Distribution of average, marginal, and participation tax rates among Czech taxpayers: Results from a TAXBEN model

Abstract

We present empirical distributions of the average, marginal, and participation tax rates on earnings across the population of Czech taxpayers under the current tax-and-benefit system. We quantify significant differences between the taxation of employees and the self-employed: The average tax rates on wage income and business income are 37.4 and 28.1 percent, respectively, even though the self-employed tend to have higher earnings. On average, employees and the self-employed face effective marginal tax rates of 47.8 and 34.2 percent, respectively. The tax system exhibits almost no overall progressivity – the top income decile earns 26.7 percent of total income and pays 26.7 percent of total taxes. There are large dispersions in the tax rates for people with similar earnings. These are primarily created by generous tax credits and the inevitable differences among taxpayers in eligibility for these credits.

JEL codes: H22, H24, D31

Keywords: taxben models, average tax rates, marginal tax rates, participation tax rates, Czech Republic

1. Introduction

Taxes on earnings constitute 56 percent of tax revenues in the Czech Republic.[1] It is crucial to design the taxes on earnings efficiently in order to avoid potentially harmful effects of such high taxes on the economy. The issues of optimal tax design gained renewed interest in the public finance literature. It is best exemplified by the Mirrlees Review (Mirrlees 2010a, 2010b), a comprehensive analysis and recommendations for reform of the British tax system. It combines new insights from optimal taxation (Saez 2001, 2002) with practical considerations of tax administration (Slemrod and Bakija 2004, chapter 5) and empirical evidence on the effects of the existing tax systems.

This paper contributes to the evidence-based approach to the taxation of earnings in the Czech Republic. It presents the distribution of key efficiency and distributional characteristics of the tax-and-benefit system (average, marginal, and participation tax rates) across the population of taxpayers. The characteristics are computed with a newly developed TAXBEN model that uses the Statistics of Income and Living Conditions (SILC), a representative sample of 8,866 households, comprising 20,620 taxpayers.

[1] Source: Fiscal Outlook of the Czech Republic (May 2013), Table B.2., Ministry of Finance, available at http://www.mfcr.cz/en/statistics/fiscal-outlook/2013/fiscal-outlook-05-2013-12701 (last accessed on July 10, 2013)

The Czech tax-and-benefit system is unusual in several respects. It is dominated by a nearly linear payroll tax with very high tax rates earmarked for funding the health and social security insurance.[2] The personal income tax has a single marginal tax rate of 15 percent. Earnings from private business (self-employment) are taxed far more lightly than earnings from employment. Various welfare benefits and tax credits provide relief predominantly to households with children rather than to households that are poor per se.[3] The system underwent frequent design reforms during the past decade.[4] Some elements of another conceptual reform, scheduled for 2015, have been already legislated. Despite such reform zeal, the evidence-based approach has been largely missing in the actual design of the Czech tax system.

Several academic papers have explored the distributional or incentive measures of the Czech tax-and-benefit system. Večerník (2006) uses the Czech Microcensus survey in 1988, 1996, and 2002. He describes the redistribution via the tax-and-benefit system at the household level, focusing on the change in redistribution during transition. Schneider and Jelínek (2004) investigate the distributive impacts of particular welfare benefits and tax allowances and the trends in their relative generosity, using the household budget surveys in 1999-2002.

Pavel (2009) computes the effective marginal tax rates and net replacement rates for standardized employees as a function of income, and tabulates their distribution in the population for the tax regime in 2008, using the SILC 2005 dataset. He also documents how these incentive measures changed with the tax reform of 2008. Galuščák and Pavel (2012) focus on the work incentives; they compute the net replacement rates for standardized households (e.g. two parents without children or with two children etc.) as a function of labor earnings, for the tax-and-benefit system in 2006 and 2007. These two studies do not count the employer contributions into their measures of marginal tax rates and replacement rates. This approach is relevant for some question (e.g., individual labor supply at given wage rates) and is used in some cross country comparisons (OECD Taxing Wages). Our focus, however, is on the

[2] The current health and social security insurance rates are 4.5 and 6.5 percent for the employee and 9 and 25 percent for the employer; when added together, these payroll taxes take 45 percent of the gross wage.

[3] Main parameters of the Czech tax and benefit system in 2013 are summarized in Table A1.

[4] In 2005, joint taxation of married couples with children was introduced. In 2006, the many deductions from taxable income were replaced by tax credits. In 2007, the concept of a minimum living standard was changed, and an existence minimum was introduced. In 2008, a flat income tax replaced a progressive rate structure, and the joint taxation of couples was abolished. A new flexible system of the parental leave benefit was introduced and the child allowance benefit was reformed. In 2011, birth grant became a means-tested benefit and available for the first child only. In 2012, the parental leave benefit was made even more flexible and the social supplement benefit was abolished. In 2013, a special surcharge on high earners was added.

full tax wedge between the employer cost and the net wage. The disemployment effects of taxes depend on both labor supply and demand responds in equilibrium. Other efficiency costs of taxation, such as the cost of evasion and avoidance, use of subcontractors instead of employees, or excessive consumption of tax-preferred goods or employee perks depend crucially on the employer contributions (Feldstein 1999, Gorodnichenko, Sabirianova and Martinez 2009). In the Czech context, the shifting of income between employment and self-employment is particularly important because of the large differences in the taxation of business and wage income that are driven mainly by very high employer contribution rates.

Taxing Wages, a regular publication by the OECD (2013), presents standardized international comparisons of the tax wedges between the employer costs and the net wage of workers. The comparisons are computed for “stylized” individuals earning 100, 67 and 167 percent of the average wage, and do not reflect finer detail of the income tax provisions. The tax wedges are higher in the Czech Republic than the OECD average for most types of stylized workers except for singles with children or married workers with children and non-working spouse. Immervoll (2004), a study that is methodologically closest to ours, tabulates the empirical distributions of ATRs and MTRs for 14 European countries[5] using the EUROMOD model and 1998, but for employees only.

This paper brings several contributions. First, it is the first Czech study that simultaneously presents the average, marginal, and participation tax rates and their distribution across the whole population of taxpayers. We compute the tax characteristics for real individuals from the SILC database. Unlike studies using only “stylized” individuals, this approach shows how taxes and benefits differ across the whole population. In the “stylized” individual approach, the impact of income increase on the tax rates is calculated keeping the characteristics of individual fixed. Our approach may thus give different results than the “stylized” approach, because higher-income taxpayers have different characteristics and thus different utilization of tax credits and deductions. We also show how many people in the population face particular levels of tax rates, and the distribution of tax rates faced by people earning similar incomes. The focus of this paper is on individuals.[6] It is therefore informative for questions such as: How are actual tax payments related to individual incomes? How progressive are the taxes at the individual level? To what extent do people with similar incomes pay similar taxes? What are the disincentives to earn additional taxable income? What are the disincentives to enter work?

[5] All EU-15 countries except Sweden.

[6] In a companion paper (Dušek, Kalíšková, and Münich 2013) we present the tax rates and benefit rates at the household level in order to assess the progressivity of the taxes and benefits combined with respect to household income and their role in reducing disparities in living standards.

Second, we are the first to analyze taxation of small business income separately from the wage income. Third, the paper brings some methodological improvements. The TAXBEN model capturers some features that are not usually captured in microsimulations (e.g. mortgage deductions, disability tax credits). Our approach also follows the standards of the Mirrlees Review.[7] Most importantly, the average, marginal, and participation tax rates measure the full tax wedge between the net disposable income received and the employer cost or the pre-tax profit. Last, the paper provides an update on the Czech tax-and-benefit system, based on the legislation in force in 2013, and some comparisons with other countries.

Among the key findings, we find that the population mean of average tax rate on wage income gradually rises from 34.1 percent in the first decile to 42.9 percent in the top decile. For the self-employed, the average tax rate first declines from 34.0 percent in the first decile to 24.85 percent in the fourth decile and then rises to 31.9 percent in the top decile. The dispersion of the average tax rates is very high, particularly at medium and low incomes. The difference between taxpayers with the same income that pay the highest and lowest average tax rates commonly exceed 20 percentage points. The tax system exhibits almost no overall progressivity: this is best illustrated by the fact that the top income decile earns 26.7 percent of total income and pays 26.7 percent of total taxes. A vast majority of workers (75 percent) face an effective marginal tax rate of 48.6 percent. The participation tax rate is, on average, between 43 to 47 percent throughout most of the income distribution. It also has very high dispersion at low incomes, and 15 percent of earners face participation tax rates exceeding 60 percent.

Business income is taxed, on average, at only 28.1 percent. The wage income is taxed at 37.4 percent on average, even though the business owners have higher gross incomes. The highly differential taxation of business and wage income is responsible for very low overall progressivity: the self-employed are disproportionately represented in the high income deciles yet they face much lower average tax rates than workers in lower deciles. The assumptions of the TAXBEN model in fact tend to over-predict the taxes actually paid by the self-employed; the true gap between taxes on wage and business income is likely to be even greater.

The rest of the paper is organized as follows. Section 2 describes the main features of the TAXBEN model and the data (detailed description is relegated to the Appendix). Section 3 presents the results – the average, marginal, and participation tax rates facing individual taxpayers. The description of the results is purposefully factual and free of normative recommendations. We reserve the normative assessments for the conclusions in Section 4.

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[7] Mirrlees (2010a), chapter 4.

2. The TAXBEN model

2.1. Data

We developed a new TAXBEN model that simulates the taxes and benefits for individuals and households in the Survey of Income and Living Conditions (SILC) dataset. The SILC is being collected annually by the Czech Statistical Office and follows a standardized methodology across all EU countries. We used the latest available SILC issue (collected in 2011) which contains information on 8866 households consisting of 20629 individuals. It reports basic information about the household structure, its dwelling, and the economic activity and health of the household members. Importantly for tax simulations, it reports each member's annual wages from employment, separated into main and secondary employment, and annual profits from small business (self-employment), also separated into main and secondary business, in the previous year (2010). It further reports the levels of various welfare benefits received by the household, the income taxes, social and health contributions (for employees only) and property taxes.

SILC is well suited for TAXBEN-type simulations. It is relatively large, representative (including weights allowing to extrapolate to the population), and contains sufficient amount of income and demographic information to capture the key aspects of the tax and benefit system. One disadvantage of the SILC is a poor quality of the data on the capital income - interest, dividends, rents etc. Even though such items exist in the database, their values are frequently zero or unrealistically low. We cannot therefore include taxation of capital income into the analysis but focus on solely on earnings from wages or self-employment.

2.2. Definitions of efficiency and distributional characteristics

The ultimate objective of the model is to compute the average, marginal and participation tax rates. Their definitions below state clearly how the provisions of the Czech tax code enter the computations and illustrate how the tax rates reflect the link between the changes in the individual's income or employment and the taxes and benefits of the entire household. The values of the tax rates and other parameters of the tax-and-benefit system are provided in the Appendix Table A1.

Average Tax Rate:

$$ATR^i = \frac{T^i(Y^i)}{Y^i} =$$

$$= \frac{W^i(\tau_{HE} + \tau_{SSE} + \tau_{HR} + \tau_{SSR}) + \max\{0, \left(W^i(1 + \tau_{HR} + \tau_{SSR}) - D^i\right)\tau_I - C^i\}}{W^i(1 + \tau_{HR} + \tau_{SSR})} (wage\ income)$$

or

$$= \frac{\pi^i f_D(\tau_{HD} + \tau_{SSD}) + \max\{0, \left(\pi_i - D^i\right)\tau_I - C^i\}}{\pi^i} \ (business\ income)$$

The average tax rate is the ratio of the total taxes paid by the individual $T^i(Y^i)$ to income (Y^i). The first component of the total taxes on wage income are the health and social security contributions, which are assessed on the gross wage W^i at linear rates τ_{HE} and τ_{SSE} (paid by employee) and τ_{HR} and τ_{SSR} (paid by employer).[8] The second component is the personal income tax. The Czech personal income tax is unusual: The tax base is equal to the full employer cost (the gross wage plus the employer contributions) instead of the gross wage, and there is a single tax rate τ_I. The tax rate applies to the taxable income after deductions D^i.[9] After that, the taxpayer deducts a number of tax credits C^i. If the tax after credits is negative, the tax liability is zero. The exception is taxpayers with children who pay a negative tax up to the amount of the child tax credit.[10] The denominator shows explicitly that our concept of wage income includes the employer contributions.

