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MATÚŠ SENAJ

ZUZANA SIEBERTOVÁ

NORBERT SVARDA

JANA VALACHYOVA

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Matúš Senaj
Council for Budget Responsibility

Zuzana Siebertová
Council for Budget Responsibility

Norbert Švarda
Council for Budget Responsibility

Jana Valachyová
Council for Budget Responsibility

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Central European Labour Studies Institute (CELSI)

Zvolenská 29
821 09 Bratislava
Slovak Republic

Tel/Fax: +421-2-207 357 67
E-mail: info@celsi.sk
Web: www.celsi.sk

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ABSTRACT

Labour Force Participation Elasticities and Move Away from the Flat Tax: the Case of Slovakia

This paper provides a microeconometric analysis of labour force participation elasticities in Slovakia. Using a fully parametric framework, a probability model for participation in labour force is estimated. Our results show that low-skilled and females are the groups that are particularly responsive to changes in income taxes and transfers. We perform a microsimulation analysis of two counterfactual scenarios of abolition of the flat tax regime. We find out that recent departure from the flat-tax system in Slovakia reduces the average probability of being economically active by 0.1 percentage points. The same average effect is found in the hypothetical scenario simulating a departure from the flat-tax system by reintroducing five tax brackets. However, we show that the impact of the two scenarios on selected subgroups of population is different.

Keywords: Labour force participation elasticity, Extensive margin, Micro-simulation, Flat-tax

JEL Classification: H31, H53, I38, J21

Corresponding Author:

Zuzana Siebertová
Council for Budget Responsibility
I. Karvaša 1, 813 25, Bratislava, Slovakia
email: siebertova@rrz.sk

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1 Introduction

This paper examines the link between labour force participation and the changes in 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 the tax system. The fundamental issue is to assess how sensitive are individuals' work incentives to changes in taxes and benefits. Analysis of labour supply behaviour is thus a key element when evaluating reforms of tax and transfer systems and the impact of different policies on changes in tax revenues, employment or wealth redistribution.

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

This paper examines the labour supply behaviour in Slovakia that is lacking in the literature. On top of that, using the detailed microsimulation model and estimates of participation decision (labour supply elasticities at the extensive margin) we quantify the recent reform of the tax system valid from 2013 that resulted in the marginal move away from flat tax and an increase in revenues. In addition, we perform a simulation of counterfactual scenario of abolition of flat tax regime with the same simulated first round revenue effect.

These findings are important, as inactivity rate persists to be high in Slovakia, and little has been done to formally assess the effects of income taxation and social welfare programs on labour market inactivity. Participation rates in Slovakia are permanently below the EU-27 average but still rather high compared to neighbouring Hungary and Poland. In 2012, EUROSTAT reports participation rate at 69 per cent for Slovakia, in the Czech Republic 72, in Poland 67 and 64 per cent in Hungary. The EU-27 average was 72 per cent. Moreover, participation rates of low-skilled (low educated) workers belong to the lowest among EU-27 countries.

Literature on microeconometric estimations of labour supply elasticities is vast. A number of studies conclude that extensive margin is much more important than intensive margin. Existing studies usually evaluate labour supply elasticities of some special demographic subgroups (single individuals, married women, couples, etc.). 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 sizable. As noted by Bargain et al. (2014) differences across studies arise due to distinct methodologies applied, including the underlying datasets used (administrative versus survey data) as well as time periods of study. An overview of recent estimates of labour supply elasticities in the U.S. economy can be found in Chetty et al (2013) or McClelland and Mok (2012). For an overview of recent empirical evidence on labour supply elasticities in Europe and U.S., see Bargain et al. (2014). However, despite the multitude of methodologies and information covered by existing studies, analyses focusing on Central and Eastern European countries are rather scarce and the case of Slovakia has been covered only in one paper so far. Chase (1995) compares labour force participation and wage elasticities between Communist and post-Communist regimes in Slovakia and the Czech Republic. He shows that women's participation in the labour market was higher under Communism and concludes that the effects of changes in earnings are smaller in Slovakia compared to the Czech Republic. This is probably a result of slower transformation of the Slovak economy.

Looking at neighbouring countries of Slovakia, Benczur et al. (2014) study labour supply at the extensive margin in Hungary. The authors modify an existing structural approach originally proposed by Hausman (1981) by taking the effects of tax and benefit system directly into account. As regards the participation decision, they show that wages, taxes and transfers have a stronger influence on the participation decision of individuals that are older, low skilled or married women and women at child-bearing age. Galuscak and Katay (2014) followed the same methodology and provide the empirical estimates for the Czech Republic which are close to those reported for Hungary. Another analysis focused on the Czech Republic has been performed by Bicakova et al (2011). Authors provide 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 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 use a fully parametric approach to 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. 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 two states: being in labour force and being out of labour force. A key component of this approach is to precisely evaluate disposable income of an individual, including also non-labour income and social transfers received by the household in both states. In order to do so, a concept of *gains to work* of an individual is introduced and defined as the difference between the net wage and the amount of social benefits lost due to taking up a full-time job.

Employing a full-parametric 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 in general dependent on the level of net income and non-labour income, including social transfers. We find that a one percent increase in net wage 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 one percent 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, 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 ex-ante assessment of the counterfactual tax and transfer system reforms and moreover, it permits 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, Svarda and Valachyova (2015). 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 the proposed tax system reforms. In such studies, the introduction of flat income tax and its impact on supply of labour is frequently analysed. Such as, Decoster et al. (2010) study the introduction of flat-tax in Belgium and they find that flat-tax system could potentially increase labour supply. The introduction of linear taxation in Germany is examined in Beninger et al. (2006) and Fuest et al. (2007). In the former paper, the authors compare the effects computed by using unitary and collective labour supply model. In the latter paper, they use a behavioural microsimulation model and conclude that flat-tax reform could potentially increase employment although the magnitude of the increase is 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 hours worked distribution and also that the reform has 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 re-introducing the tax brackets. By performing a microsimulation of two counterfactual scenarios, we show that the different way of moving away from the flat-tax system may have a different impact on labour supply decision. We find out that recent departure from flat-tax system in Slovakia effective from 2013 slightly reduced the average probability of being economically active. Although the hypothetical scenario of abolition of the flat-tax system would have almost the same 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 immediate or the "day-after" effects of two counterfactual reforms. Long-run general equilibrium analysis will be performed in the separate paper, since the discussion and execution of these issues is beyond the scope of this study.

