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## Behavioral Responses and the Equity Effects of Personal Income Taxes

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**Keywords:** Income distribution, evasion, productivity, simulation, taxes, consumption.

**JEL Classification:** D3, D63, H24, H26, H31

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## 1. Introduction

A casual inspection of personal income tax systems across the world reveals a dramatic shift in income tax policy over the last thirty years. Top statutory PIT rates have fallen by more than 20 percentage points on average (Sabirianova-Peter, Buttrick, and Duncan 2009). Marginal rates throughout the income distribution as well as measures of average rate progression all point to lower levels of income tax progressivity. In fact, regardless of the measure used, PIT schedules are significantly flatter today than they were in the late 1970s. Additionally, an increasing number of countries have adopted or are considering the adoption of a linear PIT schedule. The most popular among these is the Russian flat tax reform of 2001, which is believed to have acted as a catalyst for other countries in recent years.[1]

This trend toward flatter PIT schedules has generated significant debate in tax policy circles. For example, Fuest, Peichl, and Schaefer (2008) is among a long list of papers that try to evaluate the distributional impact of flat taxes. These studies unanimously argue against the adoption of a flat tax in Western European countries on the grounds that the equity costs are too high. In other words, flattening the PIT schedule would increase efficiency but worsen the distribution of income. However, these results fail to explain the continuous decline in income inequality in Russia even after the flat tax was adopted in 2001. One is therefore left to question whether a flatter PIT schedule necessarily increases income inequality.

The conventional argument is simple; a flatter PIT reduces the tax burden facing the rich relative to the poor thus increasing the inequality in net income. Simultaneously, those affected by the lower tax burden are induced to change their behavior in ways that improve efficiency.

[1] Current estimates put the number of countries with a flat rate PIT at 24 as at January 1st 2009. This number is up from 14 in 2005. The majority of countries using the flat rate PIT are the former communist countries of Eastern Europe.

Then, if these tax-induced behavioral responses are relatively greater among the rich, the pre-tax income of the rich increases relative to that of the poor thus leading to a further increase in net income inequality. That is, flattening PIT schedules increases income inequality due to changes in the tax burden as well as through tax-induced changes in behavior. Following this reasoning, one is forced to reject efforts to flatten PIT schedules if equity is a major policy concern.

However, the analysis above ignores the fact that tax-induced behavioral responses include evasion and avoidance, both of which are income shifting activities rather than real changes in income. These income shifting activities necessitates that a distinction be made between observed and actual net income inequality. While the conclusions above still hold for observed net income, the distributional impact of PIT rates on actual net income inequality is likely to be ambiguous and counterintuitive under certain conditions. For example, if the rich are induced to report a greater share of their hidden income, both reported gross and net income inequality will rise while actual net income inequality will fall. This example is simple but quite powerful. It shows that studying the distributional impact of tax reforms requires that a distinction be made between actual and reported income inequality. It also points to the need to carefully identify to various channels through which taxes affect the distribution of income as these channels need not all work in the same direction.

The objective of the current paper is to decompose the distributional effect of personal income (PIT) taxes into its direct effect and indirect effect. The direct effect is the change in net income distribution that occurs if PIT rates change and pre-tax income remains the same. The indirect effect, on the other hand, arises because of changes in pre-tax income induced by the tax reform as well as other factors unrelated to the tax system. I also extend the literature by identifying the tax-induced behavioral responses that contribute to the indirect effect. The tax-induced indirect effect is comprised of several components related to the many dimensions along which individuals may adjust their income in response to tax changes. Following Gorodnichenko, Martinez-Vazquez, and Sabirianova Peter (2009), I classify these responses into two broad categories; evasion/avoidance and real productivity effects.[2]

In sum, the paper answers the following questions; how much of the change in the distribution of net income can we attribute to the personal income tax system? How much of the tax-induced change in the distribution is due to the direct tax effect vis-à-vis the indirect effect? Which channel, evasion or productivity, for example, is the major driving force behind the indirect effect? Do these tax-induced behavioral responses affect reported net income inequality differently than actual net income inequality?

I implement the analysis using data from the Russian Longitudinal Monitoring Survey (RLMS) to study the distributional impact of the Russian flat tax reform. I rely on a micro-simulation counterfactual analysis and elasticities of evasion and productivity to decompose the change in income inequality into the various channels. Following the literature, I use consumption as a proxy for actual net income with the gap between consumption and reported net income reflecting the extent of underreporting. The results show that indirect behavioral responses had a significantly larger effect on the distribution of income than the mechanical direct tax effect. I identify the tax-induced components of the indirect effect and show that the evasion response had a larger impact on inequality than productivity responses. While the qualitative effect of productivity responses is the same for both reported net income and actual net income (consumption), I find that the sign of the evasion effect depends on the income

[2]The productivity effect is broadly defined to include all the possible behavioral changes that can affect the total income earned except compliance, which is identified separately. The indirect effect also includes non-tax induced changes in behavior. However, the primary focus of this paper is on the distributional impact of tax-induced behavioral responses.

measure. The results show that the evasion response lowered actual net income inequality while increasing reported net income inequality. However, the combined tax-induced effects cannot explain the decline in income inequality observed in Russia over the sample period.

This analysis makes several important contributions to the literature. It is the first study to identify the relative size and sign of the various channels through which the Russian flat tax reform affected the distribution of income. The existing literature either focuses on the US PIT system (e.g., Alm, Lee, and Wallace 2005; Poterba 2007) or use hypothetical flat tax reforms in Western Europe (Fuest, Peichl, and Schaefer 2008). It is also the first paper to decompose the tax-induced behavioral effects into evasion and productivity responses. Existing work in this area have identified parts of the productivity response (e.g., Altig and Carlstrom 1999) while no one has so far identified the evasion effect.[3]

The paper also makes worthy contributions to tax policy debates. For example, I show that changes in gross income are more important that changes in tax rates, income shifting (evasion/avoidance responses) has a greater effect than real productivity changes, and that tax-induced responses are not as important as other factors that affect gross income. These results imply that separating tax policy from income redistribution policies is superior to the philosophy of redistribution via taxes. Therefore, my results will help policy makers design policies that target specific channels in an effort to improve the distribution of income. For example, my results imply that investing in education and other training programs that improve employability and earning power would have a more significant effect on reducing inequality than tax progressivity.

[3] I distinguish between the compliance effect and productivity effect. Gramlich, Kasten and Sammartino (1993) and Altig and Carlstrom (1999) are limited in this respect; the first focus on labor supply and capital gains while the latter focuses on labor supply and savings. Also, Alm, Lee and Wallace (2005) and Poterba (2007) only identify the direct and indirect effects. They don't identify the tax-induced behavioral effects.

A final contribution of the paper relates to the popular efficiency equity trade-off literature. To see this contribution, it is important to recognize that changes in inequality that arise from income shifting via evasion/avoidance reflect pre-existing inequality and are therefore somewhat artificial. In other words, observed inequality can increase if a lower tax rate causes individuals in the right tail of the income distribution to report a relatively greater share of their income. This increase in inequality represents a shift toward the true inequality that existed prior to the tax change. Therefore, to the extent that this "artificial" effect is relatively large, the actual equity costs of the efficiency gained from switching to a flatter tax schedule will be much lower than observed. In this case, it is optimal to adopt a flatter tax schedule not only because it is more efficient but also because the true equity effects are smaller than we think. In fact, my results show that it is possible to improve both efficiency and equity in countries with high levels of evasion that is very responsive to tax rates.

The remainder of the essay is structured as follows. Section two discusses the theoretical framework. The empirical strategy is discussed in section 3 and section 4 gives a brief summary of the Russian tax reform. The data and results are discussed in sections 5 and 6, and section 7 concludes.

**2. Theoretical Framework:**

In this section I describe the theoretical framework used to inform the empirical analysis. To fix ideas, consider Figure 1. Assume that the rich hide a greater share of their income relative to the poor[4] and that the PIT schedule is progressive. Under these assumptions, actual gross

[4] This is not an innocuous assumption as there is evidence that compliance is lowest at the two endpoints of the income distribution (Bloomquist 2003; Alm, Bahl, and Murray 1990). Third-party reporting and the high share of labor income for individuals in the middle of the distribution explain much of this relationship. However, I make this assumption since the focus is on developing countries where it is more likely to hold due to less effective third

income is more unequally distributed than reported gross income, $\psi(Y_T) > \psi(Y_R)$ and actual net income is more unequally distributed than reported net income $\psi(NI_R) \leq \psi(NI_T)$; $\psi(*)$ is an inequality index with larger values indicating higher levels of inequality. Now assume that a linear personal income tax schedule is adopted, which induces individuals to increase actual gross income, $Y_T$ and decrease hidden income, $Y_H$.