The formula for the business income is similar except the relevant income is the profit before taxes and contributions. The health and social security contribution rates for the self-employed differ from the rates for the wage earners; moreover, they do not apply to the profit but to the profit scaled down by a factor f_D.[11]

The average tax rate for the individual cannot reflect the welfare benefits. The benefits are assessed at the household level and it would be arbitrary to allocate the benefits across household members. The average tax rates at the individual level are hence useful for assessing the progressivity and dispersion of taxes as a function of the individual income.

Effective Marginal Tax Rate:

$$MTR^i = \frac{dT^h\left(Y^h\right) - dB^h(Y^h)}{dY^i}$$

[8] The computation of the health and social security contributions is somewhat more complicated for people with very low or very high earnings due to minimum contributions and caps. They are reflected in the TAXBEN model but are not presented in the equations for expositional clarity.

[9] The deductible items include mainly the mortgage interest, life and pension insurance that exceeds a certain threshold, and charitable gifts.

[10] The possibly negative tax for taxpayers with a child tax credit is reflected in the TAXBEN model but is not presented in the equations for expositional clarity.

[11] The scale-down factor f_D is currently 0.5, implying that the effective social security is 14.6 percent instead of the nominal rate of 29.2 percent. The self-employed are actually allowed to set the scale-down factor voluntarily at a level higher than 0.5. Paying a higher contribution voluntarily would entitle them to higher benefits after retirement, but the tax-benefit linkage is very weak, hence it is not in the self-interest of the self-employed to pay a higher contribution. Similarly, taxes for the self-employed do not include the sick leave insurance. Participation in this scheme is voluntary for them. We would therefore expect that the self-employed pay the sick leave contributions only if participation makes them better off.

The effective marginal tax rate gives the fraction of an increase in individual income Y^i along the intensive margin that is "eaten away" by an increase in taxes and a withdrawal of benefits. Note that we consider the effect on taxes T^h and benefits B^h for the entire household.

Effective Participation Tax Rate:

$$EPTR^i = \frac{\left[T^h\left(Y^h|Y^i = Y^i\right) - B^h\left(Y^h\middle|Y^i = Y^i\right)\right] - \left[T^h\left(Y^h|Y^i = 0\right) - B^h\left(Y^h\middle|Y^i = 0\right)\right]}{Y^i}$$

The effective participation tax rate is an analogous concept for an extensive margin. It compares the taxes and benefits of a household in a situation when the member *i* works and earns income Y^i with a situation when the member does not work and earns market income of zero.[12] We compute the EPTR for the individuals that are actually employed or self-employed and for individuals that are not economically active. For the latter, we impute the wages that they would have earned from a Mincer regression.[13]

2.3. Algorithm and assumptions

A detailed description of tax-and-benefit simulations and the underlying assumptions is provided in the Appendix, here we only shortly summarize the main conceptual issues. Tax-benefit simulations are based on information from the SILC data on incomes, characteristics, and household composition, combined with a detailed tax-benefit simulator which captures the features of tax and benefit legislation in the Czech Republic in 2013.

We start by defining incomes. SILC data reports gross wages from employment and profit from business after subtracting the social and health contributions. We take these to construct the full employer costs (gross wage plus employer social and health contributions) and the gross profit of self-employed before paying the contributions. These are the main income concepts we use in further simulations.

Next, we divide household members into tax units. Tax units basically divide households into units that are relevant for tax purposes (for tax credits mainly). We assume that the highest-earning person in the tax unit claims all the tax credits for children and non-working spouse. For each individual with positive income, we then apply the appropriate tax law to compute the health and social security contributions.

[12] It is particularly important to take into account the effects of the labor supply decision on the taxes paid by other household members. When one member starts working, the tax liability of the other member increases because he/she is no longer eligible for the non-working spouse tax credit. When the household member who is claiming the child tax credits on his/her tax return stops working, the credits are claimed by the other member, reducing her/his tax liability.

[13] The wage imputation is described in more detail in the Appendix.

The income tax is computed based on sum of the full employer costs and the gross profits, which is adjusted by tax base deductions (we apply deductions for voluntary pension insurance and mortgage deductions). After computing the income tax, we subtract the tax credits – basic tax credit for each taxpayer, credit for a non-working spouse, child tax credit, credit for people with serious disability, for a non-working spouse with serious disability, and for people receiving disability pension. Finally, we divide the total taxes into taxes on wage and business income by the share of the wage and business income in the tax base (for taxpayers that have both sources of income).

Benefit simulations also start with defining benefit units. These create collections of household members who are treated separately for benefit entitlement purposes. Based on benefit units' definitions, simulated net incomes, and detailed information on households composition in the SILC data, we can simulate eligibility and amounts of most of the welfare benefits that are available in the Czech Republic. We simulate maternity benefit (*peněžitá pomoc v mateřství*), birth grant (*porodné*), child allowance (*příspěvky na děti*), housing benefit (*příspěvek na bydlení*), and aid in material need benefits: living allowance (*příspěvek na živobytí*) and housing supplement (*doplatek na bydlení*). However, some benefits cannot be simulated due to lack of information on previous incomes and employment history in the SILC data (unemployment benefit – *dávky v nezaměstnanosti*), because of the length and amount of benefit being subject of a choice of recipients (parental leave benefit – *rodičovský příspěvek*) or because of an individual assessment process for benefit eligibility (benefits for people with serious disability). These benefits are thus not simulated; the amounts of these benefits are taken from the self-reported values in SILC.

The main assumption of benefit simulation is the full take-up of all benefits for which a household is eligible. Although this is a standard assumption in the microsimulation literature (see e.g. Immervoll and O'Donoghue, 2002), the take-up of some welfare benefits in the Czech Republic is quite low. The low take-up concerns mainly housing benefit. This is illustrated in Table A2, which provides an overview of consistency checks for the tax and benefit simulations. It shows the actual budget revenues and expenditures in 2010 (the year for which the income information is available in SILC), the revenues and expenditures predicted by TAXBEN (based on tax parameters in 2010), and also the revenues and expenditures reported directly in SILC. Overall, the model does a very good job in predicting most of the tax revenues and benefit expenditures. It over-predicts the tax revenues from business income, which is probably due to discrepancy between incomes reported in SILC and those reported for tax purposes. Benefit expenditures are over-predicted mainly for the housing benefit, which has very low take-up in the Czech Republic, and for the aid in material need benefits, where the take-up probably plays its role as well.

2.4. Summary statistics

Table 1 shows basic summary statistics for individuals with non-negligible annual earnings, broken down by the source of income.

There are in total 8,328 individuals in the sample (corresponding to 4.5 million individuals in population) in their productive age having non-negligible income from work or business, with great majority of them having income from work only. The average annual income per employee is 255,000 and per a self-employed 374,000 CZK. Those with both sources of income have even higher average income exceeding on average 400,000 CZK per a year. Despite lower incomes, employees (without any business income) pay higher total taxes (134,000 CZK annually on average) than the self-employed (107,000 CZK). The personal income tax is relatively unimportant: its share in total taxes is 14 percent for employees and 22 percent for self-employed, while the payroll taxes make the rest. The employer contributions are by far the biggest item on the worker's tax bill (86,000, or 64 percent of total taxes). Employees are more likely to be women, and are a bit younger on average than self-employed.

3. Results

In this section we present the key results: that is, the distribution of average, marginal and participation tax rates across the individual taxpayers.

3.1. Average tax rates

Figures 1a and 1b plot the average tax rates as a function of the gross income, separately for wage earners and the self-employed. Each dot in the graph is an individual from the SILC sample. The line shows the mean average tax rate at varying levels of income, estimated by a kernel-weighted local polynomial regression. To portray the weight of individual observations in the population, the bottom panel of each figure shows the distribution of income and the right panel shows the distribution of tax rates.

The tax system is by and large progressive within each source of income: the mean ATR on wage income rises from little about 25 percent at lowest income to 45 percent at incomes just above 1,000,000 CZK. The ATRs slightly decline once income exceeds 1,242,000 CZK (4 times the average wage) because the social contributions are capped at that level. Tax credits make the taxes progressive despite the linear health and social contributions and the flat personal income tax. To illustrate, the ATR would have been, in the absence of tax credits and other non-linearities, 48.6 percent. A person with two children and the average gross earnings of CZK 255,000 subtracts the basic credit of CZK 24,840 and two child tax credits of CZK 13,404 and pays no income tax, which reduces his ATR to 33.6 percent. The same credits represent a far smaller fraction of income for a person with gross wages of CZK 510,000 (twice the average earnings), and his ATR is 10 percentage points higher (43.6 percent).

The mean ATR on business income is V-shaped, initially falling from 33 to 23 percent at incomes around 280,000 CZK, but then rising gradually to 36 percent at incomes between 1,500,000 and 2,000,000. The reason for the initial U-shaped pattern is the minimum income thresholds for social and health contributions which are quite high for the self-employed with main business: 155,000 CZK per year for social and 310,000 per year for health contributions. The self-employed with incomes below the thresholds pay contributions “as if” their income was at the thresholds. Interestingly, the distribution of the business income exhibits spikes around incomes that coincide with the two thresholds, suggesting an optimizing behavior whereby the self-employed bunch at incomes that minimizes the tax liability.

The distribution of the average tax rates on wage income has a distinct spike at 33.6 percent. It is made of employees who pay zero income tax but pay exactly linear health and social security contributions. The distribution of the average tax rates on business income has a mode at 28 percent. These tax rates are faced predominantly by the self-employed with middle-range incomes (200,000-280,000 CZK) who do not claim a tax credit for the spouse or children. Full 30 percent of people with wage income and 39 percent of people with business income pay no or negative income tax.[14]

Figures 1a and 1b also depict a substantial dispersion in the ATRs across individuals with the same income. The dispersion gradually declines with income. The gap between the taxpayers with the highest and lowest ATRs (at given income) exceeds 20 percentage points at low and medium income; it narrows down to less than 10 percentage points for incomes above CZK 500,000. The cause of the dispersion is again credits and deductions: The upper “envelope” of ATRs is made of people who are taxed at the full rate and do not claim any deductions or credits other than the basic credit; the people below are those claiming varying combinations of deductions and credits.[15]

The most visible message from Figures 1a-1b is the starkly different tax treatment of wage and business income. Most wage earners are taxed at between 30 to 44 percent, while most self-employed are taxed at between 22 to 38 percent. This gap is present throughout the income distribution except for the very bottom.

Table 2 further illustrates the difference by showing the mean and standard deviations of the ATR by income deciles and income sources. On average, the workers face a 37.4 percent ATR while the self-employed face a 28.1 percent ATR. On average, the full income of employees is equal to the income of the self-employed – average gross wage income of CZK 247,480 corresponds to full employer cost of CZK 331, 623, while

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[14] Not all people paying zero income tax need to be on the spikes of the distribution. They may be facing the minimum health or social security contributions, which shift their ATR upward.

