that in agreement with previous studies, the prime-age subgroup of higher educated males exhibits a low responsiveness overall.

In Table 3, we report the results for the subgroups classified by gender, age, and parental status. Overall, the responsiveness of females is again higher than that of males.

Table 2 Marginal effects by educational subgroups and prime-age subsample

	Females		Males	
	dy/dx	Std err	dy/dx	Std err
Elementary education, age 25–50				
Gains to work (logGTW)	0.201	0.019	0.146	0.017
Non-labour income (logNY)	−0.067	0.006	−0.065	0.006
Secondary education, age 25–50				
Gains to work (logGTW)	0.108	0.010	0.053	0.006
Non-labour income (logNY)	−0.036	0.003	−0.024	0.002
Tertiary education, age 25–50				
Gains to work (logGTW)	0.099	0.010	0.047	0.006
Non-labour income (logNY)	−0.033	0.003	−0.021	0.002

Note: Probit estimates are computed using full sample, and average marginal effects are evaluated at subgroups. Bootstrapped standard errors, 5000 replications

Table 3 Marginal effects by selected subgroups

	dy/dx	Std err		dy/dx	Std err
Females, age 25–50			Males, age 25–50		
Gains to work (logGTW)	0.109	0.010	Gains to work (logGTW)	0.056	0.006
Non-labour income (logNY)	−0.036	0.003	Non-labour income (logNY)	−0.025	0.002
Single females, age 25–50			Single males, age 25–50		
Gains to work (logGTW)	0.123	0.012	Gains to work (logGTW)	0.085	0.010
Non-labour income (logNY)	−0.041	0.004	Non-labour income (logNY)	−0.038	0.004
Females w. child <3 years, age 25–50			Males w. child <3 years, age 25–50		
Gains to work (logGTW)	0.236	0.023	Gains to work (logGTW)	0.021	0.005
Non-labour income (logNY)	−0.078	0.007	Non-labour income (logNY)	−0.010	0.002
Females, age 50+			Males, age 50+		
Gains to work (logGTW)	0.108	0.010	Gains to work (logGTW)	0.080	0.009
Non-labour income (logNY)	−0.036	0.003	Non-labour income (logNY)	−0.035	0.003

Note: Probit estimates are computed using full sample, and average marginal effects are evaluated at subgroups. Bootstrapped standard errors, 5000 replications

Prime-age males with small children under 3 years of age are identified as the subgroup with the smallest semi-elasticity. On the contrary, females with small children are the group with the highest responsiveness, being ten times higher than that of males in the same category.

Overall, the presented results suggest that policies that make work pay would lead to an increase in participation. The low-skilled and females are the groups that are more responsive to changes in taxes and transfers. This implies that labour market policies, namely tax and transfer system reforms that are aimed at boosting economic activity, should be primarily targeted at low-educated individuals and women.

A comparison of estimates obtained for Slovakia to those published for neighbouring countries can be found in Table 4. It appears that the magnitudes of Slovak estimates are lower compared to those for Hungary or the Czech Republic (Benczur et al. 2014, Galuscak and Katay, 2014), suggesting a lower sensitivity of individuals to changes in labour and non-labour incomes. On the other hand, Bicakova et al. (2011) provided

Table 4 Marginal effects: a comparison with neighbouring countries

	Females	Males	All individuals
Slovakia (authors' calculations)			
Gains to work (logGTW)	0.12	0.08	0.10
Non-labour income (logNY)	−0.04	−0.04	−0.04
Czech Republic (Bicakova et al. 2011)			
Effective net wage	0.06	0.01	
Other income	−0.04	−0.01	
Czech Republic (Galuscak and Katay 2014)			
Gains to work			0.27
Non-labour income			−0.10
Hungary (Benczur et al. 2014)			
Gains to work			0.29
Non-labour income			−0.30

Note: Average marginal effects (Slovakia); marginal effects at sample means (Czech Republic, Hungary) estimates for the Czech Republic that are substantially smaller in magnitude for males as well as for females. Estimates lie in the (rather wide) range of already published labour supply elasticities. However, this comparison should only be taken as indicative due to the differences in the methodologies used.

