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# *Myth and Reality of Flat Tax Reform: Micro Estimates of Tax Evasion Response and Welfare Effects in Russia*

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**Abstract**

Using micro-level data, we examine the effects of Russia's 2001 flat rate income tax reform on consumption, income, and tax evasion. We use the gap between household expenditures and reported earnings as a proxy for tax evasion with data from a household panel for 1998-2004. Utilizing difference-in-difference and regression-discontinuity-type approaches, we find that large and significant changes in tax evasion following the flat tax reform are associated with changes in voluntary compliance and cannot be explained by changes in tax enforcement policies. We also find the productivity response of taxpayers to the flat tax reform is small relative to the tax evasion response. Finally, we develop a feasible framework to assess the deadweight loss from personal income tax in the presence of tax evasion based on the consumption response to tax changes. We show that because of the strong tax evasion response the efficiency gain from the Russian flat tax reform is at least 30% smaller than the gain implied by conventional approaches.

**Keywords:** tax evasion, consumption-income gap, personal income tax, flat tax, difference-in-difference, regression discontinuity, deadweight loss, transition, Russia.

*JEL Classification Codes:* D73, H24, H36, J3, O1, P2

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## 1. Introduction

Tax evasion is a pervasive worldwide phenomenon. It is widely believed that high personal income tax rates are partially responsible for high levels of tax evasion everywhere, especially in emerging markets. High personal income tax rates are also often associated with negative effects on the real side of the economy. This paper is a general exploration of the relationship between income tax rates and the level of evasion and work effort based on Russia's recent experience with tax reform.

In January 2001, Russia introduced a fairly dramatic reform of its personal income tax when it became the first large economy to adopt a flat tax. The Tax Code of 2001 replaced the conventional progressive rate structure with a flat tax rate of 13 percent.[2] Over the next year, while the Russian economy grew at almost 5 percent in real terms revenues from the personal income tax increased by over 25 percent in real terms (Table 1). Despite the fact that economic theory does not precisely predict the effect of reduced tax rates on the degree of tax evasion,[3] advocates of the flat tax largely credit Russia's flat tax reform with this dramatic turn in revenue performance. Advocates also credit the flat tax with beneficial changes in the real side of the economy. More recently, several other Eastern European countries (Serbia, Ukraine, Georgia, Romania, Slovakia, and Macedonia) have adopted flat rate income tax reforms. At the latest count, more than 20 countries have implemented or are about to implement the flat rate income tax (Sabirianova Peter et al. 2007) so that the Russian flat tax reform had global consequences. Although after-reform data are not yet fully available for these countries, in some cases (for example, Slovakia) flat tax reform is again being credited with

[2] Estonia, first, and then Latvia and Lithuania had introduced flat rate personal income taxes during the early 1990s.
[3] For a discussion, see Andreoni, Erard and Feinstein (1998) and Alm (1999).

significant revenue turnarounds and the stimulation of economic activity. Several OECD countries are now considering the adoption of flat tax reforms in the near future.[4]

Russia's flat tax reform was quite revolutionary because it involved a large country and because it affected many people, not only the rich. But beyond the excitement Russia's flat tax reform has created, so far very little solid evidence has been provided on its impact on tax evasion or the real side of the economy. As shown in Table 1, after a period with negative real growth and high inflation rates that culminated with the financial crisis of 1998, the Russian economy started a period of solid economic growth and more stable prices in 1999. By the time the flat rate of income tax was introduced in the Tax Code of 2001, real GDP had grown by 9 percent in 2000 and 5 percent in 2001. At the same time, in the most striking performance, real collections from the personal income tax grew at close to 26 percent in 2001, the year of the reform, and continued to grow by 21 percent in 2002 and almost 12 percent in 2003; in posterior years the growth rate declined significantly. This burst in collection performance for the new personal income tax can potentially be explained by the better performance of the real economy, by improved voluntary compliance from taxpayers, and/or by stricter enforcement of the tax system via higher penalties and enforcement efforts by the tax authorities. Although real income grew during 2001 and the years after, the figures in Table 1 suggest that something else should have been behind the increase in real income tax collections. An explanation based on higher penalties for tax evasion is even less plausible. A significant feature of the new Russian Tax Code of 2001 was that it

[4] See Owens (2007). Several policy makers praised the Russian flat tax reform. For example, during a state visit of Russia's President Putin to the U.S. in 2001, President George W. Bush said, "I am impressed by the fact that [Putin] has instituted tax reform -- a flat tax. And as he pointed out to me, it is one of the lowest tax rates in Europe. He and I share something in common: We both proudly stand here as tax reformers."

generally reduced the draconian tax penalties that had been in force during the 1990s.[5] Therefore, it would seem worthy to investigate the potential roles of voluntary compliance and better administration enforcement. Some recent papers (Ivanova, Keen, and Klemm 2005 and Gaddy and Gale 2005) conclude that the large increase in income tax revenues contemporaneous with the Russia's flat tax reform can be explained by better enforcement of the tax laws, not by changes in tax compliance. The difficulty with the conclusions in those studies is that they do not measure changes in tax evasion and that the confounding effects of improved voluntary compliance and improved enforcement on tax evasion are never separated and identified.

Measuring the level of tax evasion is notoriously difficult, requiring programs of random intensive taxpayer audits such as the Taxpayer Compliance Measurement Program (TCMP) conducted by the U.S. Internal Revenue Service (Slemrod 2007). Most countries, including Russia, have not carried out this type of program. In this paper, we develop a framework to estimate the extent of tax evasion before and after the tax reform using micro-level data on income and household spending. Specifically, we estimate the gap between annual household expenditures and reported earnings as a proxy for tax evasion. Controlling for time-invariant unobservable household characteristics, we show to what extent tax evasion is associated with worker and job characteristics and policy changes. Our main finding is that the most significant reduction in tax evasion was for taxpayers that experienced the largest decrease in tax rates after the flat rate income tax was introduced. We also explore whether the decline in tax evasion in Russia following the flat tax rate reform was due to a greater enforcement effort by the tax administration authorities or to a change in voluntary compliance. We find that the significant changes in tax evasion following the adoption of the flat tax cannot be explained by concurrent

[5] See Martinez-Vazquez, Rider, and Wallace (2007).

changes in tax enforcement policies. In addition to estimating the extent of tax evasion, we also assess the effect of the tax reform on productivity and find it to be positive but small relative to the tax evasion effect.

These findings are important for social welfare calculations because, as Chetty (2007) argues, welfare gains from tax cuts can depend on the ability of taxpayers to evade taxes, and one has to separate the productivity (labor) response from the evasion response to correctly compute deadweight losses from taxes. If the cost of tax evasion is mainly in being caught and fined rather than in the real cost of hiding incomes, the deadweight loss from income tax could be much smaller than implied by a typically large elasticity of (taxable) income with respect to the tax rate. If the evasion response dominates the productivity response as in the Russian case, the efficiency gain from the tax reform would be smaller than implied by the income response. We develop a novel framework to assess the deadweight loss from personal income tax in the presence of tax evasion. The framework, which utilizes both consumption and income responses to tax changes, accommodates both real (resource) and penalty costs of tax evasion. Using this framework, we show that adjustments for tax evasion can significantly alter the magnitude of deadweight losses from personal income taxes and corresponding welfare gains from the tax reform. We estimate that deadweight losses adjusted for tax evasion are at least 30% smaller than deadweight losses based on conventional approaches which utilize only income response to tax changes.

Our approach in this paper, based on the differences between reported consumption and reported income, has not been previously used in the tax evasion literature; however, several other studies have used data on income or expenditure composition to study tax evasion. This previous research typically uses a group of taxpayers who are known to comply (e.g., employees subject to withholding) as a

benchmark to assess the true income for a group of taxpayers in question (e.g., self-employed).[6] Given this dichotomy of tax compliers and non-compliers, one can use the discrepancy between the two groups to approximate the level of tax evasion. Thus, for example, Pissarides and Weber (1989) exploit differences in food consumption, Lyssiotou, Pashardes, and Stengos (2004)[7] look at differences in the composition of consumption, and Feldman and Slemrod (2007) examine differences in charitable contributions to impute income hidden from taxes. For Russia we cannot use this approach as tax evasion has been widespread with employees quite likely practicing as much tax evasion as other groups of taxpayers.[8] There has often been an explicit or implicit agreement between employers and employees to conceal a part of wages to reduce the tax burden. The models of tax evasion have included employees receiving compensation in the form of envelopes with cash, purchase of life insurance policies and other fringe benefits, interest from bank deposits made by the employer, not reporting income from a second job, failure to consolidate incomes from different sources, and so on.

Our approach based on the differences between reported consumption and reported income before and after the tax reform allows us to use temporal variation to provide a lower bound on the degree of tax evasion. As a lower flat income tax reduces incentives to under-report income, the after-reform reported income provides a benchmark for what a worker could have actually earned at the time of high taxes. As a result, we can compute how much income he or she hid when compared to actually

[6] For example, the IRS in the U.S. reports that for 2001 filed returns only 1 percent of wages and salaries were underreported but that an estimated 57 percent of non-farm proprietor income was not reported (IRS 2006).

[7] Lyssiotou, Pashardes, and Stengos (2004) use the consumption demand approach in measuring tax evasion. They observe that the tax evasion influences the composition of consumption, and one can impute true income by adjusting income to match consumption shares.

[8] Measures of tax evasion based upon extensive integral tax audits are not available in Russia.

reported earnings before the reform. Since the reform decreases marginal tax rates only for some groups of people, we use the variation across time and tax payers to identify and estimate the effects. Previous studies typically use only cross-sectional variation.

The results of Russia's reforms are valuable for many other countries. As we noted above, another 20 or so countries besides Russia have recently introduced flat tax reforms and several other countries are considering the adoption of this reform. An important implication taken from Russia's experience is that the adoption of a flat rate income tax can lead to significant reductions in tax evasion and increased tax revenues in countries where tax rates are high and tax evasion levels are significant. But these revenues are likely to come from better reporting and increased compliance, and much less from changes in labor supply and increased economic activity.

The results of Russia's reforms also facilitate several methodological innovations in public finance. The paper offers a general approach to estimating the extent of tax evasion in different countries provided there are available longitudinal household income-expenditure surveys and intermittent tax reforms with significant changes in tax burdens. Although these conditions will not always be met, the list of countries where the methodology can be applied far exceeds that of countries that implement extensive random audit programs to examine the extent of tax evasion. Also the paper: (i) suggests a methodology for separating tax evasion and productivity responses to changes in tax rates; (ii) shows that the response of consumption to tax changes is the right approach to calculating deadweight losses; and (iii) contributes empirical evidence on the relationship between tax rates and tax evasion, which has not been clearly forthcoming in past cross-sectional studies

The remainder of the paper is organized as follows. In Section 2, we derive a tax evasion function using the difference in the log of consumption and income. In Section

3, we introduce our data and descriptive statistics. In Section 4 we present the estimates of the tax evasion function. In Sections 5 and 6, we discuss methodological issues and provide the estimates of the flat tax effect using difference-in-difference and regression-discontinuity-type approaches. In Section 7, we investigate the productivity effect of the flat tax and develop a framework to assess the deadweight loss from personal income tax in the presence of tax evasion based on the consumption response to tax changes. In Section 8 we draw some conclusions.

## 2. Data and Variables

We use the 1998, 2000-2004 rounds of the Russian Longitudinal Monitoring Survey (RLMS), a household panel survey which is based on the first national probability sample drawn in the Russian Federation.[9] This is a very rare household database with a sufficiently long panel before and after the flat tax reform. The panel structure of the data is useful in implementing before and after analysis while controlling for constant unobservable household and local characteristics in estimations. Having post-reform data for four consecutive years is particularly valuable for capturing the full extent of the response to tax rate changes since households may need some time to learn about implications of the reform, convince themselves that the reform is permanent, and make appropriate adjustments (see Johnson, Parker, and Souleles (2006) for a recent example of the dynamic response in the U.S.). There were 8,343 to 10,670 individuals who completed the adult (age 14 and over) questionnaire and 3,750 to 4,718 households who

[9] We do not use the 1994-1996 rounds because of high macroeconomic volatility during this period, with annual inflation reaching 214% in 1994, and apparent noise in respondents' answers, especially, with regard to food items. In addition, the early questionnaires did not include contractual earnings, which are the key variable for our analysis as well as several important expenditure items such as medicine, car repair, etc. RLMS was not conducted in 1997 and 1999.

completed the household questionnaire in each round. These individuals and households reside in 32 oblasts (regions) and 7 federal districts of the Russian Federation.[10]

The key variables in our analysis are household consumption and household reported income. The household questionnaire contains detailed information on separate expenditure items purchased in the last 30 days (unless indicated otherwise): more than 50 items of food at home and away from home, alcoholic and non-alcoholic beverages, and tobacco products purchased in the last 7 days;[11] expenses on clothing and footwear in the last 3 months; gasoline and other fuel expenses (3 subcategories); rents and utilities, and 15-20 subcategories of services (such as transportation, repair, health care services, education, entertainment, recreation, insurance, etc.). These expenditure items are aggregated into monthly consumption of non-durable items (C1), which is our baseline measure of consumption. The second consumption measure (C2) adds transfer payments in the last 30 days (6 subcategories include alimonies and various contributions in money and in kind to individuals outside the household unit). Although transfer payments are not typically considered as part of consumption, households may derive extra utility from altruistic motives by transferring resources to relatives (Laitner and Juster 1996, Altonji, Hayashi and Kotlikoff 1997, Kopczuk and Lupton 2007). In addition to non-durable consumption items, households also report durables purchased in the last 3 months (10 subcategories include major appliances, vehicles, furniture, entertainment equipment, etc.). Combining one third of these durable purchases and C1 gives us a third measure of

[10] Russia has 89 regions and 7 federal districts. The RLMS sample consists of the 38 randomly selected primary sample units (municipalities) that are representative of the whole country.