It is important to realize that the tax reform will affect the distribution of reported net income via a direct channel and an indirect channel, which is due to tax-induced changes in $Y_T$ and $Y_H$, and other non-tax related factors. If the indirect effect is relatively greater among the rich, then reported net income will become more unequally distributed. More importantly, the change in reported inequality is likely to be different than the change in actual inequality because of the evasion effect. To see this more clearly, assume that the tax-induced productivity effect is zero and that compliance increases to 100%. Under these assumptions, hidden income falls to zero and the new observed net income distribution would be more unequal than its pre-reform counterpart but less unequal than the pre-reform true net income distribution; i.e., $\psi(NI_T^{t-1}) > \psi(NI_T^{t}) = \psi(NI_R^{t}) > \psi(NI_R^{t-1})$. While it is clear that observed inequality has increased, the reality is that the distribution of true post-reform net income is more equal than its pre-reform counterpart. In other words, the evasion response increases observed inequality but reduces true inequality. It also follows from this example that the observed change in the distribution of net income includes an artificial component, which results in an overstatement of the change in inequality.[5]

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party reporting and law enforcement. Most incidence studies find that PIT schedules, even in developing countries, are progressive (see Martinez-Vazquez (2008) for an extensive review of the tax incidence literature).

[5] Implicit in this example is the assumption that the percentage change in evasion is greater than the percentage change in the tax rate and that the tax reform affects the rich disproportionately.

We can show these results more formally by relying on actual inequality indices as in Duncan and Sabirianova Peter (2008). Here I will illustrate the distributional effects using the variance of log as an index of inequality starting with observed net income inequality.

**2.1 Observed Net Income Inequality**

From the above analysis, we know that each individual will choose how much to earn and how much to evade. I use the variance of log income as a measure of income inequality to demonstrate the effect of a change in the tax rate, $t$, on the distribution of reported net income, $NI_R$.[6] The effect of taxes on the distribution of income can be obtained by differentiating the index with respect to taxes. I write the variance of log net income as:

$$VLI = Var(log\,NI) = \frac{1}{n}\sum_{i=1}^{n}(log\,NI_i)^2 - (log\tilde{\mu})^2 \qquad 1$$

where $log\tilde{\mu} = \frac{1}{n}\sum_{i=1}^{n}(log\,NI_i)$ is the mean of log income, $NI_i = (y_i^* - E_i)(1 - t_i)$ is reported net income, $y_i^*$ is true earned income, and $E$ is hidden income. Totally differentiating eq. 1 with respect to $t_i$ yields the following.[7]

$$\mathrm{d(VLI)} = \frac{2}{\mathrm{n}}\sum_{i=1}^{n}(\log(NI_i) - log\tilde{\mu})\,{NI_i}^{-1}\left[\left(y_i^*\varepsilon_{y_i} - E_i\varepsilon_{E_i}\right)\left(\frac{1-t_i}{t_i}\right) - (y_i^* - E_i)\right]dt_i \qquad 2,$$

which I rewrite as

$$\mathrm{d(VLI)} = \frac{2}{\mathrm{n}}\sum_{i=1}^{n}A_i\left[\left(\varepsilon_{y_i} - \pi_i\varepsilon_E\right)\left(\frac{1-t_i}{t_i}\right) - (1 - \pi_i)\right]dt_i \qquad 3$$

where $A_i = (\log(NI_i) - log\tilde{\mu})\frac{(1-t_i)}{(1-\pi_i)}^{-1}$, $\pi_i = \frac{E_i}{y_i^*}$, and $\varepsilon_j = \frac{dj}{dt}\frac{t}{j}$ is the elasticity of $j$ (evasion or income) with respect to taxes.

6 Since y and E are derived from a utility maximization problem they are functions of the tax rate, among other parameters. Note also, that I ignore transfers for this exercise. See appendix 2 for an extension.
7 I am assuming that individual *i's* tax rate does not affect individual *k's* behavior.

It is clear from eq. 3 that the net effect of taxes on inequality depends on the sum of its effect on the various parts of the income distribution. While the sign of the term in square brackets is likely to be negative for everyone (as discussed in more detail later), the sign of the first term varies along the income distribution. It is negative for those earning less than mean income and positive for those earning more than mean income. Therefore, reducing the tax rate on individuals above mean income should increase income inequality, while reducing taxes on those below mean income should reduce inequality. The net effect will depend on which of these two effects dominates.[8] This finding is consistent with the previous literature. In particular, it is commonly known that the impact of any tax reform on the distribution of income depends on the existing income distribution (Poterba, 2007; Fuest, Peichl, and Schaefer 2008; Paulus and Peichl, 2008).

Equation 3 also shows that taxes affect inequality through direct and indirect channels. The direct effect is captured by the term $(1-\pi_i)$ while the tax-induced indirect effects are captured by $\left(\varepsilon_{y_i}-\pi_i\varepsilon_E\right)\left(\frac{1-t_i}{t_i}\right)$, which includes both the productivity effect, $\varepsilon_{y_i}$ and the evasion effect, $\pi_i\varepsilon_E$. Now, to see the distributional impact of a tax reform, let us assume that $dt_i$=0 for everyone below mean income, $dt_i$<0 for those above mean income, $\varepsilon_{y_i}<0$, and $\varepsilon_E>0$.[9] Under these assumptions, all three channels contribute to an unambiguous increase in observed net income inequality. This result is due to the fact that both the evasion and productivity responses lead to a relative increase in reported gross income for the rich, which in turn leads to an increase in observed net income inequality. The direct effect is also straight forward; the lower rates on

[8] Obviously, if a tax reform involves reducing top rates only, the change in inequality will be positive. This assumes that the top rate applies only to individuals whose income is above the mean.
[9] I make these assumptions to simplify the discussion. Note that $A_i$ is positive for these individuals. Besides convenience, these assumptions are similar to the changes made via the tax reform that I analyze in the empirical section.

the rich reduce their tax burden relative to the tax burden facing the poor thus resulting in an increase in net income inequality.

### 2.2 True net income inequality

Unlike observed net income inequality, the effect of taxes on actual net income is ambiguous even under reasonable assumptions and may be counterintuitive in some cases. I illustrate this by making one change to the net income definition: specifically, I add the amount of hidden income to the observed net income. The distributional statistic, all parameters, and variables are as defined in the previous section. I start by defining true net income as follows

$$NI_i^T = (1 - t_i)y_i^* + t_i E_i \qquad 4$$

Totally differentiating eq. 1 with net income defined as in eq. 4 yields

$$\mathrm{d(VLI))} = \frac{2}{\mathrm{n}}\sum_{i=1}^{n}\left(\log\left(NI_i^T\right) - log\tilde{\mu}\right)[(1 - t_i) + t_i\pi_i]^{-1}\left[\varepsilon_{y_i}\left(\frac{1-t_i}{t_i}\right) + \pi_i\varepsilon_E - (1 - \pi_i)\right]dt_i \qquad 5$$

Note that the sign of the first term, $\left(\log\left(NI_i^T\right) - log\tilde{\mu}\right)$, and the direct effect, $(1 - \pi_i)$ are as in the previous section. However, the distributional effect of taxes on actual net income remains ambiguous even if we make similar assumptions to those made in the previous section. In fact, it is possible for a reduction in the tax rate to reduce actual net income inequality. This possibility is greatest when evasion is widespread (large $\pi$) and is very responsive (large positive $\varepsilon_E$) to the tax rate. Under these conditions, shifting to a flatter tax schedule will make the distribution of actual net income more equal as the evasion response outweighs both the direct and productivity effects.

The theoretical discussion above tells a compelling story about the possible distributional impact of tax reforms and how such effects should be evaluated. In particular, it points to the need to distinguish between direct and indirect effects by acknowledging the role played by behavioral responses, and between actual and observed net income inequality by acknowledging the role played by evasion. Ignoring these distinctions can lead to seriously misguided policy prescriptions. For example, whereas a reduction in tax rates can be expected to increase observed net income inequality, it can also reduce actual net income inequality. Similarly, the evasion response is shown to affect observed net income inequality differently than it does actual net income inequality; the evasion effect leads to increased observed inequality but may lower true inequality, ceteris paribus. An empirical analysis is therefore required to identify the sign and size of the various channels discussed above.

## 3. Russia and the Flat Tax

Although the issues discussed in this paper apply broadly to all countries, the data requirement greatly restrict the number of countries for which the analysis can be implemented. The ideal data set would have longitudinal data on true and reported gross income before and after a major tax reform. This would allow me to identify the evasion and real productivity elasticities using appropriate econometric techniques. The data would also include information on deductions, credits and other allowances, tax liability, and hence measures of net income. Unfortunately, these data do not exist for any country in the world. I overcome these data limitations by focusing on Russia. I should note that Russia does have certain limitations that must also be addressed for the study to be feasible. Below I describe the pros and cons of analyzing Russia as well as the assumptions under which the analysis is valid.