6.2 Tax reform scenario simulation

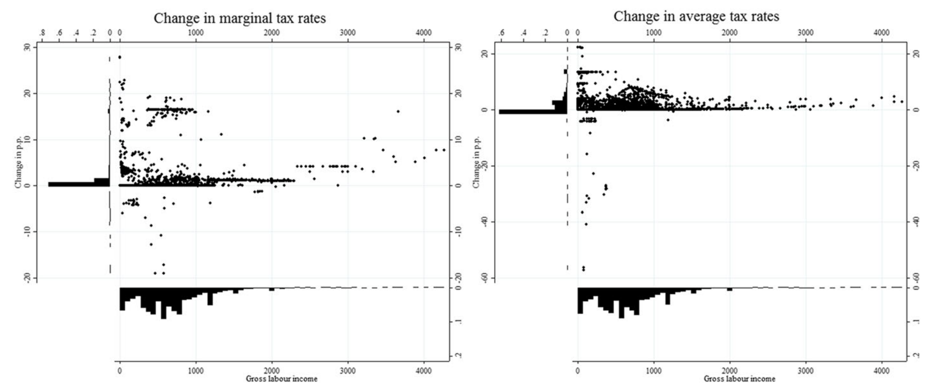
Using the SIMTASK microsimulation model and the model of labour force participation decision estimated above, we conducted a policy analysis of static and behavioural effects of two tax system reforms. As a baseline, the tax and transfer system valid in 2012 in Slovakia was taken. We performed a microsimulation of two scenarios. Firstly, we simulated the effects of adopting the legislation valid since January 2013, which includes a marginal departure from the flat tax and results in higher revenues. Secondly, we estimate the impact of a hypothetical abolition of the flat-tax regime with the same simulated fiscal impact as in the first scenario. Although revenue-neutral scenarios are usually analysed in the academic literature, in our setup, we preferred to simulate the reform with the same first-round fiscal effect that is directly comparable with the first scenario.

The "2013 scenario" directly assessed the effect of recent changes in Slovak legislation, including the marginal deviation from a flat tax and a significant increase in social security contributions. The two tax brackets of PIT were introduced so that incomes were taxed at the 19% tax rate as before, and an additional 25% rate was applied to those earnings exceeding a threshold value. The higher rate applies approximately to the top 2% of earners. Moreover, this scenario includes a significant increase in the maximum assessment base for social security and health care contributions as well as an increase in the burden for income from agreement contracts. To solely assess the effects of changes in PIT legislation, government transfers and other system parameters that enter the computations in SIMTASK (for example, the minimum subsistence level and the minimum wage) were fixed to the level valid in 2012.

The "hypothetical scenario" simulated the effect of reintroducing the tax brackets that were valid before the flat-tax reform in 2004. Five tax brackets with rates of 10, 20, 28, 35, and 38% were defined as in 2003; their thresholds were updated according to the growth of the average nominal wage between 2003 and 2012. As this elementary setup of tax rate regime would result in a decline in tax revenues, a further hypothetical measure needed to be applied to make the fiscal effect of the reform comparable to the 2013 scenario. Specifically, the basic tax allowance is reduced by two thirds.

Firstly, we looked at the static or "day-after" effect of the two scenarios. In particular, the change in individual tax burden and in households' disposable income was assessed under the assumption that people do not change their behaviour. The behavioural aspect was analysed afterwards using the estimates of the probit model of the labour force participation decision.

Figures 3 and 4 depict the first-round effects of the analysed tax reforms in terms of changes in individual marginal and average effective tax rates. It can be clearly seen that simulated changes affect individuals across the whole income distribution in positive as well as negative ways. The variability arises mainly from various combinations of incomes (labour and non-labour) and the fact that the individual income components



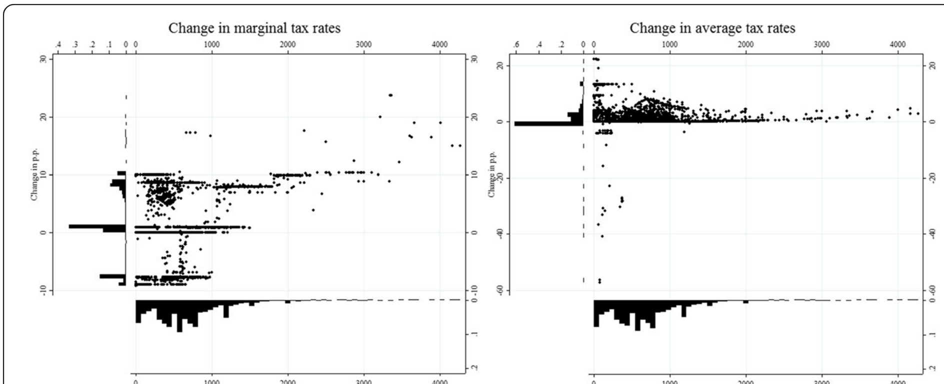
Source: authors' calculations

Fig. 3 Simulated change in individual effective tax rates in scenario 2013

might be considered differently in tax liability computations (in particular, the entitlement to apply different tax allowances).