[11] Monthly expenditures on food are computed as the sum of weekly expenditures on individual food items multiplied by 30/7=4.286. Since some food items are storable (flour, sugar, potatoes and vegetables) and expenditures on these goods tend to be seasonal (typically, in the fall), we use top coding for unreasonably high amounts of food purchases conditional on household structure and food prices. The procedure of top coding of food items is described in Gorodnichenko, Sabirianova Peter and Stolyarov (2007).

monthly consumption (C3). For each expenditure item, it is known whether or not a household purchased the item, as well as the amount of the purchase.[12]

Total household income is the combined income of all household members after taxes from all jobs and other regular sources. The labor income is reported by the reference person as after-tax payments received by all household members from all places of work in the form of money, goods, and services in the last 30 days. Non-labor income includes pensions, stipends, unemployment benefits, rental income, interests and dividends, alimonies, and child care benefits. Our base income measure includes regular portions of labor and non-labor income, as defined above (Y1). The second income measure (Y2) adds irregular receipts from the last 30 days that consist of lump-sum payments from insurance, amounts received from the sales of material assets, and 11 subcategories of contributions from persons outside the household unit, including contributions from relatives, friends, charity, international organizations, etc. These irregular receipts are generally not included in the definition of income.[13] Finally, since households may derive supplementary income from household production, we also calculate the third income measure (Y3) by adding Y1 and income from selling household-grown, mostly agricultural products.[14] As with expenditures, missing income amounts for the subcategories of non-labor income, irregular receipts, and household

[12] When a household purchased the item but did not report the amount of the purchase, the missing amounts are imputed by regressing the log of expenditure on the complete interaction between year dummies and federal district dummies, controlling for the size of the household, number of children (18 years old or younger), and number of elderly members (60+). The procedure is described in Gorodnichenko, Sabirianova Peter, and Stolyarov (2007). The subcategories with the largest number of missing values include utilities (2.12% of the sample), gasoline and motor oil (1.63%), transportation services (1.54%), and contributions to non-relatives (1.35%). Missing values for other subcategories are trivial.

[13] A large component of the irregular income is private transfers (typically from relatives). Because these transfers are not taxed, taxpayers do not have strong incentives to conceal this source of income, and thus adding transfers does not affect tax evasion directly. However, Y2 can help us rule out explanations based on intra-family transfers in cases where households have large consumption because they are supported by other households.

[14] Income from household production is calculated by multiplying the amount of sold agricultural products (33 subcategories) and local price per unit of product (see Gorodnichenko, Sabirianova Peter and Stolyarov 2007 for details).

production are imputed using the regression approach described in Gorodnichenko, Sabirianova Peter, and Stolyarov (2007). Overall, imputations are minimal. Labor income is not imputed.

In addition to consumption expenditures and income, we also calculate change in net financial worth (net savings) as the difference between the net change in financial assets and the net change in liabilities. The net change in financial assets includes purchases of stocks, bonds, and other securities in the last 30 days, plus current cash savings in the last 30 days, minus sales of stocks, bonds, and other securities in the last 30 days, minus the amount of spent savings, foreign currency and valuables in the last 30 days. The net change in liabilities is computed as money borrowed in the last 30 days, minus money lent outside the household unit in the last 30 days, minus payments to creditors in the last 30 days, plus amounts received from debtors in the last 30 days.

All monetary values at the household level are expressed in December 2002 prices and adjusted for regional cost-of-living differences by using the regional value of a fixed basket of goods and services.[15]

The household-level data are supplemented by individual information on the head of the household, including employment participation, earnings, age, schooling, tenure, and characteristics of the primary employer such as formal organization, ownership, location, and firm size. The head of the household is defined as the person with the largest income. If more than one individual within a household have similar incomes, then the oldest person is defined as the head of the household. In a few exceptional cases

[15] To adjust for monthly inflation, we express all flow variables in December prices of the corresponding year by using a country average monthly CPI and the date of interview. If the date of the interview is in the first half of the month, the previous month CPI is used. If the date of interview is in the second half of month, the current month CPI is used. Then the annual (December to December) CPI for each 32 oblasts (regions) is applied to convert the flow variables into December 2002 prices.

of multiple household members with the same age and income, the priority is given to the first person in the roster files.

## 3. Conceptual Framework: Derivation of Tax Evasion Function

Our theoretical starting point is the permanent income hypothesis which suggests that consumption equals permanent income. Consequently, consumption contains important information about resources (income) available to households. If consumption consistently deviates from reported income holding everything else constant, one may suspect that some part of the income is not reported. In fact, tax authorities often use the discrepancy between income and expenditures to detect tax evasion. Thus, the differential between consumption and income can inform us about whether and to what extent households evade taxes. In the rest of this section, we formalize this idea and develop an econometric specification of the tax evasion function.

Let $Y_{ht}^{*}$ be the (true) income received by household *h* at time *t*. Households may choose to conceal a part of their income and report only $Y_{ht}^{R} = \Gamma_{ht} Y_{ht}^{*}$, where $\Gamma_{ht}$ is the fraction of reported current income. We can model $\Gamma_{ht}$ as a function of observable characteristics $S_{ht}$ that influence tax compliance: $\Gamma_{ht} = \Gamma(S_{ht}) = \exp(-\gamma S_{ht} + error)$. In addition to job and worker characteristics, the vector $S_{ht}$ might also include various central and regional government policies, in particular, the 2001 flat tax reform, which is our focus.

Further, let's assume that current household income $Y_{ht}^{*}$ is related to permanent income $Y_{ht}^{P}$ as $Y_{ht}^{*} = \mathrm{H}_{ht} Y_{ht}^{P}$, where $\mathrm{H}_{ht} = \mathrm{H}(X_{1,ht}) = \exp(\eta X_{1,ht} + error)$ captures deviations of current 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 into the error term. Accounting for the life-cycle factors is necessary because the difference between permanent/life-time income and current income exhibits strong life-cycle dynamics (e.g., Hubbard, Skinner, and Zeldes 1995, Gourinchas and Parker 2002, and Haider and Solon 2006).

Since service flows of durable goods are often unknown, we should further assume that expenditures on non-durables $C_{ht}$ constitute a fraction of permanent income, that is, $C_{ht} = \Theta_{ht} Y_{ht}^P$. This fraction is fixed if the consumption aggregator for durables and non-durables has a Cobb-Douglass form in the utility function.[16] We allow the fraction $\Theta$ to vary across households. In particular, we let $\Theta_{ht} = \Theta(X_{1,ht}) = \exp(\theta X_{2,ht} + error)$, where $X_{2,ht}$ consists of the number of household members and number of children in order to account for economies of scale, while the number of elderly members, age, schooling, and marital status are included as taste shifters. This list of variables is commonly used in empirical consumption functions (e.g., Blundell et al. 1994, Browning and Lusardi 1996).

Given our assumptions, we obtain three important relationships:

$$\ln Y_{ht}^R - \ln Y_{ht}^* = -\gamma S_{ht} + error, \quad (1a)$$

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

[16] We assume constant unitary income elasticity of consumption because we consider the total consumption of non-durables goods. The ratio of non-durables to income is fairly stable in macroeconomic data, which is consistent with the constant unitary elasticity. Although Pissarides and Weber (1989) and several subsequent papers allow the income elasticity to be different from one, those studies deal with food consumption and other specific goods instead of total consumption. We also note that even if the household survey had collected information on the value of durables, households have strong incentives to underreport consumption/ownership of durables because it is highly visible and indicative of true earnings. Hence, using that information to construct the service flow of durables and consequently total consumption would most likely underestimate the extent of tax evasion. Our results hardly change when we add the recent purchases of durables to the consumption of non-durables, as will be shown below.

$$\ln C_{ht} - \ln Y_{ht}^{P} = \theta X_{2,ht} + error. \qquad (1c)$$

Even though $Y_{ht}^{*}$ and $Y_{ht}^{P}$ are not observable, we can still estimate our parameter of interest $\gamma$ if we combine equations (1a-1c) into the observed consumption-income gap function (2). Since vectors $X_{1,ht}$ and $X_{2,ht}$ are likely to overlap considerably, we let $X_{ht}$ be a union of $X_{1,ht}$ and $X_{2,ht}$ to simplify notation and write our final specification as

$$\ln C_{ht} - \ln Y_{ht}^{R} = \gamma S_{ht} + \beta X_{ht} + u_h + \varepsilon_{ht}, \qquad (2)$$

where $\gamma$ shows the effect of $S_{ht}$ on tax evasion; $u_h$ 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.[17]

Following Pissarides and Weber (1989), Lyssiotou, Pashardes, and Stengos (2004), and others, we assume that the consumption of non-durables, which is our preferred measure of consumption, is correctly reported, and the income reported in the household survey is used for tax purposes. If consumption of non-durables is under-reported, we *underestimate* the extent of the tax evasion. Johnson and Moore (2005), among others, find that income reported in surveys is typically greater than income reported for tax purposes. This pattern implies that we may again *underestimate* the extent of tax evasion.

On the right-hand side of equation (2), we have two vectors of covariates *S* and *X*. The vector *S* accounts for individual variation in tax evasion due to age, schooling,

[17] The consumption-income gap function has a convenient semi-log functional form. From the permanent income/life-cycle theory of consumption, the consumption-income ratio should be equal to one and the log of this ratio is zero. Thus, we can interpret the coefficients in equation (3) as percentage deviations of the consumption-income ratio from the "steady state". Using the log-ratio also improves the statistical properties of our estimates as the consumption-income ratio is highly skewed.

marital status, tenure, type of job (enterprise vs. self-employment), sector (private vs. public), and the firm size for the head of the household. It also contains year dummies and a trend variable for the after-reform period. Based on our earlier discussion, the vector $X$ includes age, schooling, marital status, employment participation, number of household members, number of children, and number of elderly members. Since some of the factors are present in both vectors (e.g., age, schooling, and marital status), we have to be cautious not to attribute the estimates solely to tax evasion. In summary, if proper controls are included, the consumption-income gap function (2) becomes a useful tool for analysis of tax evasion.[18]

## 4. Tax Evasion and Consumption-Income Gap

In this section, we perform a series of estimations to verify that the consumption-income gap is an informative indicator of tax evasion behavior. We do not have estimates of tax evasion from tax audits like the Taxpayer Compliance Measurement Program (TCMP) in the U.S. However, we know from studies based on the TCMP and similar programs in other countries that tax evasion is correlated with observable characteristics of taxpayers. We can utilize this information to check whether our estimates of the consumption-income gap function are consistent with common tax evasion determinants.

[18] The permanent income hypothesis assumes that households have the ability to borrow and lend to smooth consumption. This could be a strong assumption in the Russian context, and one may be inclined to use the cash-on-hand as a chief determinant of consumption (instead of permanent income). In this case, the consumption-income gap function continues to be the relevant tool for studying tax evasion because constrained households should spend available income on consumption (equation (1b) can be omitted in this case). We also note that the inability to borrow in formal credit markets can be mitigated by intra-family transfers.

We begin by reporting household fixed effect estimates of specification (2) for four combinations of income and consumption in Table 2.[19] All four specifications show that the consumption-income gap is declining with age but not changing with schooling. Although we cannot interpret results on age, schooling, and marital status as factors of tax evasion, the sign of coefficients on age is consistent with other studies showing that the tax evasion is less likely among older (and risk-averse) workers (e.g., Clotfelter 1983, Andreoni, Erard, and Feinstein 1998, Slemrod and Yitzhaki 2002). Married individuals are estimated to have a significantly smaller consumption-income gap.[20] The estimated positive effect of tenure might be due to accumulated additional experience regarding tax evasion opportunities while working at the same job. The coefficient on working at an enterprise (as opposed to being self-employed) is negative and statistically significant, and it is consistent with previous U.S. studies showing that self-employed individuals tend to have higher noncompliance rates (Feinstein 1991, Feldman and Slemrod 2007, Slemrod 2007).

Firm size is another important determinant of tax evasion, but the previous literature provides mixed evidence. The size effect is found to be positive in the U.S. firm-level studies (Slemrod 2007), but negative for Cameroon businesses (Gauthier and Gersovitz 1997) and positive or negative depending on whether an individual taxpayer in Jamaica works in the private or public sector (Alm, Bahl, and Murray 1990). Our results show that the consumption-income gap is smaller for Russian workers employed in larger enterprises. Since larger firms are subject to more extensive tax-compliance monitoring,

[19] We experimented with other definitions of consumption, such as the one that uses a non-itemized food expenditure variable or the one that includes net change in financial worth (net savings). For these and other measures, we find similar results which we do not report.

[20] This finding is opposite to what typically found in the U.S. literature (e.g., Feinstein 1991, Martinez-Vazquez and Rider 2005, Slemrod 2007). The marriage tax penalty and complex married return are two common explanations for why married individuals in the U.S. are more likely to evade. However, the Russian tax law does not allow for separate tax filing of married people, and the marriage tax penalty does not exist.

workers are less likely to have loopholes in underreporting their incomes. Larger firms also find it harder to implement tax evasion schemes with a variety of workers.[21]

We also find that the gap is largest for workers in the state sector, which is in line with the finding by Gorodnichenko and Sabirianova Peter (2007a), who show that a greater consumption-income gap in the public sector in Ukraine reflects widespread corruption and bribery of public sector employees. Overall, estimated coefficients on control variables are broadly consistent with the results reported in evasion studies based on tax audits.

One may expect that households are more likely to evade in the local jurisdictions where people are skeptical about whether the majority of the population pays taxes. In 1998 and 2002 (coincidentally before and after the tax reform), the RLMS collected information on attitudes and perceptions about taxes. We construct a district-level measure for the share of individuals who believe that most people don't pay taxes or pay taxes on less than half of their income and use it as an additional regressor in the consumption-income gap function. We find an overwhelmingly strong relationship between the consumption-income gap and average tax perceptions.[22] In the districts where people tend to believe that most people do not pay taxes, households indeed have a larger consumption-income gap (see Table 3). Thus, a consumption-income gap is likely to provide meaningful information about tax evasion at the household level.

Overall, the estimates of the consumption-income gap function are consistent with a tax evasion story and its common determinants. Obviously, tax evasion is a concealed act and therefore without audit data we cannot test directly whether the consumption-

[21] The negative tax evasion effect of the firm size could also be linked to the employer size-wage premium literature (Brown and Medoff 1989). Employees of large firms earning a wage premium will have weaker incentives to seek additional employment in the shadow economy.
[22] Alm, Martinez-Vazquez, and Torgler (2006) discuss the influence of these perceptions on taxpayers' tax morale in Russia.

income gap truly captures the extent of latent tax evasion. However, we can provide compelling, indirect evidence to support our claim that the consumption-income gap is related to tax evasion.

## 5. Tax Evasion Function: Difference-in-Difference Approach

### 5.1. Identifying the Effect of Flat Tax Reform

Apart from confirming our intuition that the consumption-income gap is informative about tax evasion, Table 2 contains another remarkable result: after being constant prior to 2001, the consumption-income gap started to continuously decline over time. Table 2, Panel B reports a large and statistically significant coefficient on the after-reform trend variable indicating an average 6-7% decline in the consumption-income gap per year from 2001 to 2004. The timing of the decline coincides with the Russian flat income tax reform.