[15] Other, but quantitatively less important, causes of the dispersion are the exemption on informal wage income from health and social contributions and the absence of minimum contributions for secondary business.

the average gross business income is CZK 331,233. However, the self-employed pay almost 27-percent lower taxes than employees (CZK 95,310 as opposed to CZK 129,680).

In the bottom decile, the ATRs on wage and business income are equal. The gap between them exceeds 11 percentage points from in the 4th through the 10th decile, and is highest in the 6th decile where it reaches 14 percentage points. The self-employed in the 8th decile who earn CZK 415,000 on average still pay lower absolute amounts in taxes than workers in the 6th decile who earn CZK 238,000, almost half as little.

The differential taxation of wage and business income also has implications for the overall progressivity of taxes, portrayed with an alternative gauge in Table 3. The table shows the share of each decile in the total gross income, and the share of each decile in total taxes. In a strictly proportional tax system, the income shares and tax shares would be equal. The taxation of wage income and business income, when considered separately, is somewhat progressive. The tax share of the top decile of wage earners is 26.8 percent as opposed to their 24.5 percent income share. The taxes on business income exhibit even more progressivity at the top: the tax share of the top decile is 37.0 percent as opposed to the 32.3 percent income share.[16] However, the lowest-income self-employed pay actually more than their share in income due to the minimum contributions.

One popular measure of tax progressivity is the ratio of the concentration coefficient of taxes to the Gini coefficient of income, with higher values indicating higher progressivity[17] The values of both coefficients and their ratios are reported at the bottom of Table 3. The ratios are 1.12 for wage and 1.20 for business income.

The overall progressivity of taxes – when wage and business earners are considered together – is markedly lower. The tax shares of 1st through 5th deciles are only negligibly lower than their income shares, and the tax shares of 8th and 9th deciles are only negligibly higher than their income shares. Strikingly, the tax share of the top decile is exactly equal to its income share (26.7 percent, respectively). The ratio of the

[16] The distribution of business income is also more unequal than the distribution of the wage income: The top decile has an income share of 32 percent as opposed to the 1 percent share of the bottom decile; for wage income, the top decile income share is 24 percent as opposed to the 2 percent share of the bottom decile.

[17] The concentration coefficient, like the Gini coefficient, is the ratio of the area between the diagonal of the unit square and a concentration curve and the area below the diagonal. The concentration curve $F^T(q)$ denotes the share of total taxes paid by the fraction q of the poorest taxpayers (Seidl, Pogorelskiy and Traub (2013), p. 19). The concentration coefficient of taxes in general differs from the Gini coefficient of taxes because the ordering of taxpayers from the lowest to the highest income is generally not the same as the ordering from the lowest to the highest tax payments.

tax concentration and income Gini coefficient is 1.05 – it is not a weighted average of the equivalent ratios for wage or business income, but it is actually *lower than both* of them.

The reason is that the share of the business income in total income rises as we move to the highest income deciles, from 6 percent in the 5th decile to 41 percent in the top decile. Taxpayers with business income get a higher weight in higher deciles, and therefore the overall ATR does not rise as fast as it does within the wage or business income only.

To put these results in international perspective, we can compare the average ATRs with 14 European countries covered by Immervoll (2004). They varied from 55 percent (Belgium) to 27 percent (Ireland). The Czech average ATR on wage income (37 percent) and the ATR on the top decile (43 percent) would rank the 9th highest. However, a comparison based on today's tax codes would most likely put the Czech Republic on a higher rank because the statutory tax rates on labor income declined in 10 out of the 14 countries (OECD 2013).[18] The relative progressivity can be assessed by comparing the ratio of the ATRs for the top and bottom decile. This ratio lies between 1.5-1.6 in half of the countries, and is far higher in the others. The corresponding ratio of 1.34 for the Czech tax code would be the second lowest (after Denmark).[19]

It is impossible to precisely to compare the gap in ATRs on wage and business income with other countries because of the lack of studies with a comparable methodology. An illustrative comparison can be made with findings in OECD (2009). The authors compute the effective tax rates (including the income taxes and social security contributions) for stylized businesses in four countries: New Zealand, Sweden, Norway, and the UK. The stylized business yields income at 2 or 4 times the average wage. The business activity can be carried out either under an employment contract or under unincorporated (self-employed) business, and the authors make additional assumptions that affect the tax gap between employment and self-employment. Under the assumptions that generate the largest gap, the effective average tax rate on the self-employed is lower than on employees by 0 percent (New Zealand), 22 percent (Norway), 31 percent (Sweden) and 32 percent (UK).[20] In our TAXBEN sample, the corresponding numbers are 27 percent (for the whole sample) or 28 percent (when

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[18] OECD (2013) allows an up-to-date consistent comparison of the average tax rate (defined the same way as in this paper) for several types of stylized workers. For single workers with average earnings, the ATR in the Czech Republic is the 5th highest.

[19] The ratio of 1.34 has the ATR of the second, not the first, decile in the denominator. The second decile is more appropriate for this comparison: Immervoll (2004) excludes employees with less than full-year employment from the analysis; these are dominantly represented in the bottom decile of the Czech sample and face somewhat higher ATR's because of the minimum health insurance payments.

[20] OECD (2009), figure 3.1-3.2, pages 58-79.

restricting the sample to taxpayers with earnings 2 times the average wage, plus or minus 10 percent). The preferential tax treatment of the self-employed is therefore high, although not the highest, in international comparison. Moreover, since TAXBEN tends to over-predict the average tax rates on the self-employed, the actual gap in the Czech Republic is most likely even greater.

3.2. Marginal tax rates

Marginal tax rate (MTR) is a measure of work incentive at the intensive margin – it measures the fraction of the marginal product of labor created by longer work hours, greater efforts, or increased productivity that is taxed away. It is also an important measure of the incentives to engage in tax evasion or avoidance. The MTR captures the incentives to compensate employees through taxed salary as opposed to legal or illegal alternatives such as perks, stocks, or employing subcontractors instead of employees.

The relationships between the marginal tax rates and income and their distributions are depicted in Figures 2a-2b, 3a-3b, and in Table 4.[21] We distinguish two marginal tax rates: The first, "tax only" rate measures the change in taxes paid due to an increase in income. The second, "effective" marginal tax rate (EMTR) adds the rate at which benefits are reduced (as defined in equation 2; the difference between the two is thus the benefit withdrawal rate). The distinction allows us to see the overall disincentive effect of the tax-and-benefit system as well the extent in which the disincentive is created by taxes or benefits.

The most prominent marginal tax rate on wage income is 48.6 percent, because it faced by the people who bear the full burden of the income tax and the health and social contributions on the margin. Over three quarters of all wage earners face this MTR, and they are distributed across all levels of wage income,[22] up to the cap on social security contributions which kicks in at 1,242,000. It is also *the only* MTR faced by taxpayers with wages between 300,000 up to the cap. Lower MTRs are faced by the wage earners at the very top (33.8 percent) who are above the cap on social contributions. Lower MTRs are also faced by many taxpayers with wages below 300,000. The 33.6 percent MTR is faced by 15 percent of wage earners, who claim enough credits to pay zero income tax, are not eligible for the child tax credit refund, but face the standard health and social contributions. Even lower MTRs are faced by the remaining wage earners who pay zero personal income tax, are below the minimum health contributions, have informal work contract which is taxed more lightly, or a combination of these. The share of such people evaporates quickly, which is demonstrated by the sharply rising average MTR depicted with a line. The average MTR exceeds 46 percent for taxpayers in the 3rd decile or higher (Table 4).

[21] The distribution of income is the same as in the average tax rate Figures 1a and 1b, therefore it is not shown.

[22] The lowest-earning taxpayer in SILC facing the 48.6% MTR has annual income of CZK 28,000.

The picture and the logic are similar for business income, but the marginal tax rates are much lower. The main MTR is 36.3 percent, which is faced by 46 percent of taxpayers. The other frequent rates are 29.6 percent (18 percent of taxpayers; these are above the minimum social contributions but below the minimum health contributions, i.e., with income between 155,000 and 310,000) and zero (17 percent of taxpayers; these are below both minima and claim enough credits in order not to pay income tax either). The self-employed with income above 1,242,000 face a quite a high MTR of 43.3 percent because they still pay the social security and health contributions and a new income tax surcharge as well. In this income range the self-employed pay higher tax rates *on the margin* than employees.

The variance of MTRs is very large in the first decile, both for wage and business income (standard deviations are 1.48 and 2.37, respectively – see columns 3 and 7 in Table 4). It is order of magnitude smaller in the other deciles.

Adding benefits withdrawals to generate effective marginal tax rates (Figure 3a-3b, right-subpanels of Table 4) gives two main results: First, the MTRs are increased in the lower deciles. When considering all earners together, the average effective MTRs are higher than the "tax only" MTRs by 11 percentage points in the first decile, 7 percentage points in the second decile, and they almost coincide with the "tax only" MTRs from the 5th decile up. The upper half of the income distribution therefore does not experience cuts in benefits if their income rises. Because of the benefit withdrawals, the first decile of the overall income distribution faces higher MTR (50.8 percent) than the upper deciles.

Second, the benefits impose high benefit withdrawal rates on a few low-income taxpayers while leaving most taxpayers unaffected. In fact, 92 percent of all taxpayers and even 78 percent of taxpayers in the first decile face zero benefit withdrawal. But Figures 3a-3b clearly show clusters of taxpayers with effective MTR's between 50 to 90 percent. Those who are affected by benefit withdrawals (22 percent of taxpayers in the 1st decile, 17 percent in the 2nd), face withdrawal rates of 17 percent at least. Most commonly, the benefit withdrawal rates for such taxpayers are either 20 or 46 percent.

The main reason why so few taxpayers have positive benefit withdrawal rates is that many benefits are means-tested with fixed amount of benefit (e.g. child allowance and birth grant). Therefore, only those who are right below the threshold for benefit eligibility face some withdrawal of the benefits if their income increases marginally. The second group of benefits has the amount of benefit dependent on income as well (in general, higher income means lower benefit amount), but these have very low eligibility thresholds for income (housing benefit, aid in material need), so that they are mostly collected by non-working individuals. Therefore, these benefits also do not affect the benefit withdrawal rates based on income increase for the majority of working individuals. However, this does not imply that benefits have no impact on work incentives in the Czech Republic. The important role of benefits is captured by the participation tax rate, which shows how the benefits change with changes in labor market participation (see next section).

The distribution of effective marginal tax rates is demonstrated in the right-side panels of Figures 3a-3b. It confirms that a vast majority of wage earners is in the 40-50 percent interval and a vast majority of the self-employed is in the 30-40 percent interval. About 3 percent of taxpayers are exposed to effective MTRs exceeding 60 percent.

Immervoll (2004) also provides the tabulation of EMTRs for the entire working population (workers and self-employed together). The average Czech EMTR (45.5 percent) would be the 4th highest in comparison with 14 other EU countries.[23] The Czech Republic not only has one of the highest levels of EMTRs, but it has by far the highest dispersion of EMTRs despite the flat tax: The standard deviation of EMTRs is 0.63, while the highest standard deviation in Immervoll (2004) sample is 0.45 (The Netherlands) and most countries have standard deviation of around 0.3. The high dispersion is explained by high benefit withdrawal rates for those (few) taxpayers that face positive withdrawals, a large fraction of self-employed and employees paying no income tax, and by the large differences between tax rates on wage and business income.

