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RIGOROUS THESIS

**The Effect of Czech 2008 Flat Rate  
Personal Income Tax on Tax Evasion**

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## **Declaration of Authorship**

The author hereby declares that he compiled this thesis independently, using only the listed resources and literature.

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Prague, February 14, 2012

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Signature

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## Abstract

The main goal of this thesis is to examine the effect of Czech's 2008 flat rate personal income tax reform on consumption, income and tax evasion since there is a belief that personal income tax rates are partially responsible for high levels of tax evasion. We use the gap between household expenditures and reported income as a proxy for tax evasion with the Czech microeconomic data from the 2006-2009 Household Budget Survey. Employing difference-in-difference approach, we find that the Czech flat personal income tax reform has significantly decreased the gap between reported household consumption and income for households with only one economically active individual that experienced a reduction in marginal tax rates after the tax reform relative to households experiencing no change and that it takes time for households to adapt to new tax policy.

**JEL Classification** H20, H21, H24, H26, H29,

**Keywords** Tax Evasion, Personal Income Tax, Optimal Taxation, Flat Tax

## Abstrakt

V této práci si klademe za cíl vyšetřit vliv české rovné daně z příjmů fyzických osob z roku 2008 na spotřebu, příjem a daňový únik, neboť teorie naznačuje, že daň z příjmů fyzických osob je částečně zodpovědná za vysokou úroveň daňového úniku. Užitím českých mikroekonomických dat za období 2006-2009 ze Statistiky rodinných účtů odhadujeme rozdíl mezi přiznanými výdaji a příjmy domácnosti jako proxy pro daňový únik. Použitím ekonometrické metody difference-in-difference jsme zjistili, že se daňové úniky po přijetí rovné daně z příjmů fyzických osob významně změnily pro domácnosti s jedním ekonomicky aktivním členem vzhledem k domácnostem, které změnu nepociťují a že domácnosti reagují na změnu v daňové politice s časovým spožděním.

**Klasifikace JEL** H20, H21, H24, H26, H29,

**Klíčová slova** daňový únik, daň z příjmů fyzických osob, optimální zdanění, rovná daň

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# Chapter 1

## Introduction

The objective of this thesis is to find the effect of Czech 2008 flat rate personal income tax on tax evasion,<sup>1</sup> since there is a belief that personal income tax rates are partially responsible for high levels of tax evasion. The Czech Republic has adopted a flat tax which came into effect on the January 1, 2008. The new personal income tax has been imposed at a flat rate of 15%, replacing the old system of four rates (12%, 19%, 25%, and 32%). The method which this thesis uses helps to assess the effect of changes in personal income tax on the rate of tax evasion by using consumption and income from the Czech microeconomic data from the 2006-2009 Household Budget Survey.

By adopting the flat tax reform, the Czech Republic joined other European countries (Estonia, Slovak Republic, Bulgaria, Lithuania, Latvia, Romania, Serbia, Ukraine, and Macedonia) which have adopted flat rate income tax reforms. However, no study has been made so far, after the Czech 2008 flat tax reform, to show the effect of this reform on tax evasion.

The Czech economy experienced a solid above 6% economic growth before the flat tax reform while the real GDP in 2008 grew only 2.5%. The collection from the personal income tax declined by more than one percentage point from 11.34% in 2007 to 10.21% in 2008. This decline in collection could be explained by worse performance of the real economy or by worsen voluntary compliance from taxpayers. Moreover, the average real monthly income grew by 1.9% from 2007 to 2008. Knowing all this we try to find whether there is an effect of flat tax reform that stands behind the decline in collections from the personal income tax.

Tax evasion is not traceable by tax authorities because it bears a problem of

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<sup>1</sup>Tax evasion is an illegal practice of intentional avoidance of paying true tax liability. On the contrary tax avoidance is legal practice of lowering tax payments, usually at some cost.

identification and therefore it is hard to measure any rate of it. However, there is a growing number of studies with several attempts to measure and/or estimate the extent/effect of tax evasion. In this thesis, we, inspired by the study of Gorodnichenko *et al.* (2009), use the difference between reported consumption and reported income, which Gorodnichenko *et al.* (2009) call the consumption-income gap, as a proxy of tax evasion. We show that this difference between reported income and consumption should not be used as a measure of savings.

The approach used in this thesis is the standard difference-in-difference approach with identified treatment group based on after-reform reported income because a taxpayer experiencing the flat marginal tax rate should not have behavioral response to the pre-reform tax rate threshold. Since the design of the Czech reform does not provide a clean comparison group by keeping the same marginal tax rate for the lowest tax brackets we calculated the effective tax rate (ETR) in order to be able to sort households into treatment and comparison groups. The effective tax rates for post-reform period were nearly 19% which was the marginal rate for the second tax bracket in the pre-reform period. Therefore, we take the upper threshold for the second tax bracket in year-period 2006-2007 as comparison group. Describing the treatment group we find that households in the treatment group have fewer members, children and seniors than households in comparison group and that the heads of households in treatment group are more educated, less likely to be married and work more often at enterprise or in private sector than the ones in comparison group.

In our thesis we give a brief overview of the theoretical concept of flat tax and describe principles of good tax policy. It helps us to understand the flat tax which the Czech Republic introduced and see that there still are several features of the Czech flat tax that make it an imperfect flat tax. In particular there is still some double taxation of corporate income, and the personal income tax is still biased against saving and investment.

Next, we present Hindriks & Myles (2006) version of theoretical Allingham and Sandmo model to explain why people evade taxes and what variables make taxpayers evade. This model is the simple application of individual choice under uncertainty firstly introduced by Allingham & Sandmo (1972). The variables that have an effect on taxpayer's decision to evade taxes are changes of the probability of detection, fine rate, income level, and tax rate. Theoretical results suggest that an increase in probability of detection, in fine rate and in tax rate decrease evasion rate while an increase in income level rises the amount of evaded income.

We continue with a description of the Household Budget Survey the micro-level data and create nine panels that combine pre-reform (2006, 2007) with post-reform (2008, 2009) years, taking the panel including all years as our base panel. We do so in order to replicate the study of Gorodnichenko *et al.* (2009). Their article is probably the first article to examine the effect of flat rate income tax on consumption, income, and tax evasion. They find, using micro-level data, that the Russia's 2001 flat rate income tax reform decreased the difference between consumption and reported income by about 9 to 12 percent for households that experienced a reduction in marginal tax rates.

Following their econometric specification we find that the Czech Republic 2008 flat personal income tax reform has significantly decreased the gap between reported household consumption and income for households with only one economically active individual that experienced a reduction in marginal tax rates after the tax reform relative to households experiencing no change. Results from our base panel using various combinations of consumption and income measures show a significant decrease of the gap by about 4 to nearly 7 percent for households with one economically active individual that experienced a reduction in marginal tax rates. However, the largest significant decrease by about nearly 8 to 13 percent is observed in panel consisting of years 2007 and 2009.

This thesis contributes to the empirical public finance literature by providing estimates of tax evasion in the Czech Republic for households with one economically active individual by exploiting natural experiment that occurred because of the tax reform. We are limited to households with one economically active individual because the way Household Budget Survey data is structured; we are unable to classify who of the individuals in household have what revenue.

The thesis is structured as follows: Chapter 2 reviews previous theoretical and empirical work on tax evasion as well as combination of tax evasion with flat tax. Chapter 3 describes principles of good tax policy highlighting equity, efficiency, and simplicity; and discusses the theoretical concept of flat tax. Chapter 4 introduces the modified flat tax of the Czech Republic and its important changes in corporate income tax, personal income tax, and other taxes. Chapter 5 presents the basic theoretical model of the taxpayer's evasion decision focusing on the effect of change of the probability of detection; fine rate; income level; and tax rate. It also touches the government's policy decision against tax evasion. Chapter 6 describes the Czech individual-level data on household consumption and income from the Household Budget Survey and

defines the key variables. Chapter 7 describes and replicates the Gorodnichenko *et al.* (2009) approach of analyzing tax evasion based on the permanent income hypothesis suggesting the equality of consumption and permanent income. The econometric specification is developed here and adjustment steps for baseline dataset are described. Furthermore, this chapter explains why the difference between reported consumption and reported income should not be used to measure savings and describes the assignment of households into treatment and comparison groups. Chapter continues with estimates of the tax evasion response and with comparing of results. Chapter 8 concludes.

As a requirement for the rigorous thesis, the rigorous thesis must be substantially extended compared to the master thesis and the comments made by the referees of the master thesis are supposed to be incorporated.

First, In the original master thesis we used the Czech Household Budget Survey from which we formed a panel covering 2006 through 2008 period. We showed that the reform had no significant impact on the extend of tax evasion among the treatment group households. A question that the thesis with such available data could not answer was whether this result was driven by the fact that the analysis ended with year 2008, first post-reform one, or was a general in nature. We believed that the effect of flat tax rate on tax evasion could show some effect since it takes time for households to adapt to new tax policy. This rigorous thesis is a follow-up study to the master thesis which substantially extends the data set by adding one more post-reform year 2009 from Household Budget Survey to answer the question which the master thesis could not.

Next, here is the excerpt from the referee report by PhDr. Jana Votápková: *I have two major objections which are worth reconsidering when the problems will be dealt with in the future.*

1. I doubt that the difference between instantaneous consumption and instantaneous income can be a proxy for tax evasion. ... I would suggest in this context, that it would be interesting to find out whether the people can correctly identify their life-time or rest-of-life consumption.
2. Gorodnichenko et al (2009) used as treatment and control groups lower tax bracket individuals and upper tax bracket individuals. However, are the groups really otherwise the same? Could there not be some kind of self-selection? Is the sample really random? That is always a huge problem with natural experiments in general. The author should state

why the experiment of Gorodnichenko et al (2009) was in this way ok. And do the like with his experiment.

These two major comments were incorporated as follows:

1. Gorodnichenko *et al.* (2009) claim, and we share their claim, that the discrepancy between consumption and income provides certain information about the extent of household tax evasion. We also added a discussion about PIH in Chapter 7.
2. We added the explanation in Section 7.7. Further we checked the assumptions about equal trends in consumption and income behind difference-in-difference in Section 7.4, because what matters for difference-in-difference estimate to be consistent is that the trends are the same not the levels.

PhDr. Jana Votápková also had a number of minor comments:

- Limiting oneself on one earner household is too restrictive. The author should think about the way to incorporate two earner households into the analysis. I would assume that majority of Czech households are two-earner households. Would that indeed not be possible to aggregate household income as a unit and consider them as “one joint earner”? That would be more representative for our environment, I think.
- I would at least appreciate the percentage of how many households consist of one earner only.
- Is parental leave considered as ‘out of labor force’ and thus are these families excluded from the analysis?
- Discussion on the conclusion that the higher tax rate can reduce tax evasion.
- To explain the methodology behind the statement that ‘the reported income and consumption should not be used to measure savings’ and the way the saving rates were calculated, and to provide the source of the data.
- The reader should be introduced more into the problem in the introduction.
- Wrong references to figures.

These minor comments were incorporated as follows:

- We admit that limiting this thesis on one earner household is too restrictive, but, we are unable to incorporate two earner households into the analysis due to the data limitation in classifying who of the individual in household have what revenue, which we need to know for treatment and control group definition as explained in Sections 7.1 and 7.6.
- There is 34.65% of households with one economically active individual in household in our HBS data after we create panel data.
- Parental leave is considered as out of labor force and it is explained in Section 7.1.
- We added a discussion in Section 5.1.
- The methodology behind the saving rate calculations explaining why the reported income and consumption should not be used to measure savings and the source of the data is explained and described in new Section 7.3.
- Introduction was completed accordingly.
- Wrong references to figures were corrected.

Comment made by referee MRes PhDr. Jan Zápál was about clarification of definition of the treatment and comparison groups. Definition of the treatment and comparison group is to be found in Section 7.6 and in Appendix A.

Other suggestions/comments from referees such as typos, float of figures and others were incorporated accordingly.

## Chapter 2

### Literature Survey

The first method to measure tax evasion is survey evidence, either direct or indirect. However, surveys asking directly whether a taxpayer does evade or does not evade are not very credible because of the simple fact that those respondents who already evade taxes will not provide truthful answers. To eliminate this problem the survey should be indirect, and most studies are. In other words collected information should be about attitudes toward evasion. The second method is to measure tax evasion via measurable economic variables. Usually this method is used to measure size of shadow economy the tax evasion is connected with. This measure of shadow economy is determined by the total economic activity from which the measured activity is subtracted. There are two approaches: the direct input approach and the monetary approach. The former employs electricity as an input to production from which the output is predicted. The latter employs the demand for cash because all transactions in shadow economy are done via cash. (Bank accounts are easily traceable.) Then the estimation of shadow economy is estimated due to the relationship between the quantity of cash and the level of economic activity.

The connection of flat tax with tax evasion is not new to the literature, however, probably the only paper measuring the tax evasion under flat tax is Gorodnichenko *et al.* (2009). Gorodnichenko *et al.* (2009), using the micro-level data (1998, 2000-2004 rounds of the Russian Longitudinal Monitoring Survey), examine the effect of Russia's 2001 flat rate income tax reform on consumption, income, and tax evasion. They use the difference between reported consumption and reported income, which they call the consumption-income gap, as a proxy for tax evasion. They find large and significant changes in tax evasion following the flat tax reform which are associated with changes in voluntary



compliance and cannot be explained by changes in tax enforcement policies. More about their approach is written later in this paper, since we base our analysis based on their approach.

There are studies concerned with tax evasion in the Czech Republic by Hanousek & Palda (2008), Hanousek & Palda (2002a), and Hanousek & Palda (2002b), however, none of these are in connection with flat tax. On the other hand, the first two mentioned studies model how tax evasion evolves and do not explain why people evade taxes as most of studies do. Hanousek & Palda (2008) provide the first study to use individual data to track aggregate dynamics of tax evasion in the Czech Republic since 1995, because as they say: ‘understanding the dynamics of evasion is crucial for predicting future evasion’. They conducted their own survey every second year for six years since 2000 asking individuals whether they were presently, two, and five years ago evading taxes. They find that the number of evaders rose and then fell calling this ‘inverse-U’ path an ‘evasional Kuznets curve’. As for the evolution of tax evasion in the Czech Republic they suggest, using the estimates of Markov transition probabilities that the number of evaders will ‘flatten or fall in the decade to come’.

Earlier study by the same authors (Hanousek & Palda (2002a)) forecasted the evolution of tax evasion in the Czech Republic based on dataset of 1062 individuals by asking them whether they evade taxes often, occasionally, or never, and on the finding of Engel & Hines (2000), using the American data, that tax evasion converges to a steady state. They predicted a rising tide of tax evasion in ten consecutive years after their study. Individual characteristics that Hanousek & Palda (2002a) mention are key for tax evasion decision are the individual’s age, income, sex, and whether she lives in a town or in a village. They show that tax evasion rises with age of individuals. However, their finding is not supported by Clotfelter (1983) who concludes that common findings in indirect studies are that tax evasion declines with age and adds that it is more likely among individuals who know others who evade taxes. Hanousek & Palda (2002a) also provide suggestion to policymakers that they could fight tax evasion by lowering taxes or by making individuals believe that their reported money are spent on public goods of high quality.

The Czech Republic introduced flat tax in 2008 which was the year of global financial crisis. It can imply that, based on Engel & Hines (2000) study, rates of tax evasion in the Czech Republic fall due to the crisis. Engel & Hines (2000) when talking about the aggregate tax evasion behavior, point out that

if there is an observable aggregate economic shock influencing most taxpayers the pattern of tax evasion is predictable. As an example they give recession years because during those tax evasion rates are likely to fall because taxpayers' past evaded incomes appear to be large relative to their current incomes which are lower.

Talking about the current income, Bloomquist (2003) in his empirical analysis of the US data tests the hypothesis that a rise in income inequality leads to tax evasion. His hypothesis is similar to Christie & Holzner (2006). On the contrary, Christian (1994), as Slemrod (2007) cites, reports results that are consistent with the old saying that 'the poor evade and the rich avoid.' His non-conclusive findings say that relative to the size of people's true income higher-income people evade less than lower income people. He explains that rich do so through legal means such as avoidance because they can afford it while poor evade.

Studies measuring the responsiveness of taxable income to changes in marginal tax rates relying on the econometric method which compares the relative change in taxable income of the highest-income taxpayers with other taxpayers. However, these studies, mostly focusing on high-income taxpayers, are not in connection with tax evasion but can be partly attributed to tax evasion under flat tax since the flat tax also usually changes marginal tax rates for the highest-income taxpayers. Goolsbee (2000) using panel data finds that the higher marginal rates lead to a significant decline in taxable income. Feldstein (1995) also using panel data suggests that taxable income increases more for high income people than for low income ones. Lindsey (1987) use repeated cross sections and find that higher income taxpayers have higher elasticities. Another empirical study which estimate the sensitivity of taxable income to marginal tax rates is presented by Feenberg & Poterba (1993).

The flat tax eliminates double taxation on savings and investments which is a great incentive for individuals to save and invest more of their income. Grecu (2004) claims that the flat tax considerably reduces the time and cost of completing tax forms. Other benefits of a flat tax system presented by Grecu (2004) are that the flat tax exempts the poor from paying any tax by providing a generous personal exemptions; the flat tax may increase government revenue; and that the flat tax reduces tax evasion by lowering the opportunity cost of avoiding taxes. He supports this last benefit by saying that individuals are less willing to cheat and risk under a flat tax. He also claims that the government spends less money on monitoring and auditing a simpler fiscal system.

The theory behind the increase of government revenue is the ‘Laffer curve’<sup>1</sup> which shows the trade-off between tax rates and tax revenues. Government can maximize tax revenue by setting a tax rate at a point  $T^*$ . Any increase of tax rate after this point will cause taxpayers to evade or work less leading to the reduction of total revenue. If the government, hypothetically, taxed people with 100% rate, no one would have incentives to work at all. However, this does not need to be true in the real life. Kim *et al.* (2006) find that the empirical evidence of the flat taxes that have been adopted bear no sign of Laffer-type behavioral responses generating revenue increases from the tax cut. Hall & Rabushka (1995) and Hall & Rabushka (2007) claim that under the single taxation rate it is easier to collect tax due, and that tax avoidance and evasion are discouraged. They say that high tax rates reduce economic output and also foster tax avoidance and evasion. Hall & Rabushka (1995) also present three reasons of Lawrence B. Lindsey why lower rates increased the share of taxes paid by the rich. The first reason is that the highest income group of taxpayers will shift money from consumption or tax-sheltered investments into more productive, taxable investments, implying that the tax avoidance declined and efficiency increased. The second reason claims that taxpayers become more honest as evasion become less rewarding which imply decrease of tax evasion. The final reason is that incentives improved because some taxpayers, who gain higher after-tax returns, simply work harder.

Lastly, Feld & Frey (2006) argue that a psychological tax contract which establishes a fiscal exchange between the state and the citizens shapes tax compliance to a large extent. They find, through the study conducted in Switzerland, that the more respectfully Swiss citizens are treated, the more they acknowledge it by higher tax compliance.

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<sup>1</sup>The Laffer curve was not invented by Arthur B. Laffer but named after him, when he drew the curve to illustrate the concept.

# Chapter 3

## Principles of Good Tax Policy & Flat Tax

In this chapter we describe principles of good tax policy and discuss the theoretical concept of flat tax.

### 3.1 Principles of Good Tax Policy

When the Czech Republic built the new tax policy it had to cope with the traditional measures of effective taxation such as equity, simplicity, and economic efficiency which are all difficult to fulfil simultaneously. Already Adam Smith in 1776 established so called ‘four maxims with regard to taxes’, one of which was the need for equity in a tax system. Many authors cite Adam Smith’s maxims and add their attributes for an ideal system such as simplicity, transparency, neutrality, economic efficiency, etc. Authors who follow are for example: Hall & Rabushka (1995) or Hunter & Entin (2005).