However, we cannot attribute the decline in the consumption-income gap solely to the flat tax reform because other events occurred at the same time. For example, the credit market boom in the 2000s may also have reduced the consumption-income gap by providing incentives to report income in order to obtain a housing mortgage or other credit lines (Gorodnichenko and Sabirianova, 2007b). Likewise, improved macroeconomic conditions might have induced households to save more, thus diminishing the consumption-income gap. The 2001 tax reform by itself was comprehensive and was not limited to the changes in the personal income tax rates (Ivanova, Keen, and Klemm 2005). Among the most significant tax code changes are *i*) the replacement of separate contributions to four social funds by the unified social tax

paid by employers at the overall reduced rate, *ii*) abolished rules for multiple job holders to submit tax declarations, *iii*) a considerably higher 35% rate for income received from gambling, prizes, voluntary insurance contributions and excessive interest in attempt to combat various schemes of tax avoidance, and *iv*) a new system of tax deductions providing incentives to declare income (Russian Tax Code 2000).[23]

In principle, the on-going reforms of tax administration might also have contributed to better income reporting. Available descriptive statistics, however, show ambiguous changes in the work of the tax administration. Using the Federal Tax Department archive, we have assembled time-series information on tax audits and charges for tax law violations and reported these data in Table 4. Some measures favor the tax enforcement argument. For example, both the ratio of received to accrued additional tax payments due to tax audits and the number of blocked bank accounts for tax related violations did increase after 2000. At the same time, the number of on-site tax audits, total amount of charges, and the number of managers and entrepreneurs charged for breaching tax law have declined considerably after year 2000, which could be due, in part, to less tax evasion caused by the tax reform. If the tax enforcement argument is valid, then it could also explain some of the decline in the consumption-income gap after 2000.

As a first step in separating the tax evasion effect of reduced marginal rates from other factors, we use the difference-in-difference approach considering those who are affected by the flat tax reform (higher tax brackets) as a treatment group while those who are not affected (lower tax brackets) as a control group. Although the difference-in-

[23] The 2000 amendments to the Russian Tax Code allow residents to claim tax deductions for their expenses on education, health care, charitable contributions, housing purchases, and other property-related deductions. The number of declarations claiming tax deductions has been steadily growing at 28% per year for housing deductions, 25% per year for educational deductions, and 58% per year for medical bills over the 2002-2005 assessment years (or 2001-2004 income years). The numbers are computed using the annual results of declaration campaigns from the Federal Tax Department archive, www.nalog.ru.

difference method has not yet been applied to the estimation of the tax evasion function, it has been widely used in estimating the response of labor supply and earnings to changes in taxation (Feldstein 1995, Eissa and Liebman 1996). This methodology has been previously applied by Ivanova et al. (2005) and Martinez-Vazquez et al. (2006) in estimating the effect of the Russian flat tax on after-tax earnings. While the first study did not find a significant effect in the year following the reform, the second study using a longer time span and a regression approach shows a large positive effect of the flat tax on the growth of earnings.

Unlike previous studies, our paper focuses on the tax evasion effect and for the first time applies this methodology to household-level consumption-income data, controlling for changes in the characteristics of the treatment and control groups. In particular, we estimate the following specification:

$$\ln C_{ht} - \ln Y_{ht}^{R} = \gamma S_{ht} + \beta X_{ht} + \mu d_{ht}^{treat} + \alpha (d_{ht}^{treat} \times D_p) + \psi D_p + u_h + \varepsilon_{ht}, \qquad (3)$$

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 (i.e., the group that experiences a decline in marginal tax rates conditional on $Y_{ht}^{*}$) and $D_p$ is a dummy variable for the post-reform period 2001-2004.

The difference-in-difference approach is a very attractive tool as it controls for non-tax factors that simultaneously affect control and treatment groups. The key element of equation (3) is the specification of the treatment and control groups which we discuss in the next subsection.

### 5.2. Treatment and Control Groups

Since the pre-reform marginal tax rates are correlated with the pre-reform level of current income, there is a potential source of endogeneity in equation (3) as the dummy variable

$d_{ht}^{treat}$ can be correlated with the error term $\varepsilon_{ht}$. For example, households can endogenously fall into the treatment group due to their choice of income and other behavioral responses.[24] This endogeneity problem is particularly acute when we use pre-reform reported incomes to classify taxpayers into treatment and control groups in the presence of tax evasion.

To understand the source of the biases, we re-write equation (3) in first differences, consider only two periods *t*–1 and *t* (before and after the reform), and drop the subscript *h* to simplify exposition:

$$\Delta \ln C_t - \Delta \ln Y_t^R = \gamma \Delta S_t + \beta \Delta X_t + \alpha I\left(\tau_t < \tau_{t-1}\right) + \Delta \varepsilon_t, \qquad (4)$$

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 an increasing step function of current (reported and hidden) income $Y^*$. The relevant treatment group $I$ (.) consists of households experiencing a decline in the rate that they face (not the rate they decide to pay), defined on the basis of their total after-reform income that is $\tau_{t-1}(Y_t^*) - \tau_t(Y_t^*) > 0$. If the flat tax reform has reduced tax evasion, then $\alpha$ should be negative, *ceteris paribus*.

Because $Y_t^*$ is not observable, suppose we use the pre-reform reported income to identify treatment and control groups. In this case,

$$\begin{aligned}\tau_{t-1}(Y_{t-1}^R) - \tau_t(Y_{t-1}^R) &= \tau_{t-1}(Y_{t-1}^R) - \tau_t(Y_t^*) \\ &= \underbrace{\left[\tau_{t-1}(Y_t^*) - \tau_t(Y_t^*)\right]}_{\text{true treatment}} - \underbrace{\underbrace{\left[\tau_{t-1}(Y_t^*) - \tau_{t-1}(Y_{t-1}^*)\right]}_{\text{productivity bias}\geq 0} - \underbrace{\left[\tau_{t-1}(Y_{t-1}^*) - \tau_{t-1}(Y_{t-1}^R)\right]}_{\text{tax evasion bias}\geq 0}}_{\text{bias}(t-1)}, \qquad (5)\end{aligned}$$

where the first equality follows from the flat tax in the post-reform period. Classification into treatment and control groups based on observed income is correct only when

[24] See Triest (1998), Moffitt and Wilhelm (2000), and Auten and Carroll (1999) for exposition and a survey of the endogeneity problem as applied to labor supply and earnings responses without tax evasion.

$\tau_{t-1}(Y_{t-1}^R) - \tau_t(Y_{t-1}^R)$ has the same sign as $\tau_{t-1}(Y_t^*) - \tau_t(Y_t^*)$. However, as equation (5) shows, the treatment group based on pre-reform reported income excludes wage earners that increase productivity and pass the threshold (i.e., $\tau_{t-1}(Y_t^*) - \tau_{t-1}(Y_{t-1}^*) \geq 0$). In addition, the treatment group also excludes households whose current income is in the upper brackets while the reported income is in the lower bracket (i.e., $\tau_{t-1}(Y_{t-1}^*) - \tau_{t-1}(Y_{t-1}^R) \geq 0$). These are the households who are most likely to be "treated" by the reduced tax rate. In other words, assignment into control group is affected by behavioral responses to tax changes. Since the response of the control group is contaminated with the response of the treated group, the difference between control and treatment groups constructed on the basis of pre-reform income is going to be smaller. As a result, such misspecification will produce an upward bias in the estimate of $\alpha$, implying that the effect of the flat tax reform on tax evasion is less likely to be found.[25]

Now suppose we use the post-reform reported income to identify treatment and control groups. One can interpret this approach as running the reform backwards from flat tax to a progressive tax scale. Under the flat tax, all taxpayers face the same marginal tax rate irrespective of income; therefore, the assignment into the treatment and control groups is not affected by behavioral responses to differential tax rates. In this case,

$$\begin{aligned} \tau_{t-1}(Y_t^R) - \tau_t(Y_t^R) &= \tau_{t-1}(Y_t^R) - \tau_t(Y_t^*) \\ &= \underbrace{\left[\tau_{t-1}(Y_t^*) - \tau_t(Y_t^*)\right]}_{\text{true treatment}} - \underbrace{\left[\tau_{t-1}(Y_t^*) - \tau_{t-1}(Y_t^R)\right]}_{\text{bias}(t)=\text{tax evasion bias}\geq 0}, \end{aligned} \tag{6}$$

[25] To understand the sign of the bias, consider the following hypothetical case. Suppose there is an individual who receives 60,000 rubles before and after the reform (there is no productivity effect), and the reform reduces the marginal tax rate for people with more than 50,000 rubles in annual income. Before the reform, the individual evades taxes and reports only 40,000 rubles in earnings. After the reform, he reports 60,000 rubles. Also, assume that the genuine response of the control group is zero, that is, actual and reported income do not increase for this group because they continue to face the same tax rate. If the pre-reform reported income is used to identify the treatment group, then an individual would fall into the control group. In this case, the response of the control group would be large because taxpayers choose to underreport their income before the reform. It follows that holding everything else constant, the estimated treatment effect would be small because the response of the control group is large.

where the first equality again follows from the flat tax. Note that if we assume that post-reform income is fully revealed (i.e., $Y_t^R = Y_t^*$), then using post-reform income to identify the treatment effect (and treatment/control groups) yields unbiased estimates. One can show that $bias(t-1) - bias(t) = \tau_{t-1}(Y_t^R) - \tau_{t-1}(Y_{t-1}^R) > 0$, and hence the overall bias in defining the treatment group is smaller when we use the post-reform income. Furthermore there should be fewer people affected by the tax evasion bias in year *t* because there are no longer incentives for households to cluster just below the threshold, and therefore there would be fewer people whose true current income is above the threshold while their reported income is just below the threshold (see Section 6). At the same time, because taxpayers can conceal some income even when the tax schedule is flat and hence some misclassification of the treatment group taxpayers in the control group is inevitable, we *underestimate* the effect of the tax reform.

In summary, the flat tax reform itself provides a unique identification opportunity. Since all people face the same marginal tax rate, the flat rate cannot be correlated with the after-reform reported income. By applying the pre-reform rates to the post-reform income (or counterfactual rates), we can avoid the problem of reverse causality and provide a lower bound on the effect of reduced tax rates on tax evasion.

To understand another potential source of endogeneity, recall that $\varepsilon_{ht}$ is the composite error term that originates in the three equations - 1a, 1b, and 1c. The second equation (1b) contains a transitory error component that might be correlated with the marginal tax rate. Unusually high income in one period is not generally consumed immediately. As a result, large transitory movements in current income can generate a negative serial correlation in $(\ln Y_{ht}^* - \ln Y_{ht}^P)$, which can lead to a negative correlation between $(\ln Y_{ht}^* - \ln Y_{ht}^P)$ and pre-reform marginal tax rates if the rates are positively

associated with the pre-reform income (so called "reversion to the mean" problem, see Moffitt and Wilhelm (2000)). We should note, however, that a vast majority of households in the RLMS are liquidity constrained (only a tiny fraction of households report positive savings), and thus transitory income is likely to be consumed at the time it occurs. Fortunately, in addition to actually received earnings, the RLMS provides information on contractual earnings that we can use to create treatment and control groups. Contractual earnings have a much smaller transitory component than the earnings actually received last month, and therefore they are less vulnerable to "the reversion to the mean" problem.[26] To further minimize the adverse effects of transitory shocks, we follow Gruber and Saez (2000) and use the 4-year average of contractual earnings in the post-reform period to construct treatment and control groups.

In light of the discussion in this subsection, we define the treatment group as households whose heads earned more than 3,625 rubles (net of tax and after a 1% contribution to the pension fund) per month from all reported jobs at least once or on average after the tax reform. This amount is equivalent to 50,000 rubles of gross annual earnings - an upper threshold for the 12% bracket under the 2000 annual budget law. With a 1% contribution to the pension fund, the control group faces the same 13% marginal tax rate before and after the reform. Thus, the design of the Russian reform not only offers a unique solution to the endogeneity of marginal tax rates by making the tax schedule flat, but also provides a 'clean' control group by keeping the same marginal tax rate for the lowest tax bracket. We also note that the definition of the treatment group is

[26] Contractual earnings are defined as 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. Thus, contractual earnings also help to deal with the problem of irregularity of payments and wage arrears. The coefficient $\alpha$ might be negative if the reform period coincided with a smaller volatility in actual earnings (wage arrears, which were quite prevalent in the earlier years of the transition, started to fall after 1998).

not affected by standard tax deductions, which cannot be claimed by individuals earning more than 20,000 rubles per year (Russian Tax Code 2000).

We report selected statistics describing the treatment and control groups in Appendix Table A1. In short, households in the treatment group, which comprises of about 35% of all households, are larger and have more children, and the heads of those households are younger, more educated, and more likely to be married and employed than households in the control group. Working heads of households in the treatment group also have less experience with the same employer and tend to work in the private sector and larger firms.

### 5.3. Estimates of the Tax Evasion Response

Table 5 reports the estimates of equation (3), with the treatment group defined on the basis of post-reform actual earnings received last month. We find a large and significant decline in the consumption-income gap for the treatment group after 2000. The estimate of $\alpha$ is in the range between –0.11 and –0.09, suggesting that income grew by approximately 9–11% more than consumption, *ceteris paribus*. The estimate of $\alpha$ is robust to alternative definitions of income and consumption that include added components such as purchases of durable goods (C3), net savings (C4), and net income from home production (Y3) reported in Table A2.[27] Figure 1 illustrates a clear structural break in the consumption-income gap dynamics in 2001 for both groups and a more pronounced decline for the treatment group. The fact that the consumption-income gap decreases for the control group shows the importance of other factors discussed in subsection 5.1.

[27] Because net savings and durable purchases are highly volatile and irregular, we use these components only in supplementary (not primary) specifications. Unfortunately, our data do not allow us to calculate the service flow of durables, which is the appropriate measure of durable consumption.

Table 6 shows the estimates of $\alpha$ from several alternative specifications of the treatment group that use contractual earnings. The estimates of $\alpha$ based on contractual earnings are negative and statistically significant, but they are slightly smaller in magnitude than the estimates based on the actual earnings received in the last month. As follows from our earlier discussion of the reversion to the mean problem, the measures of earnings that contain a large transitory component tend to overstate in absolute terms the effect of the treatment on the consumption-income gap. This is exactly what we find when we compare the estimates based on these two measures of earnings.