The most critical parameters needed for the analysis are the evasion and productivity elasticities. Although Russia does not have data on true gross income or evasion, a recent study by Gorodnichenko, Martinez-Vazquez, and Sabirianova-Peter (GMP 2009) uses the 2001 Russian flat tax reform and data from the Russian Longitudinal Monitoring Survey (RLMS) to estimate these elasticities based on the consumption income gap approach. Their approach is valid under the assumption that consumption is a good proxy for actual net income and that the gap between consumption and reported net income is due primarily to underreporting rather than dissaving.[10] For these same reasons, I am able to use consumption as a proxy for actual net income in my analysis. The corresponding gross income measures are obtained by inverting the tax function in each period taking into account basic deductions, which are available to everyone.

Also contributing to the choice of Russia is the fact that they implemented one of the most significant PIT reforms of the 21st century. The graduated PIT schedule was replaced with a linear PIT on January 1st 2001 (Table 1). The two top rates of 30 and 20 percent were eliminated and the threshold increased from 3168 rubles to 4800 rubles. The reform also eliminated the 1 percent social contribution, which employees were required to pay. Therefore, everyone paid the same flat rate of 13 percent after the reform as long as their income was above 4800 rubles.[11] From Table 1, we observe that individuals making over 50,000 rubles were the primary beneficiaries of the reform. Therefore, focusing on Russia allows me to identify the distributional impact of an actual flat PIT reform, which is an advantage over studies that focus on hypothetical reforms (e.g. Fuest, Peichl, and Schaefer 2008). I describe the data set used and provide more information on the required variables in the following sections.

## 4. Empirical Strategy

This section outlines the empirical approach that is used to determine the effect of taxes on the distribution of income. I use estimates of the elasticity of true gross income with respect

[10] GMP (2009) provides a number of reasons and empirical test to demonstrate that this is indeed the case for Russia. They show that consumption is greater than income for the entire sample period, that the gap declined after the tax reform, that the saving rate remained stable for the duration of the sample at around 6 percent, and that the level of saving required to explain the gap is approximately -30 percent.

[11] For a more extended description of the reform see Ivanova et al. (2005).

to taxes and the elasticity of evasion with respect to taxes to simulate counterfactual net income distributions, which are then used to decompose the change in the distribution of net income into direct, evasion and productivity effects.[12] Auten and Carroll (1999) and Gruber and Saez (2002) use the reported taxable income elasticity popularized by Feldstein (1995) to emphasize the importance of tax rates in explaining changes in the distribution of income. Although this approach can be used to identify the tax-induced indirect effect, I argue that it will lead to an overstatement of the change in the distribution of net income because it fails to distinguish between evasion and real productivity responses.[13] To illustrate, write reported taxable income as $TI_R = (y^* - E)$. Differentiating with respect to $t$ and writing in elasticity form yields $\frac{\partial TI_R}{\partial t} = \frac{1}{t}\left(y^*\epsilon_y - E\epsilon_E\right)$, which includes the two main parameters of interest: the elasticity of true income $\epsilon_y$ and the elasticity of evasion $\epsilon_E$. Since evasion leads to artificial changes in the distribution of net income, using the responsiveness of taxable income to identify the effect of taxes on the distribution of income would lead to incorrect conclusions. It is for this reason that each component must be separately identified.

**Identification of the distributional effect**

The distributional impact of the tax reform is obtained using a counterfactual based analysis as in Alm, Lee, and Wallace 2005; and Poterba 2007. Implementation is via micro-simulation exercises that allow me to examine the effect of taxes on the distribution of income with and without behavioral responses. The methodology is implemented in several steps. First, I calculate an index of the income distribution for the pre-reform period (year 2000) and the post-

[12] Poterba (2007) and Alm, Lee, and Wallace (2005) uses a similar counterfactual analysis to identify the direct and indirect effects.

[13] It has been shown, both theoretically and empirically, that the taxable income elasticity also overstates the efficiency gains/losses of a tax change if the elasticity is driven by evasion or avoidance that involves only transfer costs (Chetty, 2009; and GMP). Slemrod (1998), Slemrod and Kopczuk (2002), and Gruber and Saez (2002) provide useful summaries of the taxable income elasticity literature.

reform period (years 2002 and 2003).[14] These two measures are used to calculate the total change in the distribution of net income between the two periods. I then calculate two counterfactual net income distributions; net income when pre-reform tax schedule is applied to post-reform income and net income when post-reform tax schedule is applied to pre-reform income.[15] The indirect effect is obtained by comparing the former counterfactual distribution with the observed pre-reform net income distribution. Similarly, I obtain the direct effect by comparing the latter counterfactual distribution with the observed pre-reform net income distribution.

The second step is to identify the tax-induced behavioral effects which are part of the indirect effect. This is done under two separate approaches. Under the first, I ignore the presence of evasion and treat all changes in reported gross income as real changes. By ignoring the fact that the evasion response affects the distribution of actual income differently than it does reported income inequality, this approach should overestimate the distributional impact of the tax changes. I correct for this in the second approach, which distinguishes between evasion/avoidance and real productivity responses. Both approaches require information on elasticities of evasion, productivity, and reported gross income, the pre-reform gross income distribution, and the pre-reform tax schedule.

[14] I exclude the year of the reform since it may take some time for individuals to fully respond the incentives created by the reform (Duncan and Sabirianova Peter 2009).
[15] See Tables 2 and 3 for a summary of the counterfactual income distributions and how they are compared to identify the various components of the change in income distribution. Estimating the counterfactuals require several steps of which the most important is the imputation of gross income. The steps are outlined in detail in the accompanying simulation appendix.

**Adjusting for behavioral responses**

Below I give a brief description of the approach used to adjust reported gross income for evasion and productivity responses.[16] First, write reported gross income as $Y_{ig} = Y^*_{ig} - E_i$ and define the tax-induced change in evasion and true gross income as follows:

$$\Delta E_i = E_i \times \varepsilon_e \times \frac{\Delta \tau_i}{\tau_i} \quad \Rightarrow \quad E_i^{'} = E_i (1 + \varepsilon_e \times \frac{\Delta \tau_i}{\tau_i}) \qquad 6$$

$$\Delta Y^*_{ig} = Y^*_{ig} \times \varepsilon_y \times \frac{\Delta \tau_i}{\tau_i} \quad \Rightarrow \quad Y_{ig}^{*/} = Y^*_{ig} (1 + \varepsilon_y \times \frac{\Delta \tau_i}{\tau_i}) \qquad 7$$

Equations 6 and 7 give us the new level of hidden income and true gross income induced by a change in the tax rate. Using eq. 6 and the definition of reported gross income, we can write down an expression for the new level of reported income - due to the change in evasion – as

$$Y_{ig}^{'} = Y^*_{ig} - E_i (1 + \varepsilon_e \times \frac{\Delta \tau_i}{\tau_i}) \qquad 8$$

which then implies that the percentage change in individual reported gross income due to the change in evasion (assuming no productivity response) is

$$\% \Delta Y_{ig} = (Y_{ig}^{'} - Y_{ig}) / Y_{ig} = -\varepsilon_h \times \frac{\Delta \tau_i}{\tau_i} \times \frac{\pi}{1 - \pi}; \qquad \pi = E/Y \qquad 9$$

Similarly, the percentage change in individual reported gross income due to the change in productivity (assuming no evasion response) can be written as

$$\% \Delta Y_{ig} = \varepsilon_y \times \frac{\Delta \tau_i}{\tau_i} \times \frac{1}{1 - \pi} \qquad 10$$

Finally, the percentage change in individual reported gross income due to the change in both evasion and productivity is

$$\% \Delta Y_{ig} = \frac{\Delta \tau_i}{\tau_i} \times \frac{\varepsilon_y - \varepsilon_e \pi}{1 - \pi} \qquad 11$$

[16] A more detailed step by step description of the approach used to adjust gross income for evasion and productivity responses is provided in the methodological appendix, which is available upon request.

Equations 9, 10, and 11 allow me to write reported gross income adjusted for evasion and productivity as $Y_{ig}^{ey} = Y_{ig} + Y_{ig} \times [\frac{\Delta \tau_i}{\tau_i} \times \frac{\varepsilon_y - \varepsilon_e \pi}{1-\pi}]$, which nests the evasion effect ($\varepsilon_y = 0$), the productivity effect ($\varepsilon_e = 0$), and the myopic view that ignores the distinction between evasion and real productivity changes (set $\pi$=0 and replace the elasticity of true income, $\varepsilon_y$ with the elasticity of reported gross income).