The rest of the paper is organized as follows. The next section presents the modelling approach that was employed in this article. Section 3 follows with the data description and definition of variables used in the model. Section 4 depicts a short introduction of the Slovak tax and benefit system. In section 5 we discuss the main results on estimated labour supply elasticities and we provide tax reform simulations. Finally, section 6 concludes. In the Appendix we list definitions of main variables and present detailed results of our estimations.

2 Methodology

In this section we set up the microeconometric model of labour supply behaviour. We present the approach where taxes and transfers are explicitly taken into account. This extension of the standard labour supply model leads to the specification of the 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 using this methodology, participation elasticities can be derived analytically.

2.1 Specification of the model of participation decision

Labour supply decision of individuals is usually modelled as a utility maximization problem formulated as a consumption-leisure trade off [6]:

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

subject to the budget constraint

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

where c stands for the consumption, w is wage, l is labour and NY is other non-labour income including incomes of other household members and government transfers. Note that the budget constraint includes disposable income of the whole household and thus, also income of other members 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 wage and non-labour net income. When employing the standard utility function[7] characterized by the strictly positive marginal utilities, the optimality condition is determined by the 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 non-working. In this theoretical framework, non-participation in work follows from the corner solution of the model (Hausman, 1981). Note that if an individual does not work, optimal consumption equals $c = NY$. The reservation wage is

[6] Notation is based on the model presented by Benczur et al. (2014).

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

the lowest wage rate at which the worker will be willing to accept a particular job, i.e. work non-zero hours and in this set up can be expressed as

$$w_{res} = \frac{u'_{1-l}(NY,1)}{u'_c(NY,1)} = NY^{\psi}\chi. \quad (3)$$

An individual takes up a job if the offered wage exceeds his reservation wage $w \geq w_{res}$, or put differently $\log w \geq \psi \log NY + \log \chi$. Assume that individuals differ in their preferences such that relation $\log \chi_i = Z_i'\alpha + \varepsilon_i$ holds. Z_i is a vector of observable preferences that affect individual decision to work and $\varepsilon_i \sim N(0, \sigma_\varepsilon^2)$ is the error term independently and normally distributed across 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

$$\Pr(\text{activity}_i = 1) = \Phi(\gamma \log w_i + Z_i'\alpha - \psi \log NY_i), \quad (4)$$

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

Early generation of static models of labour supply, represented essentially by the approach of Hausman (1981), were capable only partially represent the effects of tax and transfers policies on households budget sets.[8] 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 for this discrete downward jump in transfers.[9]

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 redefinition of the reservation wage, at the expense that the participation decision of an individual needs to be constrained to a full time job. 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 a full-time employment. As showed by statistics from EUROSTAT, Slovakia is the country with one of the lowest share of workers employed part-time in Europe. In 2012, the share of

[8] Shortcomings of this class of models have been extensively discussed in the literature. For a comprehensive overview of different modelling strategies, see among others Aaberge and Colombino (2014).

[9] As a reaction to these weak points, the discrete choice framework based on the concept of a random utility maximization presents a suitable alternative. This approach introduced originally by van Soest (1995) has become rather standard in recent years. Model is in its set-up general, preferences should be evaluated at each alternative and the tangency conditions need not to be imposed. Utility maximization problem of individuals is reduced to choose among discrete set of options (yielding different utilities) such as working full-time, part-time or not to work. Being inactive thus presents one of the alternatives and the extensive and intensive margins could be directly estimated, such that labour supply decisions are evaluated even in the presence of non-convexities in budget constraints.

part-time workers was 4 per cent as opposed to 20 per cent reached in EU-27.[10] Similar situation has been documented in Hungary and the Czech Republic.

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

$$GTW_i = \widehat{w_i} - (SB^{NW} - SB^{W}) = \widehat{w_i} - \Delta SB, \quad (5)$$

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. The standard Heckman selection model is used to predict gross wages for non-workers, details on the specification and results are presented in the Appendix. In order to obtain a consistent vector of gains to work GTW and to reduce the division bias we use the predicted values of gross wages for every individual in our sample (also for the employed), as it is common in the labour supply literature, see, for example, Bargain et al. (2014) or Breunig and Mercante (2010). To construct the vector GTW, a microsimulation tool is needed. The tax and benefit calculator, SIMTASK, is used to compute net wages from gross wages and to simulate the amount of social benefits an individual is entitled to when working (SB^{W}) and when not working (SB^{NW}) taking into account the individual characteristics as well as characteristics of the corresponding household. In our implementation, considering the details of tax and transfer system, social benefits that enter to variable GTW include means tested material need allowance and its supplements allocated at the household level.[11]

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 social benefits that an individual is entitled to when not working, non-labour income of all household members (including individual i) and net labour income of other members of the household. Non-labour income covers pensions, income from property, dividend payments, but also family related benefits (eligibility does not depend on whether parent works or not) and 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 again 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: $c = NY, 1 - l = 1$ and the utility is given as $u(NY, 1)$. When working full-time (l^*), the budget constraint can be expressed as $c = wl^* - \Delta SB + NY, 1 - l = 1 - l^*$ and the corresponding utility as $u(GTW + NY, 1 - l^*)$.

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

[11] Our approach to the construction of GTW variable differs to the set up used by Benczur et al. (2014) or Galuscak and Katay (2014). They construct GTW (using the microsimulation tool) for workers and estimate GTW using the Heckman selection model for non-workers.

