

Distribution of Average, Marginal and Participation Tax Rates among Czech Taxpayers: Results from a TAXBEN Model*

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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%, respectively, even though the self-employed tend to have higher earnings. On average, employees and the self-employed face effective marginal tax rates of 46.4% and 30.9%, respectively. The tax system exhibits almost no progressivity—the top income decile earns 26.7% of total income and pays 26.7% of total taxes—despite the fact that it is designed to be progressive by providing generous tax credits. There are large dispersions in the tax rates for people with similar earnings.

1. Introduction

Taxes on earnings constitute 56% of tax revenues in the Czech Republic.¹ It is crucial to design taxes on earnings efficiently in order to avoid potentially harmful effects on the economy. The issues of optimal tax design have gained renewed interest in the public finance literature. This 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, ch. 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 Living Conditions survey (SILC), a representative sample of 8,866 households comprising 20,620 taxpayers.

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

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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)

social security and health insurance. The personal income tax has a single marginal tax rate of 15%. Earnings from private business (self-employment) are taxed far more lightly than earnings from employment. Various tax credits and welfare benefits are meant to introduce progressivity into the flat-tax regime but they target primarily households with children rather than households that are poor per se.² The system has undergone frequent design reforms during the past decade.³ Some elements of another conceptual reform, scheduled for 2015, have already been 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 carried out 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 work incentives; they compute the net replacement rates for standardized households (e.g., two parents without children or with two children) 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 questions (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 full tax wedge between the employer costs and the net wage. The disemployment effects of taxes depend on both labor supply and demand responses 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

² The main parameters of the Czech tax-and-benefit system in 2013 are summarized in *Table A1*.

³ In 2005, joint taxation of married couples with children was introduced. In 2006, 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 the 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, the 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.

wage of workers. The comparisons are computed for “stylized” individuals earning 100%, 67% and 167% of the average wage and do not reflect finer details 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 a non-working spouse. Immervoll (2004), the study that is methodologically closest to ours, tabulates the empirical distributions of ATRs and MTRs for 14 European countries⁴ using the EUROMOD model and data from 1998, but for employees only. Our TAXBEN model fits into the tradition of similar microsimulation models in other countries, such as NBER’s TAXSIM model for the United States (Feenberg and Coutts, 1993) or the IFS’s TAXBEN model for the United Kingdom (Giles and McCrae, 1995). Our TAXBEN is of course tailored to the particularities of the Czech tax code and the available data on Czech taxpayers. Compared to the EUROMOD, which is also based on the EU-SILC data for several EU countries, it captures more details of the Czech system.⁵

This paper brings forth 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 these tax rates for real individuals from the SILC database. Unlike studies using only “stylized” individuals, this approach captures the actual utilization of tax credits and deductions by taxpayers and households with different incomes and other characteristics, and allows showing 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 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?

Second, we analyze taxation of small-business income separately from the wage income. The existence of a gap in taxation of business and wage income is well known and has been the subject of intense political debates. However, knowledge about its empirical magnitude has been lacking. We provide the first estimates of the empirical magnitude based on observational data. Third, the paper brings some methodological improvements. The TAXBEN model captures 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 costs or 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.

⁴ All EU-15 countries except Sweden

⁵ For example, deductions from taxable income, tax credits for disability, the differentiation of the minimum tax bases for social security and health insurance contributions by the months of self-employment and the type of income, etc.

⁶ In a companion paper (Dušek, Kališková 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.

⁷ Mirrlees (2010a), chapter 4.

Among the key findings, we find that the population mean of the average tax rate on wage income gradually rises from 34.1% in the first decile to 42.9% in the top decile. For the self-employed, the average tax rate first declines from 34.0% in the first decile to 24.9% in the fourth decile and then rises to 31.9% in the top decile. Business income is taxed, on average, at only 28.1%. The wage income is taxed at 37.4% on average. In fact, the assumptions of the TAXBEN model 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 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 actual “flatness” of the flat tax is compromised by a fairly large number of taxpayers who face marginal tax rates other than the full flat rate: three-quarters of workers face the full effective marginal tax rate of 48.6% and only 44% of the self-employed face the full effective marginal tax rate of 36.4%. The participation tax rate is, on average, between 40% and 47% throughout most of the income distribution. It also has very high dispersion at low incomes, and 11% of earners face participation tax rates exceeding 60%.

The progressivity of the tax system exhibits an unusual pattern: it is expected to be progressive (despite being nominally a flat tax) due to generous tax credits. We indeed find that taxes on wage income and business income are progressive within each income source. However, when the two income sources are combined and we investigate the progressivity over total income, the tax system exhibits almost no progressivity. This is best illustrated by the fact that the top income decile earns 26.7% of total income and pays 26.7% of total taxes. Differential taxation of the wage and business income is the main reason: the self-employed are disproportionately represented in the high-income deciles and their lower taxes reduce the average tax rates in the high-income deciles.