The beauty of this approach is that the level of evasion, which cannot be observed, is not needed. Although the share of evasion in true income, $\pi$ is unknown, sensitivity analysis can be used to determine its effect on the results. Using a similar procedure, I calculate the change in true gross income as $Y_{ig}^{*y} = Y_{ig}^{*} + Y_{ig}^{*} \times \varepsilon_y \times \frac{\Delta \tau}{\tau}$. The premise of this derivation is that the level and responsiveness of evasion does not affect true gross income.[17] Adjusting income as suggested above ignores the fact that, tax induced changes in savings, say, may lead to changes in capital, which in turn affects income. My analysis ignores these second round effects.[18]

The above procedure allows me to write down counterfactuals that I use to determine the size and sign of the evasion and productivity effects.[19] I estimate the evasion effect, by comparing the pre-reform (year 2000) distribution of net income with the distribution of net income that would obtain if the only tax-induced behavioral response to the tax reform was evasion. The productivity effect is obtained similarly, except that I assume the only response is through productivity changes. I also estimate the total behavioral effect by allowing both evasion and productivity to change simultaneously (calculations are summarized in Tables 2 and

[17] It is possible that the ability to hide income affects the amount of income earned just as the amount of income earned might affect the amount of income that individuals hide (Slemrod 2001). However, estimates of these cross elasticities do not yet exist. As such, I ignore any possible cross effects.
[18] See Elmendorf et al. (2008) for a discussion of these additional second round effects.
[19] The adjustments use income in year 2000 as the base. Additionally, I hold the tax schedule constant so that any change must be due to the change in income only; base calculations are done using the pre-reform tax schedule.

3). Finally, I estimate the total tax-induced behavioral effect using the reported gross income elasticity, which ignores the difference between evasion and real productivity responses.

## 5. Data

The data are taken from the Russian Longitudinal Monitoring Survey (RLMS), which is a household level survey conducted annually since 1992 in two phase.[20] It is widely representative of the Russian population, covering approximately 32 regions, 38 randomly selected primary sampling units, and 7 Russian federal districts. The survey is administered in the last quarter of each year and includes four separate questionnaires; one for each household, each adult in the household, each child in the household, and a community questionnaire. According to the host website of the RLMS, the response rate exceeds 80 percent for households and 95 percent for individuals within each household. The data cover more than 4000 households and 10000 adults on average. Besides the relatively large sample size, the data set has a panel feature with two years before and 4 years after the Russian tax reform, which makes it suitable for my purposes.

The sample used in the empirical analysis is restricted to households in which at least one individual is between the ages of 25 and 60 years old. This restriction eliminates households that are either too young or too old, which may contribute to non-random fluctuations in income. Additionally, I focus on the years 2000 (pre-reform base year) and 2002 for my base results. Although the reform became effective on January 1st 2001 and data are collected in the last quarter of the year, I exclude the year 2001 from the analysis to allow individuals more time to respond to the new tax schedule.

[20] No survey was conducted in 1997 and 1999. The survey is a joint project between the Population Center at the University of North Carolina and the Russian Academy of Sociology. Information on sample selection, attrition and the like can be obtained from the host site; http://www.cpc.unc.edu/projects/rlms.

Sample attrition is relatively minor in the RLMS as compared to other large panel datasets. Nonetheless, there is some evidence that the attrition is nonrandom; those who leave the sample tend to be more educated, have higher income, and are more likely to have lived in Moscow and St. Petersburg (Mu 2006). This non-random attrition means that any observed decline in inequality maybe due to the fact that the upper tail of the income distribution loses a relatively larger share of people over time. However, the RLMS makes an effort to replenish the sample over time, especially for Moscow and St. Petersburg, thus partly solving the attrition (Gorodnichenko, Sabirianova Peter, and Stolyarov et al. 2009).

### 5.1 Variables

The RLMS has some, but not all, of the ideal variables needed to complete the analysis. No data is available for true gross income, reported gross income, true net income, or tax liability. I do have data on reported net income and the tax function, including the rules for calculating basic deductions. I also have data on consumption, which I use as a proxy for true net income under the assumption that the consumption income gap observed in Russia cannot be explained by dissaving (GMP 2009, and Ivanova et al. 2005). The core analysis is conducted at the household level because data on consumption and some components of income are only available the household level. Where possible I do provide individual level results as well. Below I briefly describe each measure of income.[21]

### Reported Net Income

The RLMS collects reported net income data at both the individual and household levels. Individual measures include actual monetary labor income earnings received last month and contractual monetary labor earnings (received on average over the last 12 months). Contractual

[21] The simulation appendix outlines the iterative process used to recover gross income measures.

monetary labor earnings are used to create a third income measure; imputed contractual monetary labor earnings.[22] Actual income is more prone to monthly income shocks, which may be the result of wage arrears, forced leave, and sickness, among others. Contractual earnings on the other hand, are more stable as they reflect the usual income received per month over a one year period. Using the imputed contractual earnings is advantageous because it provides a more accurate description of income within households, which is the unit of measurement used to test the main hypotheses of the paper. The baseline results at the individual level use imputed contractual labor earnings at the primary and secondary job. Although labor earnings are the only component of income available at the individual level, it represents over 80% of income and should therefore do a good enough job of describing the distributional impact of the tax reform at the individual level.

Imputed contractual labor earnings are summed across individuals within households to obtain a base measure of household reported net income. A second measure, reported disposable income before public transfers is obtained by adding non-labor income to household labor earnings.[23]

**Actual Net Income**

I use consumption as a proxy for actual net income, which is, by definition, unobservable. The fact that consumption is also subjected to under-reporting means that it gives us a lower bound on actual net income. Therefore, any differential effect of taxes on consumption should represent a lower bound to the differential effect on actual net income. While income measures

[22] The imputation is for working non-respondents. Because the PIT is assessed on the individual, the imputation is done in an effort to obtain an accurate measure of household net income, which involves summing tax liability across individuals within households.

[23] These include net private transfers and financial income, which are received at the household level. Net private transfers refer to receipts (money and in kind) from non-government sources minus contributions to individuals outside the household unit.

are available at both individual and household level, consumption is only available at the household level. I use non-durable consumption, which includes expenditure data on more than 55 food items at home and away from home plus durable consumption as my baseline measure of true income.[24]

**Gross Income Measures**

Unfortunately, the RLMS does not collect information on gross income. Since the analysis requires these data, I impute them by inverting the tax function for each period. The implicit assumptions underlying the inversion are that monthly income is received uniformly throughout the year and that reported net income reflects tax liability actually paid. Starting with net income, I recover the gross income measures using an iterative process in STATA. The iterative process simultaneously imputes gross income and the implied tax liability for each individual. Next, I calculate gross income at the household level by adding household level tax liability to the respective measures of household net income, where household tax liability is the within household summation of the individual level tax liability based on imputed contractual earnings.[25] I then proceed with the analysis as described in the empirical section and the simulation appendix.

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[24] Food items are reported for the last 7 days while other non-durables are reported for the last 30 days. See table A1 for a detail description of each variable.

[25] This is necessary because tax is administered at the individual level. The alternative would be to impute household level gross income measures directly using the iterative procedure that is used for individuals. However, this approach would lead to incorrect estimates of pre-reform gross income since the effective tax rate of the household would be at least as great as the effective rate facing any given member of that household. This is due to the fact that the pre-reform tax schedule is a graduated one. It doesn't matter which approach is taken in the post reform period since the tax rate is flat. I base all household level gross income measures on the individual level imputed contractual earnings variable in an effort to deal with non-response of working adults within some households.

## 6. Results

Implementation of the micro-simulation exercise involves a number of steps that are outlined in section 4 of the simulation appendix. The first step in the exercise is to recover the gross income measures since the RLMS only reports net figures. The imputed gross income measures are then used to calculate each of the counterfactual net incomes in Table 3 using the formulas in Table 1. The counterfactual net incomes are then used to calculate several indices of income inequality. These include the GINI coefficient, coefficient of variation (CV), and the variance of log (Var-log). Baseline indices are calculated using only non-zero values of each income measure. All income/consumption measures are converted to December 2002 prices, and household measures are adjusted using the OECD equivalence scale. Additionally, the individual (household) level inequality indices are calculated using the RLMS individual (household) sample weights to address sample attrition and other sampling errors.[26]

### 6.1 PIT progressivity

Before discussing the direct/indirect effects of the tax reform, Table 4 shows two measures that summarize the ability of the pre-reform and post-reform PIT schedules to reduce income inequality. The first measure, percent change in the GINI coefficient, captures the degree to which the tax schedules reduce the inequality in gross income by taking the difference between the GINI of individual reported gross contractual earnings and the GINI of net contractual earnings (Alm, Lee, and Wallace 2005). The second is a measure of effective progressivity defined as $1-G_a/1-G_b$ , where $G_a$ is the GINI of net income and $G_b$ is the GINI of gross income; a value above (below) 1 indicate that the tax is progressive (regressive) (Musgrave and Thin 1948). Panel A of Table 4 applies the pre-reform tax schedule to gross

[26] The RLMS sample weights adjusts for sample design factors and deviations from the census characteristics, which implicitly address sample attrition.

income in each year while Panel B uses the post-reform tax schedule. Therefore, each panel captures the effectiveness of each tax schedule to reduce inequality over time.

The results show that the graduated tax schedule of the pre-reform era is more effective at reducing income inequality than the linear post-reform schedule. In fact, the effectiveness of the pre-reform schedule increases over the sample period while the post-reform schedule becomes less effective. For example, the pre-reform PIT schedule reduced inequality, as measured by the GINI coefficient, by 4 percent in 2000. This is compared to a 2.7 percent decline that would have taken place had the post-reform PIT schedule existed in the year 2000. A similar comparison for the remaining years reveal that the pre-reform schedule out performs the post-reform schedule through the sample period. The implications of these results are addressed in the next sections where I decompose the change in the distribution of income across periods into direct and indirect effects.