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

$$u(GTW + NY, 1 - l^*) \geq u(NY, 1). \qquad (6)$$

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

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

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

$$\log GTW - \psi \log NY - \log \chi \geq \varepsilon. \qquad (8)$$

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 equation (4):

$$\Pr(\text{activity}_i = 1) = \Phi(\gamma \log GTW_i + Z'_i\alpha - \psi \log NY_i). \qquad (9)$$

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

2.2 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, point estimates of the coefficients do not indicate 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 probability of economic activity and our wage measure gains to work is given in natural logarithm, note that in fact we evaluate semi-elasticities.[12] To calculate the corresponding income elasticities, one has to divide the computed semi-elasticities by the predicted probability of economic activity.[13]

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:

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

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

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

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

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

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

3 Data

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

3.1 SILC

The data used for microeconometric analysis come from three waves (2010-2012) of SK-SILC, the national version of EU-SILC (Statistics on Income and Living Conditions). Data are collected on an annual basis from 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 the global economic crisis (i.e. after 2010) due to structural changes between these two periods and major shifts in the labour market functioning in particular. The dataset contains cross-sectional data on household and individual level and it provides information on income, living conditions, social exclusion and poverty. The original datasets contain information on more than 15,000 individuals and 5,200 households annually. We combined these three datasets to a pooled cross-section and we estimate probit models of participation decision as a pooled regression.

The SK-SILC comprises detailed information describing the personal characteristics of individuals. These include age, gender, education and region of permanent residency and marital status. The dataset also reports detailed information related to labour market status – whether an individual was employed (full-time, part-time), self-employed or whether he stayed 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 also transfers from the state, among others family related and unemployment benefits or pensions (old-age, disability). Further description and summary statistics of variables can be found in Tables A1-A2 in the Appendix.

The dataset we use in the econometric estimation is restricted by age to persons older than 15, to exclude children in compulsory education. The average retirement age was 61 in Slovakia in 2012 and those receiving old-age pensions can participate in the paid work, but majority of individuals older than 75 does not get paid income and does not participate in the labour market. Thus we restrict the sample to persons younger than 75. However, when computing the household income and household social benefits, the whole dataset is considered. We do not exclude self-employed from the estimation sample, although they are usually not considered in majority of analyses due to data unrepresentativeness. Our decision not to exclude those declaring income from self-employment is based on two perspectives. First, a number of individuals declare income both from the employment and self-employment and we take this into account in our microsimulation model when simulating tax due. Second, in our model of labour force participation we model explicitly decision making at the household level and if the declared income from self-employment will not be considered, this may lead to bias in results. We drop out from 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 per cent and we are left with nearly 38,000 individual observations in the pooled sample.

3.2 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 „prevailing activity in the income reference period“, which comprises the categories of children, employed, unemployed, pensioners and other inactive. Economically active are those who declared themselves as employed or unemployed (in terms of ILO definition of economic activity), category of inactive consists of children, pensioners and other inactive. However, those pensioners and students who have declared positive labour income are considered in our model as being 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 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 available in the SK-SILC database only 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 wage from main and second job, income from self-employment, income from company shares and income from agreements (temporary contracts). Information on fringe benefits, severance and termination payments, and company car is also available. Non-labour income covers income from rental of a property or land, interests, dividends and profit from capital investments. Transfers involve pensions (old-age, disability), means-tested benefits (such as material need benefit), contributory benefits (unemployment and maternity) and family related benefits.

4 Microsimulation model of the tax-benefit system

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

4.1 Slovak tax-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 and interest income. Social and health insurance contributions are exempt from the tax base which is given as gross earnings net of paid social and health insurance contributions. The tax law allows for deductions from the tax base and these include basic tax allowance, spouse tax allowance, employee tax credit and child tax credit. Every individual can apply for the basic tax allowance - its amount is based on the legally defined minimum subsistence level and a progressive reduction in its amount applies when earnings exceed threshold value. If earnings of spouse are under certain level, the tax payer may be entitled to spouse tax allowance. Employee tax credit is targeted at low-income groups who pay health and social insurance contributions. One spouse may claim child tax credit, an allowance for every child in the household. Income tax is calculated by applying the appropriate tax rate schedule to tax base. From 2004 to 2012 PIT was set to a 19 per cent flat rate, from 2013 tax brackets were re-introduced and 25 per cent rate is applied to incomes exceeding the threshold. However, this threshold is sufficiently high, so the higher tax rate relates to less than 2 per cent of employees.

The social and health insurance payments are split between employer and employee. From 2013 assessment bases for social and health insurance contributions of employees were unified, before they differed based on the type of insurance and employment contract. The assessment base for contributions differs from the base for computation of PIT and has a maximum (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 pay contributions to a reserve solidarity fund, accident insurance and guarantee insurance.

The Slovak benefit system comprises three components namely contributory benefits, social assistance and poverty benefits and state social support. Each component consists of several programs.

a) Contributory benefits cover various pensions (old-age, disability, widower’s, orphans), sickness benefit, maternity benefit and unemployment insurance benefit.

b) Social assistance program includes material needs benefit which is a means-tested transfer provided to families to provide them basic living standard if their income is below the minimum subsistence level.

c) The state social support program includes several family related benefits (e.g. child birth grant, child benefit, or parental allowance). Eligibility to these transfers does not depend on the contribution history and is not means-tested.

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

A microsimulation model SIMTASK 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 EUROMOD team at ISER, 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. Development of the model and validation tests of the simulations are comprehensively documented in the related paper by Siebertova et al. (2016). Simulations cover direct taxes (namely labour and capital income taxes), health and social insurance contributions paid by employees, employers and self-employed. Selected transfers are also simulated – namely unemployment benefit, material needs benefit and family related transfers (child birth grant, child benefit and parental allowance).

5 Findings

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

5.1 Labour force participation elasticities

Equipped with the vectors of gains to work $\log GTW$ and non-labour income $\log NY$ that are constructed using a microsimulation model, we estimate the probit model of labour force participation decision given by equation (9). Estimation sample is a pooled dataset over three years (2010-12) constructed with the intention to include only post crisis waves of SILC survey. Model is estimated separately for males and females. Point estimates and goodness-of-fit measure pseudo R2 are listed in Table A5 in the Appendix. Reported standard errors are bootstrapped (5000 replications).

In general, the estimates of parameters are in line with usual findings, 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 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). Age of the 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 significantly decreases the probability of being economically active, when having a child older than 3 years the effect becomes positive. However, being a father of a small child of arbitrary age significantly increases activity. Reporting chronic illness, being a student or 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 measure gains to work and non-labour income are given in natural logarithms, note that in fact we evaluate 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 labour force participation decision is significantly larger for females than for males. A one percent rise in gains to work increases the individuals' probability of economic activity by 0.12 and 0.08 percentage points for females and males, respectively. This effect is more pronounced for the net wage (see equation (11) for the analytical derivation). Our results show, that an own-wage semi-elasticity of the probability of participation yields 0.13 for females and 0.09 for males. Corresponding income elasticities[14] 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 one percent increase in non-labour income leads to 0.04 percentage points decrease for both genders in supplying labour. Expressed in terms of elasticities these estimates provide -0.07 and -0.05 for females and males, respectively.