Tax equity has been the most frequently discussed characteristics among scholars who define an ideal tax system. For example, Hall & Rabushka (1995) define equity as equal treatment to equals. Other definitions of equity can be in levels so that everybody pays the same amount, or in percentage terms so that everybody pays the same fraction, or in the ability to pay. Equity has the same interpretation as fairness which can have different meanings to different people, especially when considering an income tax. Tax equity thus can be understood in two different ways: vertical equity and horizontal equity. Vertical equity means that people with different income should be treated equally. However, Hall & Rabushka (1995) claim that vertical equity is not rooted in the philoso-

phy of fairness because this approach is a twentieth-century phenomenon that has come to mean that individuals with above-average incomes, in other words successful individuals, should pay higher fraction of their income in taxes. As for horizontal equity, Hall & Rabushka (1995) define horizontal equity as that individual under similar circumstances should bear equal tax burdens. To say it in other words, it means that people with equal incomes are taxed equally. They argue that a flat tax satisfies this norm.

Efficiency means that taxes should not interfere with relative prices. Whenever an individual responds to changes in relative prices due to taxation, then we talk about distortion. Hagemann *et al.* (1988) explain relative prices change based on so called ‘wedges’ between the before and after tax prices of goods, services and factors of production. They say that relative prices change when these wedges are of different sizes. Hagemann *et al.* (1988) claim that tax rates, and elasticities of supply and demand for goods and factors of production, and the elasticities of substitution in production between factors, influence the size of distortions. Efficiency is sometimes referred to as economic neutrality because taxation should not distort economic processes and influence individuals decisions.

Simplicity means that taxes should be designed in a way that tax authorities have as minimal cost to administer and enforce the tax as possible, and that individuals have minimal cost to comply with the tax. When tax rules are complicated it is difficult and costly for individuals to understand it and correctly file their tax return. A complicated tax system also makes it hard for tax authorities to monitor tax collections and creates possibility for loopholes.

## 3.2 Flat Tax

In 1985, Robert Hall and Alvin Rabushka’s book, *The Flat Tax*, developed a tax reform that is based on a single tax rate, a flat tax, for all sources of ‘earned’ income. Their proposal achieves simplicity, and fairness as explained in previous section.

The individual income tax is, under the Hall-Rabushka proposal, defined as the flat tax rate times wages, salaries and pensions, less personal allowance. And the business income tax is the multiple of the flat tax rate and the total revenue from sales of goods, less purchases of inputs from other firms, less wages, pensions paid to workers, less purchases of plant and equipment.

Flat tax should have one basic tax rate for all income, and there should

be very few deductions. The deductions that are allowed should be necessary for calculating income correctly without favoring source of income or one kind of economic activity or one taxpayer over another. Another, more important, way in which a true flat tax has to be flat is in the choice of tax base.

Simplicity of flat tax is reflected in the fact that the tax form requires only a few calculations. One of the most important features of the flat tax system is that it taxes all income once only and this income tax is applied to its source as close as possible. Another fundamental feature of the flat tax is that it taxes income uniformly. There are no rate differentials between different types of income and this is equitable.

As for efficiency, Hall and Rabushka do not discuss the implications of single tax rate for efficiency. Efficiency in taxation implies different tax rates but flat tax as proposed by Hall and Rabushka eliminates the consumption bias in income taxation.

Hall *et al.* (1996) say that the tax system Hall and Rabushka developed would put a low 19 percent tax rate on a comprehensive definition of income<sup>1</sup> which would raise the same revenue as the current tax system and that the proposed tax is fair to families. The poor would pay no tax at all. This is the single exception that makes Hall-Rabushka's proposal progressive but far less progressive than a system of rising tax brackets. The families having the income above the allowance pay tax on the income above the exemption level. In other words, the proportion of income paid in taxes rises with income.

There is a significant distinction between income-based taxes and consumption-based taxes. A true flat tax is based on the amount of national income used for consumption. Consumption-based taxes do not discriminate (they are 'neutral') between income that is used for consumption immediately and income that is used for saving and investment, and consumed at a later date. The present value of the tax on current and future consumption is the same in either case. By contrast, income-based taxes are biased against saving and investment. They are imposed on income and on returns to saving. That places a higher present value tax on income saved now and consumed later than on income consumed right away.

All income taxes are biased against saving or investment. Saving puts a cost on the saver. He must defer consumption to buy the assets that earn

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<sup>1</sup>Comprehensive income or the Haig-Simons income is, as it is defined, a measure of economic income as a sum of consumption (purchase or acquisition of goods and services of any kind without capital expenditures and the full spending is amortized) and change in wealth.

future income. The loss of consumption is the opportunity cost of the saving. Another way to say this is that the income tax ignores the time value of money by taxing the basic risk-free return on saving. If inflation is zero, and the real discount rate is 3%, then a Czech crown saved today, under the risk free interest rate, is worth exactly the same thing, in present value, as CZK 1.03 next year. The .03 CZK difference received next year is not a real income gain for the saver. If we tax the crown when it is first earned, and then also tax the CZK .03 in interest, there is a higher present value of income tax on the crown that is saved (and spent later with its interest) than on a crown earned and spent immediately.

There are two ways to eliminate this basic income tax bias against saving. One way is to defer the income tax on saving, taxing it only when the saving and its interest earnings are withdrawn for consumption. An alternative way is to tax the amount of income that is saved when it is first earned, but then not tax the future earnings of the savings. Either method makes the tax have the same present value for saving and for immediate consumption. In many countries, there are pension or personal retirement arrangements, or tax free government bonds, that have one of these kinds of neutral treatment. (In all these cases, the consumption is hit again by the VAT and any excise taxes that exist in the country whenever the consumption occurs.)

In addition to the basic income tax bias against savings, there are usually additional taxes imposed on saving. These include the corporate taxes and estate taxes. In a true flat tax system, the income from corporations would either be taxed at the corporate level, or at the individual level, but not both. If there is a corporate tax, there would be no tax on dividends or capital gains due to reinvested corporate income. If the income is not taxed at the corporate level, then the individual would pay tax on dividends or when he sells his shares (unless he saves the money to defer the tax). There would be no separate estate tax in a neutral tax system. If the income had been taxed when it was first earned, there would be no tax at the time of the transfer.

Another issue is that the income tax uses depreciation to calculate the amount that businesses are allowed to deduct against revenue to reflect the consumption of capital. Depreciation over time is always lower in present value than the immediate cost of the investment. It leads to the overstatement of the profit now, which over-taxes the profit. The correct treatment of capital consumption to avoid over-taxing the profit is to allow a deduction for the full cost of the asset in the same year as the asset was purchased. That is called

‘expensing’. Alternatively, the tax authorities could allow delayed write-offs to be expanded by some interest rate to keep the present value equal to the original purchase price.

There are several forms of tax that are consumption-saving neutral. They include consumed-income or saving-deferred income taxes, returns-exempt income taxes, the value added tax (VAT), or a retail sales tax. All of them tax the amount of national income used for consumption. These taxes tax only above-normal returns, not the time value of money. If these taxes are imposed evenly, and are not doubled-up on some income but not other income, they are truly neutral or flat in all respects. Under consumption-based taxes, all saving is given either deferred taxation, or the returns are tax exempt. Consumption taxes have no added corporate taxes or transfer taxes. All consumption taxes (consumed-income tax, saving-deferred tax, returns-exempt tax, VAT and sales tax) have expensing.



## Chapter 4

# The Modified Flat Tax of the Czech Republic

The Czech Republic has adopted a new tax system that may best be described as a 'modified flat tax'. It has some features of a broad-based income tax, and some features of neutral or consumed-income tax. The public finance reform package was approved by the lower house of the Czech Parliament by a very close vote on August 21, 2007. On September 19, 2007 it was approved by the upper chamber. It was signed into law by President Václav Klaus on October 5, 2007. The new tax system became effective January 1, 2008.

The reform package made major changes in the personal income tax and in the corporate income tax. Although it is referred to as a 'flat tax', it is not a true flat tax for a number of reasons. A true flat tax would impose a single tax rate on all income, allowing only those deductions necessary to measure income correctly, with no exemptions (except for some form of personal or family allowance to shelter the poorest citizens). There would be no double taxation of corporate and individual income, and no tax bias against income saved as opposed to income used for consumption. The result would be a saving-consumption neutral tax, sometimes called a consumed-income tax.

The Czech Republic has adopted a modified flat tax. It has two flat rate taxes, one on personal income and one on corporate income. It allows for some deductions. It has a system of pension savings deductions and matching government contributions for personal saving plans that take the income tax bias off some of the savings done by individuals. It includes corporate dividends in personal income, as well as imposing a corporate income tax. However, it exempts long term capital gains from income. In effect, there is a double tax on

corporate income paid out as dividends, but not on corporate income reinvested to raise the value of the corporation and its stock. Capital cost recovery for businesses involves depreciation rather than immediate expensing, but with some acceleration of write-offs. Consequently, the system is a hybrid between a 'broad-based income' tax and a 'consumed-income' tax.

Certain social benefits have been trimmed to offset losses in Government revenues due to the reform. Other offsets to the income tax cut include the VAT; introduction of environmental taxes; abolition of sick-leave compensation for the first three days of sick leave; and decreasing the tax relief for mortgages and life insurance policies.

All Czech residents and foreigners with permanent residence in the Czech Republic who are physically present in the Czech Republic for at least 183 days within a calendar year are considered as Czech residents for tax purposes and pay income tax on their worldwide income. Non-residents are those individuals who do not have permanent residence or spent less than 183 days in a calendar year in the Czech Republic. Non-residents pay income tax only on Czech-source income.

Following subsections introduce important changes in tax system.

## **4.1 VAT**

Under the tax reform, the lower VAT tax rate rises from 5% to 9% to balance the cost of lowering other rates. The standard VAT remains at the rate of 19%. The reduced rate of 9% applies to food, medications, services for the provision of water and heating, newspapers and books.

Some types of economic activity are exempt from the VAT tax, and do not count as VAT-deductible expenses by purchasers; exempt items include postal services, broadcasting services such as radio and television, services of financial institutions such as banks or insurance companies, planning and instructions, upbringing and education, health services and goods, welfare services, lotteries and games of chance, and non-profit making organizations.

A VAT is inherently neutral in its treatment of income that is used for consumption and income that is saved for investment. The consumer pays no VAT until he or she spends the income, so saving is tax deferred as far as VAT is concerned. At the various stages of production, the VAT is deductible from investment spending if the entity is subject to VAT payments. This is because each business receives a rebate of VAT that it pays on purchases from other

businesses. That includes the purchase of capital investment goods such as vehicles, machinery, buildings, and other structures. The result is a tax that is imposed on total consumption spending, but not on investment.

## 4.2 Corporate Income Tax

The corporate income tax rate has been reduced from 24% to 21%; it had been scheduled to be successively reduced to 20% in 2009 and to 19% in 2010. The reduction of the corporate income tax is designed to maintain competitiveness with other Central and Eastern European countries. The tax-reform package also widened the tax exemption for dividends received by a Czech parent firm or a unit of an EU company to avoid taxing income moved between companies twice. The package also exempts companies from capital gains taxes. Interest outlays are normally deductible on primary debt; however the Czech tax system imposes some limits on the deduction of interest to discourage over-leveraging of business.

## 4.3 Personal Income Tax

The new personal income tax has been initially imposed at a flat rate of 15%, replacing the old system of four rates (12%, 19%, 25%, and 32%), see Table 4.1. The flat personal income tax rate is a cornerstone of the tax-reform package. However, the amount of income subject to tax has increased to include social insurance contributions that were formerly deductible. Personal income tax is no longer calculated on an employee's net wage (the gross wage less the individual's social and health insurance contributions). It is calculated from the so-called super-gross wage, which includes the compulsory insurance contributions paid by the individual and the individual's employer. The super-gross wage is 135% of the gross wage. This makes the 15% tax rate equivalent to a rate of 22.4% on the net wage that was taxable under the old system.<sup>1</sup> The

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<sup>1</sup>Under the old system, the social insurance tax was deductible, and the income tax was imposed on the remaining wages. Under the new system, the income tax is imposed on the so called super-gross wage, which is a tax payer's gross income increased by social and health insurance paid by employer. The super-gross wage (the tax base) for an unmarried taxpayer with no child and with a monthly gross income of CZK 20,000 is CZK 27,000 (a gross income increased by 35% of gross income, in our case it is CZK 7,000). The 15% tax then is CZK 4,050 from which the tax allowance of CZK 2,070 (estimated by Tax Income Law) is subtracted. The amount of money the tax payer should pay is then CZK 1,980 but a tax payer must in addition pay 12.5% of his gross wage for social and health insurance.

increase in the tax base has been partly offset by an increase in the personal allowances, which are subtracted as credits from the tax owed. The overview of personal allowances for year 2008 and 2009 is in Table 4.2.

Table 4.1: Personal Income Tax Rate Schedule

2006-2007 Tax Base over	But not over		Of the amount over
CZK 0	CZK 121,200	12%	-
CZK 121,200	CZK 218,400	CZK 14,544 + 19%	CZK 121,200
CZK 218,400	CZK 331,200	CZK 33,012 + 25%	CZK 218,400
CZK 331,200	and more	CZK 61,212 + 32%	CZK 331,200
2008-2009 Tax Base over	But not over		Of the amount over
CZK 0	and more	15%	-

SOURCE: § 16 OF ACT NO. 586/1992 COLL. INCOME TAX

Table 4.2: Personal Allowances 2008 and 2009

Annual Allowance	Amount in CZK
Annually for each taxpayer	24,840
Pensioner	24,840
Incomeless wife/husband	24,840
Incomeless wife/husband - disabled	49,680
Disabled person with partial disability pension	2,520
Disabled person with full disability pension	5,040
Disabled person	16,140
Student	5,040 <sup>2</sup>
Child	10,680
Disabled Child	21,360

SOURCE: § 16 OF ACT NO. 586/1992 COLL. INCOME TAX.

The 2007 reform also introduced the so-called ceiling, or a maximum assessment base, for the calculation of health and social insurance contributions. The insurance tax is imposed on wages and salaries up to a maximum base of 4.8 times the average national wage.

The personal income tax is one of the most important revenue sources for

It makes it for our case CZK 2,500. Adding the tax CZK 1,980 we get the amount of CZK 4,480. The tax payer's net income then is only CZK 15,520 which makes the personal income tax higher than 15%. In reality it makes it 22.4%. With true 15% income tax the tax payer's net income would be CZK 17,000 not CZK 15,520. If our taxpayer's income was CZK 30,000 her net income would be CZK 22,245 which makes the income tax even higher with the rate of 25.85%.

the national budget.<sup>3</sup> It is imposed on individuals' labor and capital income. It is paid by employees, savers, and owners of non-corporate businesses on income from employment such as salary, wages, or other compensation for work; profits and other income from non/corporate businesses and other self-employment activities; dividend and interest income and short term capital gains from capital assets; income from rentals and leases; and other income. Because long term capital gains (on property owned for more than six months) are not subject to tax, and because private pension contributions are partly tax-deferred, the system has some of the features of a consumption-based tax.

Income from employment is taxed at the source in most cases in the form of a payroll withholding calculated and paid by the worker's employer to the Financial Office. Barring any special designation, it is normally calculated at a rate of 15% on income which exceeds CZK 5,000 per calendar month. However, because there are certain tax deductions, and credits in the form of personal allowances, that reduce the average tax rate below 15%, each worker is allowed to designate one employer who may take account of the worker's allowances in calculating a reduced withholding rate. (The designation of only one employer to take account of the allowances is necessary due to the fact that some employees have multiple simultaneous employers in the course of a year.)

## 4.4 Other Taxes

The other taxes that existed under the old tax system have been kept: the excise taxes, road tax, real estate tax, real estate transfer tax of 3%, and the inheritance and gift taxes that range from 1% for related persons to 40% for non-related persons.

## 4.5 The Czech Tax System: Improved, But Still in Need of More Reform

The Czech Republic has moved some way from an income tax system with high, graduated tax rates, especially on capital income, toward one that is both

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<sup>3</sup>The Czech National Bank reports that the national revenue accounted 11.43% (CZK 91,591 million out of CZK 801,610 million), 11.34% (CZK 102,137 million out of CZK 900,657 million), 10.21% (CZK 94,957 million out of CZK 929,914 million) and 10.28% (CZK 85,651 million out of CZK 832,972 million) of revenues from personal income taxes over the total tax revenues in 2006, 2007, 2008 and 2009 respectively.

flatter and more consumption-based and less harmful to saving and investment. However, several features of the Czech flat tax make it an imperfect flat tax that retains some of the tax biases against savings of progressive income tax. There is room for more improvement. Income that is used for saving and investment outside of the limited pension arrangements is taxed more than once in the Czech tax system. Income is taxed once when first earned. If the after-tax income is not spent, but saved, then its returns are taxed (except for long term capital gains). In addition, if the saving is in corporate stock then the profit is taxed as corporate income tax at a rate of 21%. After-corporate-income tax dividends paid to shareholders are taxed again at a 15% rate as personal income. This means that there is a double taxation of corporate income. Small amounts of investment by businesses may be immediately expensed (tangible assets with useful life more than one year and a purchase price up to CZK 40,000). Larger investment outlays must be depreciated, which delays the claiming of the cost against the business's income. This adds to the cost of capital for the firm, and is one of the differences between a saving-consumption neutral tax (in which all investment is expensed) and an income tax. Consequently, there are some fundamental changes that the Czech Republic should still try to adopt. All saving should get the same treatment as pensions now receive. On saving that is not given the tax treatment of pension arrangements, there should be no tax on interest, dividends, or capital gains. If dividends are to remain taxable, then corporations should be allowed to deduct them, or the corporate income tax should be abolished. There should be no additional inheritance tax or gift tax beyond what the ordinary income tax imposes. There should be no tax on income from abroad (with careful steps taken to prevent 'transfer pricing' abuses to artificially shift income to lower tax countries).

In conclusion, when we look at the 2008 Czech tax system and compare it to what economists would call real flat tax concepts, we realize that the Czech tax system does not perfectly match to any of them. There is still some double taxation of corporate income, and the personal income tax is still biased against saving and investment because it taxes saving and the earnings of savings, except in limited pension arrangements or the case of long term capital gains. Firms are taxed on all their worldwide income, instead of having a territorial tax system. There are still inheritance and gift taxes. With some additional changes to further reduce the elements of the tax system that discriminate against saving and investment, the Czech tax system could become even simpler and more friendly to rapid economic growth.

# Chapter 5

## Theoretical Model: The Evasion Decision

In this chapter we try to explain why people evade taxes based on theoretical model presented by Hindriks & Myles (2006) who derive it from Allingham & Sandmo (1972). Allingham and Sandmo model, also known as A-S model, is the application of individual choice under uncertainty which captures the decision of a taxpayer to evade part of her income given some probability of being caught evading. However, this model is not directly linked to flat tax framework, we illustrate this model here to outline what assumptions/parameters make taxpayers evade.

Similar work to Allingham & Sandmo (1972), are presented by Watson (1985) and Jung *et al.* (1994) who also see the choice of a taxpayer to evade as a risky decision. Tax evading individuals see the expected utility of doing so and compare it to the probability of being caught by the tax authority. Individual's benefit is in case of not being detected significant while when the individual is caught evading then she must pay a fine. In the worst scenario the individual may go to prison if the evasion is large enough. In such case the individual is clearly worse off than individual who is honest and truthfully report all of her income. Therefore individual must ask herself how much to evade. She has to weight both possible outcomes, the chance of not being caught and gain, and the chance of being caught and bear all losses. Hanousek & Palda (2002a) criticize this work for their static modeling of tax evasion over extended period.