### 6.2 Direct Vs Indirect Effect

Decomposing the total change in net income inequality between 2000 and 2002 into its direct and indirect effects is done using the counterfactuals in panel A of Table 3. For example, I calculate the net income that would be observed if the post-reform gross income existed in the pre-reform period (counterfactual C in panel A of Table 3). As indicated in panel C of Table 3, the direct tax effect can be measured by comparing the counterfactual net income labeled D with the net income distribution observed in the pre-reform year. The indirect effect, on the other hand, is obtained by comparing counterfactual C with the net income distribution observed in the pre-reform year. The results from this exercise are reported in Table 5.

Panel A of Table 5 reports the results for individual level reported imputed contractual earnings. The results show that inequality declined between the year 2000 and 2002; the GINI fell from 0.48 to 0.45. I decompose this total change into direct and indirect effects and find that indirect behavioral responses are the primary reasons for the decline. The change in the distribution of gross income between 2000 and 2002 would have led to a 12 percent decline in the GINI coefficient of net income had the pre-reform tax schedule existed in 2002. The direct effect, on the other hand, would have increased the GINI by 1.6 percent had the post reform tax schedule existed in the year 2000. Similar results are observed in Panel B where the analysis is at the household level using durable plus non-durable consumption as a proxy for actual net income and reported net income before public transfers. The direct effect had a relatively larger impact on consumption while the indirect effect is approximately equal for both measures of income.

### 6.3 Tax-Induced Indirect Effect

The results in Table 5 are consistent with previous work in this area (Alm, Lee, and Wallace 2006; Poterba 2007).[27] However, it is important to note that the indirect effect includes responses that are tax-induced as well as responses that are induced by other factors unrelated to the change in the tax schedule. This section identifies the tax-induced portion of the indirect effects under two separate assumptions; that there is tax evasion and that there is no tax evasion.

The last column of Table 6 reports the percent change in the GINI coefficient assuming that there is no tax evasion. That is, I treat the tax-induced change in reported gross income as a real change in total income available to the individual/household and adjust income using the reported gross income elasticity; GMP estimates this elasticity to be -0.21. The results show that

[27] These results remain consistent across inequality indices, measures of income, and choice of post-reform year.

the tax induced change in reported gross income led to a 15.8 percent increase in the GINI coefficient of individual contractual earnings. In other words, tax induced responses, under the assumption that there is no tax evasion, increased inequality in each measure of net income at both the individual and household level. This result is in line with expectations given that the tax reform induced individuals in the right tail of the income distribution to increase their reported income.[28]

As discussed in section 4, using this elasticity to determine the distributional impact of a tax reform will lead to biased estimates because it fails to distinguish between evasion and real productivity responses. I distinguish between these responses by using the counterfactuals in panel B of Table 3. Before applying the relevant tax schedules, I adjust the gross income of year 2000 using the procedure outlined in section 2.2 of the simulation appendix. I set the baseline parameter values equal to 0.26, -0.04, and 0.25, for evasion and productivity elasticities and evasion share, respectively; elasticities are from (GMP 2009) and the evasion share is from Ivanova et al. (2005).

One of the main problems encountered when adjusting gross income for evasion and productivity is the application of the elasticities. All tax liability figures have to be calculated at the individual level while the parameters are estimated at the household level. For example, suppose that evasion is the only tax induced behavioral response to the reform. Estimating the distributional impact of this response on household net income requires information on the gross income and tax liability implied by the evasion response. Therefore, the first step is to obtain the household gross income implied by the evasion response. As discussed above, this can only be

[28] Only individuals earning above 50,000 rubles were affected by the tax reform; see Table 1. GMP (2009), finds that individuals affected by the rate changes increased their reported income relative to those not affected by the reform. Duncan and Sabirianova Peter (forthcoming) also find evidence that labor supply increased among males who were affected by the rate changes relative to those not affected.

done if we have individual level gross income, making individual level evasion elasticity the more suitable parameter. To get around this problem, I assume that the evasion elasticity for each household applies to each member of that household.[29]

The adjustments also apply the same evasion share to everyone. While this is a strong assumption, I believe that it works in my favor because only individuals with income above 50,000 rubles are affected by the reform. Therefore, the results if I were to apply the evasion share by deciles, for example, should be stronger than what I obtain now.

The results reported in Table 6 show that distinguishing between evasion and real productivity responses is important when analyzing the distributional impact of a PIT rate change. First, I find that the combined effect of evasion and real productivity responses increases inequality in both reported net income and consumption. In other words, tax-induced behavioral responses, like the direct effect, led to an increase in net income inequality. The implication of this result is that non-tax related factors are the main driving force behind the decline in income inequality in Russia over the sample period.[30]

The importance of separating the evasion from the real productivity effects is also made clear by comparing columns 5 and 6. Such a comparison shows that the evasion effect is relatively larger than the real productivity effect regardless of income measure and unit of analysis. This suggest that a relatively larger share of the tax-induced increase in reported net income inequality at both the individual and household levels is being driven by increased reporting among those affected by the tax reform. For example, inequality in imputed

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[29] Since the estimated elasticity is for the average household, I am implicitly assuming that this is representative of the average individual. This is a strong assumption. Since the GMP method on which I rely can only be applied at the household level, I have no alternative. A similar procedure is followed for productivity. The reader should keep this in mind when interpreting the results. See the simulation appendix for details on the procedure.

[30] Gorodnichenko, Sabirianova Peter and Stolyarov (2009) provide a detail discussion of the trends in inequality in Russia between 1994 and 2005 including possible factors that may have contributed to the decline.

contractual earnings (Panel A of Table 6), as measured by the GINI coefficient, increases by 7.4 percent if evasion is the only response compared to 4.7 percent when productivity responses are the only behavioral effect. A similar pattern is observed for reported household income in Panel B. Since the evasion response involves shifting existing income, it represents an artificial change in the distribution of reported net income thus leading to an overestimate of the distributional impact of the reform. As such, I argue that policy prescriptions should be based on the contribution of the real productivity effect instead of the combined effect.

The second argument in favor of decomposing the tax-induced indirect effect into evasion and real productivity effects is evident from panel B of Table 6. I compare the distributional impact of the evasion effect on reported net income with its effect on actual net income (approximated by consumption). The results show that the evasion effect reduces consumption GINI by 0.1 percent while increasing reported net income GINI by 5.4 percent. Another obvious difference is that evasion has a much smaller effect on consumption than on reported income. Furthermore, the combined evasion and productivity effect is much larger for reported income than for consumption; GINI increase by 8.5 percent for reported income compared to 1.5 percent for consumption. These results are line with expectation since evasion can only affect actual net income through income shifting while the reported net income is directly affected by both evasion and productivity. That is, the nature of the Russian PIT reform led to a relative decline (increase) in hidden (reported) income among the rich, which then caused a decline (increase) in actual (reported) net income inequality. The productivity effect, on the other hand, increased both actual and reported net income disproportionately among the rich. Therefore, tax policies that ignore the distinction between evasion and productivity responses as well as the distinction between actual and reported net income are likely to lead to incorrect policy prescriptions.

**6.4 Robustness checks**

The results discussed here are qualitatively the same regardless of income/consumption measure, parameter values chosen, and inequality index. Furthermore, the size of the parameters used in the analysis affect the results in an intuitive way. For example, the results in Table 7 show that the artificial change in reported net income inequality increases with the share of income evaded and the responsiveness of evasion to PIT rate changes. As expected, varying the evasion parameters have little effect on consumption inequality while the size of the productivity response matters. For example, a productivity elasticity of -0.1 increases consumption GINI by 4.3 percent compared to an increase of only 1.7 percent when the productivity elasticity is -0.04. Robustness checks shown in Table A2 are qualitatively the same as those discussed here. I conduct several additional robustness checks using various measures of income and consumption that control for savings, public transfers, home production, and service value of own home consumption. These checks all support the results presented here and are available upon request. I also restrict the analysis to individuals with non-zero vales for imputed contractual earnings and find similar results.

**7. Conclusion**

Numerous researchers have identified the fact that tax payers change their behavior in response to changes in tax rates. While these behavioral changes are at the core of studies that look at efficiency and optimal tax policy, little is known about their impact on the relationship between tax rates and the distribution of income. Additionally, the existing literature either fails to identify the distributional impact of tax-induced behavioral responses all together or ignore some dimensions. In particular, the distributional impact of tax-induced changes in evasion remains an unexplored area in the empirical literature. I attempt to bridge this gap in the literature by decomposing the change income inequality into direct and indirect effects. The indirect effect is further decomposed into tax-induced evasion and productivity effects using elasticities of evasion and productivity. The analysis also distinguishes between reported income and actual income (consumption) inequality.