Table 1: Average marginal effects – 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
Netwage (*w*)	0.129	0.013	0.087	0.011

Note: Bootstrapped standard errors, 5000 replications.

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

Next we focus on selected subgroups of individuals and explore how the 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 prime-age subsample (25-49 years) and separately for females and males. The estimated semi-elasticities are substantially different by educational subgroups: the highest responsiveness is observed in the low-educated group with elementary education (these individuals are often highly transfers-dependent). Our results suggest that participation semi-elasticities substantially decrease with educational level for both genders. Contrasting males and females, responsiveness of females is in higher educated groups two times higher compared to males. Notice that in agreement with previous studies, the prime-age subgroup of higher educated males exhibits overall low responsiveness.

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 sub-groups. Bootstrapped standard errors, 5000 replications.

In Table 3, we report the results for the sub-groups classified by gender, age and parentship status. Overall, the responsiveness of females is again larger than that of males. Prime-age males with small children under three years are identified as the sub-group with the smallest semi-elasticity. On the contrary, females with small children are the group with highest responsiveness – being ten times higher than that of males in the same category.

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 <3y. , age 25-50			**Males w. child <3y. , 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 sub-groups. Bootstrapped standard errors, 5000 replications.

Finally, in Table 4, we look at the sub-groups divided by income levels, here represented by the quintiles of monthly gross wages. Results for prime age males and females differ: response of males is again significantly lower. In both groups, semi-elasticities decrease with income level. Cross quintiles differences in obtained elasticities are larger at the lower end, i.e. between first and second quintiles.

Table 4: Marginal effects by gross wage quintiles: subsample of employed individuals, age 25-50

	Females		**Males**	
	dy/dx	**std err**	**dy/dx**	**std err**
Q1	**(below 370 euro)**		**(below 452 euro)**	
Gains to work (*logGTW)*	0.121	0.011	0.075	0.009
Non-labour income (*logNY)*	-0.040	0.004	-0.033	0.003
Q2	**(below 515 euro)**		**(below 637 euro)**	
Gains to work (*logGTW)*	0.100	0.010	0.055	0.006
Non-labour income (*logNY)*	-0.033	0.003	-0.024	0.002
Q3	**(below 636 euro)**		**(below 792 euro)**	
Gains to work (*logGTW)*	0.089	0.009	0.045	0.005
Non-labour income (*logNY)*	-0.029	0.003	-0.020	0.002
Q4	**(below 801 euro)**		**(below 1012 euro)**	
Gains to work (*logGTW)*	0.081	0.008	0.039	0.004
Non-labour income (*logNY)*	-0.027	0.003	-0.017	0.002
Q5	**(above 801 euro)**		**(above 1012 euro)**	
Gains to work (*logGTW)*	0.070	0.006	0.031	0.003
Non-labour income (*logNY)*	-0.023	0.002	-0.014	0.001

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

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.

5.2 Tax reform scenario simulation

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

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

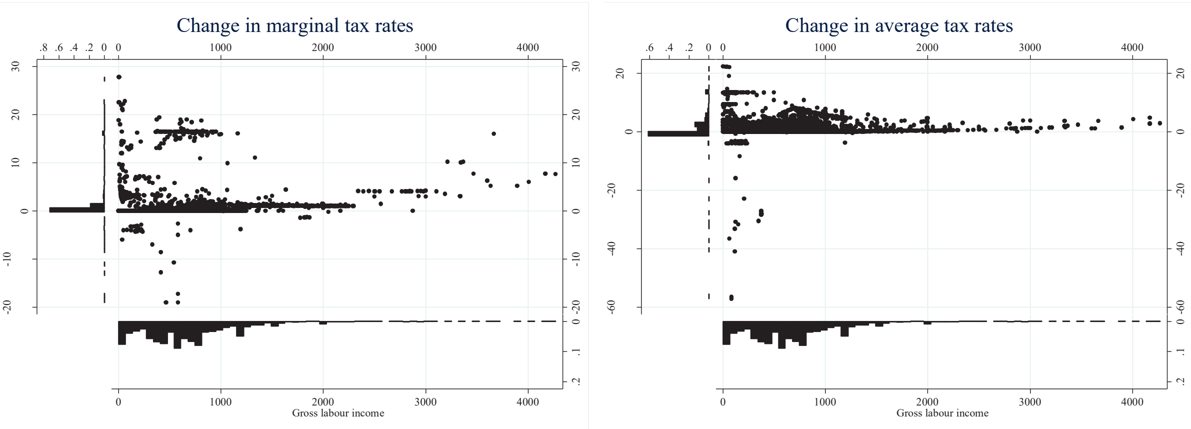
The second one, "hypothetical scenario" simulates the effect of reintroducing the tax brackets that were valid before the flat-tax reform in 2004. Five tax brackets with rates 10, 20, 28, 35 and 38 percent are defined as in 2003, their thresholds are updated according to the growth of average nominal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

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

Figure 1 and Figure 2 depict the first round effects of analysed tax reforms in terms of changes in individual marginal and average effective tax rates. It can be clearly seen, that simulated changes affect the individuals across the whole income distribution and in both, positive and negative, directions. The variability arises mainly from various combinations of incomes (labour and non-labour income) and the fact that the individual income components might be considered differently in tax liability computations (in particular entitlement for applying different tax allowances).

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

Figure 1 Simulated change in individual effective tax rates in scenario 2013



Source: authors' calculations.

For most of the earners in the lower part of income distribution, marginal and average effective tax rate stay unaffected in scenario 2013. Effective tax rates increased for those with income from agreement contracts whose burden was affected by legislation. While before the reform, the incomes from agreements were subject to only 1.05 percent rate to be paid for social insurance contributions and taxed at rate 19 percent, since 2013 the regular income from agreements is burdened at the same rate as employment income. For agreement contracts with non-regular payment, old-age pensioners or students certain exemptions apply. Additionally, due to tightened eligibility conditions for spouse tax allowance valid from 2013, an increase in tax burden could be observed for affected individuals.