In the 2013 scenario, the individuals in the upper tail of the distribution face a positive change in their marginal as well as their average effective tax rates. This is mainly the result of an increase in the maximum assessment base for social security and health care contributions. Individuals with income exceeding the pre-reform values of the maximum assessment base pay higher contributions, which at the same time decreases their tax liability. After the threshold of the new maximum assessment base is reached, both effective tax rates are solely influenced by the newly introduced second tax rate.

For most of the earners in the lower part of income distribution, the marginal and average effective tax rates stay unaffected in the 2013 scenario. Effective tax rates increased for those with income from agreement contracts, whose burden was affected by legislation. While before the reform the incomes from agreement contracts[10] were only subject to a 1.05% rate to be paid for social insurance contributions and were taxed at a rate of 19%, since 2013, the regular income from agreement contracts have been burdened at the same rate as employment income. Additionally, due to tightened



Source: authors' calculations

Fig. 4 Simulated change in individual effective tax rates in the hypothetical scenario eligibility conditions for spousal tax allowance valid from 2013, an increase in the tax burden could be observed for affected individuals. On the other hand, a decrease in the tax burden was identified for three small groups affected by the specific change in legislation.

In the hypothetical scenario, the individuals in the upper tail of the distribution face a positive change in their marginal and average effective tax rates, which is expected as the tax rates for incomes in the second to fifth tax brackets increased while the decline in the tax allowance additionally led to an increase in their burden.

A decline in effective tax rates was expected for low-income earners, being hypothetically taxed at the 10% instead of the 19% rate. However, those with earnings below the new basic tax allowance would have no tax liability after the deduction of the tax allowance, similarly as in the baseline scenario. For those with earnings above the new basic tax allowance, the effect of the lowered allowance prevails over the effect of the lower tax rate, thus leading to an increase in the tax burden. The burden would decrease mainly in those cases when the income is not eligible for a tax allowance deduction, e.g. in the case of working old-age pensioners or people with a prevailing income from capital property.

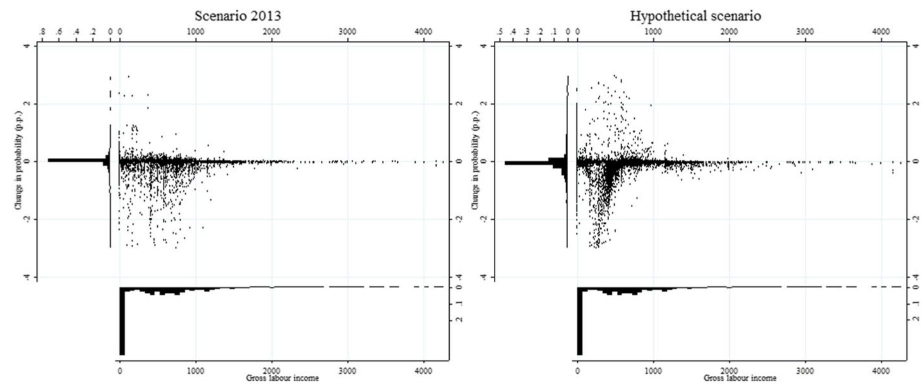
These results can be contrasted to the findings of Krajcir and Odor (2005), who analysed the 2004 Slovak flat-tax reform. They showed that an increase in the non-taxable allowance was an important factor that allowed the tax system to remain moderately progressive and made the reform revenue-neutral, leading to a modest net income decrease for certain groups of workers with below average earnings.

Following this, the impact of legislative changes on labour supply behaviour was analysed. Using the SIMTASK microsimulation model, key income variables (gains to work and non-labour income) were computed for the tax and transfers system setup valid in the baseline and in the two scenarios. Given the semi-elasticities estimated by the probit model of participation probability, we can quantify the extent of change by comparing the probabilities of individuals' participation decisions in the baseline and the scenarios.

The individual responses to analysed tax regime changes, i.e. changes in the individual participation probabilities, are presented in Fig. 5. Individuals with a higher labour income are less responsive to changes in the tax and welfare system despite the fact that they face an increase both in the METR and AETR. In line with the literature as well as our model estimates, suggesting that extensive margin decisions are taken at the lower end of income distribution, Fig. 5 shows the highest changes in probabilities for those earning less than the average wage.