The analysis focuses on Russia due to strict data requirements. In particular, I use data from the Russian Longitudinal Monitoring Survey to study the distributional impact of the Russian flat tax reform. Focusing the analysis on Russia is advantageous because there is an actual flat tax reform to analyze, the RLMS has very rich data on consumption and income, and evasion and productivity elasticities are available; the latter two are crucial for my analysis.

I find that the switch to a flat PIT reduced the ability of the PIT to equalize net income and that the post-reform PIT's ineffectiveness worsens over the sample period. The results also show that mechanical changes in the tax rates had a relatively smaller effect on the distribution of income compared to indirect behavioral responses, which actually reduced income inequality. I identify the tax-induced portion of the indirect effect by using the evasion and productivity elasticities to estimate a series of counterfactual reported and actual net income measures at the household level. Net income is approximated by consumption. The results from this analysis show that the combined effect of evasion and productivity is positive, i.e., led to an increase in income inequality. However, further analysis reveals that the evasion effect is relatively larger than the productivity effect for reported net income but smaller for actual net income. In fact, I find that while tax induced changes in evasion led to an increase in reported net income, they reduced actual net income inequality.

These results have very serious policy implications especially for policy makers currently contemplating the adoption of a flat/flatter PIT schedule. First, it is very important that a distinction be made between evasion and real productivity effects. Failure to do so will lead to an overestimation of the distributional impact of tax rate changes and can result in incorrect policy advice. This distinction is particularly relevant in countries with very high levels of evasion. The results also show that tax-induced changes in behavior are not as important as are other factors that affect earning potential. For example, it may be more useful to invest in education and other training programs that improve the employability of working age individuals than to rely on the tax schedule as a tool for redistributing income.

**References:**


Alm, James; Roy Bahl and Matthew N. Murray. 1990. "Tax Structure and Tax Compliance." *Review of Economics and Statistics*, 72 4, pp. 603-13.

Alm, James; Fitzroy Lee and Sally Wallace. 2005. "How Fair? Changes in Federal Income Taxation and the Distribution of Income, 1978 to 1998." *Journal of Policy Analysis and Management*, 24 1, pp. 5-22.

Altig, David and Charles T. Carlstrom. 1999. "Marginal Tax Rates and Income Inequality in a Life-Cycle Model." *American Economic Review*, 89 5, pp. 1197-215.

Auten, Gerald and Robert Carroll. 1999. "The Effect of Income Taxes on Household Income." *Review of Economics and Statistics*, 81 4, pp. 681-93.

Bloomquist, Kim M. 2003. "Income Inequality and Tax Evasion: A Synthesis." *OECD Papers*, 3(10), pp. 1-25.

Chetty, Raj. 2009. "Is the Taxable Income Elasticity Sufficient to Calculate Deadweight Loss? The Implications of Evasion and Avoidance." *American Economic Journal: Economic Policy*, 1(2), pp. 31-52.

Duncan, Denvil and Klara Sabirianova Peter. 2009. "Does Labor Supply Respond to a Flat Tax? Evidence from the Russian Tax Reform." *Economics of Transition forthcoming*.

____. 2008. "Tax Progressivity and Income Inequality," Andrew Young School of Policy Studies Research Paper Series, No. 08-26

Elmendorf, Douglas W.; Jason Furman; William G. Gale and Benjamin H. Harris. 2008. "Distributional Effects of the 2001 and 2003 Tax Cuts: How Do Financing and Behavioral Responses Matter?" *National Tax Journal*, 61(3), pp. 365-80.

Feldstein, Martin. 1995. "The Effect of Marginal Tax Rates on Taxable Income: A Panel Study of the 1986 Tax Reform Act." *Journal of Political Economy*, 103 (3), pp. 551-72.

Fuest, Clemens; Andreas Peichl and Thilo Schaefer. 2008. "Is a Flat Tax Reform Feasible in a Grown-up Democracy of Western Europe? A Simulation Study for Germany." *International Tax and Public Finance*, 15(5), pp. 620-36.

Gorodnichenko, Yuriy; Jorge Martinez-Vazquez and Klara Sabirianova Peter. 2009. "Myth and Reality of Flat Tax Reform: Micro Estimates of Tax Evasion Response and Welfare Effects in Russia." *Journal of Political Economy*, 117(3), pp. 504-54.

Gorodnichenko, Yuriy; Klara Sabirianova-Peter and Dmitriy Stolyarov. 2009. "Inequality and Volatility Moderation in Russia: Evidence from Micro-Level Panel Data on Consumption and Income." *Review of Economic Dynamics forthcoming*.

Gramlich, Edward M.; Richard Kasten and Frank Sammartino. 1993. "Growing Inequality in the 1980s: The Role of Federal Taxes and Cash Transfers," In *Uneven Tides: Rising Inequality in America,* ed. S. Danziger and P. Gottschalk, 225-49. New York: Russell Sage Foundation.

Gruber, Jon and Emmanuel Saez. 2002. "The Elasticity of Taxable Income: Evidence and Implications." *Journal of Public Economics*, 84 (1), pp. 1-32.

Ivanova, Anna; Michael Keen and Alexander Klemm. 2005. "The Russian 'Flat Tax' Reform." *Economic Policy*, 20(43), pp. 397-435.

Martinez-Vazquez, Jorge. 2008. "The Impact of Budgets on the Poor: Tax and Expenditure Benefit Incidence Analysis," In *Public Finance for Poverty Reduction: Concepts and Case Studies from Africa and Latin America,* ed. B. Moreno-Dodson and Q. Wodon, 113-62. Washington, D.C: World Bank.

Mu, Ren. 2006. "Income Shocks, Consumption, Wealth, and Human Capital: Evidence from Russia." *Economic Development and Cultural Change*, 54(4), pp. 857-92.

Paulus, Alari and Andreas Peichl. 2008. "Effects of Flat Tax Reforms in Western Europe on Income Distribution and Work Incentives." IZA Discussion Paper No. 3721. Institute for the Study of Labor, Bonn, Germany.

Poterba, James M. 2007. "Income Inequality and Income Taxation." *Journal of Policy Modeling*, 29 (4), pp. 623-33.

Sabirianova-Peter, Klara, Steve Buttrick, and Denvil Duncan. 2009. "Global Reform of Personal Income Taxation, 1981-2005: Evidence from 189 Countries," IZA Discussion Paper No. 4228. Institute for the Study of Labor, Bonn, Germany.

Slemrod, Joel. 1998. "Methodological Issues in Measuring and Interpreting Taxable Income Elasticities." *National Tax Journal*, 51 (4), pp. 773-88.

Slemrod, Joel and Wojciech Kopczuk. 2002. "The Optimal Elasticity of Taxable Income." *Journal of Public Economics*, 84 (1), pp. 91-112.

**Table 1: The PIT Rate Structure Before and After Reform**

| Before Reform (2000) | | After Reform (2001-2004) | |
|---|---|---|---|
| Taxable Income[1] | Marginal Rate | Taxable Income[1] | Marginal Rate |
| Below 3,168 | 0 | Below 4,800 | 0 |
| 3,168 to 50,000 | 13 | Above 4,800 | 13 |
| 50,000 to 150,000 | 21 | | |
| Above 150,000 | 31 | | |

**Note**: (source: Ivanova, Keen, and Klemm 2005). Marginal rates include the 1% payroll tax.

**Table 2: Derivation of Counterfactual Measures of Net Income due to Behavioral Responses**

| Level of analysis | Evasion effect | Productivity effect | Combined effect |
|---|---|---|---|
| | **E1** | **F1** | **G1** |
| Individual | $Y_{in}^{e} = Y_{ig}^{e} - T_{2000}(Y_{ig}^{e} - D_{2000})$ | $Y_{in}^{y} = Y_{ig}^{y} - T_{2000}(Y_{ig}^{y} - D_{2000})$ | $Y_{in}^{ye} = Y_{ig}^{ye} - T_{2000}(Y_{ig}^{ye} - D_{2000})$ |
| Household | $Y_{hn}^{*e} = Y_{hg2000}^{*} - \sum_i T_{2000}(Y_{ig}^{e} - D_{2000})$ | $Y_{hn}^{*y} = Y_{hg}^{*y} - \sum_i T_{2000}(Y_{ig}^{y} - D_{2000})$ | $Y_{hn}^{*ye} = Y_{hg}^{*y} - \sum_i T_{2000}(Y_{ig}^{ye} - D_{2000})$ |
| | **E2** | **F2** | **G2** |
| Individual | $Y_{in}^{e} = Y_{ig}^{e} - T_{2001}(Y_{ig}^{e} - D_{2001})$ | $Y_{in}^{y} = Y_{ig}^{y} - T_{2001}(Y_{ig}^{y} - D_{2001})$ | $Y_{in}^{ye} = Y_{ig}^{ye} - T_{2001}(Y_{ig}^{ye} - D_{2001})$ |
| Household | $Y_{hn}^{*e} = Y_{hg2000}^{*} - \sum_i T_{2001}(Y_{ig}^{e} - D_{2001})$ | $Y_{hn}^{*y} = Y_{hg}^{*y} - \sum_i T_{2001}(Y_{ig}^{y} - D_{2001})$ | $Y_{hn}^{*ye} = Y_{hg}^{*y} - \sum_i T_{2001}(Y_{ig}^{ye} - D_{2001})$ |

**Notes:** The top panel (E1, F1, and G1) uses the pre-reform tax schedule to calculate net income while the bottom panel (E2, F2, and G2) uses the post-reform tax schedule. Superscripts e and y indicate that income has been adjusted for evasion and productivity, respectively. Consumption based measures of household income is adjusted for productivity only. However, evasion activity at the individual level indirectly affects consumption measures via changes in tax liability. Household tax liability is first calculated at the individual level and then summed over individuals within the household.