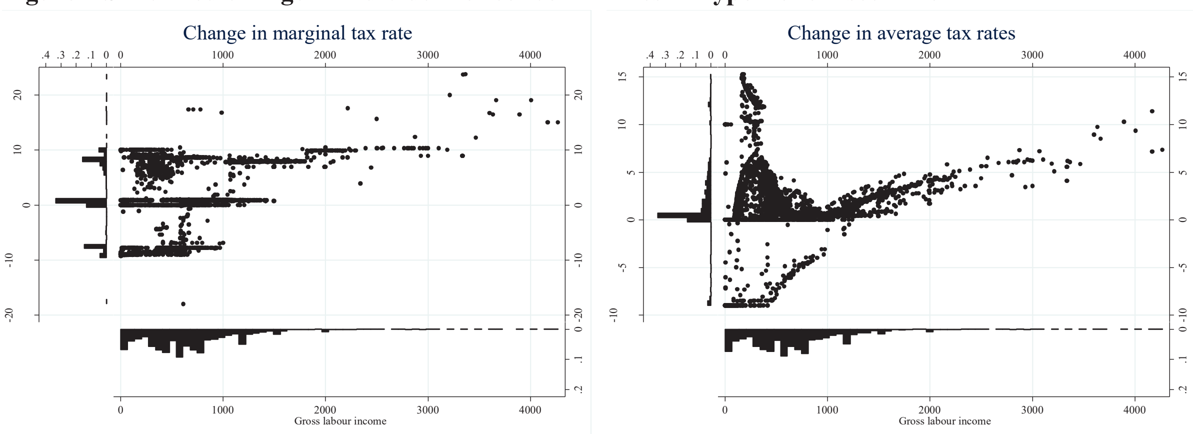
On the other hand, the decrease in tax burden, noticeable in Figure 1, was identified mainly for three specific groups. First, the self-employed who paid social insurance contributions in 2012 but, due to the change in computation of the minimum assessment base, they were not required to pay it in 2013.

Second, marginal decrease in tax burden has been observed also through the following channel: increased tax burden of a spouse lowers her disposable income, which might increase the eligibility for spouse tax allowance and consequently may lower the final tax liability of the husband. Finally, a change in the payments of health insurance contributions concerning persons for whom the insurance is paid by the state resulted in declined burden. Since 2013, the duplicity in payments when both the state and the insured person paid these contributions, has been removed from the legislation. Actually, person pays the contributions only if his income exceeds threshold value, otherwise the state pays.

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

Decline in effective tax rates shall be expected for low income earners, being hypothetically taxed by 10 percent instead of 19 percent rate. However, those with earnings below the new basic tax allowance would have no tax liability after the deduction of tax allowance, alike in baseline scenario. For those with earnings above the new basic tax allowance, too, the effect of lowered allowance prevails over the effect of lower tax rate, thus leading to increase in the tax burden. The burden would decrease mainly in those cases when the income is not eligible for tax allowance deduction, e.g. in the case of working old-age pensioners or persons with prevailing income from capital property.

Figure 2 Simulated change in individual effective tax rates in hypothetical scenario

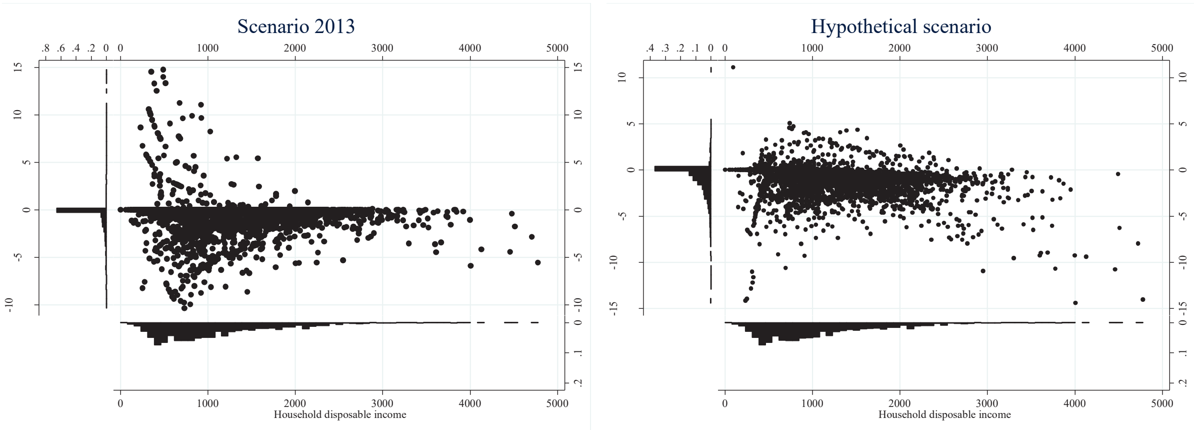


Source: authors' calculations.

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

We assume that the decisions on labour participation are taking into account implied changes in the disposable income at the households' level. The immediate or the "day after" impact on household budget constraints can be seen in Figure 3. In particular, left axis depicts the change in disposable income, whereas horizontal axis depicts the level of households' disposable income in 2012. In addition to the changes in disposable income of individuals implied by the changes in the tax burden as described above, the changes in eligibility for receiving transfers might arise at household level. If an individual faces increase in tax burden, an increased eligibility for means-tested benefit (material need benefit) can arise, thus leading to positive change in overall household's disposable income.