3.3. Effective Participation Tax Rates

Effective participation tax rate (EPTR) is a widely used measure of working incentives at the extensive margin – it describes the tax and benefit consequences of the labor force participation decision of individuals. Figures 4a-4b illustrate effective participation tax rates (including the effect of both taxes and benefits) as a function of gross income for individuals with positive wage and business income. Clearly, most of the taxpayers face EPTR somewhere between 30 and 60 percent, and between 40 to 49 percent on average. But the dispersion in EPTR is very high, mainly for the employees. The great dispersion in the EPTR, which concerns mainly the lower-income individuals, is caused by the benefit withdrawal that is connected to the decision to enter paid work. This may lead to EPTRs exceeding 60 percent. These high EPTRs are faced by as many as 15 percent of individuals with positive work income and 14 percent of those with positive business income. These very high EPTRs are concentrated not only among the workers with the lowest incomes, but spread also some taxpayers with annual incomes above CZK 500,000 (which is well above the average wage).

[23] The average EMTRs vary from just under 25 percent (Spain, Greece) to between 50-55 percent (Germany, Denmark).

In case of secondary earners (usually women), high EPTR is also a consequence of the tax credit for the non-working spouse, which the primary earner loses if the secondary earner enters the labor market. The non-working spouse credit is very high and is the same as the basic credit deducted by every taxpayer (24 840 CZK per a year). As the second earner enters work, the basic tax credits she gains for herself is offset by the non-working spouse credit that her spouse loses. Since credits for children and deductions are already claimed by the primary earner, the secondary earners typically face a perfectly linear tax schedule with a marginal and participation tax rates equal to 48.6 percent. This level is also the mode of the distribution of EPTR's among the workers.

Great variation in effective participation tax rates for the lowest income taxpayers is also illustrated in Table 5. Average EPTR for the first decile is only 32 percent for the work income, but the standard deviation is at least twice as high as for the other deciles. From the fourth decile up, the average EPTR of employees exceeds 45 percent and converges slowly to almost 48 percent in the highest decile. The self-employed in the first three deciles face higher EPTRs than the workers, between 44 to 47 percent. This is due to the minimum social and health contributions which act as fixed cost of running a business. However, people with business income from the 4th decile up face lower EPTR than the people with work income (columns 2 and 4 in Table 5). Average EPTR for business income is almost 9 percentage points lower than average EPTR for work income, which is driven mainly by lower health and social contributions on business income.

Figure 4c illustrates the EPTR for the non-working individuals under the counterfactual that they start working full-time. Clearly, the non-working potential workers face somewhat higher participation tax rates, which is consistent with their decision not to work. The average EPTR is slightly below 48 percent throughout the income distribution, and the 48.6 percent EPTR is faced by almost 20 percent of non-working individuals. 8 percent of the non-working potential workers face EPTR over 60 percent.

5. Conclusions

We document numerous facts about the distribution of the average, marginal, and participation tax rates on earnings in the Czech Republic. Here we summarize our key findings and their potential policy implications.

Perhaps the most striking feature of the Czech tax system is the large gap in taxation of wage and business income. The existence of such a gap is well known and it is repeatedly a subject of intense political debates. What has been missing in such debates is the knowledge about its empirical magnitude. We quantify that the mean ATR on business income is lower than the mean ATR on wage income by 9.3 percentage points (27 percent). In medium and upper income deciles, the gap is even higher, between 11 to 14 percentage points. These results should be thought as a lower bound of the true gap because they are based on the officially reported taxable income. The tax laws allow great deal of self-employed entrepreneurs to count part of their regular personal spending towards business costs or to deduct the estimated costs of their true costs; such factors lead to even lower effective ATRs.

There are several economic reasons why the self-employed should be taxed at lower rates than the workers (higher taxable income elasticity, higher business risk, absence of numerous labor code guarantees, etc.). We acknowledge that the literature does not provide a clear recommendation on by how much lower the tax rates should be. But the current preferential treatment of the self-employed in the Czech Republic appears too generous compared to what it was several years ago, and in comparison with a other countries for which such comparison is available. The Mirrlees Review also criticizes a similarly generous preferential treatment in the UK.[24] Large gap between ATRs on wage and business income provides very strong incentives to employ workers as business subcontractors even in cases when employment contract would be mutually preferable in the absence of the tax advantage. Incentives to engage in undeclared work and tax avoidance are also adverse side effects.

The effective marginal tax rates on wage income are very high – 80 percent of workers face EMTRs that exceed 45 percent, among the highest in international comparisons. This creates strong incentives to provide non-cash compensation, such as employer-subsidized life insurance and pension savings, food vouchers, or perks. If non-cash compensation is induced by tax avoidance, it is generally inefficient because employees consume higher quantities of the tax-preferred goods than they would consume at market prices. Such incentives are further strengthened by the fact that some of these options are even tax-favored[25] or are legally exempt.[26] High EMPTRs are also transferred into high employer costs, and may thus have serious negative effects on the demand for labor.

The income tax credits are supposed to induce some progressivity into the otherwise flat taxes and contributions. We find that their effect is empirically rather limited. The main reason is that most of the tax revenues is raised by nearly-linear health and social contributions. Moreover, about one third of taxpayers (mostly with lower and medium incomes) pay no income tax; these taxpayers face only linear health and social security contributions. The tax schedule is thus de facto perfectly proportional for this large group of taxpayers.

The ATR is rising with income within the groups of wage earners and business earners. When the two groups of taxpayers are combined together, the overall progressivity is lower than the progressivity within either group. Again, the lower taxes on business income together with the increasing share of business incomes in higher deciles are

[24] Mirrlees (2010a), chapter 19.1.
[25] Life insurance and pension savings.
[26] In-kind perks such as tickets for cultural events or sports facilities.

the reason. Strikingly, the shares of both the lowest and the highest deciles in total personal incomes (1.9 and 26.7 percent) are essentially the same as their shares in total taxes (1.7 and 26.7 percent).

A non-negligible fraction of taxpayers face strong disincentives to work on the extensive margin. In particular, the effective participation tax rate exceeds 60 percent for 14 percent of actually working taxpayers, and 8 percent of the non-working. The tax code is structured such that the EPTRs for the secondary earners (usually women) are higher than EPTRs for the (otherwise comparable) primary earners. The primary earner deducts tax credits for himself, children, non-working spouse, and potentially other deductions. When the secondary earner starts working, she can claim a tax credit of CZK 24,840 (about average monthly gross wage) for herself, but at the same time her spouse loses the non-working spouse tax credit of equal value. Moreover, the tax credits for children, the mortgage interest deduction, etc. have already been claimed by the primary earner. Due to these peculiarities, the secondary earner's wages are taxed at a perfectly linear tax rate of 48.6 percent. Since secondary earners typically exhibit much more elastic labor supply on the extensive margin and higher reservation wage (see e.g. Meghir and Phillips, 2008), this feature of the tax system violates optimal taxation rules that imply lower participation tax rates for the secondary earners.

Last, the disparity in the average, marginal and participation tax rates among taxpayers with similar incomes is high.[27] The ATR's commonly differ by 20 percentage points or more among individuals with the same income at low or medium income levels. Such differences are due primarily to generous tax credits for children and non-working spouse, mortgage deductions, and the inevitable differences among taxpayers in the consumption of these tax-preferred commodities. These deductions and credits were introduced with the objective to reduce the taxes for households with certain characteristics. The existence of the disparities in ATRs is an expected and intended consequence of these tax reliefs. The magnitude of the disparities, reflecting the joint distribution of the eligibility for various reliefs across the population, has been unknown. Our results provide useful quantitative insights into the question whether the resulting *effects* of the tax reliefs, as they are actually claimed by taxpayers, are desirable.

Our results also shed some light on their effectiveness in achieving the stated objective. Taxpayers who pay zero income tax do not benefit from these tax reliefs or benefit only partially.[28] We compute the fraction of taxpayers who are eligible for at least one credit or deduction other than the basic credit or the child tax credit and at the same time their income tax after credits (but before the child bonus) is zero. There

[27] Evaluating the impacts of tax reforms on "stylized" individuals could then be very misleading because the seemingly similar taxpayers pay substantially different taxes to begin with.
[28] The child tax credit is the only credit that may reduce the tax liability to a negative number.

are 42 percent such taxpayers. As expected, these are predominantly the poorer taxpayers; the average gross income of those with zero income tax before credits is CZK 170,000 while the average gross income of all taxpayers who are eligible for at least one credit or deduction is CZK 313,000. The objective to provide tax reliefs to taxpayers with certain characteristics, as implemented in the Czech system through deductions and credits, conflicts with the objective to reduce income disparities.