**Table 3: Summary of Counterfactual Measures of Net Income**

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | | ***Panel A*** | | |
| **Tax schedule** | *Pre-reform* | *Pre-reform* | *Post reform* | *Post reform* | - | - |
| **Income year** | *Pre-reform* | *Post reform* | *Pre-reform* | *Post reform* | - | - |
| **$\psi(Y_N)$** | **A** | **C** | **D** | **B** | **-** | **-** |
| | | | | ***Panel B*** | | |
| **Tax schedule** | *Pre-reform* | *Pre-reform* | *Pre-reform* | *Post reform* | *Post reform* | *Post reform* |
| **Income** | *Adjust E* | *Adjust Y* | *Adjust Y&E* | *Adjust E* | *Adjust Y* | *Adjust Y&E* |
| **$\psi(Y_N)$** | **E1** | **F1** | **G1** | **E2** | **F2** | **G2** |
| | | | | ***Panel C*** | | |
| | *Tax* | *Behavior* | *Tax and Behavior* | *Evasion* | *Productivity* | *Productivity and evasion* |
| | **D-A** | **C-A** | **B-A** | **E1-A** | **F1-A** | **G1-A** |
| | **B-C** | **B-D** | | **E2-D** | **F2-D** | **G2-D** |

**Note:** $\psi(Y_N)$ is a summary measure of **net** income distribution (eg., GINI, coefficient of variation etc.). Counterfactuals in *Panel A* are used to separate the direct (tax) effect from the indirect effect while those in *Panel B* are used to identify the tax-induced indirect (behavioral) effects (evasion and productivity); these are illustrated in Panel C. For example, the direct (tax) effect is calculated by holding the pre-tax distribution of income constant while allowing the tax schedule to change. This can be done by comparing D with A (pre-reform income held constant) or B with C (post-reform income held constant). The counterfactuals E1 to G2 use income in year 2000 as the base; E1 through G1 uses the pre-reform tax schedule to calculate net income while E2 to G2 uses the post-reform tax schedule.

**Table 4: Progressivity of PIT Schedules**

| | Panel A: Pre-reform Tax Schedule | | | | |
|---|---|---|---|---|---|
| **Income year** | **2000** | **2001** | **2002** | **2003** | **2004** |
| Gross income | 0.3620 | 0.3342 | 0.3189 | 0.3081 | 0.3013 |
| Net income | 0.3475 | 0.3207 | 0.3016 | 0.2907 | 0.2832 |
| Percent change in GINI | -4.0161 | -4.0428 | -5.4245 | -5.6619 | -6.0174 |
| Effective progressivity | 1.0228 | 1.0203 | 1.0254 | 1.0252 | 1.0260 |
| | **Panel B: Post-reform Tax Schedule** | | | | |
| Gross income | 0.3620 | 0.3342 | 0.3189 | 0.3081 | 0.3013 |
| Net income | 0.3521 | 0.3277 | 0.3150 | 0.3053 | 0.2994 |
| Percent change in GINI | -2.7372 | -1.9203 | -1.2299 | -0.9167 | -0.6556 |
| Effective progressivity | 1.0155 | 1.0096 | 1.0058 | 1.0041 | 1.0028 |
| Observations | 4176 | 4724 | 4949 | 5095 | 5213 |

**Note:** Reported are the within period differences between gross income and net income GINI coefficients, and a measure of effective progressivity. Effective progressivity is calculated as 1 minus after tax GINI divided by 1 minus before tax GINI (Musgrave and Thin 1948). All calculations are for non-zero values of imputed contractual earnings at the individual level.

**Table 5: Distributional Impact of the Flat Tax Reform: Direct Vs. Indirect Effect**

| | Levels | | | | Decomposition | | |
|---|---|---|---|---|---|---|---|
| **Tax Schedule**<br>**Income year** | **2000**<br>**2000** | **2002**<br>**2002** | **2000**<br>**2002** | **2002**<br>**2000** | **Total effect** | **Indirect effect** | **Direct effect** |
| | | | Panel A: Individual | | | | |
| Contractual Earnings | 0.4812 | 0.4402 | 0.4230 | 0.489 | -8.515 | -12.091 | 1.623 |
| | | | Panel B: Household | | | | |
| Consumption | 0.495 | 0.449 | 0.447 | 0.497 | -9.395 | -9.857 | 0.350 |
| Income | 0.479 | 0.445 | 0.433 | 0.486 | -7.089 | -9.616 | 1.408 |

**Notes:** Reported are the GINI coefficients in levels and percent changes. The sample is restricted to non-zero values for each variable; imputed contractual labor earnings at the individual level and durable plus non-durable consumption and reported income before public transfers at the household level. Decompositions are calculated as follows: the total effect is the change between the first two columns, the indirect effect is the change between columns one and three, and the direct effect is the change between columns one and four. All changes are in percent.

**Table 6: Distributional Impact of the Flat Tax Reform: Tax-Induced Behavioral Effects**

| | Levels | | | | Indirect effect when π>0 | | | Indirect effect when π=0 |
|---|---|---|---|---|---|---|---|---|
| **Tax Schedule Adjustment** | **2000 None** | **2000 Evasion** | **2000 Real** | **2000 Both** | **Evasion effect** | **Real effect** | **Combined effect** | |
| | | | | Panel A: Individual | | | | |
| Contractual Earnings | 0.4812 | 0.5169 | 0.5040 | 0.5356 | 7.4251 | 4.7386 | 11.3207 | 15.8223 |
| | | | | Panel B: Household | | | | |
| Consumption | 0.4954 | 0.4949 | 0.5038 | 0.5029 | -0.1003 | 1.6886 | 1.5085 | 9.2662 |
| Income | 0.4792 | 0.5049 | 0.4951 | 0.5198 | 5.3540 | 3.3180 | 8.4710 | 6.5628 |

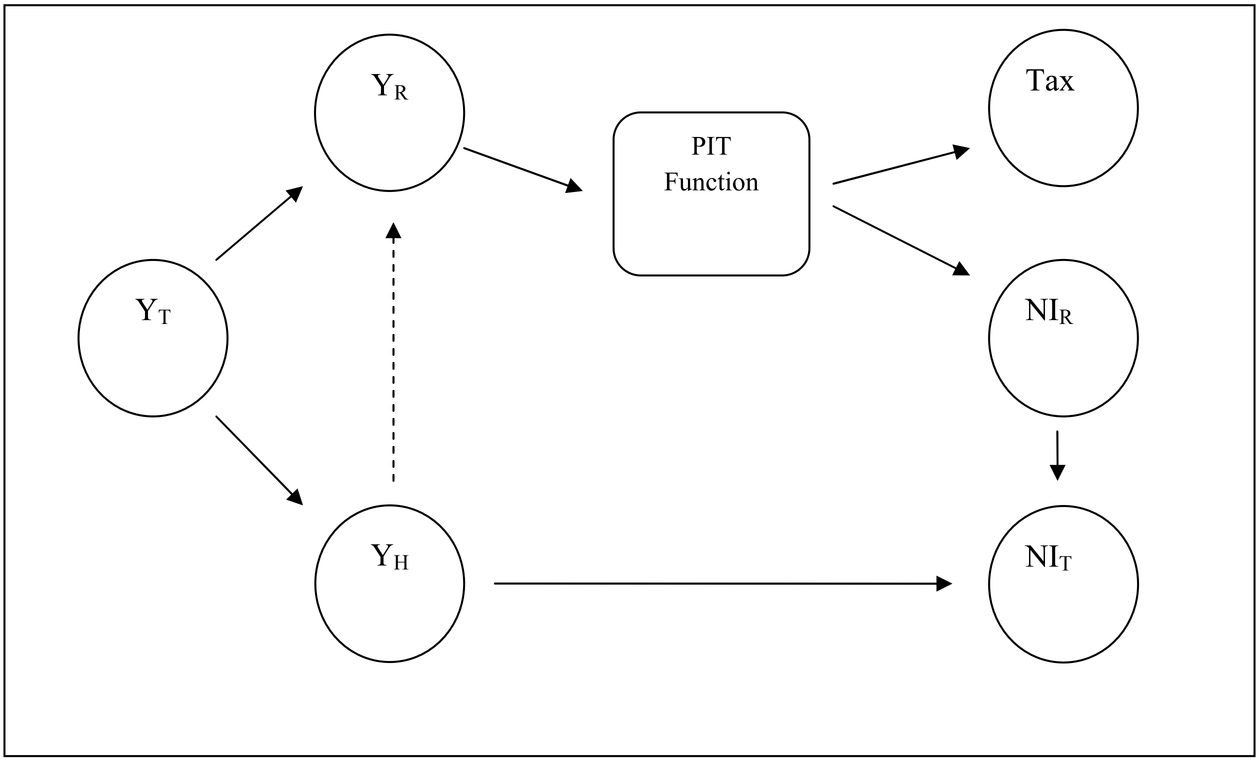
**Notes:** Reported are the GINI coefficients in levels and percent changes. The sample is restricted to non-zero values for each variable; imputed contractual labor earnings at the individual level and durable plus non-durable consumption and reported income before public transfers at the household level. Decompositions are calculated as follows: the evasion effect is the change between the first two columns (assumes productivity response is zero), the real (productivity) effect is the change between columns one and three (assumes evasion response is zero), and the total effect is the change between columns one and four (assumes both productivity and evasion responds). The last column reports the tax-induced indirect effect if evasion is ignored; i.e., it lumps the evasion and productivity responses together using the elasticity of reported gross income. Adjustments are made using the following baseline parameters: evasion elasticity 0.26, productivity elasticity -0.04, and reported gross income elasticity -0.21 (GMP 2009); evasion as a share of true income 0.25 is from Ivanova et al. (2005). All changes are in percent.