Figure 3 Simulated change in households' disposable income (in %)

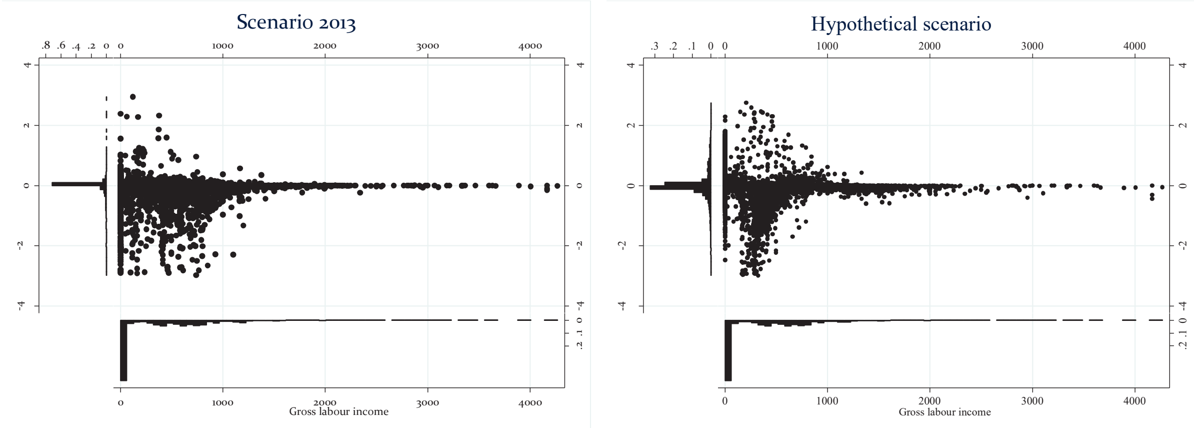


Source: authors' calculations.

Next, the impact of legislative changes on labour supply behaviour is analysed. Using the microsimulation model SIMTASK, key income variables (gains to work and non-labour income) are computed for the tax and transfers system setup valid in baseline and 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 baseline and scenarios.

The individual responses to analysed tax regime changes, i.e. changes in the individual participation probabilities, are presented in Figure 4. The individuals with higher labour income are less responsive to the changes in tax and welfare system, despite the fact that they face increase both in METR and AETR. In line with the literature as well as our model estimates, suggesting that the extensive margin decisions are taken at the lower end of income distribution, Figure 4 shows the highest changes in probabilities for those earning lower than average wage.

Figure 4 Simulated response in participation probabilities



Source: authors' calculations.

The response in average participation probabilities of specific subgroups in the two scenarios are reported in Table 5. It turns out that the average probability of participation decreases by 0.1 percentage points under both scenarios. 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.

Table 5 Simulated response in average probabilities of participation

	Baseline participation probability in per cent	**Change of baseline in p.p.**	
		Scenario 2013	Hypothetical scenario
Full sample	62.29	-0.09	-0.08
Age 15-24	39.70	-0.02	-0.22
Age 25-50, female	76.35	-0.14	-0.25
Age 25-50, male	89.63	-0.11	-0.14
Age 50+	46.76	-0.08	0.14
Female with child under 3yr., age 25-50	25.50	-0.08	-0.17
Male with child under 3yr., age 25-50	96.47	-0.13	0.00
Elementary education, age 25-50	67.35	-0.78	-0.42
Secondary education, age 25-50	84.52	-0.04	-0.21
Tertiary education, age 25-50	82.40	-0.22	-0.11
Gross wage quintile - Q1 (below 295 euro)	47.76	-0.27	-0.45
Gross wage quintile - Q2 (below 521 euro)	83.15	0.04	-0.55
Gross wage quintile - Q3 (below 722 euro)	92.04	-0.15	-0.07
Gross wage quintile - Q4 (below 1000 euro)	94.23	-0.12	0.00
Gross wage quintile - Q5 (above 1000 euro)	97.64	-0.03	-0.05

Source: authors' calculations.

The results for scenario 2013 suggest, that for each of the selected group, the probability of participation would decrease. With magnitude higher than average respond low earners (first quintile) and low educated. Result that is not in line with standard expectations is lower magnitude of response observed for females with child under three years. This can be explained by the fact that compared to males, females on parental leave are affected additionally by the specific change in legislation that removed duplicity in health care contributions payments.

It is interesting to stress that the resulting average response in terms of changes in participation probabilities in hypothetical scenario is very similar to the first scenario. For all but one of the subgroups the probability of being economically active decreased. Positive response in this scenario is observed only for persons above 50 years. This is influenced by the fact that old-age pensioners would not be worse-off by lowered tax allowance, but would benefit from significant decrease of tax rate. Note that in line with expectations, women react more than men to this reform scenario (affecting both genders in the same way) since their estimated elasticity of participation is high. The same applies for the level of education attained and the level of income earned. Low earners and low educated with high values of estimated participation elasticities are more responsive to the changes in tax system than the persons with high earnings and high level of education, respectively.

6 Conclusion

In this paper we study the responsiveness of labour force participation at the extensive margin in Slovakia. We use a labour supply model that takes into account both taxes and transfers to estimate semi-elasticities of labour force participation decision. The advantage of this model is its ability to conduct ex-ante analysis of changes in tax and welfare system. As an interesting policy application, a move away from the flat-tax system valid in Slovakia until 2012 is analysed.

In particular, a probit model for labour force participation decision is estimated and the results are extensively discussed. This analysis shows several clear results. We identify a significant individual responsiveness to the 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): highly responsive groups of population are the low-skilled and females. Therefore, the labour market policies aimed to boost economic activity should concentrate on increasing marginal gains to work, especially for low-educated individuals and women.

We perform a policy analysis of first-round and behavioural effects of two counterfactual scenarios. Both of them simulate the departure from the flat-tax system valid in 2012, however, the set up and the details of the two scenarios differ. The simulations of both scenarios confirm that the responsiveness of labour supply to legislative changes is marginal for the persons with high earnings. On the contrary, the highest change in participation probabilities face individuals with bellow average earnings.

By simulating the two different tax reform scenarios, we demonstrate that the departures from flat-tax regime with the same fiscal revenue effect have comparable impact on average probability of participation. However, the impacts on selected subgroups are different. In case of real reform in 2013, an increase in tax revenues was accompanied by the slight decrease in average probability of being economically active by 0.1 percentage points. Mainly the individuals with agreement contracts, for whom the tax burden increased significantly, were among the discouraged. In the second scenario, simulating a hypothetical departure from flat-tax system by reintroducing five tax brackets together with the significant reduction in basic tax allowance, the labour participation probability would decrease by 0.1 percentage points as well. The most discouraged groups would be low earners, low educated individuals and women.