## 5.1 Taxpayer's Decision Problem

Following Hindriks & Myles (2006) the decision problem an individual is facing can be modeled as follows: Let us have a taxpayer whose income is  $Y$  which is unknown to the tax collector, who declares  $X$ , where  $0 \leq X \leq Y$ . If there is no tax evasion then  $X = Y$ . The amount of underreported income is then given as  $0 \leq Y - X$ . Let  $t$  denote the marginal tax rate, then the total benefit of evading is  $t(Y - X)$  if not caught. If our individual evades and is not caught, which happens with probability  $(1 - p)$ , then her income is  $Y^{nc} = Y - tX$  while when caught, with probability of  $p$ , all her income is taxed and has to pay fine:  $Y^c = (1 - t)Y - Ft(Y - X)$  where  $F$  represents the fine levied on evaded tax and the cost of evasion is then  $(t + F) \cdot (Y - X)$ .<sup>1</sup>

The maximized expected utility for optimal declaration  $X$  of our individual can be written as:

$$\max_X E[U(X)] = \max_X [(1 - p)U(Y^{nc}) + pU(Y^c)] \quad (5.1)$$

or equivalently:

$$\max_X E[U(X)] = \max_X [(1 - p)U(Y - tX) + pU((1 - t)Y - Ft(Y - X))]. \quad (5.2)$$

Let us consider that our individual is not declaring at all so that  $X = 0$ , then her income is  $Y$  in the case of not being caught and  $[1 - t(1 + F)]Y$  if caught. If our individual is not evading and declares the whole income so that  $X = Y$ , then in both cases her income is  $(1 - t)Y$ . See Figure 5.1.

Figure 5.1 shows the income when the individual is not caught against income when caught. The individual can also choose any option that is on the line connecting points  $X = 0$  and  $X = Y$  based on her utility function which provides a set of indifference curves, one of which is depicted in the figure. Our individual chooses to declare  $X^*$ , achieving the highest indifference curve, which is the interior point with  $0 < X^* < Y$ . Therefore she declares less than her total income.

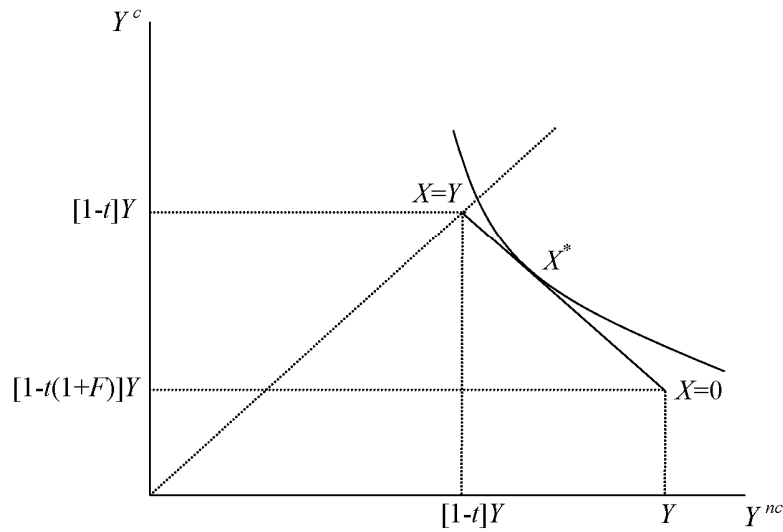
The corner solution is also possible. In the Figure 5.2a there is a choice of the individual to declare her whole income thus the optimum is  $X^* = Y$ . In the Figure 5.2b the individual evades the whole income and the optimum is  $X^* = 0$ .

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<sup>1</sup>Sandmo (2005), who retrospectively presents the A-S model, denotes  $p$  as the taxpayer's subjective probability of detection.



Figure 5.1: The Evasion Decision: Interior Choice



SOURCE: HINDRIKS &amp; MYLES (2006)

The evasion occurs when the indifference curve is steeper than the budget constraint where it crosses the 45° line. The slope of the indifference curve is:

$$\frac{dY^c}{dY^{nc}} = -\frac{[1-p]U'(Y^{nc})}{pU'(Y^c)}, \quad (5.3)$$

where  $U'(Y)$  is the marginal utility of income at level  $Y$ . Taking into account that on the 45° line  $Y^c = Y^{nc}$ , so that  $U'(Y^c) = U'(Y^{nc})$ , the slope of the indifference curve where it crosses the 45° line is:

$$\frac{dY^c}{dY^{nc}} = -\frac{1-p}{p}. \quad (5.4)$$

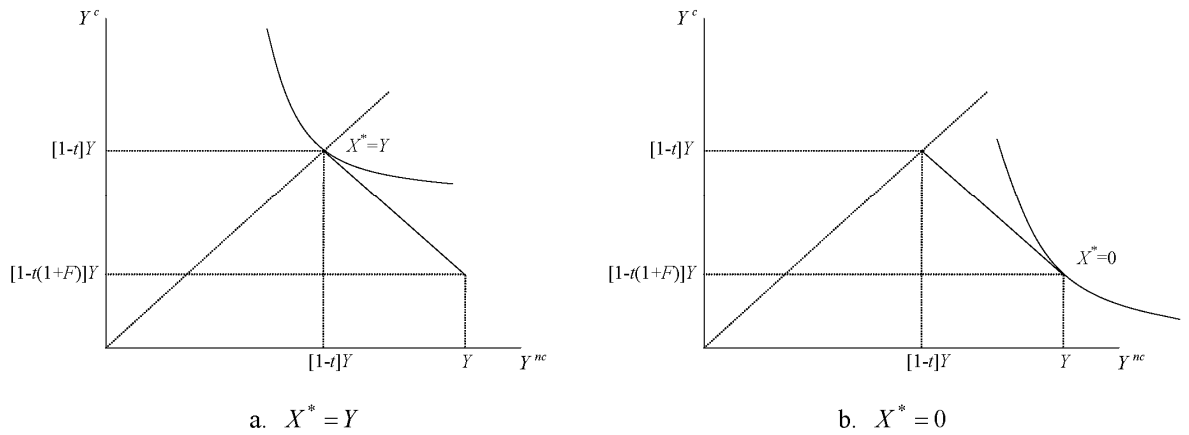
The slope of the budget constraint is  $-F$ .

From these properties the indifference curve is steeper than the budget constraint on the 45° line if

$$\frac{(1-p)}{p} > F. \quad (5.5)$$

However, this condition does not say anything about the extent of tax evasion, it only says whether evasion occurs or not. The condition does not depend on the utility function  $U$  therefore, if any individual evades then all individuals should evade. From these conditions we can partially answer the question why people evade taxes. People evade when the probability of detection is too small

Figure 5.2: The Evasion Decision: Corner Solutions



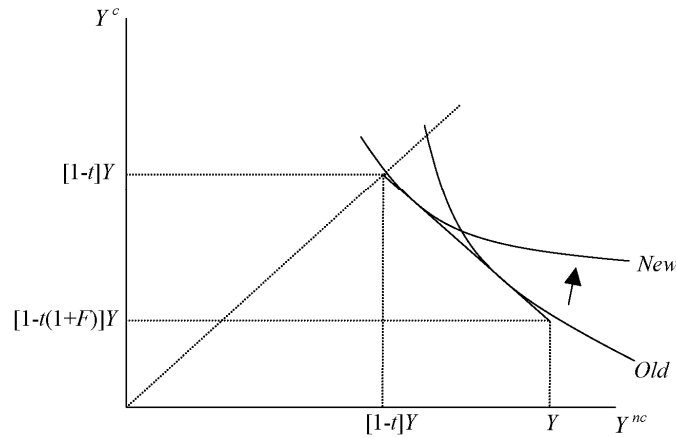
SOURCE: HINDRIKS &amp; MYLES (2006)

relative to the fine rate.

Consider a scenario when the probability of detection  $p$  increases. Intuitively, one would expect that the evasion rate will decrease since no individual wants to be caught evading and be worse off, under the assumption of non zero fine rate, than honest individuals. According to Hindriks & Myles (2006) an increase in probability of detection reduces the gradient of the indifference curves where they cross the 45° line. This effect will lead to the shift of optimal point closer to the point  $X = Y$  where the individual evades less because her income lowers whenever she is caught evading. Therefore the evasion rate decreases whenever the probability of detection rises. See Figure 5.3. This is supported by Engel & Hines (2000) who find, using the annual observations for the United States between 1947-1993, that higher audit intensity should discourage evasion.

Now let us consider change in fine rate. The fine rate plays a role only when the individual is being caught evading. When  $F$  increases then the budget constraint becomes steeper while indifference curves do not change at all. Unchanged shape of the indifference curves under an increase of  $F$  makes our individual moves again closer to the point where  $X = Y$ . See Figure 5.4. The Figure 5.4 depicts the shift from initial choice of declaration  $X^{old}$  under the fine rate  $F$  to the new choice of declaration  $X^{new}$  under the increased fine rate  $\hat{F}$ . Therefore, as it is shown in the Figure 5.4, the increase in fine rate  $F$  reduces the level of tax evasion. However, Bayer & Sutter (2009) suggest that

Figure 5.3: The Evasion Decision: Increase in Detection Probability



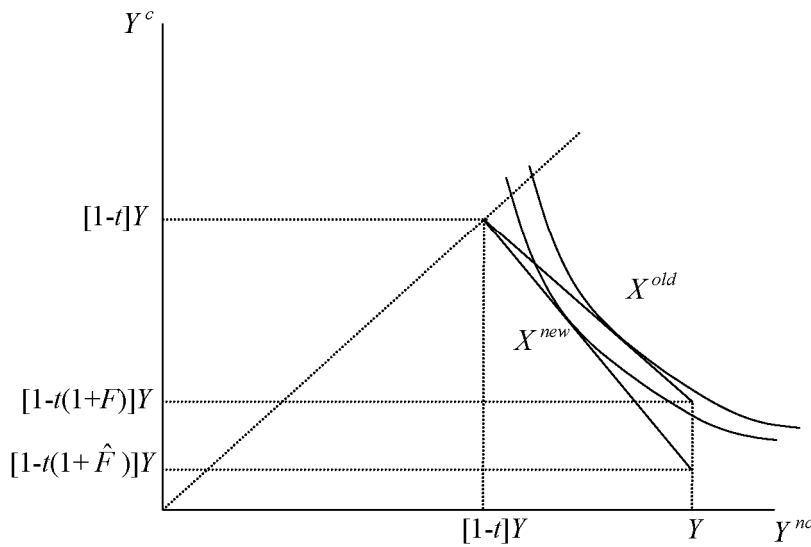
SOURCE: HINDRIKS &amp; MYLES (2006)

policy makers who care about welfare losses should do something with tax rates rather than with penalty rates. They claim so based on their empirical attempt to measure the concealment and detection costs associated with tax evasion. They show that the welfare losses from a concealment-detection contest depend positively on the prevailing tax rate, but not on the penalty which is imposed in case of detected tax evasion.

Previous effects of an increase in probability of being caught, and of an increase in fine rate on the level of reported income are intuitive. Effect of change in income level and tax rate on the level of tax evasion are not as intuitive. We examine what happens if the individual becomes richer when her income increases from the initial level  $Y$  to the level  $\hat{Y}$ . Such increase will lead to the parallel shift of the budget constraint further from the origin. The optimal choice is then depicted in Figure 5.5 which shows the shift from the initial choice of declaration  $X^{old}$  with the initial income to the new choice of declaration  $X^{new}$  with the higher income.

The measure of absolute risk aversion of the utility function, as Hindriks & Myles (2006) define it,  $R_A(Y) = -\frac{U''(Y)}{U'(Y)}$ , plays the most important role in how the evasion decision is affected. This absolute risk aversion measures the willingness to get involved in small bets with fixed size. Whenever  $Y$  increases and in the same time  $R_A(Y)$  remains constant, the optimal choice is on a locus parallel to the 45° line. Although, Hindriks & Myles (2006) argue that there is evidence that in practice,  $R_A(Y)$  decreases as income increases. Therefore,

Figure 5.4: The Evasion Decision: Increase in the Fine Rate

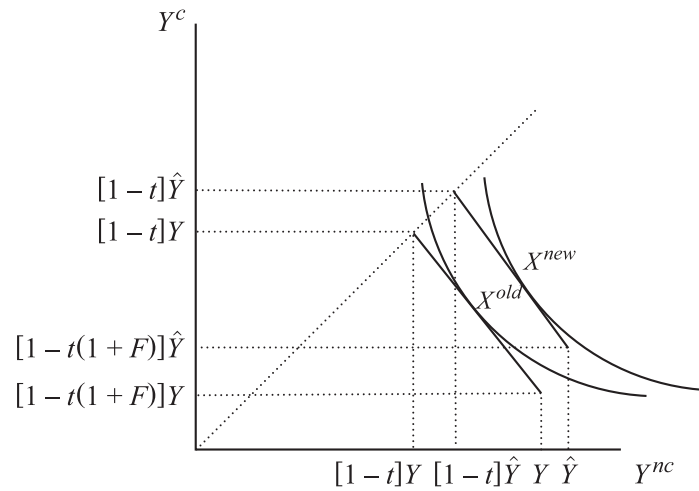


SOURCE: HINDRIKS &amp; MYLES (2006)

individuals with higher income are more willing to get involved in small bets which means that the locus of choices shifts away from the 45° line and the amount of evaded income rises as income increases. See Figure 5.5.

The last variable to consider is the tax rate. Intuitively, whenever the government increases the tax rate the individual has to give away more of her income and her budget constraint is smaller. Clotfelter (1983) investigates the relationship between marginal tax rates and tax evasion and finds that the marginal tax rates do have a significant effect on the amount of tax evasion; and Tanzi (1980) found, based on the study of the underground economy in the United States, that evasion rises with marginal tax rates. Formally, let us have an increase in the tax rate from the initial rate  $t$  to the new tax rate  $\hat{t}$ . There is negative income effect implying that higher taxes make the taxpayer poorer and, therefore, less willing to take risk. So the shift from the initial choice of declaration  $X^{old}$  with the initial tax rate to the new choice of declaration  $X^{new}$  is as shown in Figure 5.6. Hindriks & Myles (2006) say that this result is still questioned because it is against to what seems reasonable. The model predicts that with higher tax rate individuals evade less due to the definition of the fine paid by the individual as  $tF$ . Both having the same effect on each other. With an increase in the tax rate having effect of raising the penalty. Therefore, when an individual is caught, she has to give up more of her income. Hence, this

Figure 5.5: The Evasion Decision: Income Increase



SOURCE: HINDRIKS &amp; MYLES (2006)

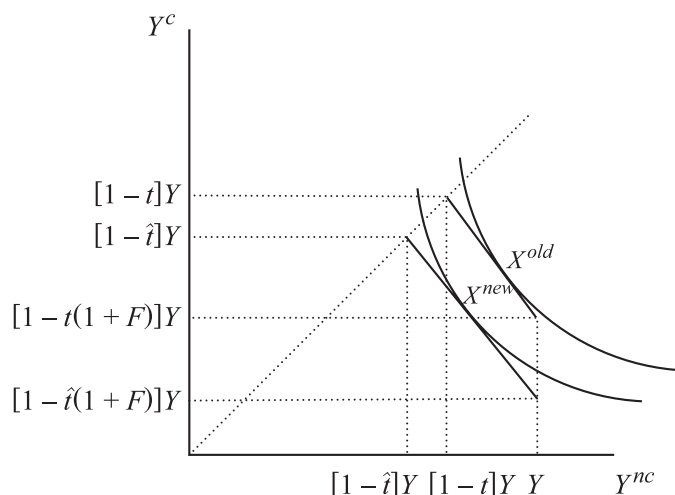
is the scenario that a higher tax rate can reduce evasion. Cordes *et al.* (2005) also say that an increase in the tax rate generally has an ambiguous effect on reported income because under plausible assumptions, compliance raises with higher tax rates. On the other hand they present evidence on tax evasion behavior that a higher tax rate leads to less compliance, with an estimated reported income-tax rate elasticity of  $-0.5$  to  $-0.3$ .

To summarize effects of income and tax rate on tax evasion we can say that an increase in  $Y$  has similar effect as decrease in  $t$ . Moreover, Engel & Hines (2000) based on empirical study claim that positive income and tax changes should increase evasion rates.

In addition if a common assumption that the measure of absolute risk aversion is decreasing is made, then the original A-S model predicts that a higher gross income increases evasion. An increase of the tax rate has in the A-S model also a substitution effect next to the income effect. Both effects have ambiguous result on tax evasion. The substitution effect that in this context means that with an increase of marginal tax rate the evasion also increase because an individual substitutes the risk of being penalized with the underreported income. The substitution effect, as Allingham & Sandmo (1972) present, has been criticized by Yitzhaki (1974). Yitzhaki (1974) claims that the substitution effect depends on the assumption that the penalty is imposed on the amount of income evaded. But, there is no substitution effect if the penalty is imposed

on the evaded tax.

Figure 5.6: The Evasion Decision: Tax Rate Increase



SOURCE: HINDRIKS & MYLES (2006)

Sandmo (2005) criticizes by pointing out one unrealistic simplification of A-S model which is the assumption that all income is unknown to the tax collector. Therefore, the whole A-S model is applied on the taxpayer's income that can be evaded with the possibility of detection. The case where the probability of being caught depends on the amount reported:  $p = p(X)$  is also considered. A-S considers two alternatives as to the slope of the  $p(X)$  function. First, the collection agency has no information about  $Y$  then it is assumed that  $p'(X) > 0$  meaning that the collection agency believes that rich individuals engage more in evasion. Second, the assumption that collecting agency is not partially informed about individual's  $Y$  may be, according to Sandmo (2005), unrealistic because it is possible to know the individual's profession and hence the average level of income for the particular profession. Therefore, the assumption is such that  $p'(X) < 0$  meaning that the probability of being caught is zero whenever the reported income reaches the average level.

## 5.2 Government's Policy Decision Against Tax Evasion

The previous section introduced the factors involved in the decision to evade tax under uncertainty. We showed that with an increase of the probability of

detection  $p$  and/or the rate of the fine levied when caught evading,  $F$ , the tax evasion decreases. Government can change  $p$  by increasing the frequency of audits and  $F$ . Since government is the collector of taxes, it decides the optimal level of  $p$  and  $F$  in order to gain certain level of revenue. Revenue is defined as the taxes paid plus the money received from fines:

$$R = tX + p(1 + F)t[Y - X]. \quad (5.6)$$

The effect on revenue of an increase in the probability of detection is:

$$\frac{\partial R}{\partial p} = (1 + F)t[Y - X] + t[1 - p - pF]\frac{\partial X}{\partial p} > 0 \quad (5.7)$$

if  $pF < 1 - p$ .<sup>2</sup> Under the same condition, an increase in  $F$  raises revenue:

$$\frac{\partial R}{\partial F} = pt[Y - X] + t[1 - p - pF]\frac{\partial X}{\partial F} > 0. \quad (5.8)$$

Therefore, government revenue raises under tax evasion whenever it increases the probability of detection  $p$  and fine  $F$ . However, increasing  $p$  is costly, increasing  $F$  is free of charge. Government is tempted to go for the policy called ‘hanging taxpayers with probability zero’ but as Hindriks & Myles (2006) say it is not observed in practice.

Anderson & Carasciuc (1999), providing an empirical evidence from the former Soviet Union Republic of Moldova, also claim that an increase in the real value of fines and penalties applied to tax evasion are one of the possible causes of the decreased tax evasion phenomenon. They, based on the classic model of tax evasion behavior by Allingham & Sandmo (1972), estimate the net benefit of tax evasion and analyze the trade-off between audit frequency and marginal fine for a tax collection in a transition economy. They conclude that increased audit frequency has a direct proportional impact on the amount of evasion detected. Anderson & Carasciuc (1999) also consider the fact that auditors are not paid regularly and therefore, as Shleifer & Vishny (1993) describe, tax auditors abuse their power and accept bribes from audited individuals.

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<sup>2</sup>There is no effect on revenue if  $pF \geq 1 - p$  because there is no evasion.