Our approach allows us to compare the impact on participation probabilities for arbitrarily defined population subgroups, thus allowing us to assess to what extent they are affected by the reform. The response in average participation probabilities of specific subgroups in the two scenarios is reported in Table 5.

It turns out that the average probability of participation decreases only negligibly (by 0.05 percentage points) in the 2013 scenario. The detailed results suggest that the probability of participation would decrease for almost all of the selected subgroups. Low earners (the first income quintile) and individuals with a lower education responded with the highest magnitudes. This can be explained by pointing out that these individuals often have income from agreement contracts (which after the reform were



Source: authors' calculations

Fig. 5 Simulated response in participation probabilities

burdened more and in the same way as income from employment) or no labour income at all. Individuals with either a low or no labour income but with a partner that faced a drop in disposable income could as a family become recipients of the material needs benefit or could have their material needs benefit increased. As a result, this translates into a decrease in participation probability in the behavioural model. A positive reaction to legislation changes was identified among young people (15–24 years old) and females with children under 3 years of age. Both of these groups are specific; individuals frequently do not have a labour income (being students and mothers on parental leave) and their own disposable income did not substantially change due to

Table 5 Simulated response in the average probabilities of participation

	Baseline participation probability in percent	Change of baseline in p.p.	
		Scenario 2013	Hypothetical scenario
Population 15–64	68.28	−0.05	−0.11
Age 15–24	39.63	0.03	−0.27
Age 25–50, female	76.26	−0.07	−0.18
Age 25–50, male	89.57	−0.06	−0.09
Age 50+	60.97	−0.08	0.03
Female with child under 3 years, age 25–50	25.39	0.02	−0.18
Male with child under 3 years, age 25–50	96.40	−0.06	−0.01
Elementary education, age 25–50	66.60	−0.33	−0.27
Secondary education, age 25–50	84.51	−0.03	−0.14
Tertiary education, age 25–50	82.28	−0.10	−0.11
Gross wage quintile—Q1 (below 315 euro), age 25–50	62.31	−0.45	−0.31
Gross wage quintile—Q2 (below 538 euro), age 25–50	85.43	0.13	−0.46
Gross wage quintile—Q3 (below 731 euro), age 25–50	92.33	−0.14	0.00
Gross wage quintile—Q4 (below 1005 euro), age 25–50	94.58	−0.11	0.00
Gross wage quintile—Q5 (above 1005 euro), age 25–50	97.94	−0.03	−0.04

Source: authors' calculations

the simulated reform. In the behavioural model, the average participation probability in these groups increased mainly due to the lower disposable income of other working family members.

In the hypothetical scenario, the average probability of labour market participation would decrease by 0.11 percentage points. Similarly to the previous scenario, the detailed results show no special pattern among particular subgroups. A positive response was observed for persons over 50 years of age. This is influenced by the fact that old-age pensioners would not be worse off by a lowered tax allowance but would benefit from a significant decrease in the tax rate. On the other hand, young individuals would decrease their labour participation by 0.27 percentage points. The same applies for the level of income earned. Low earners with high values of estimated participation elasticities are more responsive to changes to the tax system than those people with higher earnings. The individuals belonging to the third and fourth quintile would not change their participation decision under the simulated tax system.

For policymakers, it is of crucial importance to assess the distributional impacts of every proposed tax change. The fundamental question that may arise here is which subgroups of the population would benefit and which would lose after the reform. Table 6 presents the income inequality measures for the analysed scenarios. For both scenarios, the changes in the disposable income of households are simulated, and as a result, the income inequality measures can be compared in two states (before and after the reform).

The impacts of the simulated scenarios differ in terms of income inequality. The Gini coefficient, which is the most commonly used measure of inequality, suggests a slight increase in inequality in the 2013 scenario. The reason is that this tax change would increase the tax wedge for agreement contracts, which are located in the lower deciles of the income distribution and among couples with a lower income. On the other hand, the implementation of the hypothetical scenario would decrease income inequality. This would result from a combination of new tax rates and a substantial decrease in tax allowances.