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FIGURE 1a

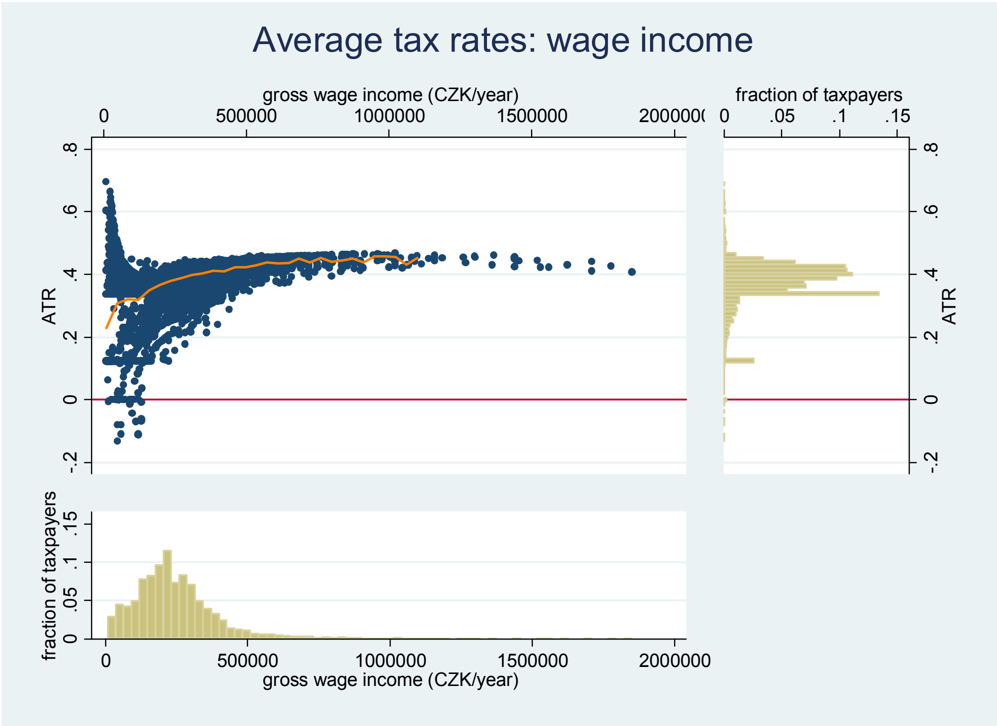


FIGURE 1b

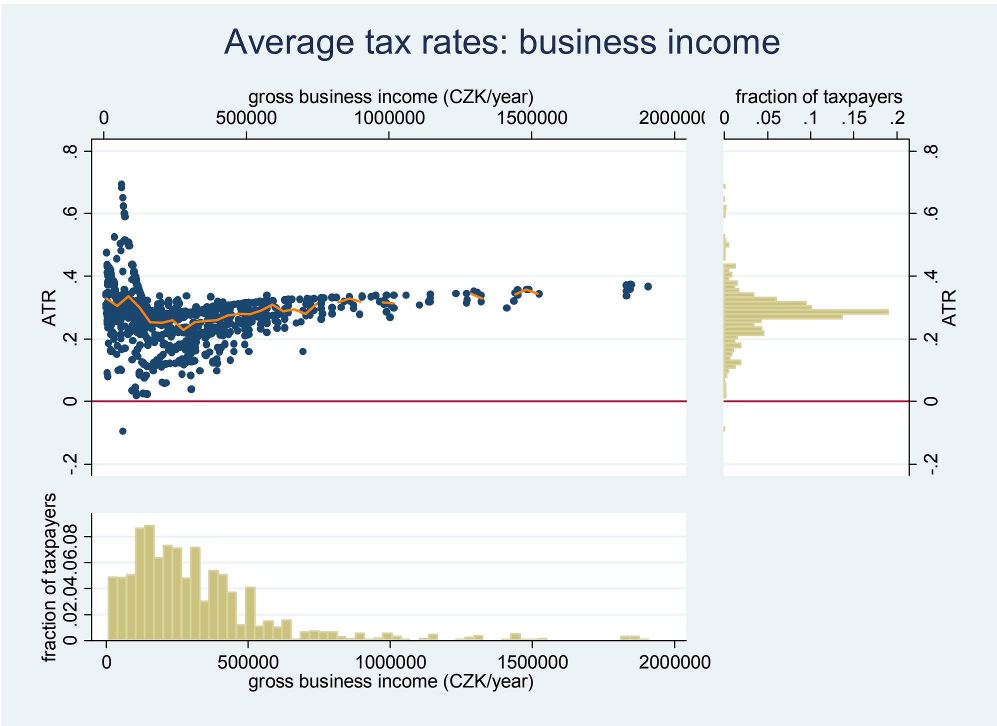


FIGURE 2a

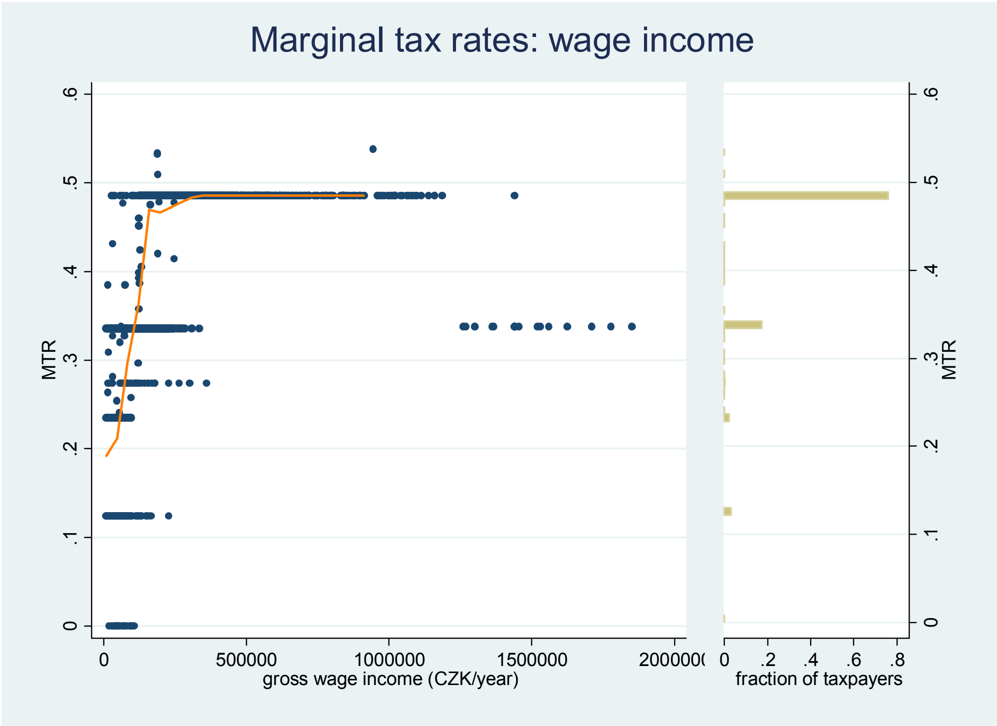


FIGURE 2b

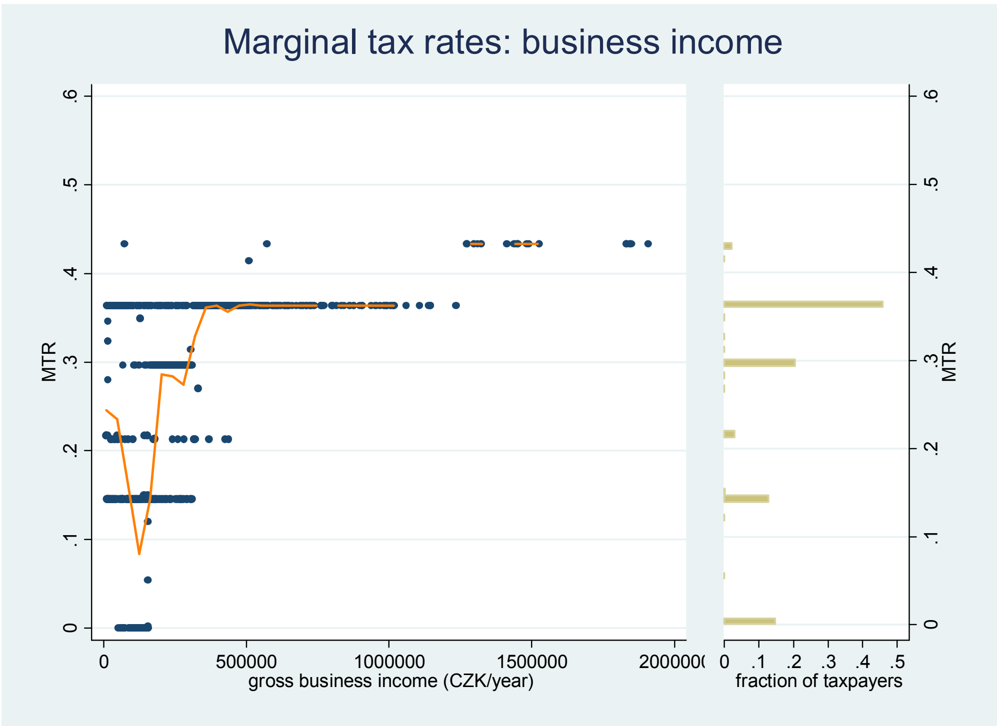


FIGURE 3a

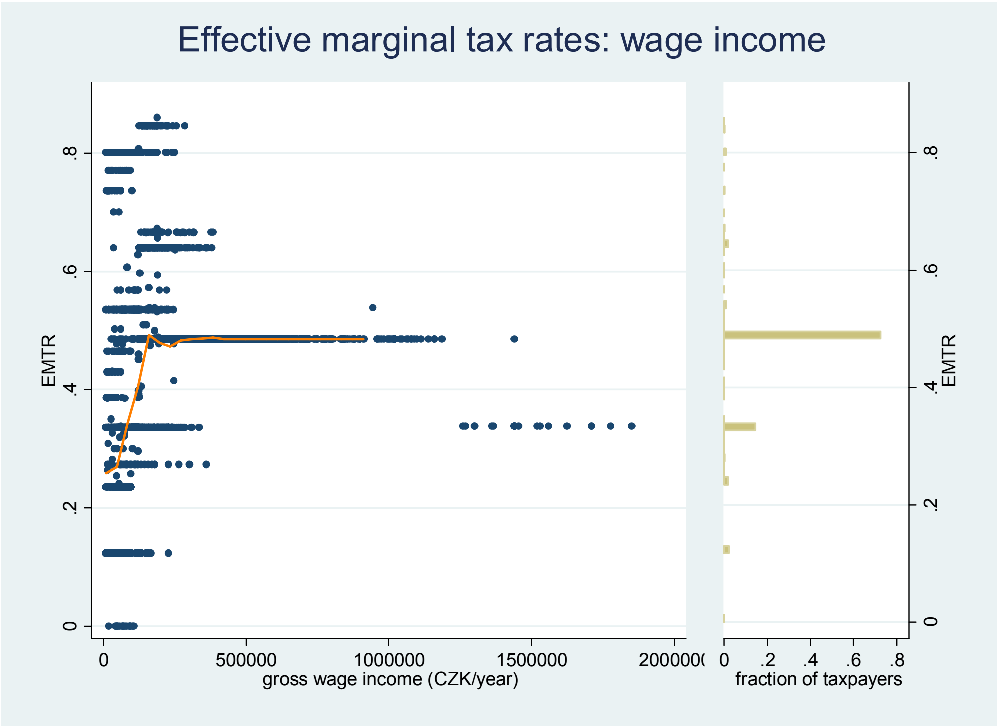


FIGURE 3b

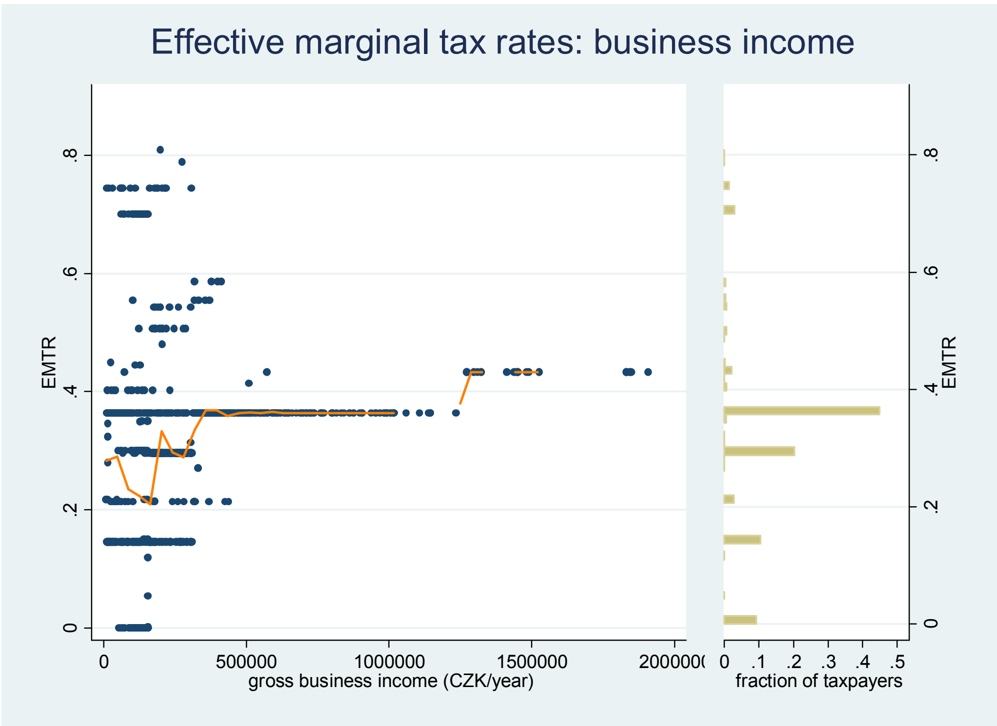


FIGURE 4a

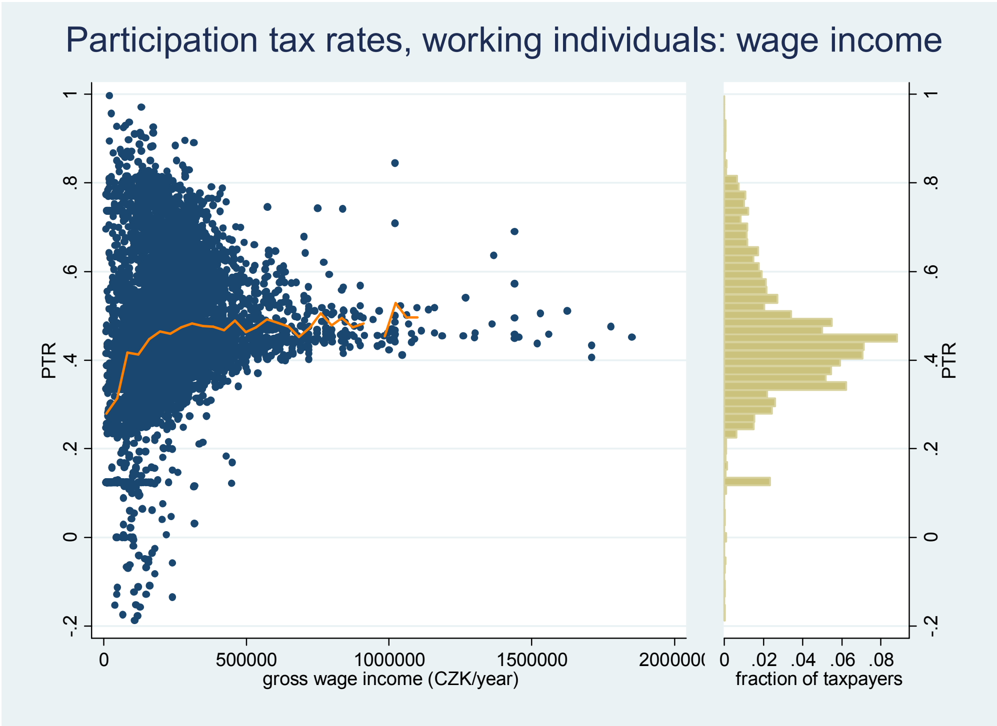


FIGURE 4b

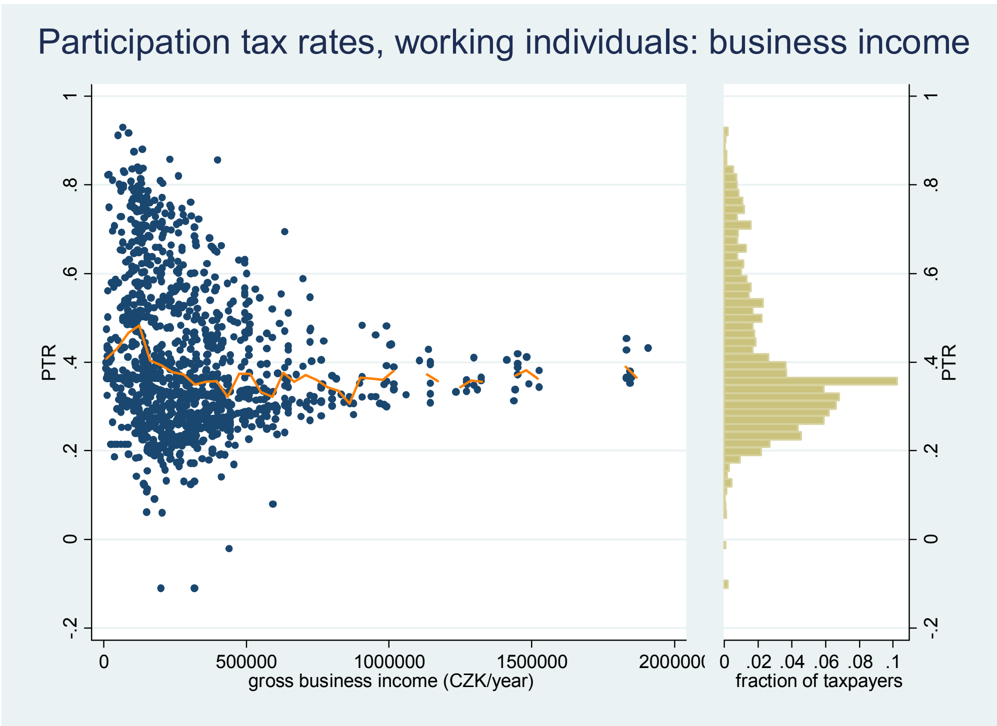
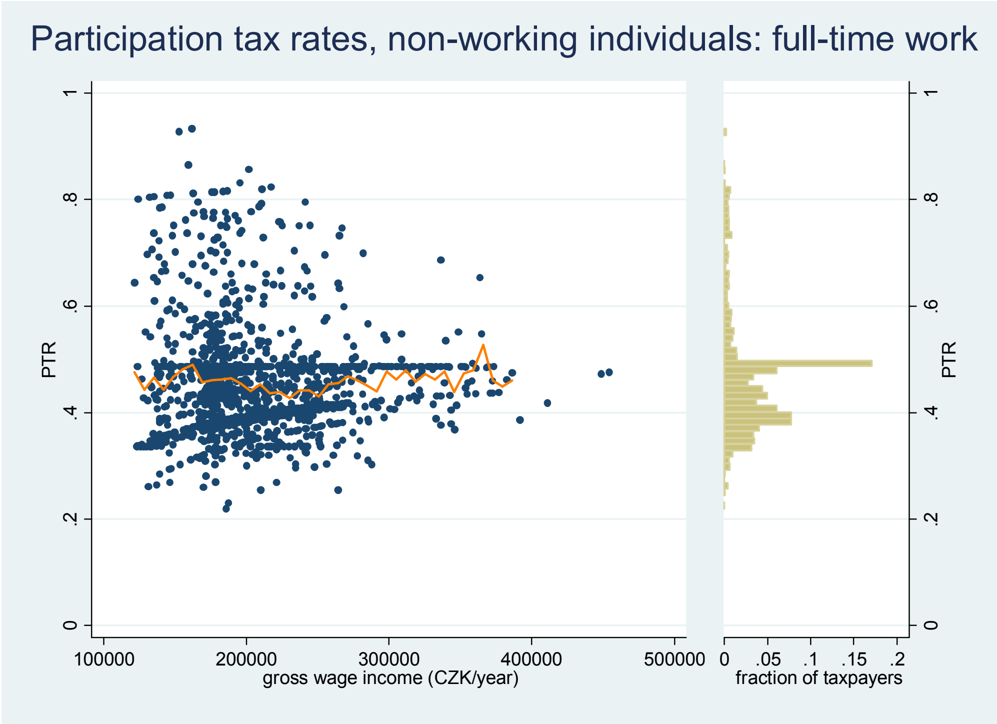


FIGURE 4c



Participation tax rates, non-working individuals: full-time work
PTR
0
.2
.4
.6
.8
1
100000
200000
300000
400000
500000
gross wage income (CZK/year)
0
.05
.1
.15
.2
fraction of taxpayers

TABLE 1

Basic characteristics of individuals, by income source

	individuals with positive wage income		individuals with positive business income		individuals with positive business and work income		all individuals with positive income	
	mean	sd	mean	sd	mean	sd	mean	sd
Annual income (wage and business)	254,965	168,262	373,512	361,216	405,270	253,395	277,651	218,530
Annual wage income	254,965	168,262	0	0	256,177	214,933	214,508	181,555
Annual business income	0	0	373,512	361,216	149,093	156,615	63,143	200,219
Annual total taxes	133,927	99,475	107,409	127,332	176,881	142,302	130,820	106,367
Annual income tax	19,448	31,684	23,430	61,728	34,761	46,017	20,474	38,544
Annual payroll taxes - employee	28,372	17,143	164	1,255	27,320	24,369	23,865	19,006
Annual payroll taxes - employer	86,107	53,687	0	0	81,578	76,683	72,317	59,071
Annual payroll taxes - self-employed	0	0	83,815	68,252	33,221	33,465	14,163	41,374
Age	39.7	10.6	42.2	9.9	41.4	9.4	40.1	11
Percentage of women	0.46	0.50	0.30	0.46	0.34	0.47	0.43	0.50
Number of children	0.78	0.92	0.88	0.98	0.98	0.98	0.81	0.93
Number of individuals (population)	3,703,576		721,172		116,666		4,541,414	
Number of individuals (sample)	7,099		1,031		199		8,329	

The summary statistics of individuals with non-negligible annual earnings (above 8000 CZK). Incomes and taxes are measured in CZK per year. Observations are weighted by the frequency weights provided in SILC that allow extrapolating from the sample to the population.

TABLE 2

Average tax rates - by individual income deciles

	wage income				business income				all income			