## Chapter 6

# Czech Data on Household Income and Consumption

This chapter presents and describes the Czech data on household income and consumption from the Household Budget Survey (HBS) which we use for our analysis.

### 6.1 Czech Household Budget Survey

The Household Budget Survey is one of the most comprehensive household surveys conducted in all Member States of the European Union. The HBS samples private households annually under the responsibility of the Czech Statistical Office (CZSO). The HBS provides detailed information about household consumption expenditure on goods and services. It also provides information on income<sup>1</sup>, possession of consumer durable goods and cars, basic information on housing, and demographic and socioeconomic characteristics. As for characteristics that HBS provide for head of household include: sex, age, economic activity, education, occupation, and coefficient of unemployment.<sup>2</sup> It is a possible source of information about household expenditures and income. The main objective of the HBS in the Czech Republic is a detailed view of spending patterns of various kinds of households. The main application of HBS is to collect information on household consumption expenditure in order to update

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<sup>1</sup>CZSO admits that the income data should be regarded as supplementary information and should not be used for in-depth analyses because of the changes of the income level. More about HBS is available at the official web-pages of CZSO.

<sup>2</sup>The coefficient of unemployment is the portion of the number of months in reporting period when the head of household was unemployed.



the ‘weights’ for the basket of commodities used in the consumer price indices. Other uses include the social and economic research or decision making in designing social policies. Moreover, this paper assumes that households believe in the anonymity of the survey and therefore households truly fill the survey out. Also, since HBS requires private information from households, the survey is based on voluntary participation.

There are two samples in the HBS. The basic reporting sample consists of about 3000 households that correspond in structure to households in the Czech Republic. The main household characteristics are economic activity of the head of household, age, occupation, education, net money income, number of dependent children in the household, pension per person in the households of economically inactive pensioners. The sample also includes several types of households which were not covered before year 2006. These households are households of unemployed, and household of pensioners with or without economically active members. The second supplementary sample of about 400 households represents households with minimal income that are also in the elementary set.<sup>3</sup>

To better understand the data structure, we present the aggregate statistics about household income and consumption expenditures. The CZSO publishes these statistics every year using indicators such as the status of economic activity and age of the head of household, municipality size or income brackets. Table 6.1 presents key statistics on household consumption, incomes and expenditures from the 2008 HBS by deciles of net money income per person. CZSO classifies the gross money income as net of borrowings, credits received and savings drawn; and net money income as gross income excluding health and social insurance payments and income tax. For expenditures classification CZSO takes gross money expenditure as net of deposits, cash-free paid up loans, paid up credits and borrowings. The difference between gross expenditure and net money expenditure is health and social insurance payments and income tax. The classification of consumption expenditure in the HBS is the international standard COICOP (Classification of Individual Consumption by Purpose). Expenditures in compliance with CZ-COICOP are arranged in 12 categories: 01 Food and non-alcoholic beverages, 02 Alcoholic beverages, tobacco, 03 Clothing and footwear, 04 Housing, water, electricity, gas and other fuels, 05 Furnishing, household equipment and routine maintenance of the house, 06 Health,

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<sup>3</sup>Households in supplementary sample are defined to live on at most 1.9 multiple of the subsistence minimum.

07 Transport, 08 Communication, 09 Recreation and culture, 10 Education, 11 Restaurants and hotels, 12 Miscellaneous goods and services, and there is additional category 13 Non-consumption expenditures which are characterized mainly as purchases or reconstruction of dwelling. More about COICOP is available at the official web-pages of CZSO. COICOP has been used since 1999 to ensure international comparability of statistical indicators.

Table 6.1: HBS 2008 - Household Composition, Income and Expenditures (Annual Averages per Capita in CZK)

	Households, total	Households by net money income per person									
		Lowest 10 %	Second 10 %	Third 10 %	Fourth 10 %	Fifth 10 %	Sixth 10 %	Seventh 10 %	Eighth 10 %	Ninth 10 %	Highest 10 %
Households - weighted in sample	2,839 2,839	283 312	284 271	284 236	284 237	284 248	285 271	284 299	284 314	283 326	284 325
Per household averages:											
Members	2.29	3.23	2.69	2.30	2.35	2.15	2.29	2.20	2.12	1.86	1.69
economically active (without unemployed)	1.03	0.87	0.90	0.60	0.67	0.72	1.01	1.22	1.44	1.49	1.40
dependent children	0.58	1.57	0.99	0.58	0.61	0.50	0.56	0.44	0.32	0.14	0.13
pensioners not working	0.52	0.18	0.57	0.99	0.96	0.82	0.63	0.45	0.30	0.18	0.12
other members	0.16	0.61	0.23	0.13	0.11	0.11	0.09	0.09	0.06	0.05	0.04
Equivalencies (OECD scale)	1.83	2.36	2.06	1.84	1.87	1.74	1.85	1.80	1.75	1.59	1.47
Equivalencies (EU scale)	1.58	1.92	1.72	1.58	1.60	1.51	1.59	1.56	1.53	1.42	1.33
<b>GROSS MONEY INCOME, TOTAL</b>	156,598	73,964	101,934	113,001	123,849	135,845	150,561	171,876	202,960	246,813	363,431
<b>NET MONEY INCOME, TOTAL</b>	137,497	69,551	93,224	104,971	114,021	123,130	133,765	149,316	172,158	204,656	305,097
Income from employment	77,464	34,003	48,708	41,967	46,854	58,316	72,174	89,918	113,942	148,844	188,089
Income from self-employment	13,227	10,786	9,712	7,233	9,715	6,851	14,531	13,999	18,921	18,299	29,115
Social income	36,755	19,734	30,718	50,821	52,431	53,019	41,436	37,710	30,222	26,442	29,184
Pensions	29,158	6,115	21,008	44,582	46,156	46,722	36,128	31,653	23,465	20,677	22,918
Sickness benefits	2,251	967	1,826	1,536	1,561	1,961	1,956	2,920	3,565	4,085	3,538
Unemployment benefits	367	670	516	236	379	181	325	205	336	232	404
State social support benefits	4,150	10,494	5,948	4,052	3,670	3,362	2,409	2,220	2,127	1,198	1,647
Other social income	829	1,488	1,421	414	664	792	617	711	729	250	677
Other income	10,051	5,029	4,085	4,952	5,021	4,946	5,623	7,689	9,072	11,072	58,709
including: income from sale of (im)movables	3,477	99	181	274	526	259	199	769	2,306	2,761	37,922
gifts from relatives	2,724	1,736	1,774	1,658	2,034	2,386	2,380	2,839	2,213	2,852	9,767
VALUE OF DECILE	x	85,596	100,065	109,480	118,809	127,571	140,648	158,705	185,960	225,632	x
<b>GROSS MONEY EXPENDITURE, TOTAL</b>	143,055	77,898	97,068	108,260	116,373	128,077	137,974	161,218	179,007	220,360	297,204
Income tax	7,545	-96	1,873	2,122	3,115	4,361	6,130	9,051	13,259	19,083	28,839
Health and social insurance	11,556	4,508	6,838	5,907	6,713	8,353	10,667	13,509	17,544	23,073	29,495
<b>NET MONEY EXPENDITURE, TOTAL</b>	123,955	73,485	88,357	100,230	106,545	115,363	121,178	138,657	148,205	178,204	238,871
<i>by purpose:</i>											
A. Consumption expenditure	112,256	67,345	83,529	93,245	99,652	105,892	112,250	123,723	136,016	159,068	198,962
B. Non-consumption expenditure	11,698	6,140	4,829	6,985	6,892	9,471	8,928	14,934	12,189	19,136	39,909
<i>by type of expenditure:</i>											
Food, beverages, public catering	28,895	19,943	23,702	26,087	27,931	28,737	29,656	31,704	32,853	37,048	40,990
Other consumer goods	38,333	18,485	27,931	29,636	32,384	35,583	35,975	43,215	48,902	56,376	80,102
Services	41,127	25,211	29,159	34,322	35,547	38,369	41,442	46,105	49,467	57,567	75,611
Payments and other expenditure	15,600	9,847	7,565	10,186	10,682	12,674	14,105	17,633	16,983	27,213	42,167
<b>INCOME IN KIND</b>	7,200	6,288	6,448	6,209	6,479	7,182	7,247	8,183	7,055	8,487	9,931
<b>EXPENDITURE IN KIND</b>	6,244	1,769	2,939	4,694	5,528	9,000	5,803	6,415	7,467	10,009	14,356
<b>BALANCE ITEMS</b>											
Balance of deposits withdrawn and deposits made	-10,783	6,195	-1,700	-1,172	-5,458	-3,918	-9,267	-8,737	-23,574	-22,198	-62,950
Balance of loans received and credits repayed	-1,622	-1,394	-1,939	-2,309	-757	-2,758	-2,286	-1,082	703	-3,097	-1,468

SOURCE: CZECH STATISTICAL OFFICE

The HBS data are repeated cross section since the CZSO does not necessarily observe the same households every year. We have available HBS data from year 2006 to year 2009. Also we convert all consumption and income data into constant 2005 prices, using the CZSO CPI, see Table 6.2.

Table 6.2: CPI Basic Indices, (Year 2005=100).

Year	2006	2007	2008	2009
Annual average CPI	102.5	105.4	112.1	113.3

SOURCE: CZECH STATISTICAL OFFICE

## 6.2 Key Variables

For our analysis, following Gorodnichenko *et al.* (2009), the key variables are household consumption and household reported income. The expenditure items which are considered as non-durable items are aggregated into non-durable items (C1) which is the baseline measure of consumption. These items are: more than 50 items of food at home and away from home (restaurants, cafeterias, etc.), alcoholic and non-alcoholic beverages, tobacco, expenses on clothing and footwear, gasoline and other fuel expenses, rents and utilities, subcategories of services including transportation, communication, repair, education, entertainment, recreation, health care services, insurance, hobby, etc. The second consumption measure (C2) adds various contributions in money and in kind to individuals outside the household unit.<sup>4</sup> Even though, Gorodnichenko *et al.* (2009) admit that these kinds of expenditure are not typically considered as part of consumption because households may derive extra utility from altruistic motives by transferring resources to relatives. The third consumption measure (C3) adds more than 40 durable consumption items consisting of furniture, appliances, vehicles, entertainment equipment, etc. Gorodnichenko *et al.* (2009) also check the importance of borrowing for the consumption-income gap by calculating net savings as the difference between the net change in financial assets and the net change in liabilities.<sup>5</sup> Adding this net savings to the baseline measure of consumption (C1) Gorodnichenko *et al.* (2009) and we following their example get the fourth (alternative) measure of consumption C4.<sup>6</sup>

Gorodnichenko *et al.* (2009) use the combined income of all household members after taxes from all jobs and other regular sources as the total household

<sup>4</sup>Gorodnichenko *et al.* (2009) include alimonies but HBS does not offer this information.

<sup>5</sup>The net change in financial assets is computed as the difference between purchase and sales of stocks, bonds, and other securities, and between current cash savings and the amount of withdrawn savings. The net change in liabilities is calculated as the difference between the money borrowed and money lent (outside the household), and between the amount of money received from debtors and payments to creditors.

<sup>6</sup>This alternative measure of consumption is negative for 26 observations, which will be excluded from our analysis.

income. Therefore, we will use the net reported income calculated as the gross reported income less the income tax expenditures and mandatory health and social insurance. Following Gorodnichenko *et al.* (2009), the base income measure (Y1) is the combination of the labor and non-labor income. The labor income is reported as after-tax payments received by all household members from all places of work in the form of money, goods and services. The non-labor income includes pensions, rental income, sale of securities, stipends, unemployment benefits, child care benefits, and other social benefits.<sup>7</sup> Thus, income consisting of wage revenues, enterprise revenues, rental income, sale of securities, and in-kind income is used for Y1. The second income measure (Y2) adds irregular revenues such as lump sum payments from insurance, amounts received from the sales of material assets, subsidies and other incomes of social character, gifts from relatives, and other incomes.<sup>8</sup> The last, third, income measure (Y3) adds to Y1 income from selling household-grown (agricultural) products because households may, according to Gorodnichenko *et al.* (2009), derive supplementary income from household production.

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<sup>7</sup>Originally Gorodnichenko *et al.* (2009) use interests and dividends instead of sale of securities but because HBS does not offer these variables we use sale of securities.

<sup>8</sup>Gorodnichenko *et al.* (2009) add 11 subcategories of contributions from persons outside the household unit, including contributions from friends, charity, international organizations, etc. We do not have these specific data available; however, we assume that the ones we have mostly cover irregular revenues. Gorodnichenko *et al.* (2009) also claim that households do not have much of incentives to conceal private transfers, such as contribution from relatives, because this source of income is not taxed and thus adding these transfers should not affect tax evasion directly.

# Chapter 7

## Analysis of Tax Evasion

This chapter describes the Gorodnichenko *et al.* (2009) approach of analyzing tax evasion. The main theoretical hypothesis that Gorodnichenko *et al.* (2009) start with for the derivation of tax evasion function is the permanent income hypothesis (PIH) which says that permanent income is equal to consumption.<sup>1</sup> Consumption is the crucial information carrier giving away the income available to households. If, *ceteris paribus*, consumption deviates from reported income then there is a misreporting of the income. Therefore, the discrepancy between consumption and income provides certain information about the extent of household tax evasion.

Campbell & Mankiw (1990) reexamine the consistency of the PIH. They nest the PIH within a more general model in which a fraction (50%) of income accrues to individuals who consume their current income rather than their permanent income. Using aggregate postwar U.S. quarterly data they conclude that there is evidence against the implication of the PIH that changes in consumption are unforecastable. However, the forecastability of consumption can be explained by more general model proposed by Flavin (1981), which is not statistically rejected and in which a fraction of income goes to individuals who consume their current income rather than their permanent income. Hall (1978) claims that no variable apart from current consumption should be of any value in predicting future consumption. Hall (1978) also answers the question whether consumption can be predicted from disposable income. He, based on the evidence of the relation between consumption and lagged income, says that there is a statistically marginal and numerically small relation between consumption and very recent levels of disposable income and that there is no

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<sup>1</sup>Here, Gorodnichenko *et al.* (2009), by permanent income mean the present discounted value of lifetime income.

evidence which would support the view that a long distributed lag covering several years helps to predict consumption.

The general understanding of the difference between consumption and reported income is savings, however, Gorodnichenko *et al.* (2009) claim that the gap between the reported income and consumption cannot be referred as savings in Russia for two reasons. First, the majority of Russian households had negligible stocks of financial assets by the mid 1990s. Second, the saving rate computed as the difference between reported income and expenditures would imply large dissaving on average over ten years which they say is impossible to last for such long period. They conclude that the difference between reported income and consumption should not be used as a measure of savings. As for the Czech Republic we will show in the Section 7.3 that the same assumption can be safely made for Czech data.

Gorodnichenko *et al.* (2009) develop an econometric specification of the tax evasion function as follows. Household  $h$  at time  $t$  receives a true income  $Y_{ht}^*$ . Such household decides how much of its income to report and how much to evade. Therefore the reported income is a fraction of the true one:  $Y_{ht}^R = \Gamma_{ht} Y_{ht}^*$ , where  $\Gamma_{ht}$  is the fraction of true income reported. The fraction of true income reported  $\Gamma_{ht}$  is a function of observable characteristics  $S_{ht}$  which influence tax compliance and can include government policies, such as 2008 flat tax reform:  $\Gamma_{ht} = \Gamma(S_{ht}) = \exp(-\gamma S_{ht} + error)$ .

Gorodnichenko *et al.* (2009) assume that the true income  $Y_{ht}^*$  is related to permanent income  $Y_{ht}^P$  as  $Y_{ht}^* = H_{ht} Y_{ht}^P$ , where  $H_{ht} = H(X_{1,ht}) = \exp(\eta X_{1,ht} + error)$ .  $H_{ht}$  includes deviations of true income from permanent income due to life cycle factors  $X_{1,ht}$  such as age, schooling, employment participation, number of children, etc. and due to transitory shocks absorbed in the error term.

Another assumption made by Gorodnichenko *et al.* (2009) is about expenditures on non-durable goods. They assume that the consumption of non-durables is correctly reported as it is their preferred measure of consumption. We assume the same. The expenditure on non-durables  $C_{ht}$  is a fraction of permanent income:  $C_{ht} = \Theta_{ht} Y_{ht}^P$ .<sup>2</sup> The fraction  $\Theta$  can vary across households:  $\Theta_{ht} = \Theta(X_{2,ht}) = \exp(\theta X_{2,ht} + error)$ , where  $X_{2,ht}$  includes the number of

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<sup>2</sup>Gorodnichenko *et al.* (2009) consider the fraction of permanent income fixed if the consumption aggregator for durables and non-durables has a Cobb-Douglas form in the utility function. They assume constant unitary income elasticity of consumption because they consider the total consumption of non-durables goods. They also note that households have strong incentives to underreport consumption/ownership of durables because it is visible and

household members and number of children in order to account for economies of scale, and the number of elderly members, age, schooling, and marital status are included as taste shifters.

From the above mentioned Gorodnichenko *et al.* (2009) obtain three relationships:

$$\ln Y_{ht}^R - \ln Y_{ht}^* = -\gamma S_{ht} + error \quad (7.1)$$

$$\ln Y_{ht}^* - \ln Y_{ht}^P = \eta X_{1,ht} + error \quad (7.2)$$

$$\ln C_{ht} - \ln Y_{ht}^P = \theta X_{2,ht} + error \quad (7.3)$$

The true income  $Y_{ht}^*$  as well as the permanent income  $Y_{ht}^P$  are for obvious reasons not observable, however, combining equations (7.1), (7.2) and (7.3) Gorodnichenko *et al.* (2009) obtain the final specification as:

$$\ln C_{ht} - \ln Y_{ht}^R = \gamma S_{ht} + \beta X_{ht} + v_h + \varepsilon_{ht}, \quad (7.4)$$

where  $\gamma$  represents the effect of  $S_{ht}$  on tax evasion;  $X_{ht}$  is the union of  $X_{1,ht}$  and  $X_{2,ht}$  because vectors  $X_{1,ht}$  and  $X_{2,ht}$  are overlapping;  $v_h$  is a time-invariant component of the error term that accounts for risk aversion, preferences, and other constant household and local characteristics affecting consumption and/or income; and  $\varepsilon_{ht}$  is a random error term.<sup>3</sup>

The explanatory variables on the right-hand side of the (7.4) are two vectors of covariates  $S$  and  $X$ . The vector  $S$  accounts for individual variation and together with  $X$  account for individual variation in tax evasion due to age, schooling, tenure, marital status, type of job (enterprise versus self-employment), the firm size where the head of the household is employed, private versus public sector, number of household members, number of children, number of elderly members, and year dummy.<sup>4</sup>

Gorodnichenko *et al.* (2009) claims that violations of PIH are not likely to lead to any major distortions of their results in practice because (7.2) could be omitted from (7.4) in case that the assumption of PIH that households have the ability to borrow and lend to smooth consumption does not hold and

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indicative of true income. Therefore the total consumption based on durables would probably lead to overestimation of tax evasion.

<sup>3</sup>The interpretation of the coefficients in this equation is a percentage deviation of the consumption-income ratio from the steady state, since the consumption-income ratio should be equal to one and the log of this ratio is zero.

<sup>4</sup>Gorodnichenko *et al.* (2009) define vectors  $S$  and  $X$  in a way that factors such as age, schooling, and marital status are in both vectors therefore the estimates can not be attributed only to tax evasion.

individuals start using cash-on-hand as a determinant of consumption. In other words, the consumption-income gap function continues to be relevant proxy for tax evasion because constrained households should spend all available after-tax income on consumption.

## 7.1 Data Adjustment: Household Drop-Out

This section describes how the 2006-2009 HBS data set is adjusted to get the baseline dataset for the upcoming analysis. We believe that data for year 2009 could capture the true effect of the household's response to flat tax because taking households as backward-looking, households need time to get used to the flat tax implications.