The rest of the paper is organized as follows: Section 2 describes the main features of the TAXBEN model and the data (a detailed description is provided in 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.

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 “Living Conditions” (SILC) dataset. The SILC is collected annually by the Czech Statistical Office as a part of the EU-SILC project. We used the latest available edition of SILC (collected in 2011), which contains information on 8,866 households comprising 20,629 individuals. It reports basic information about household structure, its housing, and the economic activity and health of the household members. Importantly for tax simulations, it reports each members’ 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, income taxes, social security and health insurance contributions (for employees only) and property taxes.

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

2.2 Definitions of Tax Rates

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 statutory tax rates and other parameters of the tax-and-benefit system are provided in *Appendix Table A1*.

Average Tax Rate:

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

or

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

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 insurance and social security contributions, which are assessed on the gross wage W^i at linear rates τ_{HE} and τ_{SSE} (paid by the employee) and τ_{HR} and τ_{SSR} (paid by the 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

⁸ The computation of the health insurance 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 for expositional clarity they are not presented in the equations.

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

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

The average tax rate for individuals does not 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 thus useful for assessing the progressivity and dispersion of taxes as a function of individual income.

Effective Marginal Tax Rate:

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

The effective marginal tax rate gives the fraction of an increase in individual income Y^i at the intensive margin that is “eaten away” by an increase in taxes and 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:

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

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 member i works and earns income Y^i with a situation when such 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.

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

¹¹ The scale-down factor f_D is currently 0.5, implying that the effective social security contribution is 14.6% instead of the nominal rate of 29.2%. 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 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.

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 members 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.

2.3 Algorithm and Assumptions

The core of the TAXBEN model simulates the taxes and benefits for each individual and household. The simulations are based on information from the SILC data on incomes, characteristics and household composition. They straightforwardly apply the tax and benefit formulas set by the Czech legislation in force in 2013. For most steps in the computations, the information in SILC corresponds to the information on the tax returns and benefit forms. For some steps, the information is insufficient and had to be supplemented with additional assumptions. Simulations of benefits that have low take-up rates (housing benefit and aid in material need) are supplemented with a model that predicts the take-up by each eligible household; the benefits used in the calculations of the marginal and participation tax rates already reflect the predicted take-up and not the mere eligibility for the benefit. A detailed description of the tax-and-benefit simulations and the underlying assumptions are provided in the *Appendix*.

The aggregate consistency of the simulations is summarized in *Table A2*, which shows the actual budget revenues and expenditures in 2010 (the year for which 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 of predicting most of the tax revenues and benefit expenditures, particularly the social security and health insurance contributions paid by employees, which are by far the largest revenue sources. It over-predicts the tax revenues from business income, which is probably due to a discrepancy between incomes reported in SILC and those reported for tax purposes. Benefit expenditures are sufficiently precisely reported for the child-related benefits. For the benefits for which we model the take-up, the simulated expenditures nearly correspond to the actual expenditures.

2.4 Summary Statistics

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

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

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	

Notes: 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.

Figure 1a

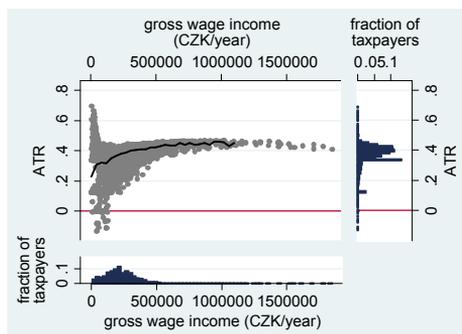
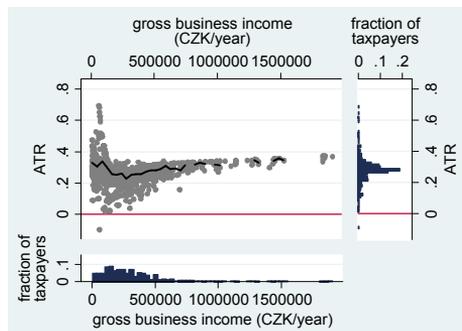


Figure 1b



3. Results

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

3.1 Average Tax Rates and Progressivity

Figures 1a–1b plot the average tax rates as a function of 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 slightly above 25% for the lowest income to 45% for incomes just above CZK 1,000,000. The ATRs decline slightly once income exceeds CZK 1,242,000 (four times the average wage) because the social security contributions are capped at that level. Tax credits make the taxes progressive despite the linear health insurance and social security contributions and the flat personal income tax.¹³

¹³ The ATR would have been, in the absence of tax credits and other non-linearities, 48.6%. For a person with two children and the average gross earnings (CZK 255,000), the credits reduce the ATR to 33.6%. For a person with twice the average earnings, the same credits reduce the ATR to 43.6%.