A more detailed insight into inequality impacts is offered by income share ratios (S90/S10, S80/S20, and S60/S40). We documented that the income share of the top 10% of the population compared to the income share of the bottom 10% would increase in both scenarios. The S90/S10 ratio would increase from 4.85 to 5.34 in the 2013 scenario and to 5.20 in the hypothetical scenario. Like the change in the Gini coefficient, the S80/S20 ratio would indicate a decrease in inequality for the hypothetical scenario. The simulated decrease in the S80/S20 ratio for the 2013 scenario is counterintuitive. Having in mind a slight increase in the Gini coefficient, we would

Table 6 Impact on income inequality

	Baseline index	Scenario indices	
		Scenario 2013	Hypothetical scenario
Gini index	24.52	24.59	24.19
S90/S10 ratio[a]	4.85	5.34	5.20
S80/S20 ratio	3.60	3.51	3.54
S60/S40 ratio	2.34	2.35	2.32

Source: authors' calculations
[a]Inter-decile income share ratios are the ratios of total income received by the top 10, 20, or 40% of the population to that received by the bottom 10, 20 or 40%. Measures are based on disposable household income and equalized by the modified OECD equivalence scale

have expected the opposite effect. Finally, if we compare the top 40% and the bottom 40% of the population, the income shares would remain stable after the implementation of either scenario.

7 Conclusions

In this paper, we studied the elasticity with respect to a unique tax reform in Slovakia whereby the flat tax was backtracked and replaced by a progressive tax. We used a labour supply model that takes into account both taxes and transfers to estimate the semi-elasticities of labour force participation decisions. The advantage of this model is in its ability to conduct an ex ante analysis of changes in the tax and welfare system. As an interesting case study, a move away from the flat-tax system which had been valid in Slovakia until 2012 was analysed.

In particular, a probit model for labour force participation decisions was estimated, and the results were extensively discussed. This analysis shows several clear results. We identify a significant individual responsiveness to changes in labour and non-labour income. It turns out that the results are qualitatively comparable to those reported for mature market economies as well as for neighbouring countries in the region (the Czech Republic and Hungary): the highly responsive groups of the population are the low-skilled and females. Therefore, labour market policies aimed at boosting economic activity should concentrate on increasing marginal gains to work, especially for low-educated individuals and women. We performed a policy analysis of the first-round and behavioural effects of two scenarios. Both of them simulate the departure from the flat-tax system valid in 2012. However, the setup and the details of the two scenarios differed. The simulations of both scenarios confirmed that the responsiveness of labour supply to legislative changes was marginal for people with high earnings. On the contrary, the highest changes in participation probabilities were faced by individuals with below average earnings.

By simulating the two different tax reform scenarios, we demonstrated that the departures from the flat-tax regime with the same fiscal revenue effect have a comparable impact on the average probability of participation. However, the impacts on selected subgroups are different. In the case of real reform in 2013, an increase in tax revenues was accompanied by a slight decrease in the average probability of being economically active by 0.05 percentage points. Individuals with agreement contracts, for whom the tax burden increased significantly, were prominent among the discouraged. In the second scenario, which simulated a hypothetical departure from the flat-tax system by reintroducing five tax brackets together with a significant reduction in the basic tax allowance, labour participation probability was shown to decrease by 0.11 percentage points. The most discouraged groups here would be low earners, individuals with a lower level of education, and women. Finally, we showed that the two simulated scenarios also differed in terms of their consequences for income inequality.

Endnotes

[1]Reform has been set up as revenue-neutral; see Brook and Leibfritz (2005). Due to data limitations, no quantitative evaluation of this reform has been reported.

[2]The notation is based on the model presented by Benczur et al. (2014).

[3]Let us assume that the utility function is an additively separable CES function considered in the form $\frac{c^{1-\psi}-1}{1-\psi}+\chi\frac{(1-l)^{1-\Phi}-1}{1-\Phi}$.

[4]This is also justified in the underlying SK-SILC survey. Less than 2% of respondents in 2012 defined their economic status as "working part time".

[5]In Heckman's framework, the model consists of two equations: selection and regression. In our implementation, the wage equation contains the degree of urbanization of a region where a person resides (dummy) and regional dummy variables (eight regions). These two variables are intended to capture differences in the regional economic environment and thus present a control for the activity indirectly. In addition, we include human capital characteristics, such as a quadratic form of years of experience and three educational groups. The group of exclusion restrictions consists of characteristics that affect the probability of being employed with the assumption that they have no direct effect on gross wages. These include other forms of income available in the household, the quadratic form of age, and unfavourable health conditions. Controls for family status include dummies like being a parent of a child (younger/older than 3 years of age). We also set a control for having a working partner and being single, married, or divorced. Finally, dummies as a control for working students and pensioners were also included. The estimated coefficients were mostly in line with findings that can be found in the literature; we found a statistically significant effect of selection. The detailed estimation results are available upon request.