income decile	mean gross income	mean total taxes	mean ATR	st.dev. ATR	mean gross income	mean total taxes	mean ATR	st.dev. ATR	mean gross income	mean total taxes	mean ATR	st.dev. ATR
1	45,147	18,817	0.341	0.21	42,246	14,700	0.340	0.14	49,684	21,283	0.361	0.22
2	106,654	45,635	0.320	0.07	104,345	34,201	0.329	0.10	113,522	46,698	0.323	0.07
3	147,178	67,482	0.342	0.05	142,051	37,788	0.267	0.07	152,004	65,743	0.333	0.06
4	179,913	86,487	0.359	0.05	183,934	45,642	0.248	0.06	185,124	84,667	0.348	0.06
5	210,118	104,392	0.371	0.05	232,691	58,781	0.252	0.05	217,576	103,550	0.360	0.06
6	238,178	121,631	0.381	0.05	282,301	67,329	0.239	0.06	246,976	117,991	0.366	0.06
7	270,922	141,674	0.390	0.04	344,782	89,352	0.259	0.04	282,815	139,634	0.375	0.07
8	308,265	164,198	0.397	0.04	415,697	112,296	0.270	0.05	326,276	157,781	0.372	0.07
9	367,222	200,666	0.408	0.04	518,702	148,695	0.286	0.04	398,847	189,344	0.372	0.07
10	605,418	348,259	0.429	0.03	1,077,743	354,665	0.319	0.03	720,886	338,517	0.386	0.07
average	247,480	129,680	0.374	0.09	331,233	95,310	0.281	0.08	269,215	126,445	0.360	0.10

The sample includes all individuals with non-negligible annual earnings (above 8000 CZK). Incomes and total taxes are measured in CZK per year. Observations are weighted by the frequency weights provided in SILC that allow extrapolating from the sample to the population.

TABLE 3

Income shares and tax shares by individual income deciles

income decile	wage income: decile share of income	wage income: decile share of total taxes	business income: decile share of income	business income: decile share of total taxes	all income: decile share of income	all income: decile share of total taxes	all income: share of business income in the decile
1	0.018	0.015	0.013	0.016	0.019	0.017	0.11
2	0.043	0.035	0.032	0.036	0.042	0.037	0.18
3	0.059	0.052	0.042	0.039	0.057	0.052	0.16
4	0.074	0.067	0.058	0.050	0.069	0.067	0.11
5	0.085	0.080	0.070	0.062	0.083	0.084	0.09
6	0.103	0.100	0.081	0.068	0.089	0.091	0.15
7	0.102	0.102	0.119	0.107	0.105	0.110	0.11
8	0.124	0.126	0.122	0.114	0.121	0.125	0.18
9	0.148	0.155	0.139	0.139	0.148	0.150	0.26
10	0.245	0.268	0.323	0.370	0.267	0.267	0.41
Gini	0.33	0.37	0.44	0.53	0.35	0.37	
Ratio		1.12		1.20		1.05	

The sample includes all individuals with non-negligible annual earnings (above 8000 CZK). Observations are weighted by the frequency weights provided in SILC that allow extrapolating from the sample to the population.