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

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

Figures 1a–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 up 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% and 44%, while most self-employed people are taxed at between 22% and 38%. 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, workers face a 37.4% ATR while the self-employed face a 28.1% ATR. On average, the full income of employees is equal to the income of the self-employed—the average gross wage income of CZK 247,480 corresponds to full employer costs of CZK 331,623, while the average gross business income is CZK 331,233. However, the self-employed pay almost 27% 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 the fourth through the tenth

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

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

Table 2 Average Tax Rates—by Individual Income Deciles

income decile	Wage income				Business income				All income			
	mean	mean	st.dev.	ATR	mean	mean	st.dev.	ATR	mean	mean	st.dev.	ATR
	gross income	total taxes			gross income	total taxes			gross income	total taxes		
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

Notes: 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		Business income		All income		
	decile share of income	decile share of total taxes	decile share of income	decile share of total taxes	decile share of income	decile share of total taxes	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	

Notes: 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.

decile, and is highest in the sixth decile, where it reaches 14 percentage points. The self-employed in the eighth decile who earn CZK 415,000 on average still pay lower absolute amounts in taxes than workers in the sixth decile who earn CZK 238,000, nearly 50% less.

The differential taxation of wage and business income causes an intriguing pattern of the 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% as opposed to their 24.5% income share. The taxes on business income exhibit even more progressivity at the top: the tax share of the top decile is 37.0% as opposed to the 32.3% income share.¹⁶ However, the lowest-income self-employed actually pay more than their share in income due to the minimum contributions.

The overall progressivity of taxes—when wage and business income earners are considered together—is markedly lower. The tax shares of the first through fifth deciles are only negligibly lower than their income shares, and the tax shares of the eighth and ninth 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%).

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

This counterintuitive finding is also portrayed by the ratio of the concentration coefficient of taxes to the Gini coefficient of income. The ratio is a popular measure of tax progressivity, with higher values indicating higher progressivity.¹⁷ The values of both coefficients and their ratios are reported at the bottom of *Table 3*. When considering wage income and business income separately, the ratios are 1.12 for wage income and 1.20 for business income, indicating some progressivity. When both sources of income are considered together, the ratio is a mere 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 and indicates rather meager progressivity.

The reason is that the share of business income in total income rises as we move to the highest income deciles, from 6% in the fifth decile to 41% 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 wage or business income only.

To put these results in the international perspective, we can compare the average ATRs with 14 European countries covered by Immervoll (2004). They varied from 55% (Belgium) to 27% (Ireland). The Czech average ATR on wage income (37%) and the ATR on the top decile (43%) would rank as the ninth highest. However, a comparison based on today's tax codes would most likely put the Czech Republic at a higher ranking because the statutory tax rates on labor income declined in ten 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 deciles. This ratio lies between 1.5 and 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 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 the OECD (2009). The authors compute the effective tax rates (including 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 two or four times the average wage. Business activity can be carried out either under an employment contract or via an 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

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.

¹⁸ The 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 fifth 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 contributions.

Figure 2a

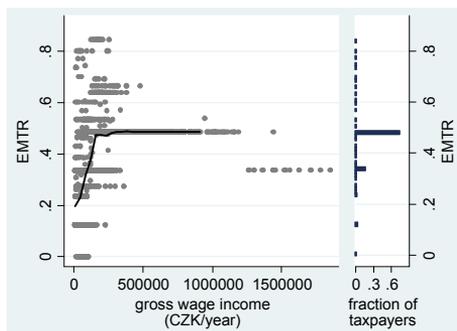
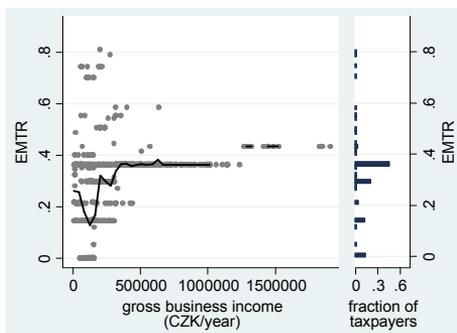


Figure 2b



average tax rate on the self-employed is lower than on employees by 0% (New Zealand), 22% (Norway), 31% percent (Sweden) and 32% (UK).²⁰ In our TAXBEN sample, the corresponding numbers are 27% (for the whole sample) or 28% (when restricting the sample to taxpayers with earnings that are twice the average wage, plus or minus 10%). The preferential tax treatment of the self-employed is therefore high, although not the highest, in the 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 Effective Marginal Tax Rates

The effective marginal tax rate (EMTR) 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 effort or increased productivity that is taxed away. It is also an important measure of the incentives to engage in tax evasion or avoidance. The EMTR captures the incentives to compensate employees through taxed salary as opposed to legal or illegal alternatives such as perks, stocks or employment of subcontractors instead of employees. The relationships between the effective marginal tax rates and income and their distributions are depicted in *Figures 2a-2b*.²¹ *Table 4* shows the averages of the EMTRs by income deciles.