We also restrict the sample to the households whose head's implied gross annual earnings are between 4,800 and 100,000 rubles and apply the above definition of the treatment group to the restricted sample. We use the restricted sample to eliminate the differential effect of the regressive unified social tax paid by employers. For each worker in the restricted sample, employers should pay the same 35.6% rate of the unified social tax after 2000. Another benefit of the restricted sample is that the treatment group would have faced the same 20% rate if the pre-reform tax scale had remained after 2000 (the next 30% bracket begins with 150,000 rubles).

According to the earlier Russian tax law, tax brackets were not automatically adjusted for inflation, and thus, an increase in nominal wages could push taxpayers into higher tax brackets ("bracket creep" effect). To assess the consequences of inflation adjustment, we apply the same criteria of the restricted sample to the earnings adjusted for inflation in December 2000 prices. The treatment group is also defined after deflating the post-reform income to December 2000 prices. Finally, we add interactions between district dummies (at the county level) and year dummies to control for changes in local characteristics such as the degree of credit market development, enforcement, and other

non-tax factors. We also allow individual and firm characteristics to have different effects before and after the reform.

Regardless of specifications and definitions of income and consumption, the magnitudes of $\alpha$ coefficients are large and vary from –0.126 to –0.091 for monthly contractual earnings.[28] Using the 4-year average of post-reform contractual earnings gives similar estimates. Even when we replace the dummy variable for the post-reform period by the post-reform time trend, we obtain a large and statistically significant decline in the consumption-income gap for the treatment group over time. The estimates vary from –0.044 to –0.031. In summary, we find that the households experiencing a decrease in the marginal tax rate have a greater reduction in the consumption-income gap.

To verify that our results make economic sense, we also test if a decline in the consumption-income gap is larger for individuals who are more likely to switch to tax compliance after the tax reform. Only individuals with potentially legitimate labor incomes can reveal their true earnings. For example, it is unlikely that employees in the public sector will disclose the portion of their income that originates from bribes and other forms of corruption, no matter how low tax rates are. At the same time, the majority of employees in the private sector as well as the self-employed can report their earnings since there is often nothing criminal in their labor market activity. Hence, the consumption-income gap should decrease more strongly for the private sector workers than for employees in the public sector.

In addition, Russian private firms have greater incentives to compensate skilled workers who earn greater wages in ways that reduce their wages reported for tax

[28] We do not adjust our estimates for changes in the volatility of the error term because the variability in both consumption and income barely changes after the reform. For example, after controlling for factors as in (4), the standard deviation of lnC1 falls by less than 0.001 after the reform.

purposes. After the reform the tax pressure is smaller, and hence the consumption-income gap should decline more for skilled than unskilled workers.

To test these two predictions, we modify the baseline specification (3) with additional interaction terms. We report results in Table 7. Consistent with theoretical predictions, the decline in the consumption-income gap is largest for private sector employees, and in the private sector white collar workers have the largest decline.

## 6. Tax Evasion Function: Examining the Response around the Threshold

The DID approach assumes that the treatment impacts subjects uniformly, while in practice the strength of the treatment effect may be heterogeneous. For example, the response of upper-income households to changes in marginal tax rates can be different from the response of middle-income households. It is also possible that subjects are heterogeneous in the ways that are difficult to control for due to unknown specification of functional forms, unobservables, etc. The DID estimates might be contaminated by the differential evasion response of treatment and control groups to the various shocks and policy changes that coincided with the introduction of the flat tax such as tax administration reform. Even though we control for the local differences in tax enforcement via interacting district and year dummies, it is still possible that the negative $\alpha$ might be attributed in part to collection efforts if tax enforcement focuses primarily on those households who are more likely to be in the treatment group (i.e., high earners).

Discontinuity of marginal tax rates at the known threshold values of income provides an opportunity to use the regression discontinuity (RD) design to assess and validate our results from the difference-in-difference approach. Under certain, relatively

mild assumptions this alternative approach can address the issues we discuss above, and provide a consistent estimate of the treatment effect at the point of discontinuity (threshold income). Since subjects just below and just above the threshold as applied to the post-reform income are likely to be similar (e.g., they should have the same probability of being subjected to the tax audit or the same propensity to consume durables), the treatment effect is less likely to be confounded with other factors. When the subjects are drawn from the same part of the income distribution, and they are minimally different along the dimension that determines whether a subject is treated or not, then one can consider the assignment of treatment as if it is random.

We do not have a sufficient number of observations to implement RD in its classical form, however we can use the RD intuition and apply weights to the DID regression, with weights as a decreasing function of the distance from the threshold. Specifically, we estimate parameters by minimizing

$$\sum_{h=1}^{N} \omega_{hp} \left\{ \ln C_{ht} - \ln Y_{ht}^{R} - \gamma S_{ht} - \beta X_{ht} - \mu d_{ht}^{treat} - \alpha (d_{ht}^{treat} \times D_p) - \psi D_p - u_h - \varepsilon_{ht} \right\}^2, \qquad (7)$$

where $\omega_{hp}$ is a fixed household-specific weight calculated on the post-reform income. For any year *t* in the post-reform period *p*, the weight is calculated as $K(\frac{\ln Y_{ht}^{R} - \ln Y_t^{\#}}{b}) \Big/ \sum_{s=1}^{N} K(\frac{\ln Y_{st}^{R} - \ln Y_t^{\#}}{b})$, where *K*(.) is the Gaussian kernel, $Y_t^{\#}$ is the threshold income at which marginal tax rate changes, and *b* is the optimal "plug-in" bandwidth for the Gaussian kernel. The weight is a function of the distance between the individual post-reform income and the pre-reform threshold value with higher weights given to the observations that are closer to the threshold. We refer to equation (7) as the weighted difference-in-difference (WDID) estimator.

Imbens and Lemieux (2007) suggest that this approach to estimating RD or RD-type treatment effects has a number of advantages. First, although we put a small weight

on observations distant from the threshold, we can use more information contained in the sample.[29] Second, estimation and inference are straightforward since one can use the standard method of weighted least squares. Third, we can easily control for other factors to further ensure that just-below and just-above samples are balanced along dimensions other than income. Thus, weighed DID serves our purposes well since it has desirable statistical properties and preserves RD intuition.

Again, for the same reasons discussed in Section 5, we use the post-reform income in identifying the treatment group and calculating the weights. It is especially important for the RD-type estimates, which are based on the assumption that the running variable (income) should not have jumps at points where a marginal tax rate changes. In other words, there is no behavioral response to the threshold. This is not the case with the pre-reform income. Figure 2 reveals that reported contractual earnings are clustered just below the threshold value (vertical line) in year 2000, but not in 2001.[30] This clustering prior to the reform manifests behavioral response to the discontinuity in the marginal tax rates. For example, households may choose to earn more income (above the threshold) but report less just to be located at the point where their reported income is taxed at the minimum rate. Clearly, we cannot use RD-type estimation when the treatment and control groups are defined on the basis of pre-reform income. In contrast, using the post-reform income satisfies the RD assumptions as the density of reported income exhibits no lumping around the threshold.

[29] Given an optimal bandwidth, taxpayers with income 43% below or above the threshold gross income of 50,000 rubles receive a weight less than 0.01.

[30] Respondents tend to report rounded figures for their incomes, and this can explain spikes in histograms.

We estimate equation (7) and report results in Table 8.[31] Generally, the WDID estimates of $|\alpha|$ are slightly larger than the DID estimates, although the difference between the estimates is not statistically significant. Factors that could have pushed WDID estimates up or down relative to DID estimates approximately cancel out. On the one hand, an estimate of $|\alpha|$ is likely be smaller in WDID than in DID if the households that are further away from the threshold (e.g., upper-income taxpayers experiencing the largest drop in the marginal tax rate) are more sensitive to changes in the marginal tax rate. On the other hand, an estimate of $|\alpha|$ should be bigger in WDID if upper-income households respond less strongly than households closer to the threshold. For example, households with high incomes may continue to find it imprudent to report all income as the risk of expropriation by the government or criminals could be so significant that it outweighs the benefits of switching to tax compliance. The net effect of these forces is roughly zero as WDID and DID estimates are close to each other.

Similar to the DID estimates, the WDID estimates based on contractual earnings are somewhat smaller than the estimates based on earnings actually received in the last month. Overall, the WDID estimates strongly support our earlier finding that the consumption-income gap fell for the treatment group after 2000.[32]

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[31] We perform a number of specification checks to verify that assumptions underlying RD-type estimation are satisfied. The running variable (post-reform income) does not exhibit jumps at points where marginal tax rate changes. The density of post-reform income is continuous in the relevant range. The estimated effect is fairly insensitive to the choice of bandwidth. The estimate of the effect somewhat decreases in absolute value as we shrink the bandwidth. We find little evidence that the consumption-income gap has jumps at the levels of income not associated with changes in marginal tax rates (that is, we do not observe changes in the consumption-income gap at points of income that are not associated with changes in the marginal tax rates). We cannot exploit another discontinuity at the income of 150,000 rubles per year when the marginal tax rate changes from 21% to 31% because we have a small number of households in the top bracket.

[32] To account for the possibility of taxpayer misclassification into treatment and control groups at the cutoff point, we also experimented with excluding taxpayers with incomes within one percent deviation from the threshold. In these experiments, the WDID estimates are very similar to our baseline estimates and hence not reported.

## 7. Welfare Analysis

Our findings so far indicate a positive effect of the Russian flat tax reform on income reporting relative to consumption. The next question we would like to raise is whether the reform had any real effect on productivity in the economy.[33] In the presence of tax evasion we may be unable to answer this question by simply estimating the earnings or earnings growth functions – a common tool for measuring the productivity response of numerous tax reforms in developed countries (e.g., Feldstein 1995, Aarbu and Thoresen 2001). An observed increase in earnings could be due to an actual increase in labor productivity as well as due to better reporting and compliance. In this section, we are going to argue that one needs to look at the consumption side to separate these two effects.

Given the permanent income hypothesis, changes in consumption should reflect changes in permanent income and hence permanent productivity. After controlling for the windfall gains due to lower taxes, the response of consumption to tax changes can capture to what extent people choose to increase their income by supplying more labor services. This would be a genuine effect of the tax reform on the real side of the economy which is a relevant variable for welfare calculations. In contrast, changes in reported income consist of productivity and tax evasion effects. As Chetty (2007) argues, the latter effect can be irrelevant for welfare calculations since shifting resources across agents in the economy does not affect social welfare as long as this shifting does not alter the size of the 'pie' available to all agents.[34]

[33] The productivity response to tax rates is not limited to changes in measurable hours of work but also includes changes in effort, job reallocation, occupational mobility, etc. (Feldstein 1995).

[34] Slemrod (1992) and others emphasize that the real response reflects how the tax system affects productive opportunities available to firms and individuals, while tax avoidance such as income shifting across time, accounts, branches, etc. does not influence the size of the 'pie' available to the society. In this respect tax avoidance is very similar to tax evasion.

### 7.1. Theoretical Framework

To formalize these ideas, we follow Chetty (2007) and assume that workers maximize their utility,

$$u(c,l,e) = c - \psi(l)$$
$$s.t.\ c = (1-t)(wl-e) + e - z(e,t) - g(e)$$

where $c$ is consumption, $w$ is wages, $l$ is labor supply, $e$ is the amount of tax evasion, $t$ is tax rate, $\psi(l)$ is disutility of labor, $z(e,t) = p(e)(et+F)$ is the cost of being caught and fined, $p(e)$ is the probability of being caught and fined, $F$ is the fixed penalty, and $g(e)$ is the real (resource) cost of tax evasion. The corresponding first order conditions are $(1-t)w - \psi'(l) = 0$ and $t - g'(e) - z'_e(e,t) = 0$.

The social welfare function is given by $W = u(c,l,e) + z(e,t) + t(wl-e) = wl - g(e) - \psi(l)$. Note that $z(e,t)$ is a pure transfer and therefore is irrelevant for social welfare. The marginal change in welfare in response to the tax change is simply

$$\begin{aligned}\frac{\partial W}{\partial t} &= \frac{\partial wl}{\partial t} - \frac{\partial g}{\partial e}\frac{\partial e}{\partial t} - \frac{\partial \psi}{\partial l}\frac{\partial l}{\partial t} \\ &= \frac{\partial wl}{\partial t} - \frac{\partial g}{\partial e}\frac{\partial e}{\partial t} - (1-t)w\frac{\partial l}{\partial t} = t\frac{\partial wl}{\partial t} - \frac{\partial g}{\partial e}\frac{\partial e}{\partial t},\end{aligned} \tag{8}$$

where the second equality follows from the first-order condition of utility maximization with respect to labor supply. Consequently, the relative welfare losses due to income taxes can be obtained as

$$\frac{1}{wl}\frac{\partial W}{\partial t} = \frac{t}{wl}\frac{\partial wl}{\partial t} - \frac{e}{twl}g'(e)\frac{\partial e}{\partial t}\frac{t}{e} = \in_{Y^*} - \frac{e}{twl}g'(e)\in_E. \tag{9}$$

Equation (9) highlights the three crucial pieces needed for welfare calculations: *i*) the elasticity of tax evasion to tax rates $\in_E$; *ii*) the marginal resource cost of tax evasion g'(*e*); and *iii*) the elasticity of total earned income to tax rates $\in_{Y^*}$.

The first piece, the elasticity of the evasion response to changes in tax rates $\in_E$, is measured by the response of the consumption-income gap to changes in tax rates. From our empirical estimates, we know that $\in_E \geq 0$. From the first order condition for tax evasion, we have an upper bound on the second piece, the marginal resource cost of tax evasion, $g'(e) = t - z'_e(e,t) \leq t$, provided that $z'_e(e,t) > 0$. This implies that welfare losses due to income taxes should be between $\in_{Y^*} - \frac{e}{wl} \in_E$ and $\in_{Y^*}$ if marginal resource cost of tax evasion are positive. Finally, we show below that the remaining piece, the elasticity of total earned income to tax rates $\in_{Y^*}$, can be well approximated with the adjusted elasticity of consumption to tax rates, which we can estimate from the available data.