Before we move to the adjustment steps themselves, the definition of household made by HBS must be presented. The household is a group of individuals who live and housekeep together. Joint housekeep means that individuals give their incomes, or its portion, into common usage from which they pay expenditures that are intended for satisfaction of needs of the whole household (rent, food) or expenditures of individuals, including needs of dependent children or other persons. Therefore, households have to fulfil certain conditions in order to remain in the sample.

The first adjustment step is to eliminate all households that were not in the HBS for the whole year. This is done so because the quality of final data is dependent on the quality of income and expenditure reports of individual households. These reports must include all incomes and all expenditures on behalf of all members of the household and are reported on a daily basis since reporting that is delayed by few days may result in high probability of mistakes and inaccuracy. Including households that do not stay in the HBS for the whole year would add noise to results. Therefore, households for which the number of months of reporting is less than twelve are dropped. This decreased the number of observations by 1,204 from the original number of 13,189 down to 11,985. Table 7.1 shows how many households are eliminated for each year.

The second adjustment step is to eliminate those households in which there is no economically active individual because these households are not relevant for the purpose of this paper. According to HBS an economically active individual is employed individual or unemployed individual who is actively searching for an occupation. Also an individual entitled to parental leave is not considered



as economically active individual.<sup>5</sup> Dropping households with economically inactive individuals brings the data set down by 2,502 observations to 9,483. Since households with economically active head of household include also unemployed head of household, also these households must be eliminated because such head of household receives support for an unemployment allowance from the state. This elimination decreases the data set by another 138 observations to 9,345.

The third adjustment step is done due to the way the HBS is structured. Thus, we do not follow Gorodnichenko *et al.* (2009) because they can separate information about income of different household members and define the head of household as a person with the largest one. HBS data does not allow us to separate each individual in household individually and determine how much each individual earning is. To be more precise we, from the data, do not know household members' income separately but different kinds of income, such as labor income, non-labor income etc., for the household as a whole. Knowing the household members' income separately will be crucial for defining treatment group in the following section. Therefore, since we do not know it, we eliminate all households where there is more than one economically active individual. This elimination decreases our data set to 4,512 observations, however it brings several pros. We are able to determine the labor income of this remaining economically active individual which, as already said, will be crucial for next analysis in the following section. By leaving only one economically active individual we solve the problem with joint taxation of married couples with children.<sup>6</sup> However, assuming that the average household is a married couple, where the married individuals are both economically active, we admit that this weakens our findings.

Previous adjustment leaves only one economically active individual in the household but Gorodnichenko *et al.* (2009) for their analysis use the head of household. Therefore, we eliminate households which head of household are not wage earners. Such elimination brings the data down to 4,018 observations.

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<sup>5</sup>Parental leave is subject to elimination from HBS any time this occurrence happens.

<sup>6</sup>The Czech Republic introduced a joint taxation of married couples with children in 2005. The Czech Republic abandoned joint taxation of spouses in 2008.

Table 7.1: Household Drop-Out

Year	2006	2007	2008	2009	Remaining observations
Original observations	3,377	3,334	3,271	3,207	13,189
Non-Reporting the whole year	294	301	328	281	11,985
Economically inactive individuals	649	632	604	617	9,483
Unemployed	30	36	31	41	9,345
More than one economically active individual in HH	1,263	1,221	1,179	1,170	4,512
Not wage earning head of HH	122	136	120	116	4,018
Observations	1,019	1,008	1,009	982	4,018

Note: HH denotes household.

## 7.2 Data Adjustment: Panles

Previous Section 7.1 described the necessary data adjustments of HBS data so that we can use them for treatment and comparison group identification as will be identified in Section 7.6. Although, before we move to the treatment and comparison group identification itself, we make one more data adjustment due to the econometric specification described in the next Section 7.5.

We create nine panels as it allows us to compare our key variables, consumption and reported income, for the same households before and after the tax reform which we need for our analysis.

Panels are combinations of years from pre and post reform period. The first panel, our base panel, is including all years 2006, 2007, 2008 and 2009. The second, third, fourth and fifth panels consist of years 2006, 2007 and 2008; 2006, 2007 and 2009; 2006, 2008 and 2009; and 2007, 2008 and 2009, respectively. The last four panels include only one year from pre reform and one year from post-reform period, thus the sixth, seventh, eighth and ninth panel include years 2006 and 2008; 2006 and 2009; 2007 and 2008; and 2007 and 2009, respectively.

We create nine separate panels because the HBS does not include the same household every year and thus having all nine panels has an effect of various number of observations (households) in each panel. We will use all nine panels for analysis that follows Gorodnichenko *et al.* (2009) although, we will prefer panels including years 2006 and 2009 to panels with years 2007 and 2008 only because households could have possibly anticipated the change of marginal tax rate and because households, as stated earlier, could be taken as backward-looking. Table 7.2 presents number of households for each panel. The advantages of having panel data compared to repeated cross-section data are that it allows us to create more realistic and more complex models, and it provides better identification. On the other hand there is a disadvantage of

having panel data because when we observe the same cross-section unit over time, then the assumption that each observation is independent is no more realistic. Another drawback of construction of these nine panels is that we drop all households which are in one year but not in another one.

Table 7.2: Number of Households in Panel

	P 6-7-8-9	P 6-7-8	P 6-7-9	P 6-8-9	P 7-8-9	P 6-8	P 6-9	P 7-8	P 7-9
Number of HH	228	384	232	230	301	388	238	538	306

Note: HH denotes household. P denotes Panel, 6 denotes year 2006, 7 denotes year 2007, 8 denotes year 2008, 9 denotes year 2009.

### 7.3 Savings

As mentioned at the beginning of this Chapter 7, the difference between reported income and consumption should not be used to measure savings. Computing the saving rate as the difference between households' net reported incomes and total consumptions over net reported income on our nine panels, the same way Gorodnichenko *et al.* (2009) do it, we get on average negative saving rates.<sup>7</sup> On the other hand, gross saving rate provided in HBS, calculated according to Gorodnichenko *et al.* (2009) as the sum of purchases of stocks, bonds, and other securities, current cash savings, and money lent over net reported income, show similar high and stable positive gross saving rates for all nine panels. Both rates, the saving rate calculated as the difference between households' net reported incomes and total consumptions over net reported income and the gross saving rate calculated as the gross saving over net reported income, are showed in Table 7.3. Therefore we conclude that the difference between reported income and consumption should not be used as a measure of savings.

Table 7.3: Saving Rate

	P 6-7-8-9	P 6-7-8	P 6-7-9	P 6-8-9	P 7-8-9	P 6-8	P 6-9	P 7-8	P 7-9
Saving rate	-4.99%	-5.63%	-4.99%	-4.07%	-3.71%	-5.13%	-3.66%	-5.10%	-3.23%
Gross saving rate	67.37%	65.33%	67.81%	68.00%	68.91%	64.75%	68.61%	67.20%	69.75%

Note: HH denotes household. P denotes Panel, 6 denotes year 2006, 7 denotes year 2007, 8 denotes year 2008, 9 denotes year 2009.

<sup>7</sup>Net reported income is the gross reported income less income taxes, mandatory insurance, and withdrawn savings and loans. Total consumption is based on COICOP classification of consumption: the sum of expenditures for food, alcohol, clothing, housing, household equipments, health, transport, communication, recreation, education, services such as restaurants and hotels, and other.

## 7.4 Consumption Income Empirics

In this section we look at the consumption ratio to see the effect of tax reform on income reporting under the hypothesis that the consumption ratio decreases after the Czech flat tax reform.<sup>8</sup> The hypothesis states that the consumption ratio decreases under the flat tax because households report more of their income and save more. Save more as it is one of the implications of the flat tax. Decreased consumption ratio assumes that, *ceteris paribus*, individuals report more of their income and therefore the tax evasion decreases.

Individuals adjust their consumption based on their true income, for the simplicity let us not consider borrowing and other income of similar character. Under the assumption that the true income does not change over the reform period, savings should increase in the post-reform period, as suggests one of the flat tax implications. Individuals also may report more of their true income in the post-reform period, which would mean that the consumption ratio would decrease. Also, individuals whom the tax rate decreases for pay less on taxes and become richer which can lead to higher consumption and increase or decrease of their consumption ratio depends on the size of reported income.

The pattern of consumption and gross income of households with one economically active individual from 2006-2009 based on the reported gross income (Y1), and consumption (C1) is presented in Table 7.4.<sup>9</sup>

Figure 7.1 is a graphical representation of consumption, consumption together with savings and income means over the period 2006-2009. The maximum mean of reported gross income and the maximum mean of consumption were for both in the year 2009. There was a slight drop in income in 2008. Possible explanation for this drop could be the world financial crisis. When adding savings mean to the consumption mean we see that there always is a consumption-income gap either with or without savings. The savings are increasing in post-reform period which is in line with the hypothesis that individuals save more under the flat tax policy.

The consumption ratios depicted in the same Figure 7.1 show a percentage decrease of about nearly three percentage points over the period 2006-2009. The consumption ratio of 74.9% was the highest in 2007 but rather decreasing over the period 2006-2009. This result is also in line with the hypothesis that the consumption-income ratio decreases under the flat tax. However, the mean

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<sup>8</sup>We use consumption-income ratio instead of consumption-income gap to be consistent with this hypothesis.

<sup>9</sup>We use the same panel as will be used in Section 7.7.1.

Table 7.4: Consumption, Gross Income and Savings: Summary Statistics (in 2005 Prices)

	2006	2007	2008	2009	Total
Consumption (C1)	161,513 (55,355)	166,999 (61,195)	167,592 (64,213)	171,273 (64,148)	166,844 (61,332)
Savings	8,973 (70,992)	-7,558 (170,378)	11,627 (122,444)	18,606 (78,810)	7,912 (117,749)
Income (Y1)	218,233 (87,182)	222,833 (88,060)	228,460 (100,893)	239,777 (110,904)	227,326 (97,428)
Consumption ratio	.740	.749	.733	.714	.733
Observations	228	228	228	228	912

Note: Consumption, Savings and Income measures are in 2005 prices.

Mean of each variable with standard deviation in parentheses.

of consumption is over the whole 2006-2009 period increasing. This could be the case for higher income individuals when becoming richer due to the decrease of marginal tax rate and their consumption increases, while their consumption ratio decreases.

Figure 7.1: Consumption and Gross Income Means 2006 - 2009 (in 2005 Prices)

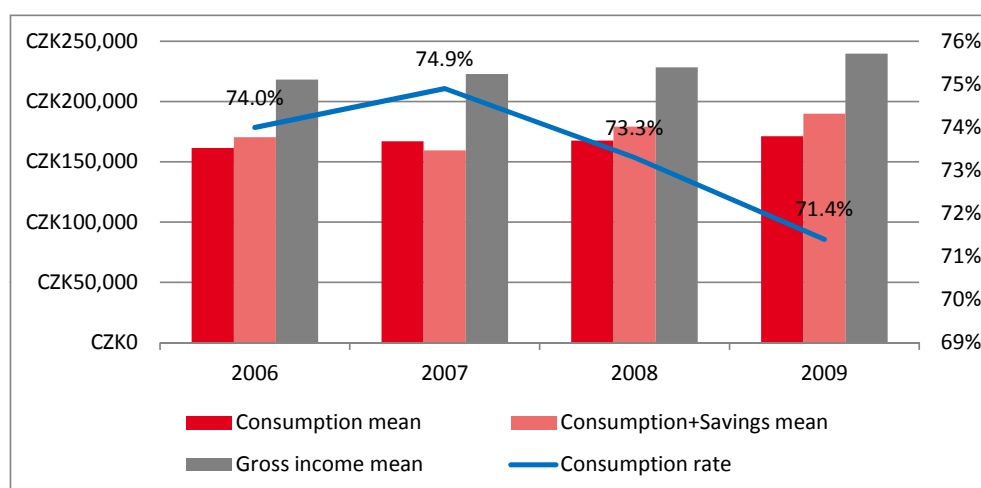


Table 7.5 presents summary statistics of consumption (C1), income (Y1) and consumption ratio for tax brackets for every year in the 2006-2009 period, taking the tax brackets from the pre-reform period 2006-2007 and apply them on the post-reform period 2008-2009. We sort households into brackets based

on labor income. We do all this to show equal trends assumptions behind upcoming econometric method called difference-in-difference in the next Section 7.5.

Results of consumption-income ratio for after-reform period for all brackets except for the second bracket show declining trend, which is again in line with the hypothesis that the consumption-income ratio decreases under the flat tax. Looking at the whole period 2006-2009 we see that the trend in consumption-income ratio is decreasing for all brackets. The consumption trend is over the whole period 2006-2009 increasing for the first, second and the third bracket but decreasing for the fourth one. As for the trend in income, we see that it is increasing for all four brackets. The largest number of observations is in the second bracket and the least number of observations is for the fourth bracket which is not surprising as there are more lower-income individuals than high income individuals in the population.

## 7.5 Econometric Specification

In this section we introduce the econometric method called difference-in-difference. Difference-in-difference method is widely used in studies called ‘natural experiments’ which examine outcome measures for observations in treatment groups and comparison groups that are not randomly assigned. A good natural experiment is according to Meyer (1994) a study in which there is a transparent exogenous source of variation in the explanatory variables that determine the assignment into treatment group. In other words natural experiments occur when some exogenous event changes the environment of treatment group but not of control group. Thus, the policy change in form of the flat tax adoption that the Czech Republic experienced in 2008 is a good example for the use of natural experiment approach because it allows us to obtain exogenous variation in the main explanatory variables.

Difference-in-difference method is a regression in which dependent variable of a treatment group, experiencing a tax change at some time period  $T$ , is compared to the same variable for a comparison group, not experiencing the same tax change. The method measures the average effect of change in tax policy on the treatment group by removing unobservable individual effects and common macro effects. The comparison group is according to Blundell & Dias (2002) difficult to choose due to the two assumptions needed for the method to be valid. The first assumption says that a common time effects must hold

Table 7.5: Tax Brackets: Summary Statistics (in 2005 Prices)

	2006	2007	2008	2009	Total
Tax bracket 1					
Consumption (C1)	129,110 (43,847)	126,326 (39,229)	134,388 (43,527)	136,038 (47,772)	131,991 (43,859)
Income (Y1)	167,118 (66,168)	168,089 (62,538)	170,744 (63,294)	186,726 (78,078)	174,310 (68,554)
Consumption ratio	0.772	0.751	0.787	0.728	0.733
Observations	35	33	39	48	155
Tax bracket 2					
Consumption (C1)	154,794 (49,200)	154,997 (54,151)	159,299 (54,702)	164,614 (55,986)	158,079 (53,306)
Income (Y1)	193,825 (51,623)	194,745 (54,402)	199,897 (64,192)	203,456 (66,864)	197,644 (58,979)
Consumption ratio	0.798	0.795	0.796	0.809	0.733
Observations	107	100	96	83	386
Tax bracket 3					
Consumption (C1)	171,199 (47,039)	183,150 (44,066)	172,604 (50,739)	181,548 (48,370)	177,336 (47,566)
Income (Y1)	239,678 (47,379)	244,740 (55,533)	238,242 (50,154)	254,824 (67,568)	244,473 (55,890)
Consumption ratio	0.714	0.748	0.724	0.712	0.733
Observations	71	79	70	73	293
Tax bracket 4					
Consumption (C1)	239,201 (75,568)	246,160 (106,203)	243,254 (99,790)	233,518 (101,591)	240,075 (95,853)
Income (Y1)	410,106 (168,359)	403,129 (156,158)	415,778 (161,175)	425,718 (176,846)	415,151 (163,517)
Consumption ratio	0.583	0.610	0.585	0.548	0.733
Observations	15	16	23	24	78

Note: Consumption and Income measures are in 2005 prices.

Mean of each variable with standard deviation in parentheses.

across the groups (treatment and comparison group) and the second says that there are no systematic composition changes within each group.

Gorodnichenko *et al.* (2009) use the difference-in-difference approach taking the higher tax brackets as a treatment group and lower tax brackets as a control

group. They estimate following specification:

$$\ln C_{ht} - \ln Y_{ht}^R = \gamma S_{ht} + \beta X_{ht} + \mu d_{ht}^{treat} + \alpha(d_{ht}^{treat} \times D_p) + \psi D_p + v_h + \varepsilon_{ht}, \quad (7.5)$$

where  $d_{ht}^{treat} = I(\tau_{ht} < \tau_{ht-1})$  is a dummy variable indicating if the head of the household is in the treatment group which experiences a decline in marginal tax rates; and  $D_p$  is a dummy variable for the post-reform period 2008-2009. Coefficient  $\mu$  captures the underlying difference between treatment and comparison group;  $\alpha$  captures the effect of the treatment; and  $\psi$  captures the underlying difference between the pre and post-reform period.

Taking the specification (7.5) we will make an attempt to describe the difference-in-difference estimator based on Blundell & Costa Dias (2008) who use panel data to describe difference-in-difference method since we will apply this method on our panel data. Inspired by Blundell & Costa Dias (2008) we get following expected conditional outcomes, where, for the simplicity, we substitute  $y_{ht} = \ln C_{ht} - \ln Y_{ht}^R$ .

$$E[y_{ht}|d_{ht}^{treat}, T] = \begin{cases} \gamma + \beta + E[\mu|d_{ht}^{treat} = 1] + E[\alpha|d_{ht}^{treat} = 1] + \psi, \\ \quad \text{if } d_{ht}^{treat} = 1 \text{ and } T = t \\ \gamma + \beta + E[\mu|d_{ht}^{treat}] + \psi, \\ \quad \text{otherwise.} \end{cases}$$

The difference-in-difference identification strategy of above mentioned expected outcomes is:

$$\begin{aligned} \alpha^{ATT} &= E[\alpha|d_{ht}^{treat} = 1] \\ &= \{E[y_{ht}|d_{ht}^{treat} = 1, T = t] - E[y_{ht}|d_{ht}^{treat} = 1, T = t - 1]\} \\ &\quad - \{E[y_{ht}|d_{ht}^{treat} = 0, T = t] - E[y_{ht}|d_{ht}^{treat} = 0, T = t - 1]\}, \quad (7.6) \end{aligned}$$

where ATT identifies the average effect on individuals that were assigned to treatment group.<sup>10</sup> The difference-in-difference estimator is sample analogy of (7.6) and is in the following form:

<sup>10</sup>Weakness of difference-in-difference is the differential macro trends which says that difference-in-difference does not consistently estimate the ATT if treatment and comparison groups do not experience the same macro shocks.



$$\hat{\alpha} = [\bar{y}_{ht_t}^1 - \bar{y}_{ht_{t-1}}^1] - [\bar{y}_{ht_t}^0 - \bar{y}_{ht_{t-1}}^0], \quad (7.7)$$

where  $\bar{y}_{ht_T}^{d^{treat}}$  is the average outcome over group  $d_{ht}^{treat}$  at time  $T$ , and the estimator is on average correct:  $E[\hat{\alpha}] = \alpha$ . The estimator is defined as the difference in average consumption-income gap in the treatment group before and after tax reform less the difference in average consumption-income gap in the control group before and after tax reform.

There are three assumptions for the difference-in-difference estimator to be unbiased. First, the model in equation is correctly specified. Second, the error term  $\varepsilon_{ht}$  is on average zero:  $E[\varepsilon_{ht}] = 0$ . The last, also known as the parallel-trend assumption, the correlation of error term with the other variables are zero:  $cov(\varepsilon_{ht}, d_{ht}^{treat}) = 0$ ,  $cov(\varepsilon_{ht}, D_p) = 0$ ,  $cov(\varepsilon_{ht}, d_{ht}^{treat} \times D_p) = 0$ .