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Appendix

Table A1: 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 3y.	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 3y.	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 urbanisation	3 binary variables are created based on 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 A2: 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)	518.7	171.3	437.1	238.8
Log of Gains to work	8.7	0.3	7.6	2.8
Non-labour income (in euros, monthly)	1081.7	649.2	1107.7	650.1
Log of Non-labour income	9.1	1.5	9.1	1.4
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 3y.	0.1	0.2	0.0	0.2
Parent with child over 3y.	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	37960		46191	

Heckman selection model for gross wages

Since income from employment is naturally unobservable for those who are unemployed or inactive, we use Heckman's sample selection methodology to predict gross wages. In Heckman's framework, the model consists of two equations: selection equation and regression equation. The first one estimates the probability (propensity score) of an individual to be employed/unemployed. The estimated propensity score model is then used to estimate the coefficients of a second regression equation that models the market wage.

In our implementation, the wage equation contains the degree of urbanization of a region where a person resides (dense, normal and sparse density) and regional dummy variables (8 regions based on NUTS3 classification). These two variables are intended to capture differences in regional economic environment and thus control for the activity indirectly. In addition, we include human capital characteristics such as 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, whereas we assume that they have no direct effect on gross wage. In our specification, we include other income available in the household, quadratic form of age and unfavourable health condition. Controls for family status include dummies like being a parent of child (younger/older than 3 years). Moreover, we control for having a working partner and being single, married or divorced. Finally, dummies controlling for the working students and pensioners are included.

The complete list of estimation results of the Heckman selection models is reported in Tables A3 and A4 below. Statistically significant effect of selection has been proved by the likelihood ratio test. By using the Heckman model, the intention is to obtain precise estimates of gross wages. It turns out that separate estimation of wages for males and females led to estimates that fit the data more closely than specification where gender is used as a dummy. This has been tested by using the RMSE (root mean squared error) criteria on the sub-sample of the employed.

The estimated coefficients in wage equation are mostly in line with findings that can be found in the academic studies analysing other market economies. First, a concave shape of "years of experience-earnings profiles" could be detected. Second, the estimates confirm the positive relationship between the wage and the degree of education. Third, we find that higher degree of urbanization leads to higher gross wages. The exclusion restrictions are statistically significant. The selection equation shows that non-labour income (including social transfers) has a significantly negative effect on selection to employment. Reporting unfavourable health, being a working student or pensioner decreases probability of employment. It turns out that being a mother of a small child younger than 3 years significantly decreases the probability of being employed (eligibility to paid parental allowance applies), while having a child older than 3 years the effect becomes positive. However, being a father of a small child of arbitrary age increases the probability of being employed. Finally, having a working partner increases the probability of being employed.

Table A3: Estimates of Heckman selection model for gross wages, females

Regression Equation	2010			2011			2012		
Region: Trnava	-0.11	***	(0.031)	-0.077	**	(0.031)	-0.087	***	(0.030)
Region: Trencin	-0.161	***	(0.029)	-0.091	***	(0.028)	-0.11	***	(0.027)
Region: Nitra	-0.112	***	(0.030)	-0.08	***	(0.029)	-0.064	**	(0.030)
Region: Zilina	-0.126	***	(0.029)	-0.093	***	(0.028)	-0.099	***	(0.027)
Region: Banska Bystrica	-0.14	***	(0.031)	-0.073	**	(0.030)	-0.06	**	(0.029)
Region: Presov	-0.194	***	(0.029)	-0.147	***	(0.029)	-0.12	***	(0.028)
Region: Kosice	-0.145	***	(0.029)	-0.099	***	(0.029)	-0.11	***	(0.028)
Density: average	-0.054	***	(0.018)	-0.066	***	(0.018)	-0.055	***	(0.018)
Density: sparse	-0.116	***	(0.018)	-0.092	***	(0.018)	-0.089	***	(0.018)
EDU: Secondary	0.144	***	(0.040)	0.158	***	(0.042)	0.16	***	(0.046)
EDU: Tertiary	0.423	***	(0.042)	0.428	***	(0.044)	0.433	***	(0.048)
Work experience	0.018	***	(0.002)	0.013	***	(0.002)	0.01	***	(0.002)
Work experience^2	0	***	(0.000)	0	***	(0.000)	0	***	(0.000)
Constant	6.184	***	(0.051)	6.291	***	(0.052)	6.259	***	(0.054)
Selection Equation									
log (other income)	-0.205	***	(0.015)	-0.202	***	(0.014)	-0.179	***	(0.014)
Parent with child under 3y.	-1.44	***	(0.117)	-1.091	***	(0.105)	-1.276	***	(0.100)
Parent with child over 3y.	0.093		(0.079)	0.17	**	(0.071)	0.107		(0.069)
Fam. Status: Married	-0.169		(0.116)	-0.172		(0.105)	-0.058		(0.098)
Fam. Status: Divorced / Widowed	0.163		(0.117)	0.143		(0.108)	0.203	**	(0.102)
Has working partner	0.258	***	(0.088)	0.191	**	(0.082)	0.143	*	(0.078)
Age	0.093	***	(0.025)	0.112	***	(0.023)	0.128	***	(0.023)
Age^2 / 100	-0.197	***	(0.032)	-0.211	***	(0.029)	-0.235	***	(0.029)
Chronic disease	-0.556	***	(0.067)	-0.525	***	(0.062)	-0.491	***	(0.061)
Student	-2.463	***	(0.156)	-2.721	***	(0.168)	-2.647	***	(0.181)
Pensioner	-2.36	***	(0.187)	-2.275	***	(0.164)	-2.324	***	(0.175)
Region: Trnava	-0.357	***	(0.135)	-0.124		(0.126)	-0.159		(0.120)
Region: Trencin	-0.344	***	(0.129)	-0.128		(0.119)	-0.247	**	(0.114)
Region: Nitra	-0.394	***	(0.130)	-0.233	*	(0.121)	-0.342	***	(0.118)
Region: Zilina	-0.266	**	(0.127)	-0.202	*	(0.117)	-0.092		(0.113)
Region: Banska Bystrica	-0.317	**	(0.134)	-0.306	**	(0.122)	-0.256	**	(0.118)
Region: Presov	-0.36	***	(0.126)	-0.317	***	(0.118)	-0.374	***	(0.113)
Region: Kosice	-0.569	***	(0.125)	-0.463	***	(0.119)	-0.415	***	(0.113)
Density: Average	-0.122		(0.076)	0.042		(0.072)	0.1		(0.074)
Density: Sparse	-0.262	***	(0.074)	-0.16	**	(0.070)	-0.088		(0.068)
EDU: Secondary	1.055	***	(0.103)	1.103	***	(0.104)	0.935	***	(0.111)
EDU: Tertiary	1.646	***	(0.117)	1.687	***	(0.116)	1.52	***	(0.122)
Work experience	0.113	***	(0.012)	0.088	***	(0.011)	0.082	***	(0.011)
Work experience^2	0		(0.000)	0		(0.000)	0		(0.000)
Constant	-1.429	***	(0.410)	-1.937	***	(0.381)	-2.125	***	(0.392)
N	6,132			6,274			6,136		
N censored	3,262			3,282			3,285		
LR test of indep. eqns. (rho = 0): chi2(1)	44.99	***		141.61	***		132.46	***	
inverse Mills ratio (lambda)	-0.136			-0.202			-0.187		