Using worker's budget constraint, one can find that

$$\begin{aligned}
\frac{\partial c}{\partial t} &= -(wl - e) + (1-t)\frac{\partial (wl - e)}{\partial t} + \frac{\partial e}{\partial t} - \frac{\partial g}{\partial e}\frac{\partial e}{\partial t} - \frac{\partial z}{\partial t} - \frac{\partial z}{\partial e}\frac{\partial e}{\partial t} \\
&= -(wl - e) + (1-t)\frac{\partial wl}{\partial t} - \frac{\partial z}{\partial t} + \underbrace{\left(t - \frac{\partial g}{\partial e} - \frac{\partial z}{\partial e}\right)}_{=0}\frac{\partial e}{\partial t} \\
&= -(wl - e) + (1-t)\frac{\partial wl}{\partial t} - \frac{\partial z}{\partial t},
\end{aligned}$$

where the last equality follows from the first order condition for *e*. The first term in this expression is the marginal change in the after-tax reported income holding the reported income constant. The second term is the after tax productivity response. The last term is the marginal change in the penalty, $\partial z / \partial t = p(e) \cdot e$.

Now we can link the elasticity of the consumption response to tax rates $\in_C$ and the elasticity of the earned income response to tax rates $\in_{Y^*}$ as follows:

$$\in_C \equiv \frac{\partial c}{\partial t}\frac{t}{c} = -\frac{t(wl-e)}{c} + (1-t)\left(\frac{\partial wl}{\partial t}\frac{t}{wl}\right)\frac{wl}{c} - p(e)e\frac{t}{c}$$
$$= -\kappa + \in_{Y^*} \underbrace{\left(\frac{(1-t)wl}{(1-t)wl + te - z(e,t) - g(e)}\right)}_{s_L} - p(e)\underbrace{\left(\frac{te}{(1-t)wl + te - z(e,t) - g(e)}\right)}_{s_E}$$
$$= -\kappa + \in_{Y^*} s_L - p(e)s_E,$$

where $\kappa$ is the effective tax rate defined as the ratio of paid tax liability to household consumption, $s_L$ is the consumption share of after-tax resources a household would have if it paid taxes from the full amount of its true income, and $s_E$ is the share of the *gross* gains from evasion ($te$) in total household consumption. It follows that

$$\in_{Y^*} = s_L^{-1}(\in_C + \kappa + p(e)s_E).$$

The value of $p(e)s_E$ is negligible and can be safely omitted. For example, if the marginal tax rate is 20% (our baseline case) and people evade on a quarter of their income (which seems to be a plausible upper bound given various estimates in the literature and the consumption to income ratios in our sample), $s_E \approx 0.2 \times 0.25 = 0.05$. Since the probability of being caught is typically just a few percent, then $p(e)s_E \approx 0$.

The share of *net* gains from tax evasion $te - z(e,t) - g(e)$ in household consumption is even smaller than $s_E$, and thus $s_L$ should be just slightly below 1, or $s_L \approx 1$.[35] It follows that $\in_{Y^*} \approx \in_C + \kappa$ and one can use the consumption response adjusted for the effective tax rate as an approximate measure of the total (true) income response, or productivity response. Importantly, the elasticity of consumption response is similar to

[35] In general equilibrium, an entry into the tax evasion sector would eliminate abnormal profits from tax evasion. Likewise, regulation could respond strongly to very 'profitable' tax evasion activities. For example, IRS and tax administrations in other countries regularly update the list of banned off-shores, accounting practices, etc.

Feldstein's (1999) elasticity of the taxable income response in the sense that it works like a sufficient statistic absorbing adjustments along many margins.

Now we can put all pieces together and provide lower and upper bounds on welfare losses due to income taxes:

$$\left|\in_C + \kappa\right| \le \left|\frac{1}{wl}\frac{\partial W}{\partial t}\right| \le \left|\in_C + \kappa - \frac{e}{wl}\in_E\right|. \qquad (10)$$

This formula contains only observable quantities as we can estimate the elasticity of the tax evasion to taxes $\in_E$, the elasticity of consumption to tax changes $\in_C$, the effective tax rate $\kappa$, and the share of tax evaded income in total income using consumption and income data. In the next subsection, we estimate the response of consumption to tax changes.

### 7.2. Productivity Effect of Flat Tax Reform

To contrast the response of consumption and income, we estimate consumption and income equations using the consistent sample and the same set of control variables (including household fixed effects) as in equation (3). Given the same set of controls, this is equivalent to the estimation of both equations by the seemingly unrelated regression (SUR) method. Again, our key parameter is the coefficient on the interaction term between the treatment group and a dummy for the post-reform period. As follows from the SUR properties, if we subtract the estimate of this coefficient in the consumption equation from the one in the income equation we should obtain exactly the estimate of $\alpha$ in the consumption-income gap function shown in Tables 5 and 6. Thus, we can link and compare the previously estimated tax evasion effect with the new estimates of the reform-induced productivity effect.

Table 9 reports the treatment effect estimates from the two systems of simultaneous equations: lnY1 and lnC1 as one system, and lnY2 and lnC2 as another one.[36] Other combinations of income and consumption equations produce similar results and they are not reported. The DID estimates provided in Table 9 indicate a large increase in reported income (18–19%) for the treatment group following the tax reform, but there is also a significant (although smaller) increase in consumption (8–9%). As we have explained above, the difference between income and consumption responses provides an estimate of the tax evasion effect, which is about 10-11% according to our full sample estimates (also shown in Table 6). Given these estimates, we reach an immediate, important conclusion that about 55% of the increase in reported after-tax income in the treatment group is explained by the reduced tax evasion.

The WDID estimates, however, are smaller for income (10–13%) and close to zero for consumption. Thus, DID and WDID methods give similar estimates of the tax evasion effect but produce different results with respect to consumption gains. We will explain below why there is a discrepancy between the WDID and DID estimates.

A decrease in the marginal tax rate creates windfall consumption gains since households will receive more resources simply by paying lower taxes. However, the size of these consumption gains is larger for the average treatment recipient (DID) than for a taxpayer who is near the threshold (WDID). Using simple algebra and data on contractual earnings we can calculate the size of these gains.[37] The average gain is 4.5% for all taxpayers experiencing a tax cut. Thus, consumption could increase by 4.5% simply because reduced tax rates raise after-tax income even if before-tax income is

[36] The full specification of the income and consumption equations, lnY1 and lnC1, is provided in Appendix Table A3.

[37] Specifically, we apply the pre-reform tax schedule to the post-reform contractual earnings and compute the counterfactual after-tax earnings. The difference between this counterfactual measure and observed after-tax contractual earnings is the windfall gain. After dividing the windfall gain by the after-tax earnings, we obtain a percentage windfall gain.

fixed. After subtracting windfall gains from the consumption response in the DID estimates, we obtain an average 4% response in consumption due to the productivity effect. Interestingly, when we augment the baseline SUR model with the differentiated response of taxpayers in the middle (20%) and top (30%) brackets (Table A4), the response of consumption is approximately 6–7% for the middle bracket and 15–16% for the top bracket (in the case of contractual earnings). After subtracting windfall gains, which are 3.3% in the middle and 10.5% in the top tax brackets, the response of consumption due to increased productivity is between 2.7% and 5.5%.[38]

At the same time, the windfall gains are approximately zero for households who are close to the threshold of 50,000 rubles. For example, the windfall gain for a taxpayer with 50,001 rubles is $\frac{(50{,}001-50{,}000)\cdot 8\%}{50{,}001} \approx 0.0016\%$. Hence, consumption for these taxpayers can respond only to productivity changes. Our WDID estimates of the consumption response have large standard errors, and we cannot reject the hypothesis that the productivity effect is either zero or 4%, which is in agreement with the DID estimates. In our view both WDID and DID estimates convey the same message that the productivity effect is relatively small when compared with the evasion effect while the windfall gains could be the main factor behind increased consumption.

A small productivity effect is consistent with a low elasticity of labor supply which is often estimated to fall between 0.1 and 0.5 for males and between 0.4 and 1.0 for females. If we assume that the elasticity of labor supply is approximately 0.3 and there is a fixed wage rate (i.e., wage rate does not vary with labor supply or effort), the implied increase in earnings in the middle bracket should be approximately

[38] Like any other survey, RLMS is likely to miss the super rich households. However, individuals who fall into the 30% personal income tax bracket are quite affluent by Russian standards, and thus the reader could get a sense of the evasion and consumption response of the rich.

$0.3 \times 8\% \approx 2.4\%$. This estimate is in the ball park of the estimates we obtain in the DID and WDID analyses.

In summary, the response of after-tax income can be decomposed into windfall gains (4–5%), productivity effect (0–4%), and tax evasion effect (10–11%). Although the reform provided more resources to households and could have increased labor supply, the main effect was improved tax compliance. The government lost some revenue due to lower tax rates, but it gained substantially more revenue from enhanced reporting of income.

### 7.3. Welfare Calculations

In this subsection, we compute the deadweight loss from personal income tax in Russia and assess the efficiency gains from the flat rate income tax reform. As a starting point, we first calculate the deadweight loss by using the elasticity of observed taxable income to the tax rate as in Feldstein (1999): $DWL = 0.5t^2(1-t)^{-1}e_{TI} = -0.5t \in_{TI}$, where the elasticity of taxable income with respect to the after-tax rate $(1-t)$, $e_{TI} = \frac{\partial TI}{\partial(1-t)} \times \frac{1-t}{TI}$, is re-written in terms of the elasticity of taxable income with respect to the tax rate *t*, $\in_{TI} = \frac{\partial TI}{\partial t} \times \frac{t}{TI}$. The last term $\in_{TI}$ can be linked to the elasticity of after-tax income $\in_Y = \frac{\partial(1-t)wl}{\partial t} \times \frac{t}{(1-t)wl}$ through the following identity: $\in_{TI} = \in_Y + \frac{t}{1-t}$.

According to our estimates, the elasticity of the after-tax income response to the change in tax rates is $\in_Y = (\partial Y / Y) \times (t / \partial t) = \alpha_Y \times (t / \partial t) = 0.18 \times 0.21/(-0.08) \approx -0.47$, where $\alpha_Y$ is the point estimate of the treatment effect in the log of income function (Table 9), and the tax rate includes 1% contributions to the state pension fund. Correspondingly, the elasticity of taxable income is

$\in_{TI} = -0.473 + t(1-t)^{-1} = -0.47 + 0.21(1-0.21)^{-1} \approx -0.21$. The equivalent elasticity of taxable income with respect to the after-tax rate is 0.8, which falls in the range between 0.5 and 1.33 used by Feldstein (1999) for the U.S. Thus, the deadweight loss is $DWL = (-0.5) \times 0.21 \times (-0.21) \approx 2.2\%$ of total taxable income or about 20% of collected personal income tax revenue, which is comparable to a 32% loss in the U.S. for much higher tax rates (Feldstein 1999). This estimate suggests a significant welfare loss due to the personal income tax.

This estimate, however, does not take into account tax evasion and therefore could overstate the social cost of taxes. We use our theoretical results from Section 7.1 to correct the estimate of welfare losses in the presence of tax evasion. From our empirical analysis, we know the elasticity of consumption response, which is $\in_C = \alpha_C \times (t/\partial t) = 0.08 \times 0.21/(-0.08) \approx -0.21$, and the elasticity of tax evasion response, which is $\in_E = \alpha_e \times (t/\partial t) = -0.10 \times 0.21/(-0.08) \approx 0.26$. Equation (10) also requires the effective tax rate $\kappa$ that is estimated in the range from 0.14 to 0.17 using alternative definitions of income and consumption in our data.

Given that the share of concealed income in total income is a quarter or less (see Section 7.1), we can provide an upper bound (in absolute terms) on the tax-evasion-corrected elasticity of welfare with respect to tax changes $\in_C + \kappa - \frac{e}{wl} \in_E = -0.21 + 0.14 - 0.25 \times 0.26 = -0.135$ and an upper bound on the deadweight loss $DWL_C = -0.5t(\in_{Y*} - \frac{e}{wl} \in_E) = 1.4\%$ of total earned income or 14.6% of collected personal income taxes. This is substantial, yet it is only about two thirds of the loss implied by the reported income elasticity. Using more conservative estimates of $\kappa$=0.17 and $\frac{e}{wl}$<0.25 will give us even smaller estimates of the deadweight loss.

Clearly, the traditional approach of using the elasticity of reported taxable income in welfare calculations can significantly overstate the real welfare gains from the tax reform in the presence of tax evasion. As we see from the Russian experience, tax evasion can make a tangible difference in welfare calculations. We find that the deadweight loss due to the personal income tax can be 30% smaller when adjusted for tax evasion. Consequently, the burden of personal income tax and the welfare gains from reducing taxes are considerable, yet smaller than thought before.[39]

## 8. Conclusions

The 2001 Russian flat rate income tax reform has often been heralded as a success story and has been credited with large increases in tax revenues and an improved business climate. Although it has been difficult to differentiate between myth and reality with the Russian experience, many other transitional countries have followed suit with flat rate income tax reforms, and an increasing number of countries around the world are considering the adoption of a flat rate income tax. In this paper we focus on the impact of the flat income tax rate on tax evasion, an issue that was, and continues to be, a major problem in Russia as well as in many other transition and developing countries. We argue that the flat tax reform was instrumental in decreasing tax evasion and that, to a certain extent, greater fiscal revenues for Russia in 2001 and several years beyond can be linked to increased voluntary tax compliance and reporting.

Since tax evasion is not directly observable when we lack integral audit programs, we use indirect techniques to measure the dynamics of tax evasion. Specifically, we use consumption-income data and economic theory to estimate the effect of the tax reform on

[39] The reform can have other benefits. For example, most developing and transitional countries badly need additional tax revenues. Increasing tax rates on those who are not evading will create excess burden losses. Getting these additional revenues from evaders is more equitable and less distortionary.

tax evasion. The core theoretical argument is that under the permanent income hypothesis consumption should be equal to permanent income. Assuming that consumption expenditures are fully reported, the discrepancy between the log of consumption and the log of income, which we call the consumption-income gap, indicates that households receive unreported income.

With the goal of separating the tax evasion effect of flat rate income tax reform from other factors, we use the difference-in-difference approach and regression-discontinuity-type analysis in various specifications. Regardless of the alternative variable definitions and methods used, we find that *ceteris paribus* the consumption-income gap decreased by about 9 to 12 percent more for households that experienced a reduction in marginal tax rates. That is, the most significant reduction in tax evasion was for taxpayers that experienced the largest decrease in tax rates after the flat rate income tax was introduced. We also find that this decline in tax evasion was likely due to changes in voluntary compliance as opposed to greater enforcement effort by the tax administration authorities.