Rewriting now the specification (7.5) into the full extent, one gets following specification which we estimate:

$$\begin{aligned} \ln C_{ht} - \ln Y_{ht}^R &= \varphi_1 \text{schooling}_{ht} + \varphi_2 \text{marital status}_{ht} + \varphi_3 \text{enterprise}_{ht} \\ &+ \varphi_4 \text{private sector}_{ht} + \varphi_5 \text{number of household members}_{ht} \\ &+ \varphi_6 \text{number of children}_{ht} + \varphi_7 \text{number of seniors}_{ht} \\ &+ \mu d_{ht}^{treat} + \alpha(d_{ht}^{treat} \times D_p) + \psi D_p + v_h + \varepsilon_{ht}, \end{aligned} \quad (7.8)$$

where *schooling* is the number of years of study; *marital status* is the marital status; *enterprise* is the type of job that individual works in; *private sector* is the sector where individual works; *number of household members* is the number of household members; *number of children* is the number of children; *number of seniors* is the number of elderly members;  $d_{ht}^{treat} = I(\tau_{ht} < \tau_{ht-1})$  is a dummy variable indicating if the head of the household is in the treatment group which experiences a decline in marginal tax rates; and  $D_p$  is a dummy variable for the post-reform period 2008 or 2009.

Variable *schooling* is adjusted for number of years of study because HBS gives only codes from 0 to 9 for the type of education - zero for no education, and nine for post-graduate. Therefore, number of years of study of the head of household is based on codes and the Czech school system. In particular, no education means zero years; the first level of elementary school means five years; the second level of elementary school means nine years; training schools without leaving certificate means twelve years; high schools with leaving cer-

tificate means thirteen years; extended study means fourteen years; higher vocation school means sixteen years; bachelor degree means sixteen as well; master's degree means eighteen years; and doctoral degree means twenty-two years of study. Variable *marital status* is a dummy variable with value 1 indicating whether the head of the household is married, and 0 otherwise. Variable *enterprise* is also dummy variable with value of 1 if the head of the household is an employee at enterprise and 0 otherwise. Variable *private sector* is a dummy variable as well and indicates whether the head of the household works in private sector either as an employee or as self-employed.

Specification (7.8) is different from the original one made by Gorodnichenko *et al.* (2009) because HBS data-set does not offer the firm size for the head of household and a trend variable for the after-reform period. We do not include variable *age* in our panels because we are not able to differentiate aging in trend in time and variable *tenure*, which means number of years the head of household has been staying with current employer, is not included because of nonavailability of the data.

## 7.6 Treatment and Comparison Groups

We follow Gorodnichenko *et al.* (2009) and define treatment and comparison groups based on post-reform reported income which they do due to concerns that the dummy variable  $d_{ht}^{treat}$  in equation (7.5) can be correlated with the error term  $\varepsilon_{ht}$  due to the correlation between the pre-reform marginal tax rates and pre-reform level of current income.<sup>11</sup>

As for the actual definition of treatment group Gorodnichenko *et al.* (2009) use the household heads' four year average of contractual earnings in the post-reform period to define treatment and comparison groups. They use contractual earnings because they have smaller transitory component than the earnings received last month.<sup>12</sup> The definition of contractual earnings as stated in Gorodnichenko *et al.* (2009) is the average monthly earnings after taxes over the last 12 months that the employee is supposed to receive regardless of whether or not it was paid on time. We also define the treatment group on the basis of post-reform earnings but earnings received for the whole year in the post-reform

<sup>11</sup>See Appendix A for explanation of sources of biases between using the pre-reform and post-reform reported income.

<sup>12</sup>Data which Gorodnichenko *et al.* (2009) use allows them to know monthly earnings of each head of household

period not as the monthly average because we can not identify from the HBS how much money the head of household earned each month.

Since the design of the Czech reform does not provide a clean comparison group by keeping the same marginal tax rate for the lowest tax brackets we calculated the net rate an individual pays if all forms of taxes are included for the post-reform period. In other words, using our base panel, we calculated the effective tax rate (ETR) in order to be able to sort households into treatment and comparison groups.

The effective tax rate is characterized by average tax rate, which is defined as the percentage ratio of tax liability and gross income:

$$\text{Effective tax rate (ETR)} = \frac{T + SI}{Y} \times 100\%, \quad (7.9)$$

where  $T$  is tax liability,  $SI$  is social insurance paid by employee and  $Y$  is the gross income out of which is  $T$  calculated. The tax liability is calculated in following steps:

- Gross income
- Supergross income (Gross income increased by 35% of gross income.)
- Tax liability (Supergross income multiplied by tax rate of 15%, deduct all applicable annual allowances such as CZK 24,840 for each taxpayer, CZK 24,840 for incomeless wife/husband, CZK 24,840 if the taxpayer is a pensioner, or CZK 10,680 for children, and add 12.5% of gross income for social and health insurance.)

The effective tax rates for years 2008 and 2009 are 18.3% and 18.2% respectively.<sup>13</sup> Looking at the personal income tax rate schedule for pre-reform period 2006-2007 in Table 4.1 we see that the second tax bracket was taxed with a rate of 19%. We will neglect the small difference between calculated effective tax rate for the post-reform period and marginal tax rate for the second tax bracket and take the upper threshold for the second tax bracket in year-period 2006-2007 as comparison group. Therefore, we define the treatment group as households whose heads, the economically active individual in our case, earned in post-reform period more than (gross) CZK 218,400 from labor income.<sup>14</sup> It means that we use the first and the second tax bracket as the comparison group.

<sup>13</sup>In 2008 there were 44 households with tax bonuses and 51 households in 2009.

<sup>14</sup>Labor income consists of wage and enterprise revenues.

The way HBS is structured, we are unable to classify who of the individuals in household have what revenue which has a limiting effect on our thesis of having one economically active individual in the household.

## 7.7 Estimates of the Tax Evasion Response

In the following sections we present results for our nine panels taking the panel with year 2006, 2007, 2008 and 2009 as the base panel. Before we move to results themselves we discuss the use of fixed-effects model.

Since we deal with panel data we can use either fixed effects-model (FE) (the individual effect  $v_h$  is fixed, correlated with explanatory variables) or random-effects model (RE) (the individual effect  $v_h$  is random variable, uncorrelated with explanatory variables). FE technique assumes that all household characteristics as well as cross-section specifics are captured in the intercepts which can not change across household or over time because it is fixed in time. While RE approach assumes random variation around the intercepts.

In order to decide which model to use, we run the Hausman specification test. Hausman specification test tests null hypothesis  $H_0$  that the difference in coefficients between FE and RE are not systematic which means that the disturbances are not correlated with explanatory variables. While coefficients of FE are consistent under  $H_0$  and also under  $H_a$  meaning that household specific effects are jointly zero  $v_h = 0$  (unbiased), and coefficients of RE are efficient under  $H_0$  and inconsistent under  $H_a$ .<sup>15</sup> Accepting null hypothesis we prefer RE to FE because RE estimate is more efficient than FE one and rejection of null hypothesis means that we should use FE estimates. There is always a tradeoff between robustness (FE) and efficiency (RE).

Table 7.6 presents p-values of Hausman specification test for all specifications presented. Since p-values are in most cases lower than 5% significance level, except for the consumption measure C4 in all cases (except for our base panel using all four years) and for three panels using years 2007, 2008 and 2009; and 2007 and 2009 for combination of consumption measures C1 and C2 combined with income measure Y2, we reject the null hypothesis and we, therefore, prefer fixed-effects model to random-effects model. Our test is thus consistent with Gorodnichenko *et al.* (2009) who also use fixed-effects model.

In our panel data we have multiple observations on the same household

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<sup>15</sup>FE controls for all time-invariant differences between households, so the estimated coefficients of FE cannot be biased because of omitted time-invariant characteristics.

Table 7.6: Results of Hausman Test (p-value)

	<i>P</i> 6-7-8-9	<i>P</i> 6-7-8	<i>P</i> 6-7-9	<i>P</i> 6-8-9	<i>P</i> 7-8-9	<i>P</i> 6-8	<i>P</i> 6-9	<i>P</i> 7-8	<i>P</i> 7-9
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
lnC1-lnY1	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
lnC2-lnY1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
lnC1-lnY2	0.00	0.00	0.00	0.00	0.09	0.02	0.01	0.03	0.16
lnC2-lnY2	0.00	0.00	0.00	0.00	0.08	0.01	0.00	0.04	0.16
lnC3-lnY1	0.00	0.01	0.00	0.00	0.06	0.00	0.03	0.00	0.06
lnC4-lnY1	0.00	0.51	0.12	0.99	0.40	0.42	–	0.54	0.47
lnC1-lnY3	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00

Note: HH denotes household. P denotes Panel, 6 denotes year 2006, 7 denotes year 2007, 8 denotes year 2008, 9 denotes year 2009. lnC4-lnY1 for panel P 6-9 model fitted on these data fails to meet the asymptotic assumptions of the Hausman test.

over pre and post-reform periods. We control for fixed unobservable attributes by including household fixed effects. Li & Prabhala (2007) says that fixed effect models are effective when time-invariant effects exist and are controlled for because the issue with using fixed effects to rule out unobservables is that the unobservables should be time invariant. Since Gorodnichenko *et al.* (2009) in his specification control for time-invariant effects we say that the presented experiment can be run.

### 7.7.1 Panel 2006-2007-2008-2009

Table 7.7 reports selected summary statistics describing treatment and comparison groups for 2006-2007-2008-2009 panel. Households in the treatment group consist of about 46% of all households and have fewer members, children and seniors than households in comparison group. The heads of households in treatment group are more educated, less likely to be married and work more often at enterprise or in private sector than those heads of households in comparison group. Our summary statistics of treatment and comparison group are almost the same to the ones made by Gorodnichenko *et al.* (2009), except for the fact that there are fewer members in our treatment group and is less likely to be married.

Table 7.7 also shows p-values of parametric Student's t-test difference of means to measure whether the means are statistically different between comparison and treatment group. We employ two-group mean comparison test to test the significance of the difference of means. We test the null hypothesis that there is no difference of means between comparison and treatment group,  $H_0 : \theta_1 - \theta_2 = 0$ , against the alternative hypothesis that there is,  $H_1 : \theta_1 - \theta_2 \neq 0$ . Our findings have the difference of variables *number of HH members* and *num-*

ber of children in HH insignificant. It is due to the adjustments of data we made because we dropped all observations from HBS where there were more than one economically active individual in the household so that we could assign the head of household into the treatment and comparison groups. Eliminating more than one economically active individual in the household affects the variable *number of children in HH* since married individuals are usually both economically active and married couples usually have children.

Table 7.8 reports the estimates with household fixed effects of the following specification:

$$\begin{aligned}
 \ln C_{ht} - \ln Y_{ht}^R &= \varphi_1 \text{schooling}_{ht} + \varphi_2 \text{marital status}_{ht} + \varphi_3 \text{enterprise}_{ht} \\
 &+ \varphi_4 \text{private sector}_{ht} + \varphi_5 \text{number of household members}_{ht} \\
 &+ \varphi_6 \text{number of children}_{ht} + \varphi_7 \text{number of seniors}_{ht} + \varphi_8 \text{year}_{ht} \\
 &+ \alpha(d_{ht}^{\text{treat}} \times D_p) + \psi D_p + v_h + \varepsilon_{ht}, \tag{7.10}
 \end{aligned}$$

which adds to (7.8) year dummy variable  $\text{year}_{ht}$  and drops  $d_{ht}^{\text{treat}}$  because when using the fixed effects estimator in the context of panel data models this regressor varies only across households and not over time for a given household. The fixed effect estimator is unable to provide a consistent estimate of  $\mu$  because there would be multicollinearity with the individual fixed effect.

We find a significant decline in the consumption-income gap for the treatment group for the consumption measure C1 after 2007. The estimate of  $\alpha$  is in the range between -0.058 and -0.041, suggesting that, *ceteris paribus*, income grew by approximately 4.1-5.8% more than consumption in our treatment group relative to comparison group. However, we do not find any significant changes in the consumption-income gap for the treatment group for the consumption measure C2 after 2007.

Gorodnichenko *et al.* (2009) suggest that the consumption-income gap should decline more for skilled workers than for unskilled ones after the reform because the skilled and high earning workers are compensated by private firms in Russia in ways that these workers reduce their wages reported for tax purposes. This ‘tax purpose reducing’ compensation is not as big after the reform, therefore Gorodnichenko *et al.* (2009) modify the baseline specification (7.5) with additional interaction terms such as private vs. public sector or blue collar workers vs. white collar workers, assuming that the consumption-income gap should decline less for unskilled workers than for skilled ones. Applying this suggestion to the Czech Republic and to our data we report results in Table

Table 7.7: Summary Statistics 2006-2007-2008-2009

	Comparison Group	Treatment Group	Total	p-value
C1	150,914 (53,618)	185,505 (64,518)	166,844 (61,332)	0.00 ***
C2	165,601 (61,179)	205,770 (73,523)	184,100 (70,034)	0.00 ***
C3	173,058 (69,371)	227,872 (101,875)	198,301 (90,080)	0.00 ***
C4	149,771 (94,459)	186,177 (191,002)	166,537 (148,047)	0.00 ***
Y1	192,320 (66,743)	268,333 (110,877)	227,326 (97,428)	0.00 ***
Y2	200,096 (69,682)	292,762 (140,743)	242,771 (117,743)	0.00 ***
Y3	192,321 (66,746)	268,395 (110,852)	227,355 (97,428)	0.00 ***
Number of HH members	1.819 (1.126)	1.710 (0.990)	1.769 (1.066)	0.12 -
Number of children in HH	0.472 (0.945)	0.447 (0.741)	0.460 (0.857)	0.66 -
Number of seniors in HH	0.242 (0.433)	0.121 (0.354)	0.186 (0.403)	0.00 ***
Years of schooling	12.63 (3.625)	14.30 (3.190)	13.40 (3.530)	0.00 ***
Married	0.280 (0.450)	0.181 (0.385)	0.235 (0.424)	0.00 ***
Works at enterprise	0.742 (0.438)	0.924 (0.266)	0.826 (0.380)	0.00 ***
Works in private sector	0.248 (0.432)	0.648 (0.478)	0.432 (0.496)	0.00 ***
Works in public sector	0.752 (0.432)	0.352 (0.478)	0.568 (0.496)	0.00 ***
Observations	492	420	912	

Note: All income and consumption measures are in 2005 prices. HH denotes household.

Mean of each variable with standard deviation in parentheses.

\*\*\*, \*\*, and \* denote significance at the 1%, 5%, and 10% levels

7.9. Our results show significant decline in the consumption-income gap for individuals working in private sector and for blue collar workers. Therefore,

Table 7.8: Tax Evasion Function: Difference-in-Difference Approach  
2006-2007-2008-2009, FE

	lnC1-lnY1	lnC2-lnY1	lnC1-lnY2	lnC2-lnY2
	(1)	(2)	(3)	(4)
Number of HH members	-.063 (.050)	-.068 (.052)	-.061 (.051)	-.066 (.052)
Number of children in HH	-.037 (.048)	-.076 (.049)	-.051 (.047)	-.090 (.047)*
Number of seniors in HH	-.154 (.126)	-.162 (.125)	-.162 (.121)	-.170 (.119)
Years of schooling	-.001 (.004)	-.001 (.004)	-.001 (.004)	-.002 (.004)
Married	-.149 (.083)*	-.140 (.079)*	-.160 (.080)**	-.150 (.077)*
Works at enterprise	.323 (.017)***	.320 (.016)***	.298 (.017)***	.295 (.016)***
Works in private sector	.050 (.039)	.087 (.039)**	.028 (.052)	.065 (.052)
Year = 2006	-.008 (.011)	-.010 (.012)	.003 (.014)	.000 (.015)
After reform dummy	.014 (.015)	.007 (.015)	.015 (.016)	.008 (.016)
Year = 2009	-.013 (.012)	-.013 (.013)	-.008 (.013)	-.008 (.013)
$d^{treat} \times D_p$	-.058 (.023)**	-.037 (.023)	-.041 (.024)*	-.019 (.023)
Obs.	912	912	912	912

Note: Robust standard errors in parentheses

\*\*\*, \*\*, and \* denote significance at the 1%, 5%, and 10% levels

Omitted categories are the public sector and years 2007 and 2008. All income and consumption measures are in 2005 prices. All specifications are estimated with household fixed effects (FE). HH denotes household. Treatment and control group are defined on the basis of post-reform earnings. C1=expenditures on non-durable goods, C2=C1+transfers, Y1=regular income, and Y2=Y1+irregular payments.

our results are consistent with theoretical prediction that the decline in the consumption-income gap is larger for private sector, but inconsistent with the theoretical prediction that the decline in the consumption-income gap is larger for the blue collar workers within the private sector.

Lastly, Gorodnichenko *et al.* (2009) in supplementary specification, extend their baseline estimates of the consumption-income gap dynamics by accounting for changes in expenditures on durables, savings and home production due to high volatility of durable purchases and net savings. They expect an increase in the consumption-income gap in treatment group if there is a growth of durable purchases and if there is a decline in home production. They expect a decline



Table 7.9: Treatment Effect in the Difference-in-Difference Approach  
2006-2007-2008-2009: Heterogeneous Response, FE

	lnC1-lnY1	lnC2-lnY1	lnC1-lnY2	lnC2-lnY2
	(1)	(2)	(3)	(4)
<i>Public vs. Private sector</i>				
$d^{treat} \times D_p$	-.023	-.010	.020	.032
<i>Public sector is omitted</i>	(.032)	(.033)	(.034)	(.034)
$d^{treat} \times D_p \times Private$	-.057	-.039	-.066	-.048
	(.027)**	(.027)	(.029)**	(.028)*
Obs.	912	912	912	912
<i>Blue collar vs. white collar</i>				
$d^{treat} \times D_p \times private$	-.055	-.035	-.067	-.047
<i>blue collar workers are omitted</i>	(.029)*	(.028)	(.031)**	(.030)
$d^{treat} \times D_p \times private \times white collar$	-.044	-.047	-.038	-.041
	(.055)	(.054)	(.054)	(.054)
Obs.	912	912	912	912

Note: Robust standard errors in parentheses

\*\*\*, \*\*, and \* denote significance at the 1%, 5%, and 10% levels

All income and consumption measures are in 2005 prices. Reported are the estimated coefficients on the interaction term between the treatment group and post-reform dummy using different measures of earnings. All specifications are estimated with household fixed effects (FE) and include the same variables as in equation (7.10). HH denotes household. Treatment and control group are defined on the basis of post-reform earnings. C1=expenditures on non-durable goods, C2=C1+transfers, Y1=regular income, and Y2=Y1+irregular payments.

in the consumption-income gap in treatment group if there is a decrease in net saving. They use alternative definition for purchases of durable goods (C3), net savings (C4), and income from home production (Y3) for this supplementary specification. Table 7.10 reports the estimates for these alternative measures of income and expenditures.

We find significant decreases in the consumption-income gap for the treatment group relative to comparison group for purchases of durable goods and for home production but insignificant for net savings.