TABLE 4

Marginal tax rates and effective marginal tax rates

income decile	wage income				business income				all income			
	MTR (taxes only)		Effective MTR (taxes + benefit withdrawals)		MTR (taxes only)		Effective MTR (taxes + benefit withdrawals)		MTR (taxes only)		Effective MTR (taxes + benefit withdrawals)	
	mean	st.dev.	mean	st.dev.	mean	st.dev.	mean	st.dev.	mean	st.dev.	mean	st.dev.
1	0.378	1.48	0.453	1.48	0.481	2.33	0.559	2.32	0.395	1.70	0.508	1.88
2	0.342	0.08	0.424	0.96	0.105	0.13	0.226	0.24	0.301	0.15	0.369	0.37
3	0.462	0.06	0.497	0.22	0.045	0.10	0.204	0.26	0.400	0.16	0.447	0.25
4	0.467	0.05	0.490	0.09	0.256	0.08	0.353	0.55	0.445	0.08	0.480	0.25
5	0.466	0.05	0.482	0.07	0.286	0.06	0.308	0.09	0.447	0.08	0.464	0.09
6	0.471	0.05	0.479	0.06	0.281	0.06	0.299	0.10	0.447	0.08	0.455	0.09
7	0.482	0.02	0.497	0.37	0.352	0.04	0.361	0.06	0.461	0.07	0.473	0.34
8	0.485	0.01	0.487	0.02	0.362	0.02	0.367	0.04	0.456	0.07	0.461	0.07
9	0.485	0.01	0.488	0.02	0.364	0.01	0.364	0.01	0.453	0.06	0.456	0.06
10	0.481	0.03	0.481	0.03	0.378	0.03	0.378	0.03	0.439	0.06	0.439	0.06
average	0.452	0.48	0.478	0.58	0.291	0.75	0.342	0.77	0.424	0.55	0.455	0.63

The sample includes all individuals with non-negligible annual earnings (above 8000 CZK). Observations are weighted by the frequency weights provided in SILC that allow extrapolating from the sample to the population.

TABLE 5

Participation tax rates, by income sources and income deciles

income decile	Effective PTR (taxes + benefit withdrawals)					
	wage income		business income		all income	
	mean	st.dev.	mean	st.dev.	mean	st.dev.
1	0.325	0.35	0.445	0.30	0.353	0.36
2	0.409	0.19	0.471	0.25	0.433	0.20
3	0.434	0.16	0.469	0.20	0.437	0.17
4	0.457	0.15	0.401	0.19	0.453	0.15
5	0.466	0.14	0.370	0.17	0.456	0.15
6	0.460	0.13	0.381	0.16	0.451	0.13
7	0.474	0.11	0.349	0.14	0.468	0.12
8	0.480	0.11	0.347	0.12	0.455	0.12
9	0.477	0.10	0.359	0.11	0.440	0.12
10	0.477	0.08	0.365	0.07	0.436	0.10
average	0.445	0.17	0.358	0.19	0.431	0.18

The sample includes all individuals with non-negligible annual earnings (above 8000 CZK). Observations are weighted by the frequency weights provided in SILC that allow extrapolating from the sample to the population.

APPENDIX

TAXBEN model – algorithms and assumptions

Computing the taxes and benefits would be straightforward if the information in the SILC dataset was the same as on the tax returns and benefit application forms. This is true for the key information (e.g., wages, family structures) but not for the numerous detailed provisions of the tax and benefit laws. We inevitably had to resort to assumptions on how to reflect those provisions which cannot be perfectly computed with the data available. Below we describe the TAXBEN computations and justify the assumptions.

i. Defining incomes

Our concept of income Y^i corresponds to the marginal product of labor. For wage income, the marginal product is the total employer cost, i.e., the sum of the wage and social and health contributions paid by the employer. For business income, the marginal product is the gross profit before subtracting the social and health contributions and the income tax.

SILC reports the gross wage income from primary and secondary employment, and also reports the type of labor contract that the person has. For tax purposes, the first distinction is not relevant, but the second is because wages from informal temporary contracts[29] up to 10,000 per month are exempt from the health and social contributions. We therefore distinguish the wages from formal work (fully-taxed) and informal work (partially taxed) based on whether the individual has the informal temporary contract. Finally, we add the employer health and social contributions, calculated from the gross wages by applying the tax laws, to obtain the full employer cost, our concept of wage income

Employees also receive some compensation in employee benefits (perks). Perks are generally not taxable, with the exception of a company car provided for private use. Ideally, the wage income should include the monetary value of the perks. SILC provides a yes/no information on some of the perks (car, food vouchers, cell phone) but not their monetary value.Therefore, perks are not included in the TAXBEN model.

The income of the self-employed reported in SILC is the difference between revenues and costs, as recorded on the tax return or self-reported by the respondent, minus the social and health contributions. The social and health contributions are then not reported for the self-employed. We therefore have to reconstruct the gross business income before paying the contributions. Fortunately, there is a one-to-one correspondence between the profit before and after subtracting the contributions,

[29] The so-called “dohoda o provedení práce” in Czech, which is currently limited to 300 hours per year with a single employer.

even if one takes into account the non-linearities induced by the minimum and maximum contributions. The exact function linking the two is:

$$
\begin{aligned}
NY &= Y - \tau_{SS}B_{SSmin} - \tau_H B_{Hmin} && if\ Y \leq \frac{B_{SSmin}}{f_D} \\
&= Y - \tau_{SS}Y - \tau_H B_{Hmin} && if\ Y > \frac{B_{SSmin}}{f_D} \text{ and } \mathrm{Y} \geq \frac{B_{Hmin}}{f_D} \\
&= Y - (\tau_{SS} + \tau_H)Y && if\ Y > \frac{B_{Hmin}}{f_D} \text{ and } \mathrm{Y} \leq \frac{B_{SSmax}}{f_D} \\
&= Y - \tau_{SS}B_{SSmax} - \tau_H Y && if\ Y > \frac{B_{SSmax}}{f_D} \text{ and } \mathrm{Y} \leq \frac{B_{Hmax}}{f_D} \\
&= Y - \tau_{SS}B_{SSmax} - \tau_H B_{Hmax} && if\ Y > \frac{B_{Hmax}}{f_D}
\end{aligned}
$$

where *NY* denotes the net income (after subtracting the contributions but not the income tax), and B_{SSmin}, B_{Hmin}, B_{SSmax} and B_{Hmax} denote the minimum and maximum tax bases for social and health contributions, and other terms have been defined in section 2.2. We invert the function to express *Y* as a function of *NY*, and apply the inverse function to the net income reported in SILC to recover the gross business income.[30]

ii. Computing taxes

We first divide the household members into tax units. A tax unit is the collection of household members where one taxpayer can potentially claim tax credits on behalf of some other members.[31] The tax unit is simply the household in single-adult, married couple, or basic parent(s)-children households. In more complicated households (typically young parents and children living with grandparents, or other relatives present), we use the information on the relationship of each member to the household head to isolate the parent(s) and children into one tax unit, the grandparents into another unit, and the remaining individuals into other single-person units.[32] We assume that the highest-earning person in the tax unit claims all the tax credits for children and non-working spouse.

For each individual with positive income, we apply the appropriate tax law to compute the health and social security contributions by the employee and employer. To compute the income tax, we first set the partial tax base, which equals the wages plus

[30] The minimum tax bases also depend on the number of months during the year when the business is operating. For main business income, this number is reported in SILC and we use it to set the individual-specific minimum tax bases. For secondary business income, the number of months is not reported. We therefore invoke the assumption that the number of months of secondary business activity is distributed uniformly and assign the number of months according to the rank in the distribution of secondary business income. (I.e., that people in the top 12th of the distribution of secondary business income are assigned 12 months, people in the second 12th are assigned 11 months etc.).

[31] Typically, a child tax credit claimed by one of the parents and the non-working spouse tax credit claimed by the primary earner for a non-working spouse.

[32] Even in basic parents-children household, a child can form a separate unit if he/she is old enough to earn income and the parents cannot claim a tax credit for him/her.

employer contributions for wage income and profit before contributions for business income. Next, taxpayers can deduct several items from the partial tax base.[33] The SILC data is rather limited for incorporating this feature of the tax system. There is no information to impute the deductions for charitable gifts, life insurance contributions, and the study costs, and we do not build them into the model. This is not too a serious omission since these deductions represent only 28 percent of all deductions.[34]The deductions for voluntary pension insurance can be computed directly, since the pension insurance amounts are reported in SILC.

The mortgage deduction is the most important, representing 62 percent of all deductions. We impute the mortgage deduction from the information on whether the household has a mortgage or not, the self-reported value of its home, how long it has lived in the current home, an assumed interest rate and repayment length. We construct a "typical" mortgage that the household is likely to have given this information and compute the interest payments.[35] Doing so inevitably implies that our imputed deductions sometimes underestimate and sometimes overestimate the true deductions, and they have lower variance than the true deductions. However, we think that our imputations are precise enough to capture the main consequences of the mortgage interest deduction: the preferential tax treatment that homeowners with a mortgage receive over other taxpayers and its regressive impact because higher-income households are more likely to have a mortgage and to deduct higher interest payments.[36]

[33] According to the income tax breakdown statistics produced by the Ministry of Finance, the total value of these deductions was 22.3 billion, or 3.6 percent of the personal income tax base. However, these income tax statistics are compiled from the individual income tax returns only. The majority of taxpayers has their taxes administered by their employers. The employers also process common deductions, such as the mortgage interest deduction. Even the tax collecting authority does not have the information to calculate the total amounts of deductions. The statistics on the deductions that we mention here are based only on the subpopulation that files a return. Unfortunately, this lack of information does not enable us to check the external validity of the assumptions that we use to impute the deductions.

[34] Source: Income tax breakdown statistics (2010), Ministry of Finance.

[35] The mortgage market in the Czech Republic expanded substantially since 2000. The SILC data demonstrates this with a large difference between the number of households that have mortgage and moved into in the current home during 2000-2010 and those who moved in during the previous decade (564,000 and 117,000, respectively, population-weighted). For that reason, we assume that households that moved in since 2000 used the mortgage to buy the home. The mortgage amount is assumed to be 50 percent of the value of the home, and naturally the households took the mortgage when they moved in. The households that had moved in earlier are assumed to have used the mortgage for the renovation of the home. The mortgage amount is assumed to be 20 percent of the value of the home and the year when they took the mortgage is assigned to them randomly from 2000-2011 interval. The interest rate and the mortgage payment period are assumed to be 4 percent and 15 years, respectively.

[36] Descriptive probit and OLS regressions on a subsample of households with positive earnings show that a 1-percent increase in household income increases the probability that a household

After subtracting the deductions, a 15 percent tax rate sets the income tax before credits. Subtracting the basic credit, credit for a non-working spouse and the child is straightforward because SILC provides enough information to determine eligibility. There are also additional credits for taxpayers and spouses with disabilities. The basic tax credit for each taxpayer is higher for people with a serious disability (the so-called ZTP/P card holders), and also the tax credit for non-working spouse is higher if the spouse is a ZTP/P card holder. The eligibility for these tax credits is assigned to people who report "very bad" health status in the SILC data (or their spouse does).[37] There is also an additional tax credit for people who receive disability pension. Disability pension is reported in the SILC data, so determining the eligibility for this tax credit is more straightforward.[38]

The differential taxation of wage and business income is one of the focuses of our analysis. We therefore have to portion the total taxes into taxes on wage and business income for taxpayers that have both sources of income. While the health and social contributions are assessed separately on wages and profits, the income tax is determined jointly. We portion the income tax by the share of the wage and business income in the tax base.

iii. Computing benefits

As with taxes, we start by defining the benefit units. It basically means creating units that are treated separately for benefit entitlement purposes. Some benefits (like housing benefit and aid in material need benefits) treat the whole household as one unit (so that characteristics and incomes of all household members are tested). In case of benefits that are connected to presence of children in a family, the benefit units sometimes do not include all household members. For entitlement to child benefit and birth grant, the benefit unit includes children and their parents (if parents are themselves dependent children, then grandparents are also included in the benefit unit). For maternity benefit, the amount of benefit depends on the previous income of mother, so the unit includes her only.

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has mortgage by 0.075 percentage points. On the subsample of households with a mortgage, a 1-percent increase in income increases the amount of the mortgage interest deduction by 0.35 percent.

[37]The information about ZPT/P card holder is not available in the data, but the "very bad" self-reported health status in SILC data corresponds well in total numbers to the total number of people with ZTP/P card.