In addition, in the paper we also analyze the productivity effect of the tax reform and find it to be relatively small by comparison to the tax evasion effect. Specifically, the productivity effect, measured by the relative increase in consumption for households that faced smaller tax rates after the reform, is zero at the threshold and about 4 percent for the treatment group over the four-year period. Obviously, this estimate is based on a relatively short sample of four years, and the long run response could be larger.

These results in the paper have several important policy implications. The adoption of a flat rate income tax generally is not expected to lead to significant increases in the tax revenues because labor supplies are believed to be fairly inelastic. However, if the economy is plagued by ubiquitous tax evasion, as was the case in Russia, then flat

rate income tax reform can lead to substantial revenue gains via increases in voluntary compliance. At the same time, given the argument in Chetty (2007), a strong evasion response suggests that the efficiency gain from the Russian tax reform perhaps is smaller than thought before. Using observable responses of consumption and income to tax changes, we find that the tax-evasion-adjusted deadweight loss from personal income tax is at least 30% smaller than the loss implied from the standard method based on the response of reported income to tax changes. Thus, although we find tangible efficiency gains from the tax reform, they are not as large as implied by conventional approaches.

The paper also offers several contributions to the public finance literature. First, we provide strong evidence of a positive relationship between (lower) tax rates and (lower) tax evasion. Until now, cross-section studies in the tax evasion literature had provided ambiguous results. Second, the paper offers a replicable empirical methodology for the estimation of tax evasion and changes in productivity in response to tax reform in other countries provided there are a longitudinal household budget survey and significant changes in the tax structure. Third, we develop a feasible framework to assess the deadweight loss from personal income tax in the presence of tax evasion based on the consumption response to tax changes. Since this framework uses only observable data, it can be widely implemented.

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**Table 1: Russian Economy Before and After the Tax Reform**

| | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Nominal GDP, bln. | 1585.0 | 2200.2 | 2585.9 | 2741 | 4767 | 7302 | 9041 | 10830.5 | 13243.2 | 16966.4 | 21598.0 |
| real growth, % | -4.1 | -3.5 | 0.8 | -4.9 | 5.4 | 9.0 | 5.0 | 4.7 | 7.3 | 7.2 | 6.4 |
| Annual CPI, end year | 232.2 | 121.8 | 111.0 | 184.4 | 136.5 | 120.2 | 118.6 | 115.1 | 112.0 | 111.7 | 110.9 |
| Budget deficit (-), bln. | -49.1 | -94.2 | -127.9 | -155 | -44 | 138 | 265 | 97 | 174 | 760 | 1759 |
| Nominal tax revenues, bln. | 353.3 | 464.3 | 593.4 | 524.8 | 891.4 | 1481.9 | 1955.8 | 2331.0 | 2671.9 | 3299.6 | 4627.2 |
| real growth, % | … | -9.9 | 11.1 | -25.4 | -1.5 | 20.7 | 13.3 | 3.0 | 0.6 | 4.7 | 15.7 |
| Nominal tax revenues from PIT, bln. | 36.7 | 56.7 | 75.6 | 72.2 | 117.1 | 174.3 | 255.5 | 357.8 | 455.3 | 574.2 | 706.6 |
| real growth, % | … | 6.0 | 15.9 | -19.4 | -5.9 | 8.1 | 25.8 | 21.1 | 11.7 | 6.9 | 1.6 |
| % of tax revenues | 10.4 | 12.2 | 12.7 | 13.8 | 13.1 | 11.8 | 13.1 | 15.3 | 17.0 | 17.4 | 15.3 |
| Top marginal PIT rate | 30 | 35 | 35 | 35 | 45 | 30 | 13 | 13 | 13 | 13 | 13 |

**Sources:** Finances in Russia 2000, Russian Statistical Yearbook (2004), Federal Tax Department website (www.nalog.ru).
**Notes:** All tax revenues are for the consolidated budget and exclude non-budgetary funds. Real growth of GDP and tax revenues is calculated using a GDP deflator.

**Table 2: Tax Evasion Function, FE**

| | lnC1-lnY1 | lnC2-lnY1 | lnC1-lnY2 | lnC2-lnY2 |
|---|---|---|---|---|
| | | *Panel A* | | |
| N of HH members | -0.010 | -0.033** | 0.018 | -0.005 |
| | (0.013) | (0.013) | (0.013) | (0.013) |
| N of senior HH members, 60+ | -0.210*** | -0.200*** | -0.180*** | -0.169*** |
| | (0.022) | (0.022) | (0.022) | (0.022) |
| N of children in HH, 18- | 0.088*** | 0.076*** | 0.034 | 0.023 |
| | (0.022) | (0.022) | (0.021) | (0.021) |
| Year = 1998 | -0.026 | -0.025 | -0.026 | -0.025 |
| | (0.020) | (0.020) | (0.020) | (0.020) |
| Year = 2001 | -0.142*** | -0.139*** | -0.140*** | -0.137*** |
| | (0.017) | (0.017) | (0.018) | (0.018) |
| Year = 2002 | -0.221*** | -0.213*** | -0.216*** | -0.208*** |
| | (0.018) | (0.018) | (0.018) | (0.018) |
| Year = 2003 | -0.208*** | -0.203*** | -0.217*** | -0.213*** |
| | (0.018) | (0.018) | (0.018) | (0.018) |
| Year = 2004 | -0.268*** | -0.262*** | -0.265*** | -0.260*** |
| | (0.018) | (0.018) | (0.018) | (0.018) |
| *HH head characteristics* | | | | |
| Age | -0.004*** | -0.004*** | -0.002** | -0.001* |
| | (0.001) | (0.001) | (0.001) | (0.001) |
| Years of schooling | -0.006 | -0.004 | -0.007* | -0.005 |
| | (0.004) | (0.004) | (0.004) | (0.004) |
| Married | -0.093*** | -0.087*** | -0.060** | -0.053** |
| | (0.024) | (0.024) | (0.023) | (0.023) |
| Currently works | -0.298*** | -0.278*** | -0.151*** | -0.130** |
| | (0.055) | (0.054) | (0.052) | (0.052) |
| Years of tenure | 0.003** | 0.003*** | 0.002* | 0.002** |
| | (0.001) | (0.001) | (0.001) | (0.001) |
| Works at enterprise | -0.076* | -0.083* | -0.081* | -0.089** |
| | (0.046) | (0.045) | (0.044) | (0.044) |
| Works in private sector | -0.105*** | -0.105*** | -0.085*** | -0.084*** |
| | (0.021) | (0.021) | (0.021) | (0.021) |
| Log (firm size) | -0.020*** | -0.019*** | -0.016*** | -0.015*** |
| | (0.006) | (0.006) | (0.006) | (0.006) |
| N observations (households) | 24129 (6135) | 24129 (6135) | 24723 (6202) | 24723 (6202) |
| $R^2$ overall | 0.05 | 0.04 | 0.03 | 0.03 |
| | | *Panel B* | | |
| After reform trend (2001=1) | -0.067*** | -0.066*** | -0.066*** | -0.065*** |
| | (0.005) | (0.005) | (0.005) | (0.005) |

**Notes:** We report Arellano (1987) robust standard errors in parentheses to control for arbitrary serial correlation; * significant at 10%; ** significant at 5%; *** significant at 1%. Omitted categories are the year 2000 and the state sector. All specifications are estimated on the full sample with household fixed effects (FE). HH denotes household. Household head is the person with the largest income. The dependent variable - consumption-income gap - is defined in the text. Besides the after-reform trend, the model estimated in Panel B includes the same set of covariates as in Panel A. Two dummy variables for missing sector and firm size are included but not shown here. C1=expenditures on non-durable goods,

C2=C1+transfers, Y1=regular income, and Y2=Y1+irregular payments. The number of observations in specifications with lnY2 is greater than that with lnY1 because the former specifications include the households reporting irregular payments as the only source of their income.

**Table 3: Consumption-Income Gap and Attitudes toward Taxes, 1998 and 2002**

| | **lnC1-lnY1** | **lnC2-lnY1** | **lnC1-lnY2** | **lnC2-lnY2** |
|---|---|---|---|---|
| Perception of tax payments | 0.266*** | 0.254** | 0.359*** | 0.348*** |
| (at the district level) | (0.102) | (0.102) | (0.102) | (0.102) |
| Year = 2002 | -0.172*** | -0.161*** | -0.170*** | -0.160*** |
| | (0.020) | (0.020) | (0.020) | (0.020) |
| N observations | 7539 | 7539 | 7806 | 7806 |
| $R^2$ | 0.09 | 0.07 | 0.05 | 0.04 |

**Notes:** We report Arellano (1987) robust standard errors in parentheses to control for arbitrary serial correlation; * significant at 10%; ** significant at 5%; *** significant at 1%. Household head is the person with the largest income. The dependent variable - consumption-income gap - is defined in the text. Perception of tax payments is a district-level measure for the share of individuals who believe that most people don't pay taxes or pay taxes on less than half of their income. Besides perception of tax payments, the model includes the same set of covariates as in Table 2. C1=expenditures on non-durable goods, C2=C1+transfers, Y1=regular income, and Y2=Y1+irregular payments.

**Table 4: Tax Enforcement in Russia Before and After the Tax Reform**

| | 1999 | 2000 | 2001 | 2002 | 2003 |
|---|---|---|---|---|---|
| | | *Tax Audits* | | | |
| Accrued tax revenues from tax audits and sanctions, bln. Rubles | 189[c] | 283 | 274 | 220.6 | 261 |
| Of which received, bln. rubles | 30.5 | 41.6 | 59.7 | 68.7 | NA |
| Number of on-site audits, thousands | 796 | 690 | 605 | 468.2 | 331.9 |
| Number of on-site audits of individual entrepreneurs, thousands | 759[c] | 664 | 415 | 222.9 | 124.1 |
| Accrued tax revenues from on-site audits, bln rubles | 49.7 | 75 | 68.4 | NA | 47.7 |
| of which received, bln rubles | 20.3 | 21 | 17.8 | NA | NA |
| | | *Charges for Tax Law Violations* | | | |
| Administrative charges against enterprise managers, thousands people | 329 | 350 | 312 | 186 | NA |
| Administrative charges against individual entrepreneurs, thousands people | 480 | 510 | 289 | 96 | NA |
| Total amount of charges, millions rubles | 195 | 247 | 255 | 150 | NA |
| Number of blocked bank accounts, thousands | 172 | 256 | 344 | 408 | NA |
| Number of cases sent to the tax police for further investigation, thousands | NA | 14.4 | 17 | 13.4 | 9.5 |
| Of which number of criminal cases opened, thousands | 1.3 | 3.2 | 4 | 2.6 | 1.1 |

**Source:** Federal Tax Department archive (www.nalog.ru); c – calculated from percentage changes reported in 2000.

**Table 5: Tax Evasion Function: Difference-in-Difference Approach, FE**

| | lnC1-lnY1 | lnC2-lnY1 | lnC1-lnY2 | lnC2-lnY2 |
|---|---|---|---|---|
| N of HH members | -0.016 | -0.037*** | 0.014 | -0.007 |
| | (0.014) | (0.014) | (0.014) | (0.014) |
| N of senior HH members, 60+ | -0.181*** | -0.173*** | -0.159*** | -0.152*** |
| | (0.027) | (0.027) | (0.026) | (0.026) |
| N of children in HH, 18- | 0.087*** | 0.077*** | 0.034 | 0.024 |
| | (0.022) | (0.022) | (0.022) | (0.022) |
| Year = 1998 | -0.020 | -0.016 | -0.028 | -0.025 |
| | (0.025) | (0.025) | (0.025) | (0.025) |
| Year = 2002 | -0.073*** | -0.068*** | -0.072*** | -0.066*** |
| | (0.020) | (0.020) | (0.020) | (0.019) |
| Year = 2003 | -0.076*** | -0.073*** | -0.080*** | -0.077*** |
| | (0.020) | (0.020) | (0.019) | (0.019) |
| Year = 2004 | -0.136*** | -0.129*** | -0.128*** | -0.120*** |
| | (0.021) | (0.021) | (0.020) | (0.020) |
| *HH head characteristics* | | | | |
| Age | -0.004*** | -0.003*** | -0.002** | -0.001 |
| | (0.001) | (0.001) | (0.001) | (0.001) |
| Years of schooling | -0.007 | -0.006 | -0.010** | -0.009* |
| | (0.005) | (0.005) | (0.005) | (0.005) |
| Married | -0.070*** | -0.071*** | -0.031 | -0.030 |
| | (0.027) | (0.027) | (0.026) | (0.026) |
| Currently works | -0.293*** | -0.277*** | -0.158*** | -0.142*** |
| | (0.055) | (0.055) | (0.052) | (0.051) |
| Years of tenure | 0.002* | 0.002* | 0.001 | 0.002 |
| | (0.001) | (0.001) | (0.001) | (0.001) |
| Works at enterprise | -0.083* | -0.084* | -0.081* | -0.083* |
| | (0.046) | (0.046) | (0.043) | (0.043) |
| Works in private sector | -0.100*** | -0.099*** | -0.085*** | -0.083*** |
| | (0.021) | (0.021) | (0.021) | (0.021) |
| Log (firm size) | -0.019*** | -0.018*** | -0.014** | -0.013** |
| | (0.006) | (0.006) | (0.006) | (0.006) |
| After reform dummy ($D_p$) | -0.103*** | -0.104*** | -0.106*** | -0.107*** |
| | (0.031) | (0.031) | (0.031) | (0.031) |
| $d^{treat} \times D_p$ | -0.109*** | -0.108*** | -0.105*** | -0.102*** |
| | (0.033) | (0.033) | (0.033) | (0.033) |
| N observations (households) | 17081 (4174) | 17081 (4174) | 17444 (4184) | 17444 (4184) |
| $R^2$ overall | 0.06 | 0.05 | 0.04 | 0.04 |

**Notes:** We report Arellano (1987) robust standard errors in parentheses to control for arbitrary serial correlation; * significant at 10%; ** significant at 5%; *** significant at 1%. Omitted categories are the state sector and years 2000 and 2001. All specifications are estimated on the full sample with household fixed effects (FE). HH denotes household. Household head is the person with the largest income. The dependent variable - consumption-income gap - is defined in the text. Treatment and control groups are defined on the basis of post-reform unadjusted for inflation earnings received in the last month. The sample includes households whose head is a wage earner (in contrast to Table 2 that is based on the full sample). Two dummy variables for missing sector and firm size are included but not shown here. C1=expenditures on non-durable goods, C2=C1+transfers, Y1=regular income, and Y2=Y1+irregular payments.