### 7.7.2 Other Panels - $\alpha$ Estimates

Tables 7.11 and 7.12 show the estimates of  $\alpha$  from all remaining eight panels. The estimates of  $\alpha$  are for all eight panels and for the basic consumption measure C1 combined with regular income measure Y1 negative suggesting the decline in the consumption-income gap. The sign of estimates of  $\alpha$  vary for the remaining combinations of consumption and income measures. The estimates of  $\alpha$  are statistically significant in majority of cases for panels where there is year 2007 and 2009 in one panel either alone or with other years. Significance

Table 7.10: Tax Evasion Function with Alternative Measures of Income and Expenditures: Difference-in-Difference Approach 2006-2007-2008-2009, FE

	lnC3-lnY1 with Purchases of Durables	lnC4-lnY1 with Net Savings	lnC1-lnY3 with Home Production
	(1)	(2)	(3)
Number of HH members	-.073 (.049)	.077 (.065)	-.063 (.050)
Number of children in HH	-.053 (.049)	.106 (.052)**	-.036 (.048)
Number of seniors in HH	-.139 (.117)	-.006 (.048)	-.154 (.126)
Years of schooling	-.000 (.005)	-.002 (.005)	-.001 (.004)
Married	-.091 (.092)	-.168 (.220)	-.150 (.083)*
Works at enterprise	.343 (.020)***	.104 (.019)***	.323 (.017)***
Works in private sector	.005 (.048)	.063 (.054)	.050 (.039)
Year = 2006	-.013 (.014)	.018 (.024)	-.008 (.011)
After reform dummy	.009 (.016)	.024 (.020)	.014 (.015)
Year = 2009	-.021 (.014)	.007 (.018)	-.013 (.012)
$d^{treat} \times D_p$	-.066 (.028)**	.025 (.037)	-.058 (.023)**
Obs.	912	886	912

Note: Robust standard errors in parentheses

\*\*\*, \*\*, and \* denote significance at the 1%, 5%, and 10% levels

Omitted categories are the public sector and years 2007 and 2008. All income and consumption measures are in 2005 prices. All specifications are estimated with household fixed effects (FE). HH denotes household. Treatment and control group are defined on the basis of post-reform earnings. C1=expenditures on non-durable goods, C3=C1+purchases of durable goods, C4=C1+net savings, Y1=regular income, and Y3=Y1+income from selling home grown goods.

of the  $\alpha$  estimate at the 10% level is also for the panel with year 2006 and 2009 only for the basic consumption measure C1 combined with regular income measure Y1 and for purchases of durables and for alternative measures of purchases of durables and home production. The alternative measure of net savings shows a positive sign for all panels except for the last panel with years 2007 and 2009, however, all estimates of  $\alpha$  are insignificant.

The largest significant decline in the consumption-income gap for the treatment group after the tax reform is observed in panel consisting of years 2007 and 2009. The estimate of  $\alpha$ , including the alternative measures of income and expenditures, is in the range between -0.124 and -0.076, suggesting that, *ceteris paribus*, income grew by approximately 7.6-12.4% more than consumption. Be-

cause the largest estimates of  $\alpha$  is for the panel including year 2007 and 2009, we show the summary statistics, estimates of tax evasion function for this panel in the Appendix B. Other significant declines in the consumption-income gap for the treatment group after the tax reform are observed in panel including years 2006, 2007 and 2009 with the approximate growth of income by 4.3-10.4% more than consumption, then in panel including years 2007, 2008 and 2009 with the approximate growth of income by 4.7-8.7% more than consumption, and in panel including years 2006 and 2009, suggesting that the income grew by approximately 5.9-6.5% more than consumption, *ceteris paribus*.

The possible explanation why the estimates of  $\alpha$  are significant for panels including years 2007 and 2009 could be that individuals need time to adapt to new tax policy. There was a personal income tax change in 2006 and a tax reform in 2008 and we assume that households are backward-looking and therefore it took some time, a year, for them to get used to new tax policy. Thus we assume that years 2007 and 2009 capture the true effect of the household's response to tax policies, especially to flat tax reform from 2008 in year 2009.

## 7.8 Further Analysis

Previous Sections 7.7.1 and 7.7.2 showed difference-in-difference analysis with household fixed effects having comparison group as the first and the second tax bracket from the pre-reform period 2006-2007. One could argue that individuals in the first bracket should not be included in the comparison group because the marginal tax rate increased for them. Therefore, we run the same difference-in-difference analysis with household fixed effects as in previous sections but with the difference that the comparison group is consisted of households in which the economically active individual belongs to the second tax bracket in the pre-reform period. Thus, we define treatment group as in Section 7.6 and comparison group as household whose heads, the economically active individual, earned in post-reform period more than (gross) CZK 121,200 but less than CZK 218,400 from labor income.

Table 7.13 shows results of the difference-in-difference analysis with household fixed effects on our base panel having second tax bracket from pre-reform period as comparison group. We find a decreasing effect for all measures of consumptions and incomes and a significant decline in the consumption-income gap for the treatment group after 2007, except for the consumption measure C2 combined with income measure Y2. The estimate of  $\alpha$  is in the range between

Table 7.11: Tax Evasion Function: Difference-in-Difference Approach  
-  $\alpha$  Estimates, FE

	lnC1-lnY1	lnC2-lnY1	lnC1-lnY2	lnC2-lnY2
	(1)	(2)	(3)	(4)
P 6-7-8	-.026 (.018)	-.018 (.019)	-.009 (.021)	-.001 (.021)
Obs.	1,152	1,152	1,152	1,152
P 6-7-9	-.088 (.028)***	-.061 (.028)**	-.070 (.029)**	-.043 (.029)
Obs.	696	696	696	696
P 6-8-9	-.026 (.027)	-.003 (.027)	-.013 (.027)	.010 (.027)
Obs.	690	690	690	690
P 7-8-9	-.078 (.020)***	-.068 (.021)***	-.058 (.023)**	-.047 (.023)**
Obs.	903	903	903	903
P 6-8	-.007 (.022)	.003 (.022)	.002 (.025)	.012 (.025)
Obs.	776	776	776	776
P 6-9	-.059 (.032)*	-.027 (.033)	-.050 (.034)	-.018 (.034)
Obs.	476	476	476	476
P 7-8	-.022 (.016)	-.020 (.017)	.017 (.024)	.018 (.023)
Obs.	1,076	1,076	1,076	1,076
P 7-9	-.115 (.026)***	-.103 (.026)***	-.088 (.028)***	-.076 (.028)***
Obs.	612	612	612	612

Note: Robust standard errors in parentheses

\*\*\*, \*\*, and \* denote significance at the 1%, 5%, and 10% levels

All income and consumption measures are in 2005 prices. All specifications are estimated with household fixed effects (FE). Treatment and control group are defined on the basis of post-reform earnings. C1=expenditures on non-durable goods, C2=C1+transfers, Y1=regular income, and Y2=Y1+irregular payments. P denotes Panel, 6 denotes year 2006, 7 denotes year 2007, 8 denotes year 2008, 9 denotes year 2009.

-0.069 and -0.046, suggesting that, *ceteris paribus*, income grew by approximately 4.6-6.9% more than consumption in our treatment group relative to comparison group.

Comparing these results with results in Table 7.8 where we used first and second brackets as comparison, we find significant change in the consumption-income gap for the treatment group for the consumption measure C2 combined with income measure Y1 after 2007.

Table 7.14 shows the estimates of  $\alpha$  of the difference-in-difference analysis

Table 7.12: Tax Evasion Function with Alternative Measures of Income and Expenditures: Difference-in-Difference Approach -  $\alpha$  Estimates, FE

	lnC3-lnY1 with Purchases of Durables	lnC4-lnY1 with Net Savings	lnC1-lnY3 with Home Production
	(1)	(2)	(3)
P 6-7-8	-0.009 (.024)	.027 (.036)	-.026 (.018)
Obs.	1,152	1,119	1,152
P 6-7-9	-.104 (.034)***	.014 (.044)	-.088 (.028)***
Obs.	696	676	696
P 6-8-9	-.031 (.032)	.024 (.037)	-.027 (.027)
Obs.	690	674	690
P 7-8-9	-.087 (.026)***	.017 (.036)	-.078 (.020)***
Obs.	903	875	903
P 6-8	.016 (.027)	.010 (.037)	-.007 (.022)
Obs.	776	756	776
P 6-9	-.065 (.038)*	.012 (.044)	-.060 (.032)*
Obs.	476	466	476
P 7-8	-.015 (.022)	.011 (.039)	-.022 (.016)
Obs.	1,076	1,037	1,076
P 7-9	-.124 (.030)***	-.006 (.042)	-.116 (.026)***
Obs.	612	592	612

Note: Robust standard errors in parentheses

\*\*\*, \*\*, and \* denote significance at the 1%, 5%, and 10% levels

All income and consumption measures are in 2005 prices. All specifications are estimated with household fixed effects (FE). Treatment and control group are defined on the basis of post-reform earnings. C1=expenditures on non-durable goods, C3=C1+purchases of durable goods, C4=C1+net savings, Y1=regular income, and Y3=Y1+income from selling home grown goods. P denotes Panel, 6 denotes year 2006, 7 denotes year 2007, 8 denotes year 2008, 9 denotes year 2009.

with household fixed effects on our remaining eight panels having second tax bracket from pre-reform period as comparison group. These estimates of  $\alpha$  do not differ much from  $\alpha$  estimates in Table 7.11. The estimates of  $\alpha$  are for all eight panels and for the basic consumption measure C1 combined with regular income measure Y1 negative suggesting the decline in the consumption-income gap. The sign of estimates of  $\alpha$  vary for the remaining combinations of consumption and income measures. The estimates of  $\alpha$  are statistically

Table 7.13: Tax Evasion Function: Difference-in-Difference Approach  
2006-2007-2008-2009, FE, 2nd Tax Bracket as Comparison

	lnC1-lnY1	lnC2-lnY1	lnC1-lnY2	lnC2-lnY2
	(1)	(2)	(3)	(4)
Number of HH members	-.077 (.051)	-.082 (.053)	-.074 (.051)	-.079 (.053)
Number of children in HH	-.030 (.049)	-.069 (.051)	-.041 (.048)	-.081 (.049)*
Number of seniors in HH	-.141 (.131)	-.150 (.130)	-.150 (.127)	-.159 (.125)
Years of schooling	-.004 (.005)	-.004 (.005)	-.004 (.005)	-.004 (.005)
Married	-.094 (.075)	-.082 (.074)	-.110 (.072)	-.098 (.071)
Works in private sector	.054 (.045)	.092 (.044)**	.033 (.059)	.071 (.059)
Year = 2006	-.014 (.012)	-.016 (.013)	-.004 (.017)	-.006 (.017)
After reform dummy	.020 (.018)	.011 (.019)	.020 (.020)	.011 (.021)
Year = 2009	-.018 (.014)	-.017 (.015)	-.008 (.016)	-.007 (.016)
$d^{treat} \times D_p$	-.069 (.026)***	-.046 (.026)*	-.053 (.026)**	-.029 (.026)
Obs.	757	757	757	757

Note: Robust standard errors in parentheses

\*\*\*, \*\*, and \* denote significance at the 1%, 5%, and 10% levels

Omitted categories are the public sector, enterprise sector and years 2007 and 2008. All income and consumption measures are in 2005 prices. All specifications are estimated with household fixed effects (FE). HH denotes household. Treatment and control group are defined on the basis of post-reform earnings. C1=expenditures on non-durable goods, C2=C1+transfers, Y1=regular income, and Y2=Y1+irregular payments.

significant in majority of cases for panels where there is year 2007 and 2009 in one panel either alone or with other years, except for panel 2006-2008-2009.

The largest significant decline in the consumption-income gap for the treatment group after the tax reform is observed in panel consisting of years 2007 and 2009. The estimate of  $\alpha$  is in the range between -0.131 and -0.089, suggesting that, *ceteris paribus*, income grew by approximately 8.9-13.1% more than consumption.

Table 7.14: Tax Evasion Function: Difference-in-Difference Approach  
 -  $\alpha$  Estimates, FE, 2nd Tax Bracket as Comparison

	lnC1-lnY1	lnC2-lnY1	lnC1-lnY2	lnC2-lnY2
	(1)	(2)	(3)	(4)
P 6-7-8	-.026 (.020)	-.018 (.021)	-.007 (.023)	.000 (.023)
Obs.	967	967	967	967
P 6-7-9	-.107 (.032)***	-.077 (.032)**	-.095 (.034)***	-.065 (.034)*
Obs.	577	577	577	577
P 6-8-9	-.040 (.030)	-.013 (.031)	-.027 (.030)	-.000 (.031)
Obs.	568	568	568	568
P 7-8-9	-.091 (.023)***	-.082 (.024)***	-.064 (.025)**	-.054 (.026)**
Obs.	763	763	763	763
P 6-8	-.005 (.025)	.005 (.025)	.002 (.028)	.013 (.028)
Obs.	649	649	649	649
P 6-9	-.082 (.037)**	-.045 (.039)	-.080 (.040)**	-.043 (.041)
Obs.	391	391	391	391
P 7-8	-.024 (.017)	-.024 (.018)	.018 (.027)	.018 (.026)
Obs.	916	916	916	916
P 7-9	-.131 (.029)***	-.120 (.030)***	-.100 (.032)***	-.089 (.033)***
Obs.	515	515	515	515

Note: Robust standard errors in parentheses

\*\*\*, \*\*, and \* denote significance at the 1%, 5%, and 10% levels

All income and consumption measures are in 2005 prices. All specifications are estimated with household fixed effects (FE). Treatment and control group are defined on the basis of post-reform earnings. C1=expenditures on non-durable goods, C2=C1+transfers, Y1=regular income, and Y2=Y1+irregular payments. P denotes Panel, 6 denotes year 2006, 7 denotes year 2007, 8 denotes year 2008, 9 denotes year 2009.

## 7.9 Results Summary

This section summarizes results obtained from previous analyses.

In Section 7.1 we describe necessary adjustments of HBS data for analysis that is inspired by study of Gorodnichenko *et al.* (2009). We eliminated all households that: were not reporting for full 12 months; all households consisted of only unemployed individuals; all households where the head of household was not economically active; and where there were more than one economically active individuals in household. Last data adjustment was made because of

the way HBS is structured. We did so because it was crucial for us to identify households into treatment group for difference-in-difference method based on head of household's reported post-reform earnings received over the whole year, as described in Section 7.6.

Another adjustment we made, in order to construct panel data, was to drop all observations that were not in all years, for years that were included in the panel. We created nine panels which we used for finding the effect of flat tax on tax evasion. Our base panel includes years 2006, 2007, 2008 and 2009, the remaining eight panels are combinations of pre-reform period years (2006, 2007) with post-reform period years (2008, 2009). For the analysis, we include all nine panels because of the number of households in each one, having the most households in panel including years 2007 and 2008.

Summary statistics in Table 7.7 reports almost the same results for treatment and comparison groups as Gorodnichenko *et al.* (2009), except for the fact that there are fewer household members in the treatment group and that the individuals in the treatment group are less likely to be married. Possible explanation to it is the data adjustment which excludes all households where there is more than one economically active individual since the average household in the Czech Republic consists of married couple with children. The treatment group is defined as households whose head, the economically active individual, earned in post-reform period more than (gross) CZK 218,400 from labor income.

To examine the differences between comparison and treatment group we run the parametric Student's t-test difference of means and find that differences of variables *number of HH members* and *number of children in HH* are not statistically different. The explanation to it is again data adjustment which excludes all households where there is more than one economically active individual. We also checked the assumptions about equal trends in consumption and income behind difference-in-difference because what matters for difference-in-difference estimate to be consistent is that the trends are the same not the levels.

We employed difference-in-difference specification with household fixed-effects to find the effect in the consumption-income gap using various measures of consumption C1, C2, C3, and C4, in combination with various measures of reported income Y1, Y2, and Y3. Next, we run the same analysis with the difference that we define comparison group as those households who belong to the second tax bracket in the pre-reform period. It means those households whose head, the economically active individual, earned in post-reform period



more than (gross) CZK 121,200 but less than CZK 218,400 from labor income. These analysis use the same variables as previous ones but are performed only on the baseline combinations of consumption measures C1 and C2 with income measures Y1 and Y2.

We find that, *ceteris paribus*, it takes time for households to adapt to new tax policy because the consumption-income gap in post-reform period, for panels including year 2009, relative to pre-reform period show significant declines in the consumption-income gap while panels not including year 2009 show insignificant declines. Significant results suggest that the Czech Republic 2008 flat personal income tax reform has decreased the gap between reported household consumption and income for households with only one economically active individual that experienced a reduction in marginal tax rates after the tax reform relative to households experiencing no change by about 4 to 13 percent for various combinations of consumption and income measures and various panels.

# Chapter 8

## Conclusion

The contribution of this work is to measure the impact of the Czech Republic 2008 flat personal income tax rate on tax evasion. Tax evasion continues to be an issue in many countries. Moreover, tax evasion is not directly observable and thus hard to measure. Following Gorodnichenko *et al.* (2009), we use indirect technique to measure the dynamics of tax evasion. To do so, we use micro-level data on household income and consumption from the Household Budget Survey to estimate the effect of the tax reform on tax evasion because there is an argument that the flat tax reform helps to decrease tax evasion. These micro level data are used to form number of panels covering 2006 through 2009 period.

We employ the standard difference-in-difference regression estimation to separate the tax evasion effect of flat rate personal income tax reform from other factors. Treatment group is defined as a group of households experiencing significant decline/change in marginal personal income tax rate due to the reform and control group is defined as a group of household experiencing no significant change coming from the reform. Dependent variable is a gap between reported household consumption and income. The consumption-income gap estimates, our proxy for tax evasion, are obtained by using panel data that trace the consumptions and reported incomes of the same households before and after the 2008 tax reform.

We find that, *ceteris paribus*, the Czech Republic 2008 flat personal income tax reform has decreased the gap between reported household consumption and income for households with only one economically active individual that experienced a reduction in marginal tax rates after the tax reform relative to households experiencing no change and that it takes time for households to

adapt to new tax policy.

# Bibliography

- ALLINGHAM, M. G. & A. SANDMO (1972): "Income tax evasion: a theoretical analysis." *Journal of Public Economics* **1(3-4)**: pp. 323–338.
- ANDERSON, J. E. & L. CARASCIUC (1999): "Tax Evasion in a Transition Economy: Theory and Empirical Evidence from the Former Soviet Union Republic of Moldova." *Working paper*.
- BAYER, R.-C. & M. SUTTER (2009): "The excess burden of tax evasion—An experimental detection-concealment contest." *European Economic Review* **53(5)**: pp. 527–543.
- BLOOMQUIST, K. M. (2003): "Tax Evasion, Income Inequality and Opportunity Costs of Compliance." *Paper presented at the 96th annual conference of the national tax association*.
- BLUNDELL, R. & M. COSTA DIAS (2008): "Alternative Approaches to Evaluation in Empirical Microeconomics." *IZA Discussion Papers 3800*, Institute for the Study of Labor (IZA).
- BLUNDELL, R. & M. C. DIAS (2002): "Alternative approaches to evaluation in empirical microeconomics." *CeMMAP working papers CWP10/02*, Centre for Microdata Methods and Practice, Institute for Fiscal Studies.
- CAMPBELL, J. Y. & N. G. MANKIW (1990): "Permanent Income, Current Income, and Consumption." *Journal of Business & Economic Statistics* **8(3)**: pp. 265–79.
- CHRISTIAN, C. W. (1994): "Voluntary Compliance With the Individual Income Tax: Results from the 1988 TCMP Study." *The IRS Research Bulletin, 1993/1994, Publication 1500 (Rev. 9-94)*, Washington, D.C.: Internal Revenue Service,.