²⁰ OECD (2009), figure 3.1–3.2, pages 58–79.

²¹ The distribution of income is the same as shown in *Figures 1a and 1b*.

Table 4 Effective Marginal Tax Rates

income decile	Wage income				Business income				All income			
	effective MTR		benefit withdrawal rate		effective MTR		benefit withdrawal rate		effective MTR		benefit withdrawal rate	
	mean	st.dev.	mean	st.dev.	mean	st.dev.	mean	st.dev.	mean	st.dev.	mean	st.dev.
1	0.401	1.48	0.023	0.09	0.503	2.33	0.022	0.10	0.448	1.88	0.053	0.81
2	0.399	0.96	0.057	0.96	0.148	0.18	0.043	0.14	0.331	0.36	0.031	0.34
3	0.469	0.07	0.007	0.04	0.099	0.17	0.054	0.16	0.411	0.16	0.011	0.06
4	0.477	0.07	0.010	0.04	0.274	0.12	0.019	0.09	0.454	0.09	0.010	0.05
5	0.473	0.06	0.007	0.04	0.304	0.09	0.018	0.08	0.457	0.08	0.010	0.05
6	0.476	0.06	0.005	0.04	0.294	0.09	0.013	0.07	0.454	0.09	0.007	0.04
7	0.496	0.37	0.014	0.37	0.358	0.05	0.006	0.04	0.472	0.34	0.012	0.33
8	0.487	0.02	0.002	0.02	0.364	0.03	0.002	0.02	0.459	0.07	0.003	0.03
9	0.486	0.02	0.001	0.01	0.364	0.01	0.000	0.00	0.454	0.06	0.001	0.01
10	0.481	0.03	0.000	0.01	0.380	0.04	0.003	0.02	0.439	0.06	0.001	0.01
aver- age	0.464	0.57	0.013	0.33	0.309	0.75	0.018	0.09	0.438	0.62	0.014	0.30

Notes: 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.

The Czech Republic has a nominally flat tax. In a genuine flat-tax regime, all taxpayers would face the same effective marginal tax rates that involve paying income tax and the health insurance and social security contributions on the margin. Taking the differential taxation of wage and business income as a given fact, these “full” EMTRs would be 48.6% for wage income and 36.4% for business income. Our results show that the reality is different. Seventy-four percent of wage earners and only 44% of the self-employed face these full EMTRs. These taxpayers are concentrated in the middle and higher income levels.²²

At incomes above CZK 1,242,000, the EMTR is 33.8% for employees and 43.3% for the self-employed. In this income range the self-employed pay higher tax rates *on the margin* than employees.

At lower incomes, the EMTRs are lower on average but their variance is high (see columns 3 and 7 in *Table 4*). The variance is due primarily to different tax treatment of low incomes rather than the withdrawal of benefits. Many wage earners pay zero income tax but pay the standard health insurance and social security contributions. Such taxpayers (16% of wage earners) face an EMTR of 33.6 percent. Even lower EMTRs are faced by the remaining wage earners who pay zero personal income tax, are below the minimum health insurance contributions, have an informal work contract which is taxed more lightly, or a combination of these factors. Among the self-employed, 19% of taxpayers face the EMTR of 29.6% (these are above the minimum social security contributions but below the minimum health insurance contributions) and 13% of taxpayers face the EMTR of zero (these are below both minima and claim enough credits in order not to pay income tax either).

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

Some low-income taxpayers face effective marginal tax rates between 50% and 90%. About 2% of taxpayers are exposed to effective MTRs exceeding 60%. These taxpayers face positive withdrawals of benefits if their earnings increase. The benefit withdrawal rates are reported separately in the right subpanels of *Table 4*.²³ When considering all earners together, the average benefit withdrawal rates are 5.3% in the first decile, 3.1% in the second decile, and practically zero from the third decile up.