[38] However, the amount of tax credit differs based on the type of disability pension that an individual collects, and the information on the type of disability pension is not reported the in data. We thus again apply the assumption that only people with "very bad" self-reported health status in SILC collect the most generous disability pension, and therefore are eligible for the most generous tax credit.

Based on benefit units' definitions and detailed information in the SILC data, we can simulate eligibility and amounts of most of the welfare benefits that are available in the Czech Republic. We simulate maternity benefit (*peněžitá pomoc v mateřství*), birth grant (*porodné*), child allowance (*příspěvky na děti*), housing benefit (*příspěvek na bydlení*), and aid in material need benefits: living allowance (*příspěvek na živobytí*) and housing supplement (*doplatek na bydlení*). However, some benefits cannot be simulated due to lack of information on previous incomes and employment history in the SILC data (unemployment benefit – *dávky v nezaměstnanosti*), because of the length and amount of benefit being subject of a choice of recipients (parental leave benefit – *rodičovský příspěvek*) or because of very individual assessment process for benefit eligibility (benefits for people with serious disability). These benefits are thus not simulated; the amounts of these benefits are taken from the self-reported values in SILC.

Simulation of some of the means-tested benefits is further complicated by the fact that period for which incomes are tested does not always correspond to the period for which incomes are reported in SILC. SILC data reports incomes in the previous calendar year, while for example the housing benefit and the birth grant are assigned based on income from the previous quarter. Therefore, we have to apply an assumption that incomes are spread smoothly across the whole year and there are no big jumps in it. Moreover, the reported benefits in SILC are reported for the same period as reported incomes, while in reality benefits are often assigned based on incomes from previous period. So, to some extent, we also assume no big jumps in incomes across years, because some of the reported results are based on combination of reported benefits from SILC (unemployment benefit and parental leave benefit) and simulated benefits (all other benefits).

The simulation of maternity leave benefit requires further assumptions. Eligibility for this benefit is conditioned upon paying health insurance contributions for at least 270 days in the previous two years. We assume this condition is satisfied for all women who have positive incomes from work or business in the previous calendar year. In the simulation of housing benefit, we compare information about actual housing costs reported in the SILC data with the maximum normative costs (taken from legislation).

Finally, the main assumption of benefit simulation is the full take-up of all benefits for which a household is eligible. Although this is a standard assumption in the microsimulation literature (see e.g. Immervoll and O'Donoghue, 2002), the take-up of some welfare benefits in the Czech Republic is quite low. The low take-up concerns mainly housing benefit, but the extent of non-take-up is not known.

iv. Consistency with external data

The accuracy of the TAXBEN model in predicting tax revenues and benefit expenditures is evaluated in Table A2. It shows the actual budget revenues in 2010 (the year for which the income information is available in SILC),[39] the revenues predicted by TAXBEN (based on tax parameters in 2010), and also the revenues reported directly in SILC (however, SILC does not report the health and social security contributions of the self-employed).

The model does an excellent job in predicting the two most significant revenue sources: social security and health contributions paid on wage income. The TAXBEN predictions differ from the actual revenues by 0.2 and 1.7 percent, respectively. The TAXBEN under-predicts the income tax on wage income and over-predicts the income tax on business income, such that the total income tax revenues are still under-predicted by 15.1 percent. The relative disparity between business and wage income is in part due to differences in the way the income tax is allocated between wage and business income in the official statistics and in TAXBEN.[40] The over-prediction of the income tax on business income is most likely due to the discrepancy between the incomes of the self-employed reported in SILC and incomes that are actually taxed. SILC contains direct information on the income tax paid by the self-employed, which, however, is not taken from the tax returns but is imputed by the Czech Statistical Office based on reported incomes and family structures. The income tax revenue reported in SILC exceeds the actual revenue by the order of 3.5. Also, the TAXBEN predicted health and social security contributions on business income are higher than the actual revenues, despite the fact that these are very simple, almost linear taxes. SILC thus appears to be over-reporting business income. One reason might be the availability of several (legitimate) deductions that reduce the tax base below the actual profits. The most important are the estimated costs that the self-employed may deduct instead of their true costs. The estimated costs are set as a fixed percentage of revenues (40, 50, 60 or 80 percent, depending on the industry) are deducted by about 300,000 self-employed.[41] Total tax revenues are over-predicted by the TAXBEN model by mere 1.9 percent.

Benefit expenditures are over-predicted mainly for the housing benefit, which has very low take-up in the Czech Republic, and for the aid in material need benefits, where the take-up probably plays its role as well. The child allowance, birth grant and maternity benefit expenditures are predicted very well by the TAXBEN model.

[39] Ideally, we would like to use the tax liability on income earned in 2010 instead of the cash revenues of the government. However, Ministry of Finance was not able to provide this information separately for employment and business income.

[40] Persons that have both wage and business income have the income tax on wages withheld by the employer. They also file a tax return on which both income sources are consolidated and all tax credits and deductions are claimed. Taxes paid based on this return appear in the official statistics as taxes paid by the self-employed, and hence the tax credits and deductions disproportionately reduce the reported income taxes paid by the self-employed. In TAXBEN, we divide the income tax in proportion to the share of business and wage income in the tax base.

[41] Source: Explanatory memorandum to Act no. 500/2012, available at http://www.psp.cz/sqw/historie.sqw?o=6&t=801 (last accessed June 28, 2013).

v. Computing the tax rates

The average tax rate is a simple division of the total taxes paid by the individual to his income. The marginal tax rates are computed by increasing the annual gross income (either the wage or business income) by CZK 1000 and simulating the change in the household's taxes and benefits under the increased income.

The participation tax rates of the currently employed or self-employed individuals are computed by setting their earnings to zero, holding the earnings of other household members constant, and simulating the change in the household's taxes and benefits under the reduced income.

vi. Wage imputation for non-working individuals

When constructing the participation tax rates for the non-working individuals, we do not observe the counterfactual – the earnings they would have earned had they worked. Their earnings have to be imputed. We impute wages only for individuals who could potentially work – we assume that includes all individuals in their productive age (19-61 years old for men, and 19-58 years for women based on current retirement age), who are not full-time students and do not suffer from serious health problems. We assume that these individuals (if they enter the labor market) would start working as employees in formal employment and they would work for 12 months a year in a full-time job (40 hours a week).

Wage imputation is based on a Mincer wage regression with a Heckman correction that accounts for the fact that non-working people are a selected group that would earn lower wages if employed, conditional on the observable characteristics. The Mincer wage regression is run for men and women separately to allow for different influence of characteristics on wages for these two groups. We first run a participation regression that predicts labor force participation probability for each working and non-working individual (excluding self-employed as wage imputation is for work income only), and create a Heckman correction based on this participation probability, which is then used in the wage regression.[42] Wage regression is run for employees who have positive income from formal work. Their hourly wage is regressed on individual characteristics (age, education, marital status, nationality, region of residence, size of the city of residence, and household composition) and the Heckman correction term. Wages are then predicted for the non-working potential workers, and their annual wage is calculated for working either full-time or part-time for 12 months. This imputed wage (either for full- or part-time work) represents the counterfactual used in EPTR calculation for the non-working.

[42] This two-stage Heckman's approach requires presence of an exclusion restriction (variables that predict participation probability, but not wages). We use dummy variables for presence of children of various ages in the household as an exclusion restriction in our analysis (so that in the participation regression we include these variables together with all explanatory variables from the wage regression).

TABLE A1

Main parameters of the Czech tax and benefit system, 2013

<u>Taxes</u>	
Personal income tax	
tax rate - basic	15.00%
tax rate - surcharge	7.00%
surcharge applies if gross income exceeds	1,242,432
basic tax credit	24,840
child tax credit	13,404
Health contributions	
Tax rate - employees	4.50%
Tax rate - employers	9.00%
Tax rate - self-employed	13.50%
Tax base for the self-employed	50% of profit
Min tax base for the self-employed	155,304/year
Max tax base	none
Minimum contribution (employees and non-workers)	1,080/month
Social security contributions	
Tax rate - employees	6.50%
Tax rate - employers	25.00%
Tax rate - self-employed	29.20%
Tax base for the self-employed	50% of profit
Min tax base for the self-employed	77,652/year
Max tax base (employees, employers, self-employed)	1,242,432/year

TABLE A1 – CONTINUED

Benefits	
Child allowance (přídavky na děti)	
Eligibility	Income below 2.4 times minimum living standard
Amount per child up to 5 years	CZK 500 / month
Amount per child 6 - 14 years	CZK 610 / month
Amount per child 15 years and older	CZK 700 / month
Birth grant (porodné)	
Eligibility	Income below 2.4 times minimum living standard
Amount per first new-born child	CZK 13000
Amount if twins, triplets etc.	CZK 19500
Maternity benefit (peněžitá pomoc v mateřství)	
Eligibility	Previous health insurance contributions
Duration	28 weeks
Amount	70% of average wage in the last 12 months (reduced)
Parental allowance (rodičovský příspěvek)	
Eligibility	Raising child up to 4 years of age
Total amount	CZK 220,000
Duration	Flexible (up to 2 to 4 years of age of a child)
Housing benefits (příspěvek na bydlení)	
Eligibility (Prague)	Housing costs (socially respectable) above 35% of income
Eligibility (out of Prague)	Housing costs (socially respectable) above 30% of income
Amount	Difference between housing costs and 30 (35)% of income
Living allowance (příspěvek na živobytí)	
Eligibility	Income below subsistence level
Amount	Difference between subsistence level and income
Housing supplement (doplatek na bydlení)	
Eligibility	Income below 1.3 * subsistence level
mount	Difference between subsistence level and income

TABLE A2

External validity of the TAXBEN model: Tax revenues and benefit expenditures (mil. CZK)

	2010			
Taxes:	**External statistics**	**TAXBEN predictions**	**SILC values**	**TAXBEN vs. external statistics**
Income tax - wage income	111,842	82,407	83,426	-26.3%
Income tax - business income	7,987	19,193	27,304	140.3%
Social security - wage income	323,095	323,658	322,989	0.2%
Social security - business income	22,450	45,670	N/A	103.4%
Health insurance - wage income	148,582	145,855	140,040	-1.8%
Health insurance - business income	14,280	23,791	N/A	66.6%
Total taxes on earnings	628,237	640,573	N/A	2.0%
Benefits:				
Child allowance (přídavky na děti)	3,875	3,690	3,916	-4.8%
Birth grant (porodné)	1,565	1,572	1,266	0.4%
Maternity benefit (peněžitá pomoc v mateřství)	7,409	5,547	N/A	-25.1%
Housing benefits (příspěvek na bydlení)	5,321	11,175	2,833	110.0%
Aid in material need (pomoc v hmotné nouzi: příspěvek na živobytí a doplatek na bydlení)	3,882	6,945	1,896	78.9%
Parental allowance (rodičovský příspěvek)	27,765	from SILC	26,345	N/A
Unemployment benefit (podpora v nezaměstnanosti)	13,355	from SILC	9,355	N/A
Other benefits (příspěvek na péči, příspěvky pro zdravotně postižené, výsluhový příspěvek atd.)	N/A	from SILC	12,854	N/A

Sources: Ministry of Finance, Tax Statistics (http://www.mfcr.cz/cs/verejny-sektor/regulace/dane/danova-statistika); Ministry of labor and social affairs, Bilance dávkových příjmů (internal statistics available upon request); UZIS, Ekonomicke informace ve zdravotnictvi 2010, 2011 (http://www.uzis.cz/katalog/zdravotnicka-statistika/ekonomicke-informace-ve-zdravotnictvi); Ministry of labor and social affairs, Statistical yearbook of labor and social affairs (http://www.mpsv.cz/cs/3869).