[6]Our approach to the construction of the GTW variable differs from the setup used by Benczur et al. (2014) and by Galuscak and Katay (2014). They constructed GTW (using the microsimulation tool) for workers and estimate GTW using the Heckman selection model for non-workers.

[7]Income semi-elasticity (η) of labour force participation is defined as $\eta = \frac{\partial \Pr(\text{activity}) = 1}{\partial \text{GTW}} \times \text{GTW}$, implying that the marginal effect of wages on the probability of economic activity can be expressed as $\text{MFX} = \frac{\partial \Pr(\text{activity} = 1)}{\partial \log\text{GTW}} = \gamma\, \varphi(\gamma \log\text{GTW} - \psi \log\text{NY} + Z'\alpha)$, where $\varphi(\cdot)$ denotes the standard normal density function. The estimated effect should be interpreted so that a 1% rise in gains to work leads to the increase of the probability of supplying labour by $0.01 \times$ MFX.

[8]The income elasticity (ε) of labour force participation is defined as $\varepsilon = \frac{\partial \Pr(\text{activity} = 1)}{\partial \text{GTW}} \times \frac{\text{GTW}}{\Pr(\text{activity} = 1)}$ and can be calculated as $\varepsilon = \frac{\eta}{\Pr(\text{activity} = 1)}$, knowing the values of semi-elasticity η and predicted probability of activity Pr(activity = 1).

[9]The income elasticity (ε) of labour force participation is defined as $\varepsilon = \frac{\partial \Pr(\text{activity}=1)}{\partial W} \times \frac{W}{\Pr(\text{activity} = 1)}$ and can be calculated as $\frac{\eta}{\Pr(\text{activity} = 1)}$, knowing the values of semi-elasticity η and predicted probability of activity Pr(activity = 1).

[10]Agreement contracts were a popular form of temporary employment contract before the reform in 2013. In our estimation sample (related to the pre-reform period from 2010 to 2012), a higher share of individuals with this type of contract were observed in the subsample of students, among females, and among younger age cohorts. Detailed descriptive statistics is available upon request.

Appendix

Table 7 List of variables

Active	Binary indicator that equals 1 if the person is economically active in the income reference period.
Employed	Binary indicator that equals 1 if the person is employed in the income reference period.
Gains to work (logGTW)	Variable defined as annual net wage minus the difference between social benefits if not working and social benefits if working.
Non-labour income (logNY)	Variable defined as a sum of two components, namely non-labour income of all household members (for example, pensions, income from property, parental allowance, unemployment benefit, dividend payments) and labour income of other members of the household.
Female	Binary variable that equals 1 if the person is woman, 0 if man.
Age	Variable indicating the person's age.
Years of work experience	Variable representing the person's work experience in years.
Education group dummies	3 binary variables are created based on ISCED classification (EDU: primary [reference cat.], EDU: secondary, EDU: tertiary). If the person belongs to a group according to his highest degree awarded, the corresponding binary variable equals 1, otherwise 0.
Chronic disease	Binary indicator that equals to 1 if the person reports a chronic/long-standing disease.
Parent with child under 3 years	Binary indicator that equals to 1 if the person is a parent of a child that is younger than 3 years.
Parent with child over 3 years	Binary indicator that equals to 1 if the person is a parent of a child that is over 3 years old.
Student	Binary indicator that equals to 1 if the person is a student, 0 otherwise.
Pensioner	Binary indicator that equals to 1 if the person is a pensioner, 0 otherwise.
Working partner	Person has a working partner.
Married	Binary indicator that equals to 1 if the person is married, 0 otherwise.
Separated, divorced, or widowed	Binary indicator that equals to 1 if the person is separated, divorced, or widowed, 0 otherwise.
Degree of urbanization	3 binary variables are created based on the number of inhabitants of the area where the person resides (dense [reference category], average, sparse). If the person belongs to a group according to the degree of urbanization of his residence, the corresponding dummy variable equals 1, otherwise 0.
Regional dummies	8 binary variables are created based on NUTS3 classification (REG: Bratislava [reference cat.], REG: Trnava, REG: Trencin, REG: Nitra, REG: Zilina, REG: Banska Bystrica, REG: Presov, REG: Kosice). If the person belongs to a group, the corresponding binary variable equals 1, otherwise 0.