Most taxpayers are unaffected by any benefit withdrawals. Ninety-six percent of all taxpayers and even 92% of taxpayers in the first decile face zero benefit withdrawal. Those who are affected by benefit withdrawals (8% of taxpayers in the first decile, 7% in the second decile), face withdrawal rates of at least 15%. Most commonly, the benefit withdrawal rates for such taxpayers are either 20% or 46%.

The main reason why so few taxpayers have positive benefit withdrawal rates is that many benefits are means-tested with a fixed amount of benefits (e.g., child allowance and birth grant). Therefore, only those who are right below the threshold for benefit eligibility face withdrawal of benefits on the margin. The second group of benefits (housing benefit, aid in material need) has the benefit amount dependent on income, but they have very low eligibility thresholds so that benefits are mostly collected by non-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 the next section).

Immervoll (2004) also provides the tabulation of EMTRs for the entire working population (workers and the self-employed together). The average Czech EMTR (43.8%) would be the fourth highest in comparison with 14 other EU countries.²⁴ The Czech Republic not only has one of the highest EMTR levels, but it has by far the highest dispersion of EMTRs despite the flat tax: the standard deviation of EMTRs is 0.62, while the highest standard deviation in the Immervoll (2004) sample is 0.45 (the Netherlands) and most countries have a 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 the large differences between tax rates on wage and business income.

3.3 Effective Participation Tax Rates

The effective participation tax rate (EPTR) is a widely used measure of work incentives at the extensive margin—it describes the tax and benefit consequences of the labor force participation decision of individuals. *Figures 3a-3b* 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 between 30% and 60%, and between 40% and 49% on average. But the dispersion in EPTR is very high, mainly for employees. The great

²³ The difference between the effective marginal tax rates and the benefit withdrawal rates is thus the “tax only” marginal tax rate that measures only the increase in taxes.

²⁴ The average EMTRs vary from just under 25% (Spain, Greece) to between 50% and 55% (Germany, Denmark).

Figure 3a

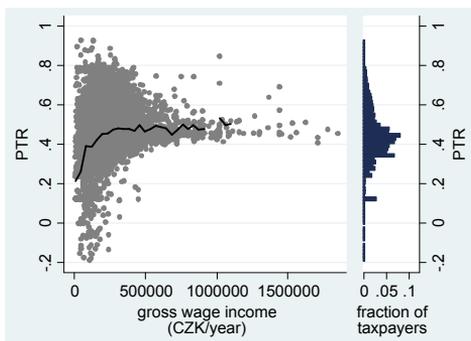
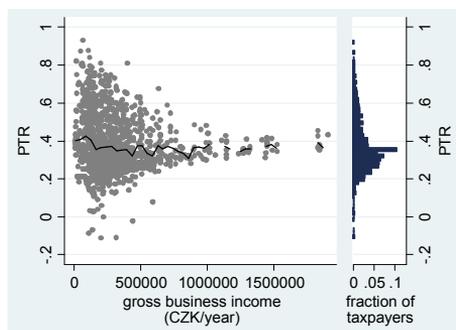


Figure 3b



dispersion in the EPTR, which concerns mainly 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%. These high EPTRs are faced by as many as 12% of individuals with positive work income and 9% of those with positive business income. These very high EPTRs are concentrated not only among the workers with the lowest incomes, but are spread also to some taxpayers with annual incomes above CZK 500,000 (which is well above the average wage).

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 (CZK 24,840 per year). As the secondary earner enters work, the basic tax credits she receives for herself are 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 earner typically faces a perfectly linear tax schedule with marginal and participation tax rates equal to 48.6%. This level is also the mode of the distribution of EPTRs 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 27% for 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 43% and

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	0.269	0.32	0.419	0.31	0.296	0.34
2	0.382	0.17	0.407	0.23	0.395	0.18
3	0.408	0.14	0.382	0.18	0.405	0.14
4	0.437	0.14	0.362	0.17	0.429	0.14
5	0.454	0.12	0.356	0.16	0.445	0.13
6	0.457	0.12	0.379	0.15	0.449	0.13
7	0.472	0.11	0.346	0.13	0.466	0.12
8	0.479	0.10	0.344	0.12	0.453	0.12
9	0.476	0.09	0.360	0.11	0.439	0.11
10	0.478	0.08	0.365	0.07	0.437	0.10
average	0.431	0.166	0.372	0.18	0.421	0.17

Notes: 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.

rises slowly to nearly 48% in the highest decile. The self-employed in the first three deciles face higher EPTRs (slightly above 40% percent) than workers. This is due to the minimum social security and health insurance contributions, which act as fixed costs of running a business. However, people with business income from the fourth decile up face lower EPTRs than people with work income (columns 2 and 4 in *Table 5*). The average EPTR for business income is almost 6 percentage points lower than the average EPTR for work income, which is driven mainly by lower health insurance and social security contributions on business income.