*Note: Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1. Reference categories for the dummies: Region (ref. Bratislava), Density of settlement (ref. Dense), Education (ref. Elementary), Family status (ref. Single).*

Table A4: Estimates of Heckman selection model for gross wages, males

Regression Equation	2010			2011			2012		
Region: Trnava	-0.066	*	(0.036)	-0.085	**	(0.035)	-0.107	***	(0.036)
Region: Trencin	-0.112	***	(0.034)	-0.102	***	(0.033)	-0.12	***	(0.033)
Region: Nitra	-0.098	***	(0.035)	-0.06	*	(0.034)	-0.132	***	(0.036)
Region: Zilina	-0.054		(0.034)	-0.067	**	(0.033)	-0.137	***	(0.033)
Region: Banska Bystrica	-0.096	***	(0.036)	-0.071	**	(0.035)	-0.153	***	(0.035)
Region: Presov	-0.138	***	(0.033)	-0.072	**	(0.033)	-0.159	***	(0.033)
Region: Kosice	-0.095	***	(0.033)	-0.087	***	(0.032)	-0.136	***	(0.033)
Density: average	-0.052	**	(0.020)	-0.059	***	(0.020)	-0.051	**	(0.021)
Density: sparse	-0.11	***	(0.020)	-0.091	***	(0.020)	-0.066	***	(0.021)
EDU: Secondary	0.043		(0.045)	0.072		(0.046)	0.041		(0.048)
EDU: Tertiary	0.362	***	(0.047)	0.381	***	(0.048)	0.306	***	(0.051)
Work experience	0.03	***	(0.002)	0.02	***	(0.002)	0.022	***	(0.002)
Work experience^2	-0.001	***	(0.000)	0	***	(0.000)	-0.001	***	(0.000)
Constant	6.38	***	(0.058)	6.524	***	(0.057)	6.581	***	(0.059)
Selection Equation									
log (other income)	-0.169	***	(0.017)	-0.171	***	(0.016)	-0.158	***	(0.015)
Parent with child under 3y.	0.341	**	(0.154)	0.67	***	(0.161)	0.574	***	(0.121)
Parent with child over 3y.	-0.022		(0.097)	0.049		(0.090)	0.206	**	(0.084)
Fam. Status: Married	0.496	***	(0.126)	0.372	***	(0.114)	0.296	***	(0.104)
Fam. Status: Divorced / Widowed	-0.115		(0.148)	-0.214		(0.138)	-0.003		(0.135)
Has working partner	0.222	***	(0.084)	0.217	***	(0.081)	0.256	***	(0.074)
Age	0.08	***	(0.025)	0.113	***	(0.023)	0.159	***	(0.023)
Age^2 / 100	-0.23	***	(0.031)	-0.248	***	(0.029)	-0.274	***	(0.029)
Chronic disease	-0.555	***	(0.074)	-0.672	***	(0.073)	-0.645	***	(0.069)
Student	-2.187	***	(0.132)	-2.539	***	(0.148)	-2.812	***	(0.202)
Pensioner	-2.76	***	(0.267)	-2.606	***	(0.220)	-2.299	***	(0.191)
Region: Trnava	-0.051		(0.154)	-0.148		(0.148)	-0.189		(0.144)
Region: Trencin	-0.239	*	(0.143)	-0.165		(0.143)	-0.194		(0.139)
Region: Nitra	-0.053		(0.144)	-0.238	*	(0.143)	-0.353	**	(0.142)
Region: Zilina	-0.113		(0.147)	-0.208		(0.142)	-0.11		(0.140)
Region: Banska Bystrica	-0.381	***	(0.144)	-0.427	***	(0.142)	-0.285	**	(0.140)
Region: Presov	-0.395	***	(0.136)	-0.465	***	(0.135)	-0.448	***	(0.132)
Region: Kosice	-0.34	**	(0.138)	-0.496	***	(0.136)	-0.396	***	(0.136)
Density: Average	-0.093		(0.080)	-0.108		(0.081)	-0.169	**	(0.082)
Density: Sparse	-0.125		(0.077)	-0.193	**	(0.078)	-0.221	***	(0.077)
EDU: Secondary	1.211	***	(0.099)	1.145	***	(0.103)	1.036	***	(0.105)
EDU: Tertiary	1.908	***	(0.122)	1.77	***	(0.123)	1.585	***	(0.125)
Work experience	0.121	***	(0.014)	0.087	***	(0.013)	0.041	***	(0.012)
Work experience^2	0		(0.000)	0.001	*	(0.000)	0.001	***	(0.000)
Constant	-1.286	***	(0.406)	-1.63	***	(0.389)	-2.416	***	(0.379)
N	5,196			5,306			5,044		
N censored	2,247			2,282			2,167		
LR test of indep. eqns. (rho = 0): chi2(1)	70.49	***		126.72	***		97.38	***	
inverse Mills ratio (lambda)	-0.189			-0.237			-0.259		

*Note: Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1. Reference categories for the dummies: Region (ref. Bratislava), Density of settlement (ref. Dense),Education (ref. Elementary), Family status (ref. Single).*

Table A5: 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 3y.	-2.215	***	(0.049)	0.475	***	(0.128)
Parent with child over 3y.	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		
R2 pseudo	0.548			0.615		

*Note: Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1. Reference categories for the dummies: Education (ref. Elementary), Family status (ref. Single), Year (ref. 2010). Bootstrapped standard errors, 5000 replications.*

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