Table 8 Descriptive statistics of the estimation subsample and original SK-SILC 2010–2012

Dataset	Subsample for estimation		SK-SILC 2010–2012	
Variable	Mean	Std. dev.	Mean	Std. dev.
Active	0.6	0.5	0.5	0.5
Employed	0.6	0.5	0.5	0.5
Gains to work (in euros, monthly)	519.2	168.6	437.6	237.4
Log of gains to work	6.2	0.3	6.1	0.5
Non-labour income (in euros, monthly)	1110.3	632.1	1133.4	633.9
Log of non-labour income	6.8	0.6	6.9	0.6
Male	0.5	0.5	0.5	0.5
Female	0.5	0.5	0.5	0.5
Education: primary	0.1	0.4	0.3	0.4
Education: secondary	0.7	0.5	0.6	0.5
Education: tertiary	0.2	0.4	0.2	0.4
Age	42.4	16.5	39.9	21.0
Years of experience	19.0	14.8	17.4	15.5
Chronic disease	0.3	0.4	0.3	0.4
Parent with child under 3 years	0.1	0.2	0.0	0.2
Parent with child over 3 years	0.3	0.5	0.2	0.4
Pensioner	0.2	0.4	0.2	0.4
Student	0.1	0.4	0.1	0.3
Working partner	0.4	0.5	0.3	0.5
Family: married	0.5	0.5	0.4	0.5
Family: separated, divorced, or widowed	0.1	0.3	0.1	0.3
Density: dense	0.2	0.4	0.2	0.4
Density: average	0.3	0.5	0.3	0.5
Density: sparse	0.4	0.5	0.5	0.5
Region: Bratislava	0.1	0.3	0.1	0.3
Region: Trnava	0.1	0.3	0.1	0.3
Region: Trencin	0.1	0.3	0.1	0.3
Region: Nitra	0.1	0.3	0.1	0.3
Region: Zilina	0.1	0.3	0.1	0.3
Region: Banska Bystrica	0.1	0.3	0.1	0.3
Region: Presov	0.2	0.4	0.2	0.4
Region: Kosice	0.1	0.4	0.1	0.4
Sample size	37,960		46,191	

Table 9 Point estimates of probit model (pooled regression 2010–2012)

Dependent variable ACTIVE	Females			Males		
logGTW	0.704	***	(0.067)	0.628	***	(0.070)
logNY	−0.234	***	(0.022)	−0.279	***	(0.027)
EDU: secondary	0.468	***	(0.040)	0.542	***	(0.044)
EDU: tertiary	0.557	***	(0.054)	0.576	***	(0.062)
Parent with child under 3 years	−2.215	***	(0.049)	0.475	***	(0.128)
Parent with child over 3 years	0.094	***	(0.034)	0.328	***	(0.050)
Married	−0.021		(0.046)	−0.134	**	(0.053)
Divorced/widowed	0.135	***	(0.047)	−0.230	***	(0.079)
Has working partner	0.257	***	(0.044)	0.349	***	(0.050)
Chronic disease	−0.715	***	(0.031)	−1.070	***	(0.041)
Student	−1.996	***	(0.042)	−2.165	***	(0.046)
Pensioner	−2.435	***	(0.042)	−2.762	***	(0.062)
Year 2011	−0.016	*	(0.031)	−0.092	***	(0.038)
Year 2012	0.020		(0.031)	−0.128	***	(0.038)
Constant	−2.917	***	(0.542)	−1.635	**	(0.589)
Number of observations	20,277			17,641		
R^2 pseudo	0.548			0.615		

Standard errors in parentheses. Reference categories for the dummies: education (ref. elementary), family status (ref. single), year (ref. 2010). Bootstrapped standard errors, 5000 replications
***$p < 0.01$; **$p < 0.05$; *$p < 0.1$