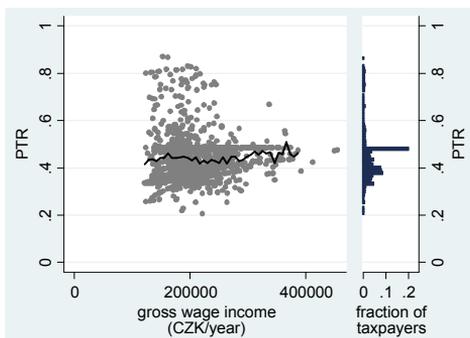
Figure 3c illustrates the EPTR for non-working individuals under the counterfactual that they start working full-time. Clearly, non-working potential workers face somewhat higher participation tax rates, which is consistent with their decision not to work. The average EPTR is around 45% throughout the income distribution, and the 48.6% EPTR is faced by nearly 16% of non-working individuals. Seven percent of non-working potential workers face an EPTR of over 60%.

4. Conclusions

We have documented 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. We quantify that the mean ATR on business income is lower than the mean ATR on wage income by 9.3 percentage points (27%). In the medium and upper income deciles, the gap is even wider, between 11 and 14 percentage points. These results should be thought of as a lower bound of the true gap because they are based on officially reported taxable incomes. The tax laws allow many self-employed people to count part of their regular personal

Figure 3c



spending towards business costs or to deduct generous estimated costs instead 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 employees (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 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 a comparison is available. The Mirrlees Review also criticizes the similarly generous preferential treatment in the UK.²⁵ The large gap between ATRs on wage and business income provides very strong incentives to employ workers as business subcontractors even in cases when an 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—77% of workers face EMTRs that exceed 45%, among the highest in international comparisons. Assessing the harmful effects of such high EMTRs on the economy would require empirical knowledge of the incidence of the taxes on wage income in the Czech context, which is lacking. To the extent that high EMTRs are even partially transferred into employer costs, they may potentially have serious negative effects on demand for labor.

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

The ATR rises with income within the groups of wage earners and business income earners. When the two groups of taxpayers are combined, 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 income in higher dec-

²⁵ Mirrlees (2010a), chapter 19.1.

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

A non-negligible fraction of taxpayers face strong disincentives to work on the extensive margin. In particular, the effective participation tax rate exceeds 60% for 11% of working taxpayers, and 8% of the non-working. The tax code is structured such that the EPTRs for secondary earners (usually women) are higher than EPTRs for (otherwise comparable) primary earners. The primary earner deducts tax credits for himself, his children and his non-working spouse, and potentially uses other deductions. When the secondary earner starts working, she can claim a tax credit of CZK 24,840 (roughly the 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%. Since secondary earners typically exhibit a much more elastic labor supply on the extensive margin and higher reservation wage (see, for example, Meghir and Phillips, 2008), this feature of the tax system violates optimal taxation rules that imply lower participation tax rates for secondary earners.

Lastly, the disparity in the average, marginal and participation tax rates among taxpayers with similar incomes is high.²⁶ The ATRs 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 spouses, mortgage deductions and the inevitable differences among taxpayers in the consumption of these tax-preferred commodities. These forms of tax relief were introduced with the objective of reducing taxes for households with certain characteristics. The disparities in ATRs are an expected and intended consequence. The magnitude of the disparities, reflecting the joint distribution of the eligibility for various forms of relief across the population, is unknown. Our results provide useful quantitative insights into the question of whether the resulting *effects* of these forms of tax relief, 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 forms of tax relief or benefit only partially.²⁷ 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. This fraction comprises 42% of taxpayers. As expected, these are predominantly 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 of providing tax relief to taxpayers with certain characteristics, as implemented in the Czech system through deductions and credits, has problematic distributional consequences.

²⁶ Evaluating the impacts of tax reforms on “stylized” individuals could then be very misleading because seemingly similar taxpayers pay substantially different tax rates to begin with.

²⁷ The child tax credit is the only credit that may reduce the tax liability to a negative number.

APPENDIX

TAXBEN Model—Algorithms and Assumptions

Computing 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 security and health insurance contributions paid by the employer. For business income, the marginal product is the gross profit before subtracting social security and health insurance 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 a person has. For tax purposes, the first distinction is not relevant, but the second is relevant because wages from informal temporary contracts²⁸ up to CZK 10,000 per month are exempt from health insurance and social security contributions. We therefore distinguish wages from formal work (fully taxed) and informal work (partially taxed) based on whether the individual has an informal temporary contract. Finally, we add the employer's health insurance and social security contributions, calculated from gross wages by applying the tax laws to obtain the full employer cost, which is 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, wage income should include the monetary value of the perks. SILC provides 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 social security and health insurance contributions. Social security and health insurance 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 profit before and after subtracting the contributions, even if one takes into account the non-linearities induced by the minimum and maximum contributions. The exact function linking the two is:

²⁸ The so-called “dohoda o provedení práce” in Czech, which is currently limited to 300 hours per year with a single employer.