- CHRISTIE, E. & M. HOLZNER (2006): “What Explains Tax Evasion? An Empirical Assessment based on European Data.” *Working Papers 40*, The Vienna Institute for International Economic Studies.
- CLOTFELTER, C. T. (1983): “Tax Evasion and Tax Rates: An Analysis of Individual Returns.” *The Review of Economics and Statistics* **65(3)**: pp. 363–73.
- CORDES, J., R. EBEL, J. GRAVELLE, & U. INSTITUTE (2005): *Encyclopedia of taxation and tax policy*. Urban Institute Press.
- ENGEL, E. & J. HINES (2000): “Understanding Tax Evasion Dynamics.” *Econometric Society World Congress 2000 Contributed Papers 1117*, Econometric Society.
- FEENBERG, D. R. & J. M. POTERBA (1993): “Income Inequality and the Incomes of Very High-Income Taxpayers: Evidence from Tax Returns.” In “Tax Policy and the Economy, Volume 7,” NBER Chapters, pp. 145–177. National Bureau of Economic Research.
- FELD, L. P. & B. S. FREY (2006): “Tax Evasion in Switzerland: The Roles of Deterrence and Tax Morale.” *IEW - Working Papers 284*, Institute for Empirical Research in Economics - University of Zurich.
- FELDSTEIN, M. (1995): “The Effect of Marginal Tax Rates on Taxable Income: A Panel Study of the 1986 Tax Reform Act.” *Journal of Political Economy* **103(3)**: pp. 551–72.
- FLAVIN, M. A. (1981): “The Adjustment of Consumption to Changing Expectations about Future Income.” *Journal of Political Economy* **89(5)**: pp. 974–1009.
- GOOLSBEE, A. (2000): “What Happens When You Tax the Rich? Evidence from Executive Compensation.” *Journal of Political Economy* **108(2)**: pp. 352–378.
- GORODNICHENKO, Y., J. MARTINEZ-VAZQUEZ, & K. S. PETER (2008): “Myth and Reality of Flat Tax Reform: Micro Estimates of Tax Evasion Response and Welfare Effects in Russia.” *NBER Working Papers 13719*, National Bureau of Economic Research, Inc.

- GORODNICHENKO, Y., J. MARTINEZ-VAZQUEZ, & K. S. PETER (2009): "Myth and Reality of Flat Tax Reform: Micro Estimates of Tax Evasion Response and Welfare Effects in Russia." *Journal of Political Economy* **117(3)**: pp. 504–554.
- GRECU, A. (2004): *Flat Tax - The British Case*. Adam Smith Institute, London.
- HAGEMANN, R. P., B. R. JONES, & R. B. MONTADOR (1988): "Tax Reform in OECD Countries: motives, constraints and practice." *OECD Economic Studies 10*, OECD, Paris.
- HALL, R. E. (1978): "Stochastic Implications of the Life Cycle-Permanent Income Hypothesis: Theory and Evidence." *Journal of Political Economy* **86(6)**: pp. 971–87.
- HALL, R. E. & A. RABUSHKA (1995): *The Flat Tax*. Hoover Institution Press, Stanford, CA, 2 sub edition.
- HALL, R. E. & A. RABUSHKA (2007): *The Flat Tax*. Hoover Institution Press, Stanford, CA, updated revised edition.
- HALL, R. E., A. RABUSHKA, D. A. R. EISNER, & H. STEIN (1996): *Fairness and Efficiency in the Flat Tax*. AEI Press.
- HANOUSEK, J. & F. PALDA (2002a): "The Evolution of Tax Evasion in the Czech Republic: A Markov Chain Analysis." *Public economics*, EconWPA.
- HANOUSEK, J. & F. PALDA (2002b): "Why People Evade Taxes in the Czech and Slovak Republics: A Tale of Twins." *Public economics*, EconWPA.
- HANOUSEK, J. & F. PALDA (2008): "Tax Evasion Dynamics in the Czech Republic: First Evidence of an Evasional Kuznets Curve." *CERGE-EI Working Papers 360*, The Center for Economic Research and Graduate Education - Economic Institute, Prague.
- HINDRIKS, J. & G. D. MYLES (2006): *Intermediate Public Economics*, volume 1 of *MIT Press Books*. The MIT Press, Cambridge, MA.
- HUNTER, L. A. & S. J. ENTIN (2005): "A Framework for Tax Reform." *A publication of the institute for policy innovation center for tax analysis*, Institute for Policy Innovation, Lewisville, TX.

- JUNG, Y. H., A. SNOW, & G. A. TRANDEL (1994): "Tax evasion and the size of the underground economy." *Journal of Public Economics* **54(3)**: pp. 391–402.
- KIM, K., R. VARSANO, & M. KEEN (2006): "The Flat Tax(es): Principles and Evidence." *IMF Working Papers 06/218*, International Monetary Fund, Washington, D.C.
- LI, K. & N. PRABHALA (2007): *Self-selection models in corporate finance*, volume 1 of *Handbooks in Finance Series*. Elsevier/North-Holland, Handbooks in Finance Series.
- LINDSEY, L. B. (1987): "Individual taxpayer response to tax cuts: 1982-1984: With implications for the revenue maximizing tax rate." *Journal of Public Economics* **33(2)**: pp. 173–206.
- MEYER, B. D. (1994): "Natural and Quasi- Experiments in Economics." *NBER Technical Working Papers 0170*, National Bureau of Economic Research.
- SANDMO, A. (2005): "The Theory of Tax Evasion: A Retrospective View." *National Tax Journal* **58(4)**: pp. 643–664.
- SHLEIFER, A. & R. W. VISHNY (1993): "Corruption." *NBER Working Papers 4372*, National Bureau of Economic Research.
- SLEMROD, J. (2007): "Cheating Ourselves: The Economics of Tax Evasion." *Journal of Economic Perspectives* **21(1)**: pp. 25–48.
- TANZI, V. (1980): "The Underground Economy in the United States: Estimates and Implications." *Banca Nazionale del Lavoro Quarterly Review* (**135**).
- WATSON, H. (1985): "Tax evasion and labor markets." *Journal of Public Economics* **27(2)**: pp. 231–246.
- YITZHAKI, S. (1974): "Income tax evasion: A theoretical analysis." *Journal of Public Economics* **3(2)**: pp. 201–202.

# Appendix A

## Endogeneity in Pre-reform Reported Income

To show the endogeneity problem of using the pre-reform reported income to classify taxpayers into treatment and comparison group in the presence of tax evasion they re-write equation (7.5). By considering only two periods  $t - 1$  as before treatment and  $t$  as after treatment and dropping the subscript  $h$  to simplify exposition they come to the following equation:

$$\Delta \ln C_t - \Delta \ln Y_t^R = \gamma \Delta S_t + \beta \Delta X_t + \alpha I(\tau_t < \tau_{t-1}) + \Delta \varepsilon_t, \quad (\text{A.1})$$

where  $\tau_t$  is the flat tax rate in year  $t$  that is independent of income and  $\tau_{t-1}$  is the pre-reform marginal tax rate as a function of current income  $Y^*$ . Treatment group  $I(\cdot)$  includes households that experience a decline in the rate that they face, defined on the basis of their total after-reform income. One note to the rate that households face is that this rate is not the rate upon which households make decision to pay. The estimate of parameter  $\alpha$  should be negative, *ceteris paribus*, if the flat tax reform has reduced tax evasion.

Recalling that current income  $Y^*$  which consists of reported and hidden income is not observable, Gorodnichenko *et al.* (2008) by using the pre-reform reported income to identify treatment and comparison groups show why the pre-reform reported income is not appropriate to use. The difference between the pre-reform and post reform marginal tax rate as a function of pre-reform reported income is as follows:



$$\begin{aligned}
\tau_{t-1}(Y_{t-1}^R) - \tau_t(Y_{t-1}^R) &= \tau_{t-1}(Y_{t-1}^R) - \tau_t(Y_t^*) & (A.2) \\
&= \underbrace{[\tau_{t-1}(Y_t^*) - \tau_t(Y_t^*)]}_{\text{true treatment}} \\
&\quad - \underbrace{[\tau_{t-1}(Y_t^*) - \tau_{t-1}(Y_{t-1}^*)]}_{\text{productivity bias} \geq 0} - \underbrace{[\tau_{t-1}(Y_{t-1}^*) - \tau_{t-1}(Y_{t-1}^R)]}_{\text{tax evasion bias} \geq 0}. \\
&\hspace{15em} \underbrace{\hspace{10em}}_{\text{bias}(t-1)}
\end{aligned}$$

The first equality in equation (A.3) comes from the flat tax in the post-reform period. If the equality between the first difference,  $\tau_{t-1}(Y_{t-1}^R) - \tau_t(Y_{t-1}^R)$ , and the second difference,  $\tau_{t-1}(Y_{t-1}^R) - \tau_t(Y_t^*)$  holds, then the identification of treatment and comparison groups based on reported income is correct. However,  $\tau_{t-1}(Y_t^*) - \tau_{t-1}(Y_{t-1}^*) \geq 0$ , which means that the treatment group excludes wage earners that increase productivity and pass the threshold; and  $\tau_{t-1}(Y_{t-1}^*) - \tau_{t-1}(Y_{t-1}^R) \geq 0$  which means that the treatment group excludes households whose reported income is in the lower bracket while the current income is in the higher ones. Gorodnichenko *et al.* (2008) conclude that behavioral responses to tax changes affect the comparison group identification which results in an upward bias in the estimate of  $\alpha$ . Therefore, the effect of the flat tax reform on tax evasion would be hard to find.

Taking now the post-reform reported income to identify treatment and control groups Gorodnichenko *et al.* (2008) show that under the assumption that  $Y_t^R = Y_t^*$ , meaning that the post-reform income is truly reported, or that there is no tax evasion, the estimate of  $\alpha$  is unbiased. They claim that under the flat tax the identification of treatment and comparison groups is not affected by behavioral responses to tax changes, as it is in previous case, because all taxpayers face the same marginal tax rate. Therefore,

$$\begin{aligned}
\tau_{t-1}(Y_t^R) - \tau_t(Y_t^R) &= \tau_{t-1}(Y_t^R) - \tau_t(Y_t^*) \\
&= \underbrace{[\tau_{t-1}(Y_t^*) - \tau_t(Y_t^*)]}_{\text{true treatment}} - \underbrace{[\tau_{t-1}(Y_t^*) - \tau_{t-1}(Y_t^R)]}_{\text{bias}(t)=\text{tax evasion bias} \geq 0}. & (A.3)
\end{aligned}$$

One can also notice that the difference between  $\text{bias}(t-1)$  in equation (A.2) and  $\text{bias}(t)$  in equation (A.3) is  $\tau_{t-1}(Y_t^R) - \tau_{t-1}(Y_{t-1}^R)$ . From this difference, under the assumption that post-reform reported income would not change or increases due to better compliance, the pre-reform income tax scale implies

that  $\tau_{t-1}(Y_t^R) \geq \tau_{t-1}(Y_{t-1}^R)$ , and from that  $bias(t-1) \geq bias(t)$ . Gorodnichenko *et al.* (2009) conclude that using the post-reform income decreases the overall bias in treatment group definition. They also claim that in the post-reform period, there should be fewer people whose reported and current income fall in opposite sides from thresholds because of no incentives of households to fall just below the threshold.

# Appendix B

## Panel 2007-2009

Estimates of the tax evasion response for panel 2006-2009.

The summary statistics describing treatment and comparison groups in panel 2006-2009, showed in the Table B.1, are the same as in Table 7.7, except that households in the treatment group have slightly more children. P-values of parametric Student's t-test difference of means show as in our base panel insignificant difference of variables *number of HH members* and *number of children in HH*.

Reported estimates with household fixed effects in Table 7.8 suggest that, *ceteris paribus*, income grew by approximately 7.6-11.5% more than consumption in our treatment group relative to comparison group (for all consumption and income measures).

Results for heterogeneous response, in Table B.3, show significant decline in the consumption-income gap for individuals working in private but also in public sector and for blue collar workers suggesting that the consumption-income gap decline less for skilled workers than for unskilled ones. This result is inconsistent with result presented by Gorodnichenko *et al.* (2009).

Table B.4 reports significant supplementary estimates of the consumption-income gap for alternative measures with purchases of durables and with home productions but insignificant for measures with net savings. This finding is in line with results from our base panel.

Table B.5 shows estimates with household fixed effect taking the second tax bracket from pre-reform period as comparison group. We find a significant decline in the consumption-income gap for the treatment group suggesting that, *ceteris paribus*, income grew by approximately 8.9-13.1% more than consumption in our treatment group relative to comparison group.

Table B.1: Summary Statistics 2006-2009

	Comparison Group	Treatment Group	Total	p-value
C1	153,567 (54,963)	191,018 (62,653)	170,701 (61,463)	0.00 ***
C2	168,607 (64,531)	212,387 (73,105)	188,637 (71,922)	0.00 ***
C3	177,632 (71,808)	236,980 (105,037)	204,785 (93,311)	0.00 ***
C4	155,397 (118,559)	181,495 (214,180)	167,337 (169,503)	0.05 *
Y1	196,022 (67,317)	281,314 (109,658)	235,044 (98,764)	0.00 ***
Y2	211,705 (105,706)	305,346 (137,118)	254,547 (129,686)	0.00 ***
Y3	196,054 (67,329)	281,401 (109,640)	235,101 (98,771)	0.00 ***
Number of HH members	1.886 (1.126)	1.836 (1.133)	1.863 (1.129)	0.58 -
Number of children in HH	0.535 (0.940)	0.547 (0.826)	0.541 (0.889)	0.86 -
Number of seniors in HH	0.229 (0.435)	0.0964 (0.319)	0.168 (0.392)	0.00 ***
Years of schooling	12.48 (3.329)	14.28 (3.202)	13.31 (3.390)	0.00 ***
Married	0.286 (0.453)	0.207 (0.406)	0.250 (0.433)	0.02 **
Works at enterprise	0.765 (0.425)	0.907 (0.291)	0.830 (0.376)	0.00 ***
Works in private sector	0.259 (0.439)	0.604 (0.490)	0.417 (0.493)	0.00 ***
Works in public sector	0.741 (0.439)	0.396 (0.490)	0.583 (0.493)	0.00 ***
Observations	332	280	612	

Note: All income and consumption measures are in 2005 prices. HH denotes household.

Mean of each variable with standard deviation in parentheses.

\*\*\*, \*\*, and \* denote significance at the 1%, 5%, and 10% levels

Table B.2: Tax Evasion Function: Difference-in-Difference Approach  
2006-2009, FE

	lnC1-lnY1	lnC2-lnY1	lnC1-lnY2	lnC2-lnY2
	(1)	(2)	(3)	(4)
Number of HH members	-.083 (.093)	-.088 (.089)	-.066 (.091)	-.071 (.087)
Number of children in HH	.053 (.095)	.040 (.089)	.011 (.093)	-.002 (.089)
Number of seniors in HH	-.120 (.159)	-.119 (.156)	-.116 (.159)	-.115 (.155)
Years of schooling	-.001 (.004)	-.003 (.004)	-.007 (.005)	-.008 (.005)
Married	-.065 (.095)	-.095 (.090)	-.110 (.083)	-.140 (.078)*
Works at enterprise	.297 (.225)	.293 (.219)	.097 (.094)	.093 (.088)
Works in private sector	.017 (.049)	.035 (.055)	.020 (.062)	.038 (.064)
After reform dummy	.036 (.017)**	.030 (.017)*	.029 (.020)	.023 (.020)
$d^{treat} \times D_p$	-.115 (.026)***	-.103 (.026)***	-.088 (.028)***	-.076 (.028)***
Obs.	612	612	612	612

Note: Robust standard errors in parentheses

\*\*\*, \*\*, and \* denote significance at the 1%, 5%, and 10% levels

Omitted categories are the public sector and year 2007. All income and consumption measures are in 2005 prices. All specifications are estimated with household fixed effects (FE). HH denotes household. Treatment and control group are defined on the basis of post-reform earnings. C1=expenditures on non-durable goods, C2=C1+transfers, Y1=regular income, and Y2=Y1+irregular payments.

Table B.3: Treatment Effect in the Difference-in-Difference Approach  
2006-2009: Heterogeneous Response, FE

	lnC1-lnY1	lnC2-lnY1	lnC1-lnY2	lnC2-lnY2
	(1)	(2)	(3)	(4)
<i>Public vs. Private sector</i>				
$d^{treat} \times D_p$	-.063	-.062	-.036	-.034
<i>Public sector is omitted</i>	(.031)**	(.032)*	(.031)	(.031)
$d^{treat} \times D_p \times Private$	-.101	-.086	-.088	-.074
	(.030)***	(.029)***	(.035)**	(.035)**
Obs.	612	612	612	612
<i>Blue collar vs. white collar</i>				
$d^{treat} \times D_p \times private$	-.109	-.096	-.097	-.083
<i>blue collar workers are omitted</i>	(.031)***	(.031)***	(.038)**	(.038)**
$d^{treat} \times D_p \times private \times white\ collar$	-.025	-.006	-.012	.007
	(.068)	(.062)	(.062)	(.056)
Obs.	612	612	612	612

Note: Robust standard errors in parentheses

\*\*\*, \*\*, and \* denote significance at the 1%, 5%, and 10% levels

All income and consumption measures are in 2005 prices. Reported are the estimated coefficients on the interaction term between the treatment group and post-reform dummy using different measures of earnings. All specifications are estimated with household fixed effects (FE) and include the same variables as in equation (7.10). HH denotes household. Treatment and control group are defined on the basis of post-reform earnings. C1=expenditures on non-durable goods, C2=C1+transfers, Y1=regular income, and Y2=Y1+irregular payments.

Table B.4: Tax Evasion Function with Alternative Measures of Income and Expenditures: Difference-in-Difference Approach 2006-2009, FE

	lnC3-lnY1 with Purchases of Durables	lnC4-lnY1 with Net Savings	lnC1-lnY3 with Home Production
	(1)	(2)	(3)
Number of HH members	-.065 (.086)	-.018 (.063)	-.084 (.093)
Number of children in HH	.018 (.090)	.160 (.072)**	.052 (.094)
Number of seniors in HH	-.155 (.141)	.077 (.025)***	-.120 (.159)
Years of schooling	-.002 (.005)	.001 (.006)	-.001 (.004)
Married	-.052 (.093)	.082 (.078)	-.065 (.095)
Works at enterprise	.280 (.221)	.013 (.137)	.297 (.225)
Works in private sector	-.024 (.060)	.144 (.070)**	.017 (.049)
After reform dummy	.017 (.017)	.053 (.022)**	.036 (.017)**
$d^{treat} \times D_p$	-.124 (.030)***	-.006 (.042)	-.116 (.026)***
Obs.	612	592	612

Note: Robust standard errors in parentheses

\*\*\*, \*\*, and \* denote significance at the 1%, 5%, and 10% levels

Omitted categories are the public sector and year 2007. All income and consumption measures are in 2005 prices. All specifications are estimated with household fixed effects (FE). HH denotes household. Treatment and control group are defined on the basis of post-reform earnings. C1=expenditures on non-durable goods, C3=C1+purchases of durable goods, C4=C1+net savings, Y1=regular income, and Y3=Y1+income from selling home grown goods.

Table B.5: Tax Evasion Function: Difference-in-Difference Approach  
2006-2009, 2nd Tax Bracket as Comparison, FE

	lnC1-lnY1	lnC2-lnY1	lnC1-lnY2	lnC2-lnY2
	(1)	(2)	(3)	(4)
Number of HH members	-.078 (.097)	-.082 (.092)	-.062 (.096)	-.066 (.091)
Number of children in HH	.072 (.099)	.058 (.093)	.032 (.099)	.018 (.095)
Number of seniors in HH	-.124 (.163)	-.124 (.160)	-.115 (.163)	-.115 (.160)
Years of schooling	-.004 (.005)	-.005 (.005)	-.010 (.006)	-.011 (.006)*
Married	-.033 (.093)	-.063 (.093)	-.084 (.076)	-.113 (.078)
Works in private sector	.064 (.054)	.089 (.059)	.041 (.079)	.066 (.081)
After reform dummy	.049 (.022)**	.045 (.023)*	.036 (.027)	.032 (.028)
$d^{treat} \times D_p$	-.131 (.029)***	-.120 (.030)***	-.100 (.032)***	-.089 (.033)***
Obs.	515	515	515	515

Note: Robust standard errors in parentheses

\*\*\*, \*\*, and \* denote significance at the 1%, 5%, and 10% levels

Omitted categories are the public sector, enterprise and year 2007. All income and consumption measures are in 2005 prices. All specifications are estimated with household fixed effects (FE). HH denotes household. Treatment and control group are defined on the basis of post-reform earnings. C1=expenditures on non-durable goods, C2=C1+transfers, Y1=regular income, and Y2=Y1+irregular payments.