**Table 6: Treatment Effect in the Difference-in-Difference Approach**

| Alternative Specifications | lnC1-lnY1 | lnC2-lnY1 | lnC1-lnY2 | lnC2-lnY2 |
|---|---|---|---|---|
| *Panel A. Upper brackets × after reform dummy* ($D_p$ = 1 *if* 2001-2004) | | | | |
| Contractual earnings | | | | |
| Full sample | -0.095*** | -0.091*** | -0.101*** | -0.096*** |
| | (0.032) | (0.032) | (0.032) | (0.032) |
| | [17287] | [17287] | [17684] | [17684] |
| Restricted sample in current prices | -0.102*** | -0.098*** | -0.100*** | -0.095*** |
| | (0.032) | (0.032) | (0.032) | (0.032) |
| | [16068] | [16068] | [16434] | [16434] |
| Restricted sample in fixed prices | -0.124*** | -0.126*** | -0.116*** | -0.116*** |
| | (0.032) | (0.032) | (0.032) | (0.032) |
| | [16068] | [16068] | [16434] | [16434] |
| Restricted sample with | -0.114*** | -0.105*** | -0.101*** | -0.092*** |
| *district* × *year* interactions | (0.033) | (0.033) | (0.034) | (0.034) |
| | [16068] | [16068] | [16434] | [16434] |
| Restricted sample using the 4-year | -0.122*** | -0.122*** | -0.134*** | -0.132*** |
| average of contractual earnings | (0.031) | (0.031) | (0.031) | (0.031) |
| | [16068] | [16068] | [16434] | [16434] |
| *Panel B. Upper brackets × after reform time trend* ($t_p$ = 1 *if* 2001) | | | | |
| Contractual earnings | | | | |
| Full sample | -0.033*** | -0.031*** | -0.034*** | -0.032*** |
| | (0.010) | (0.010) | (0.010) | (0.010) |
| Restricted sample in current prices | -0.038*** | -0.035*** | -0.035*** | -0.033*** |
| | (0.010) | (0.010) | (0.010) | (0.010) |
| Restricted sample in fixed prices | -0.041*** | -0.040*** | -0.036*** | -0.035*** |
| | (0.009) | (0.009) | (0.009) | (0.009) |
| Restricted sample with | -0.044*** | -0.039*** | -0.039*** | -0.035*** |
| *district* × *year* interactions | (0.010) | (0.010) | (0.010) | (0.010) |
| Restricted sample using the 4-year | -0.037*** | -0.035*** | -0.037*** | -0.035*** |
| average of contractual earnings | (0.009) | (0.009) | (0.009) | (0.009) |
| Earnings received last month | | | | |
| Full sample | -0.038*** | -0.036*** | -0.034*** | -0.032*** |
| | (0.010) | (0.010) | (0.010) | (0.010) |
| Restricted sample in current prices | -0.039*** | -0.037*** | -0.034*** | -0.032*** |
| | (0.010) | (0.010) | (0.010) | (0.010) |

**Notes:** Robust standard errors are in parentheses and the number of observations is in brackets; * significant at 10%; ** significant at 5%; *** significant at 1%. We use Arellano (1987) robust standard errors to correct for arbitrary serial correlation. The dependent variable - consumption-income gap - is defined in the text. Reported are the estimated coefficients on the interaction term between the treatment group (upper brackets) and a post-reform dummy (or trend in Panel B) using different measures of earnings and samples. All specifications are estimated with household fixed effects and include the same set of variables as in equation (3) and Table 4. The number of observations in panels B is the same as in Panel A. C1=expenditures on non-durable goods, C2=C1+transfers, Y1=regular income, and Y2=Y1+irregular payments.

**Table 7: Treatment Effect in the Difference-in-Difference Approach: Heterogeneous Response**

| Alternative Specifications | lnC1-lnY1 | lnC2-lnY1 | lnC1-lnY2 | lnC2-lnY2 |
|---|---|---|---|---|
| *State vs. public sector* | | | | |
| $d^{treat} \times D_p$ (State sector is omitted) | 0.001 | -0.017 | -0.014 | -0.030 |
| | (0.054) | (0.054) | (0.052) | (0.052) |
| $d^{treat} \times D_p \times$ Private | -0.229*** | -0.192** | -0.236*** | -0.201** |
| | (0.080) | (0.080) | (0.079) | (0.079) |
| N observations | 17287 | 17287 | 17684 | 17684 |
| *Blue collar vs. White collar* | | | | |
| $d^{treat} \times D_p \times$ Private (Blue collar workers are omitted) | -0.111 | -0.073 | -0.133 | -0.097 |
| | (0.103) | (0.103) | (0.099) | (0.099) |
| $d^{treat} \times D_p \times$ Private $\times$ White collar | -0.302** | -0.308** | -0.295** | -0.297** |
| | (0.123) | (0.125) | (0.124) | (0.124) |
| N observations | 17287 | 17287 | 17684 | 17684 |

**Notes:** We report Arellano (1987) robust standard errors in parentheses to control for arbitrary serial correlation; * significant at 10%; ** significant at 5%; *** significant at 1%. The dependent variable - consumption-income gap - is defined in the text. Reported are the estimated coefficients on the interaction term between the treatment group (upper brackets) and a post-reform dummy using different measures of earnings. Treatment and control group are defined on the basis of post-reform contractual earnings. All specifications are estimated with household fixed effects and include the same set of variables as in equation (3) and Table 4. C1=expenditures on non-durable goods, C2=C1+transfers, Y1=regular income, and Y2=Y1+irregular payments.

**Table 8: Treatment Effect in the Weighted Difference-in-Difference Approach**

| Alternative specifications | lnC1-lnY1 | lnC2-lnY1 | lnC1-lnY2 | lnC2-lnY2 |
|---|---|---|---|---|
| Earnings received last month | -0.120** | -0.120** | -0.123*** | -0.123** |
| | (0.050) | (0.050) | (0.050) | (0.050) |
| N observations (weighted) | 16909 | 16909 | 17261 | 17261 |
| $R^2$ overall | 0.11 | 0.11 | 0.09 | 0.08 |
| Contractual earnings | -0.098** | -0.095** | -0.109** | -0.108** |
| | (0.048) | (0.048) | (0.047) | (0.046) |
| N observations (weighted) | 17180 | 17180 | 17571 | 17571 |
| $R^2$ overall | 0.11 | 0.10 | 0.08 | 0.07 |

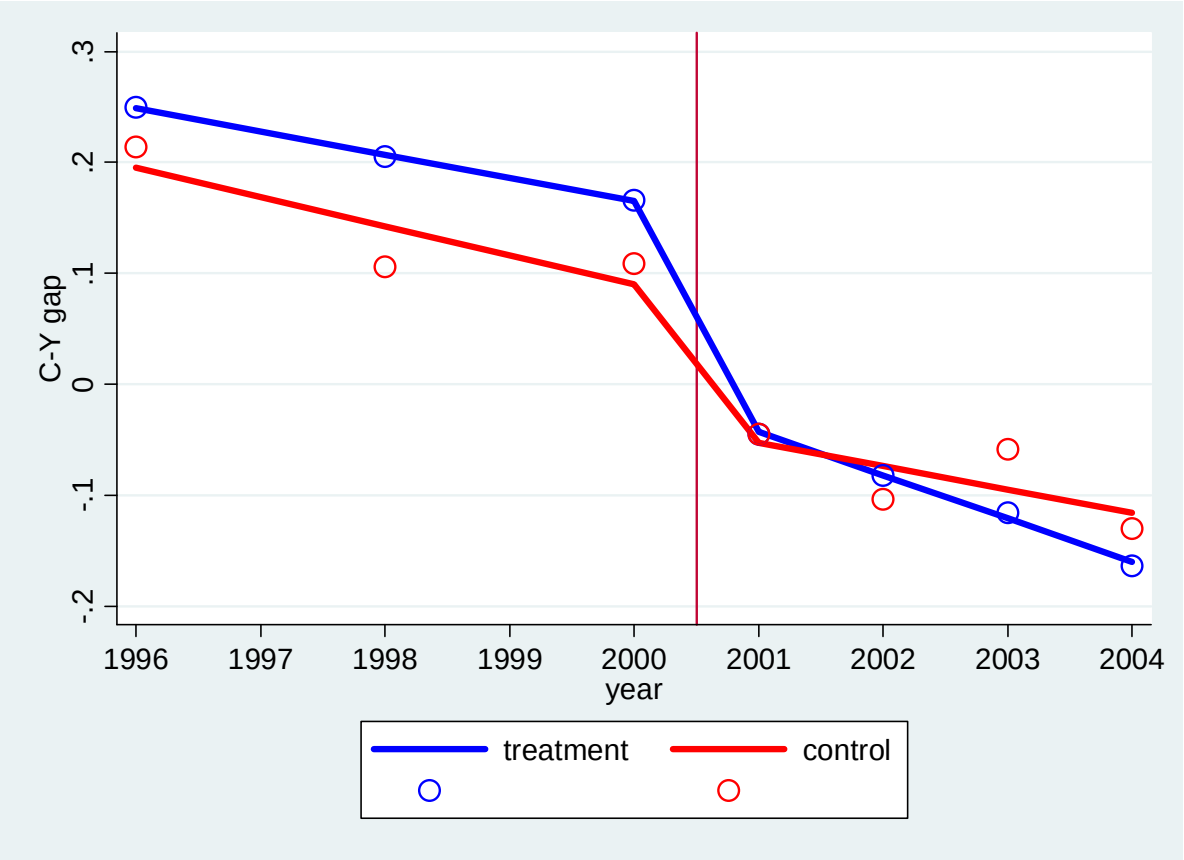
**Notes:** We report Arellano (1987) robust standard errors in parentheses to correct for arbitrary serial correlation; * significant at 10%; ** significant at 5%; *** significant at 1%. The dependent variable - consumption-income gap - is defined in the text. Reported are the estimated coefficients on the interaction term between the treatment group (upper brackets) and a post-reform dummy. All specifications are estimated by weighted least squares with household fixed effects, and include the same set of variables as in equation (3) and Table 4. The WDID approach produces the same estimates for both full and restricted samples because observations beyond the restricted sample have zero weights. C1=expenditures on non-durable goods, C2=C1+transfers, Y1=regular income, and Y2=Y1+irregular payments.

**Table 9: Tax Evasion vs. Productivity Effects**

| Alternative specifications | lnY1 | lnC1 | lnY2 | lnC2 |
|---|---|---|---|---|
| | *Difference-in-difference* | | | |
| Earnings received last month | 0.189*** | 0.080*** | 0.188*** | 0.087*** |
| | (0.029) | (0.024) | (0.030) | (0.024) |
| N observations | 17081 | 17081 | 17444 | 17444 |
| $R^2$ overall | 0.23 | 0.18 | 0.21 | 0.17 |
| Contractual earnings | 0.175*** | 0.080*** | 0.184*** | 0.088*** |
| | (0.028) | (0.023) | (0.029) | (0.023) |
| N observations | 17287 | 17287 | 17684 | 17684 |
| $R^2$ overall | 0.22 | 0.18 | 0.21 | 0.17 |
| | *Weighted difference-in-difference* | | | |
| Earnings received last month | 0.101*** | -0.019 | 0.106** | -0.017 |
| | (0.045) | (0.036) | (0.044) | (0.035) |
| N observations | 16909 | 16909 | 17261 | 17261 |
| $R^2$ overall | 0.25 | 0.20 | 0.24 | 0.19 |
| Contractual earnings | 0.117*** | 0.018 | 0.130*** | 0.022 |
| | (0.041) | (0.037) | (0.043) | (0.037) |
| N observations | 17180 | 17180 | 17571 | 17571 |
| $R^2$ overall | 0.26 | 0.21 | 0.25 | 0.20 |

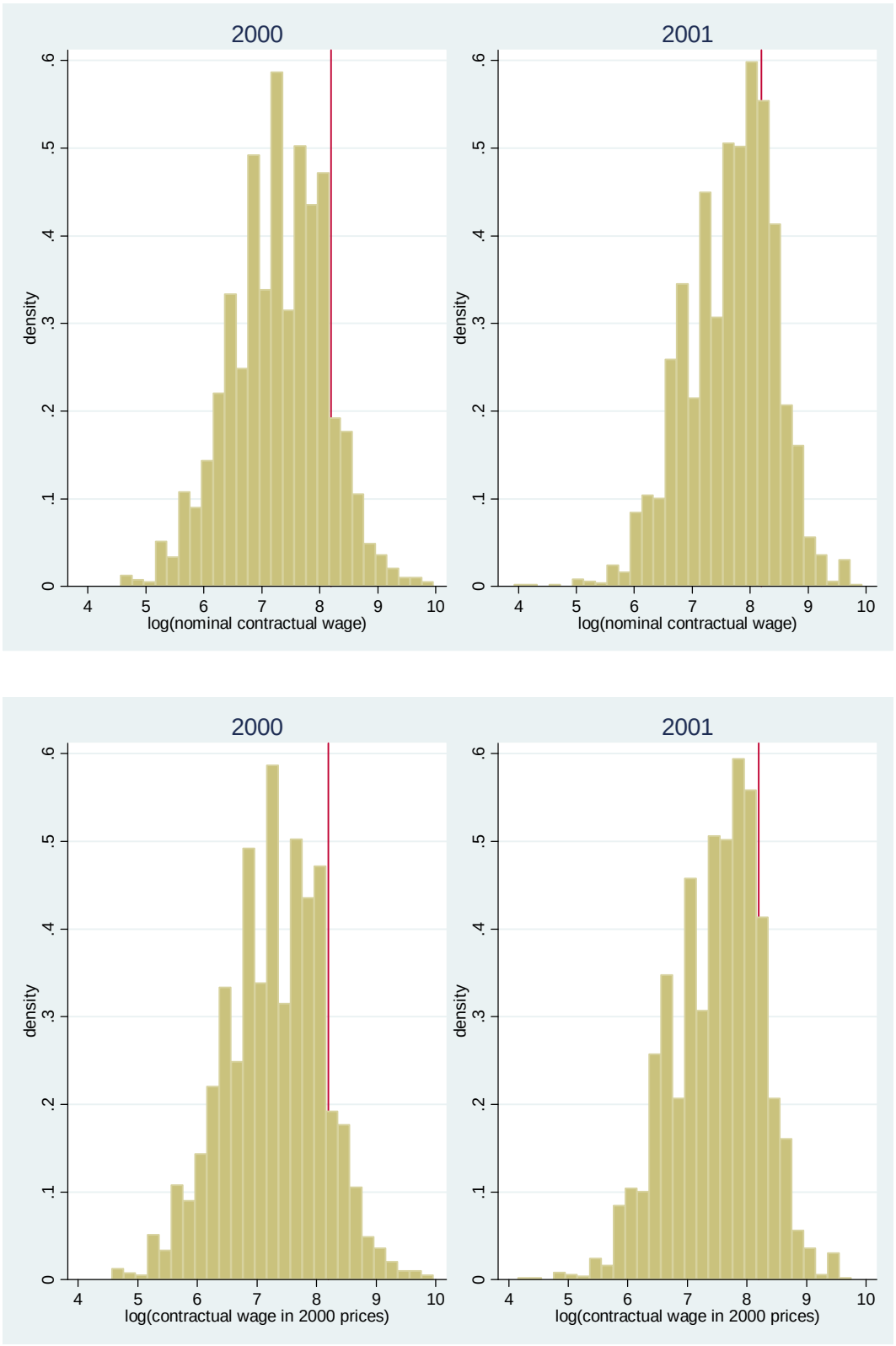
**Notes:** We report Arellano (1987) robust standard errors in parentheses to correct for arbitrary serial correlation; * significant at 10%; ** significant at 5%; *** significant at 1%. Reported are the estimated coefficients on the interaction term between the treatment group (upper brackets) and a post-reform dummy. All specifications are estimated on the full sample with household fixed effects and include the same set of variables as in equation (3) and Table 4. C1=expenditures on non-durable goods, C2=C1+transfers, Y1=regular income, and Y2=Y1+irregular payments. The estimates are obtained from the two systems of simultaneous equations: a) lnY1 and lnC1 and b) lnY2 and lnC2.