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

where NY denotes 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 security and health insurance contributions; other terms were 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.²⁹

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.³⁰ 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 with other relatives present), we use the information on the relationship of each member to the head of the household 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.³¹ We assume that the highest-earning person in the tax unit claims all the tax credits for the children and non-working spouse.

For each individual with positive income, we apply the appropriate tax law to compute the health insurance and social security contributions provided by the employee and employer. To compute the income tax, we first set the partial tax base, which equals wages plus employer contributions for wage income and profit before contributions for business income. Next, taxpayers can deduct several items

²⁹ The minimum tax bases also depend on the number of months during the year when the business is operating. For the 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 apply 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., people in the top twelfth of the distribution of secondary business income are assigned 12 months, people in the second twelfth are assigned 11 months, etc.).

³⁰ 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.

³¹ Even in a 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.

from the partial tax base.³² 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 study costs, and we do not include them in the model. This is not a very serious omission since these deductions represent only 28% of all deductions.³³ 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% 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 the home, how long the current home has been occupied by the household, an assumed interest rate and the length of the repayment period. Based on this information, we construct a “typical” mortgage that the household is likely to have and compute the interest payments.³⁴ 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.³⁵

After subtracting the deductions, a 15% tax rate sets the income tax before credits. Subtracting the basic credit, credit for a non-working spouse and the child tax credit 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 (so-called ZTP/P card holders), and also the tax credit for a non-working

³² According to the breakdown of income tax statistics produced by the Ministry of Finance, the total value of these deductions was CZK 22.3 billion, or 3.6% percent of the personal income tax base. However, these income tax statistics are compiled from individual income tax returns only. The majority of taxpayers have 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.

³³ Source: *Breakdown of income tax statistics* (2010), Ministry of Finance.

³⁴ The mortgage market in the Czech Republic has expanded substantially since 2000. The SILC data demonstrates this with the large difference between the number of households that have a mortgage and moved into in their current home during 2000–2010 and those that 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 a mortgage to buy their home. The mortgage amount is assumed to be 50% 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 renovation of the home. The mortgage amount in this case is assumed to be 20% of the value of the home and the year when the mortgage was taken is assigned to them randomly in the 2000–2011 range. The interest rate and the mortgage payment period are assumed to be 4% and 15 years, respectively.

³⁵ Descriptive probit and OLS regressions on a subsample of households with positive earnings show that a 1% increase in household income increases the probability that a household has a mortgage by 0.075 percentage point. On the subsample of households with a mortgage, a 1% increase in income increases the amount of the mortgage interest deduction by 0.35%.

spouse is higher if the spouse is a ZTP/P card holder. The eligibility for these tax credits is assigned to people who report (or whose spouse reports) “very bad” health status in the SILC data.³⁶ There is also an additional tax credit for people who receive a disability pension. Disability pensions are reported in the SILC data, so determining the eligibility for this tax credit is more straightforward.³⁷

The wage and business income taxation differential 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 insurance and social security 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. This basically means creating units that are treated separately for benefit entitlement purposes. Some benefits (like the housing benefit and aid in material need benefits) treat the whole household as one unit (so that the characteristics and incomes of all household members are tested). In the case of benefits that are connected to the presence of children in a family, the benefit units sometimes do not include all household members. For entitlement to the 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 the maternity benefit, the amount of the benefit depends on the previous income of the mother, so the unit includes only her.

Based on the definitions of benefit units and detailed information in the SILC data, we can simulate eligibility for and the amounts of most of the welfare benefits that are available in the Czech Republic. We simulate the maternity benefit (*peněžitá pomoc v mateřství*), birth grant (*porodné*), child allowance (*příspěvky na děti*), housing benefit (*příspěvek na bydlení*) and the aid in material need benefits: living allowance (*příspěvek na živobytí*) and housing supplement (*doplatek na bydlení*). However, some benefits cannot be simulated due to a 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 the benefit being the subject of a choice made by recipients (parental leave benefit—*rodičovský příspěvek*) or because of the very individual assessment process for benefit eligibility (benefits for people with a 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 the period for which incomes are tested does not always correspond to

³⁶The information about ZTP/P card holders 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 a ZTP/P card.

³⁷ However, the amount of the 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 in the 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.

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 the assumption that incomes are spread smoothly across the whole year and there are no big jumps therein. 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 the 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 a combination of reported benefits from SILC (unemployment benefit and parental leave benefit) and simulated benefits (all other benefits).