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References

Aaberge R, Colombino U (2014) Labour supply models. In: Cathal O'Donoghue (ed) Handbook of microsimulation modelling, contributions to economic analysis, vol. 293, 167–221, Emerald Group Publishing Limited. http://www.emeraldinsight.com/doi/abs/10.1108/S0573-855520140000293006
Bargain O, Orsini K, Peichl A (2014) Comparing labor supply elasticities in Europe and the US: new results. J Hum Resour 49(3):723–838
Benczur P, Katay G, Kiss A, Racz O (2014) Income taxation, transfers and labour supply at the extensive margin. Working Papers 487, Banque de France. https://ideas.repec.org/p/bfr/banfra/487.html
Beninger D, Bargain O, Beblo M, Blundell R, Carrasco R, Chiuri M, Laisney F, Lechene V, Longobardi E, Moreau N, Myck M (2006) Evaluating the move to a linear tax system in Germany and other European countries. Rev Econ Househ 4(2):159–180, Springer
Bicakova A, Slacalek J, Slavik M (2011) Labor supply after transition: evidence from the Czech Republic. Czech J Econ Finan (Finance a úvěr) 61(4):327–347
Blundell R, MaCurdy T (1999) Labor supply: a review of alternative approaches, handbook of labor economics. In: Ashenfelter O & Card D (ed) Handbook of labor economics, 1st edn, vol3, chapter 27, 1559–1695 Elsevier. http://www.sciencedirect.com/science/article/pii/S1573446399030084
Breunig R, Mercante J (2010) The accuracy of predicted wages of the non-employed and implications for policy simulations from structural labour supply models. Econ Rec 86(272):49–70, The Economic Society of Australia
Brook AM, Leibfritz W (2005) Slovakia's introduction of a flat-tax, OECD Economics Department Working Paper, No. 448
Chase RS (1995) Women's labor force participation during and after communism: a case study of the Czech Republic and Slovakia. Yale Economic Growth Center Working Paper No. 768. http://www.econ.yale.edu/growth_pdf/cdp768.pdf. Accessed 22 Jan 2014.

Chetty R, Guren A, Manoli DS, Weber A (2013) Does indivisible labor explain the difference between micro and macro elasticities? A meta-analysis of extensive margin elasticities. In: Acemoglu D, Parker J, Woodford M (eds) The NBER macroeconomics annual, vol 27., pp 1–56
Decoster A, De Swerdt K, Orsini K (2010) A Belgian flat income tax. Effects on labour supply and income distribution. Rev Bus Econ 1:23–54, LV Issue
Duncan D, Sabirianova Peter K (2010) Does labour supply respond to a flat-tax? Econ Transit 18(2):365–404
Fuest C, Peichl A, Schaefer T (2008) Is a flat-tax politically feasible in a grown-up welfare state? Int Tax Public Financ 15(5):620–636, Springer;International Institute of Public Finance
Galuscak K, Katay G (2014) Labour force participation and tax-benefit systems: a cross-country comparative perspective. Working Papers 2014/10, Czech National Bank. http://www.cnb.cz/en/research/research_publications/cnb_wp/download/cnbwp_2014_10.pdf. Accessed 12 Feb 2015.
Hausman JA (1981) Labor supply. How taxes affect economic behavior. In: Aaron H and Pechman J (eds) The Brookings Institution, Washington D.C, pp 27–72. http://www.nber.org/papers/r0245
Heckman JJ (1979) Sample selection bias as a specification error. Econometrica 47(1):153–161
Heim BT (2008) The incredible shrinking elasticities: married female labor supply, 1978–2002. J Hum Resour 42(4):881–918
Krajcir Z, Odor L (2005) Prvy rok danovej reform alebo 19% v akcii [The first year of the tax reform or 19 percent in action], Financial Policy Institute, Economic Analysis No. 8. http://www.finance.gov.sk/Default.aspx?CatID=4650
McClelland R, Mok S (2012) A review of recent research on labor supply elasticities. Congressional Budget Office Congressional Budget Office. Washington D.C. https://www.cbo.gov/publication/43675
Meghir C, Phillips D (2010) Labour supply and taxes. In: J Mirrlees, S Adam, T Besley, R Blundell, S Bond, R Chote, M Gammie, P Johnson, G Myles, and J Poterba (eds) Dimensions of tax design: the Mirrlees Review, Oxford University Press for Institute for Fiscal Studies. http://www.ifs.org.uk/publications/7184
Moffitt RA (2002) Welfare programs and labor supply, handbook of public economics. In: A. J. Auerbach & Feldstein M (ed), Handbook of public economics, 1st edn, vol 4, chapter 34, pp 2393–2430 Elsevier. http://www.sciencedirect.com/science/article/pii/S1573442002800131
Porubsky M, Machlica G, Strizencova K (2013) EUROMOD country report, Slovak Republic (2009–2012). Institute for Social & Economic Research, University of Essex
Siebertova Z, Svarda N, Valachyova J (2016) Improving the validity of microsimulation results: lessons from Slovakia. Int J Microsimulation 9(2):77–105
Van Soest A (1995) Structural models of family labor supply: a discrete choice approach. J Hum Resour 30:63–88
World Bank (2012) Providing the right incentives: analysis of the tax-benefit system in the Slovak Republic, Social Safety Net Assessment and Poverty Mapping. https://www.employment.gov.sk/en/analyses-statistics/. Accessed 22 Jan 2014.