**Figure 1: Consumption-Income Gap Dynamics for Treatment and Control Groups**




**Notes:** The figure shows annual means of the consumption-income gap for treatment and control groups after controlling for observable characteristics and household fixed effects. Treatment and control group are defined on the basis of post-reform contractual earnings.

**Figure 2: Income Distribution Below and Above the Threshold**




**Notes:** The histograms display income distribution before and after the 2001 flat tax reform. The vertical line indicates the threshold in the personal income tax. Before the reform (2000), individuals to the left of

the line paid 12% personal income tax rate and 1% pension fund contributions. Individuals to the right of the line paid 20% (or 30% for higher incomes) personal income tax rate and 1% pension fund contributions.

**Table A1: Summary Statistics**

| | All | Treatment Group | Control Group |
|---|---|---|---|
| C1 | 6462 | 7608 | 4331 |
| | (5995) | (6675) | (3592) |
| C2 | 6922 | 8135 | 4667 |
| | (6743) | (7453) | (4348) |
| C3 | 7816 | 9393 | 4884 |
| | (11566) | (13420) | (5863) |
| C4 | 5768 | 6767 | 3909 |
| | (12939) | (15336) | (6003) |
| Y1 | 6442 | 7880 | 3767 |
| | (7134) | (7017) | (6555) |
| Y2 | 7317 | 8822 | 4517 |
| | (12392) | (13005) | (10610) |
| Y3 | 6573 | 7973 | 3969 |
| | (7242) | (7184) | (6600) |
| N of HH members | 3.089 | 3.184 | 2.911 |
| | (1.322) | (1.286) | (1.370) |
| N of senior HH members, 60+ | 0.329 | 0.288 | 0.406 |
| | (0.609) | (0.575) | (0.661) |
| N of children in HH, 18- | 0.829 | 0.864 | 0.765 |
| | (0.862) | (0.845) | (0.889) |
| Age | 42.229 | 40.622 | 45.219 |
| | (14.084) | (12.981) | (15.498) |
| Years of schooling | 11.869 | 12.234 | 11.190 |
| | (2.632) | (2.465) | (2.793) |
| Married | 0.583 | 0.618 | 0.518 |
| | (0.493) | (0.486) | (0.500) |
| Currently works | 0.833 | 0.884 | 0.740 |
| | (0.373) | (0.321) | (0.439) |
| N1 | 17046 | 5959 | 11087 |
| | | | |
| Years of tenure | 8.080 | 7.639 | 9.062 |
| | (9.376) | (9.006) | (10.082) |
| Works at enterprise | 0.930 | 0.927 | 0.938 |
| | (0.255) | (0.260) | (0.241) |
| Works in state sector | 0.439 | 0.390 | 0.548 |
| | (0.496) | (0.488) | (0.498) |
| Works in private sector | 0.449 | 0.502 | 0.331 |
| | (0.497) | (0.500) | (0.470) |
| Log (firm size) | 3.357 | 3.473 | 3.098 |
| | (2.749) | (2.826) | (2.552) |
| N2 | 14203 | 4407 | 9796 |

**Notes:** All income and consumption measures are in December 2002 rubles. HH denotes household. Household head is the person with largest earnings. N1 includes the same households as in column 1 of

Table 4 whose head was employed at least once after the reform. N2 includes only those households whose head is currently employed in any given year. C1=expenditures on non-durable goods, C2=C1+transfers, C3=C1+purchases of durables, C4=C1+net savings, Y1=regular income, Y2=Y1+irregular payments, and Y3=Y1+income from selling home grown goods. Treatment and control groups are defined on the basis of post-reform contractual earnings.

**Table A2: Tax Evasion Function with Alternative Measures of Income and Expenditures: Difference-in-Difference Approach, FE**

| | lnC3-lnY1 with Purchases of Durables | lnC4-lnY1 with Net Savings | lnC1-lnY3 with Home Production |
|---|---|---|---|
| N of HH members | -0.002 | -0.028* | -0.019 |
| | (0.015) | (0.016) | (0.014) |
| N of senior HH members, 60+ | -0.212*** | -0.149*** | -0.170*** |
| | (0.028) | (0.029) | (0.026) |
| N of children in HH, 18- | 0.081*** | 0.083*** | 0.088*** |
| | (0.023) | (0.025) | (0.022) |
| Year = 1998 | -0.044* | -0.033 | -0.003 |
| | (0.026) | (0.027) | (0.025) |
| Year = 2002 | -0.058*** | -0.060*** | -0.073*** |
| | (0.021) | (0.022) | (0.020) |
| Year = 2003 | -0.051** | -0.040* | -0.084*** |
| | (0.021) | (0.022) | (0.020) |
| Year = 2004 | -0.107*** | -0.106*** | -0.135*** |
| | (0.022) | (0.022) | (0.020) |
| *HH head characteristics* | | | |
| Age | -0.004*** | -0.004*** | -0.004*** |
| | (0.001) | (0.001) | (0.001) |
| Years of schooling | -0.005 | -0.010* | -0.006 |
| | (0.005) | (0.005) | (0.005) |
| Married | -0.067** | -0.038 | -0.067*** |
| | (0.028) | (0.028) | (0.026) |
| Currently works | -0.297*** | -0.277*** | -0.265*** |
| | (0.058) | (0.060) | (0.054) |
| Years of tenure | 0.003** | 0.002 | 0.002 |
| | (0.001) | (0.001) | (0.001) |
| Works at enterprise | -0.076 | -0.048 | -0.084* |
| | (0.048) | (0.049) | (0.045) |
| Works in private sector | -0.093*** | -0.068*** | -0.099*** |
| | (0.023) | (0.023) | (0.021) |
| Log (firm size) | -0.021*** | -0.021*** | -0.017*** |
| | (0.006) | (0.006) | (0.006) |
| After reform dummy ($D_p$) | -0.110*** | -0.098*** | -0.085*** |
| | (0.032) | (0.033) | (0.030) |
| Upper brackets × $D_p$ | -0.091*** | -0.105*** | -0.114*** |
| | (0.034) | (0.035) | (0.032) |
| N observations (households) | 17059 (4174) | 16373 (4152) | 17081 (4174) |
| $R^2$ overall | 0.04 | 0.04 | 0.05 |

**Notes:** We report Arellano (1987) robust standard errors in parentheses to correct for arbitrary serial correlation; * significant at 10%; ** significant at 5%; *** significant at 1%. Omitted categories are the state sector and years 2000 and 2001. All specifications are estimated on the full sample with household fixed effects (FE). HH denotes household. Household head is the person with the largest income. The dependent variable - consumption-income gap - is defined in the text. Treatment and control groups are defined on the basis of post-reform unadjusted for inflation monthly earnings received in the last month. The sample includes households whose head is a wage earner (in contrast to Table 2 that is based on the full sample). Two dummy variables for missing sector and firm size are included but not shown here. C1=expenditures on

non-durable goods, C3=C1+purchases of durables, C4=C1+net savings, Y1=regular income, and Y3=Y1+income from selling home grown goods.

**Table A3: Tax Evasion vs. Productivity Effects, Full Specification**

| | Difference-in-Difference | | Weighted Difference-in-Difference | |
|---|---|---|---|---|
| | **lnY1** | **lnC1** | **lnY1** | **lnC1** |
| N of HH members | 0.214*** | 0.198*** | 0.242*** | 0.204*** |
| | (0.013) | (0.011) | (0.017) | (0.015) |
| N of senior HH members, 60+ | 0.069*** | -0.110*** | 0.045* | -0.121*** |
| | (0.024) | (0.020) | (0.028) | (0.029) |
| N of children in HH, 18- | -0.140*** | -0.047*** | -0.174*** | -0.062*** |
| | (0.022) | (0.016) | (0.027) | (0.021) |
| Year = 1998 | -0.224*** | -0.245*** | -0.238*** | -0.292*** |
| | (0.023) | (0.017) | (0.030) | (0.025) |
| Year = 2001 | 0.154*** | 0.077*** | 0.130*** | 0.100*** |
| | (0.018) | (0.013) | (0.024) | (0.017) |
| Year = 2002 | 0.239*** | 0.159*** | 0.223*** | 0.167*** |
| | (0.019) | (0.013) | (0.024) | (0.018) |
| Year = 2003 | 0.344*** | 0.203*** | 0.317*** | 0.217*** |
| | (0.019) | (0.013) | (0.024) | (0.018) |
| *HH head characteristics* | | | | |
| Age | 0.002** | -0.002*** | 0.003** | -0.002** |
| | (0.001) | (0.001) | (0.001) | (0.001) |
| Years of schooling | 0.009** | 0.002 | 0.009 | 0.005 |
| | (0.005) | (0.004) | (0.006) | (0.005) |
| Married | 0.182*** | 0.105*** | 0.158*** | 0.116*** |
| | (0.024) | (0.019) | (0.034) | (0.028) |
| Currently works | 0.434*** | 0.144*** | 0.447*** | 0.195*** |
| | (0.049) | (0.035) | (0.070) | (0.052) |
| Years of tenure | -0.002** | -0.000 | -0.002 | -0.000 |
| | (0.001) | (0.001) | (0.002) | (0.001) |
| Works at enterprise | 0.054 | -0.031 | 0.115** | -0.021 |
| | (0.041) | (0.030) | (0.058) | (0.043) |
| Works in private sector | 0.150*** | 0.055*** | 0.137*** | 0.028 |
| | (0.021) | (0.015) | (0.027) | (0.020) |
| Log (firm size) | 0.026*** | 0.007* | 0.023*** | 0.010* |
| | (0.006) | (0.004) | (0.007) | (0.006) |
| After reform dummy ($D_p$) | 0.153*** | 0.041** | 0.172*** | 0.041 |
| | (0.026) | (0.020) | (0.039) | (0.033) |
| Upper brackets*$D_p$ | 0.175*** | 0.080*** | 0.117*** | 0.018 |
| | (0.028) | (0.023) | (0.041) | (0.037) |
| N observations (households) | 17287 | 17287 | 17180 | 17180 |
| $R^2$ overall | 0.22 | 0.18 | 0.26 | 0.21 |

**Notes:** We report Arellano (1987) robust standard errors in parentheses to correct for arbitrary serial correlation; * significant at 10%; ** significant at 5%; *** significant at 1%. Omitted categories are the state sector and years 2000 and 2001. All specifications are estimated on the full sample with household fixed effects. C1=expenditures on non-durable goods, C2=C1+transfers, Y1=regular income, and Y2=Y1+irregular payments. The estimates are obtained from the system of two simultaneous equations lnY1 and lnC1. Two dummy variables for missing sector and firm size are included but not shown here. Treatment and control groups are defined on the basis of post-reform contractual earnings.

## Table A4: Tax Evasion vs. Productivity Effects

| Alternative specifications | lnY1 | lnC1 | lnY2 | lnC2 |
|---|---|---|---|---|
| | *Earnings received last month* | | | |
| Upper brackets × $D_p$ | 0.139*** | 0.052** | 0.136*** | 0.059** |
| | (0.030) | (0.025) | (0.031) | (0.025) |
| 31% top bracket × $D_p$ | 0.212*** | 0.120*** | 0.225*** | 0.119*** |
| | (0.041) | (0.032) | (0.041) | (0.033) |
| N observations | 17081 | 17081 | 17444 | 17444 |
| $R^2$ overall | 0.23 | 0.18 | 0.21 | 0.17 |
| | *Contractual earnings* | | | |
| Upper brackets × $D_p$ | 0.141*** | 0.063*** | 0.145*** | 0.070*** |
| | (0.029) | (0.024) | (0.030) | (0.024) |
| 31% top bracket × $D_p$ | 0.182*** | 0.091** | 0.207*** | 0.093** |
| | (0.046) | (0.036) | (0.046) | (0.037) |
| N observations | 17287 | 17287 | 17684 | 17684 |
| $R^2$ overall | 0.23 | 0.18 | 0.21 | 0.17 |

**Notes:** We report Arellano (1987) robust standard errors in parentheses to correct for arbitrary serial correlation; * significant at 10%; ** significant at 5%; *** significant at 1%. Reported are the estimated coefficients on the interaction of a post-reform dummy with the two upper brackets and the 31% top bracket. All specifications are estimated on the full sample with household fixed effects and include the same set of variables as in equation (3) and Table 4. C1=expenditures on non-durable goods, C2=C1+transfers, Y1=regular income, and Y2=Y1+irregular payments. The estimates are obtained from the two systems of simultaneous equations: a) lnY1 and lnC1 and b) lnY2 and lnC2.