The simulation of the maternity 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 the housing benefit, we compare information about actual housing costs reported in the SILC data with the maximum normative costs (taken from legislation).

Finally, the standard assumption in the microsimulation literature (see, for example, Immervoll and O'Donoghue, 2002) is the full take-up of social benefits. However, the take-up of some welfare benefits in the Czech Republic is quite low—this mainly concerns the housing benefit and aid in material need.³⁸ For these benefits, we thus create a model that predicts take-up for each eligible household based on the information about actual collected benefits (reported in the SILC data). We run a probit model for all eligible households, where the dependent variable is a dummy variable for households that report positive amounts of the benefit and explanatory variables include the amount of the benefit, demographic characteristics of the head of household (age, education, marital and health status), household composition and regional dummies. We sort all eligible households by their take-up probability (from highest to lowest) and assign the simulated amount of the benefit to the households with the highest take-up probability up to the point where the total expenditures on the benefit approximately fit the external statistics of the Ministry of Labor and Social Affairs. We do this for the housing benefit and aid in material need benefits, while we assume full take-up for other simulated benefits that are linked to the presence of children in the family.³⁹

iv. Consistency with External Data

The accuracy of the TAXBEN model in predicting tax revenues and benefit expenditures is evaluated in *Table A2*, which shows the actual budget revenues in 2010 (the year for which income information is available in SILC),⁴⁰ the revenues

³⁸ Mareš (2001) estimates the take-up of the housing benefit to be only around 50%; the take-up of aid in material need is unknown.

³⁹ The consistency checks in the next subsection show that full take-up for the child-related benefits is probably a reasonable assumption, as our simulated expenditures on these benefits are quite close to the actual expenditures reported by the Ministry of Labor and Social Affairs.

⁴⁰ Ideally, we would like to use the tax liability on income earned in 2010 instead of the cash revenues of the government. However, the Ministry of Finance was not able to provide this information separately for employment and business income.

predicted by TAXBEN (based on tax parameters in 2010), and also the revenues reported directly in SILC (however, SILC does not report the health insurance 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 insurance contributions paid on wage income. The TAXBEN predictions differ from the actual revenues by 0.2% and 1.7%, 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%. The relative disparity between business and wage income is in part due to differences in the way that income tax is allocated between wage and business income in the official statistics and in TAXBEN.⁴¹ 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 insurance 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 for this might be the availability of several (legitimate) deductions that reduce the tax base below 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%, depending on the industry) deducted by about 300,000 self-employed people.⁴² Total tax revenues are over-predicted by the TAXBEN model by a mere 1.9%.

Benefit expenditures are predicted very well for the child-related benefits. The expenditures on the maternity benefit are somehow under-predicted, but otherwise we match the external data very closely. For the benefits for which we model the take-up (housing benefit and aid in material need), the take-up is modeled in such a way that the simulated expenditures match the external data, which is confirmed in *Table A2*.

v. Computing the Tax Rates

The average tax rate is a simple division of the total taxes paid by the individual on his income. The marginal tax rates are computed by increasing the annual gross income (either the wage or business income) by CZK 1,000 and simulating the change in the household's taxes and benefits under the increased income.

⁴¹ 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 thus 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.

⁴² Source: Explanatory memorandum to Act No. 500/2012, available at:<http://www.psp.cz/sqw/historie.sqw?o=6&t=801> (last accessed on June 28, 2013).

The participation tax rates of 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 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 old for women based on the 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 influences 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 the 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.⁴³ 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 based on either full-time or part-time work for 12 months. This imputed wage (either for full- or part-time work) represents the counterfactual used in EPTR calculation for the non-working.

⁴³ This two-stage Heckman's approach requires the presence of an exclusion restriction (variables that predict participation probability, but not wages). We use dummy variables for the 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

Taxes	
<i>Personal income tax</i>	
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
<i>Health contributions</i>	
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
<i>Social security contributions</i>	
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 Main Parameters of the Czech Tax and Benefit System, 2013 (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
Amount	Difference between subsistence level and income

**Table A2 External Validity of the TAXBEN Model:
Tax Revenues and Benefit Expenditures (mil. CZK)**

	2010			
	External statistics	TAXBEN predictions	SILC values	TAXBEN vs. external statistics
Taxes:				
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	5,293	2,833	-0.5%
Aid in material need (pomoc v hmotné nouzi: příspěvek na živobytí a doplatek na bydlení)	3,882	3,726	1,896	-4.0%
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, Balance dávkových příjmů (internal statistics available upon request); UZIS, Ekonomické informace ve zdravotnictví 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>)

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