**Table 7: Distributional Impact of the Flat Tax Reform: Sensitivity Analysis of Tax-Induced Behavioral Effects**

| Parameters | | | Contractual Earnings | | | Consumption | | | Income | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| π | ε(e) | ε(y) | Evasion effect | Real effect | Combined effect | Evasion effect | Real effect | Combined effect | Evasion effect | Real effect | Combined effect |
| 0.20 | 0.26 | -0.04 | 5.7034 | 4.4585 | 9.5526 | -0.0895 | 1.6982 | 1.5429 | 4.0378 | 3.1116 | 7.0324 |
| 0.25 | 0.26 | -0.04 | 7.4251 | 4.7386 | 11.3207 | -0.1003 | 1.6886 | 1.5085 | 5.3540 | 3.3180 | 8.4710 |
| 0.30 | 0.26 | -0.04 | 9.2907 | 5.0562 | 13.2319 | -0.0942 | 1.6780 | 1.4899 | 6.8227 | 3.5535 | 10.0651 |
| 0.25 | 0.20 | -0.04 | 5.8393 | 4.7386 | 9.9134 | -0.0907 | 1.6886 | 1.5353 | 4.1404 | 3.3180 | 7.3235 |
| 0.25 | 0.30 | -0.04 | 8.4427 | 4.7386 | 12.2255 | -0.1005 | 1.6886 | 1.4967 | 6.1493 | 3.3180 | 9.2206 |
| 0.25 | 0.26 | 0.00 | 7.4251 | 0.0000 | 7.4251 | -0.1003 | 0.0000 | -0.1003 | 5.3540 | 0.0000 | 5.3540 |
| 0.25 | 0.26 | -0.10 | 7.4251 | 10.8599 | 16.4149 | -0.1003 | 4.2874 | 3.9936 | 5.3540 | 8.0927 | 12.8113 |

**Notes:** Reported are percent changes in GINI coefficients. The sample is restricted to non-zero values for each variable; imputed contractual labor earnings at the individual level, and durable plus non-durable consumption and income before public transfers at the household level. Decompositions are calculated as described in the notes to Table 6 (also see Table 3).

**Figure 1: True and Reported Income Flow**




**Notes:** The arrows indicate the direction in which income flows. For example, an individual must allocate true pre-tax income, $Y_T$, between evaded income, $Y_H$, and reported income, $Y_R$. Reported income passes through the PIT function which produces taxes and reported net income, $NI_R$. The evaded income plus the reported net income gives the true net income, $NI_T$. The broken arrow indicates one possible reallocation of income following a reduction in tax rates. That is, lower tax rates may induce individuals to report a greater share of their income, thus reducing the share that is hidden. A missing link in this table is the flow of welfare benefits to true pre-tax income (if taxable) or to observed net income (if non-taxable).

**Table A1: Variable Description and Notes**

| Variable Name | | Definition | Notes |
|---|---|---|---|
| | | Individual Income | |
| *IMP* | Imputed contractual labor earnings per month | | Labor earnings of working-age non-respondents are imputed as predicted earnings times the predicted probability of working using the full set of interactions between the four age groups (18-60) and two gender groups and controlling for urban and federal district dummies for each year separately. |
| | | *Household Income* | |
| *yL* | Contractual labor earnings per month | = sum of IMP within each household. | |
| *y* | Household income before government transfers | = *yL* + net private transfers + financial income received last month. | "Private transfers received" include received alimonies and 11 subcategories of contributions from persons outside the household unit, including contributions from relatives, friends, charity, international organizations, etc. "Private transfers given" include alimonies paid and various contributions in money and in kind given to individuals outside the household unit (6 categories). Financial income includes dividends on stocks and interest on bank accounts. |
| | | *Household Consumption* | |
| *c* | Non-durable expenditures | Sum of expenditures on non-durables in the last 30 days. Non-durable items include food, alcohol, tobacco, clothing and footwear, gasoline and other fuel expenses, rents and utilities, and 15-20 subcategories of services (such as transportation, repair, health care services, education, entertainment, recreation, insurance, etc.). | |
| *cD* | Aggregate expenditures | = *c* + expenditures on durables in the last 3 months / 3. Durable items include 10 subcategories such as major appliances, vehicles, furniture, entertainment equipment, etc. | This is compared with purchases of goods and services from NIPA |

**Source:** With permission from Gorodnichenko, Sabirianova-Peter and Stolyarov (2009)

**Table A2: Distributional Impact of the Flat Tax Reform: Tax-Induced Behavioral Effects**

| Parameters | | | Contractual Earnings (IMP) | | | Consumption (cD) | | | Income (y) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| π | ε(e) | ε(y) | Evasion effect | Real effect | Combined effect | Evasion effect | Real effect | Combined effect | Evasion effect | Real effect | Combined effect |
| 0.20 | -0.26 | -0.04 | 3.974 | 4.459 | 9.553 | -0.236 | 1.272 | 1.018 | 2.761 | 2.146 | 4.705 |
| 0.25 | -0.26 | -0.04 | 5.188 | 4.739 | 11.321 | -0.259 | 1.255 | 1.019 | 3.623 | 2.284 | 5.619 |
| 0.30 | -0.26 | -0.04 | 6.511 | 5.056 | 13.232 | -0.197 | 1.235 | 1.307 | 4.571 | 2.441 | 6.621 |
| | | | | | | | | | | | |
| 0.25 | -0.20 | -0.04 | 4.070 | 3.297 | 6.953 | -0.240 | 1.255 | 1.011 | 2.829 | 2.284 | 4.890 |
| 0.25 | -0.30 | -0.04 | 5.908 | 3.297 | 8.610 | -0.242 | 1.255 | 1.080 | 4.138 | 2.284 | 6.091 |
| | | | | | | | | | | | |
| 0.25 | -0.26 | 0.00 | 5.188 | 0.000 | 5.188 | -0.259 | 0.000 | -0.259 | 3.623 | 0.000 | 3.623 |
| 0.25 | -0.26 | -0.10 | 5.188 | 7.630 | 11.648 | -0.259 | 3.150 | 2.792 | 3.623 | 5.379 | 8.324 |

**Notes:** Reported are percent changes in variance of log coefficients. The sample is restricted to non-zero values for each variable; imputed contractual labor earnings at the individual level, and durable plus non-durable consumption and income before public transfers at the household level. Decompositions are calculated as described in the notes to Table 6 (also see Table 3).

## APPENDIX 2

**Inequality index with transfers**

Here I include transfers in the definition of observed net income. The variance of log income is define as in the text with the exception that transfers are now included as a non-taxable source of income.

$$\mathrm{y_i} \equiv \mathrm{NI_i} = (\mathrm{y_i^*} - \mathrm{E_i})(1 - \mathrm{t_i}) + \mathrm{B} \qquad 12$$

where $B = \alpha[\sum_{i=1}^{N} t_i(y_i^* - E_i)]$ is government transfers to individual $i$ defined as a constant share, $\alpha$, of tax revenues.[31] Totally differentiating with respect to $t_i$, yields

$$\mathrm{d(VLI))} = \frac{2}{\mathrm{n}}\sum_{i=1}^{n}(\log(NI_i) - log\tilde{\mu})\, {NI_i}^{-1}\left[\left(y_i^*\varepsilon_{y_i} - E_i\varepsilon_E\right)\left(\frac{1-t_i}{t_i}\right) - (y_i^* - E_i) + \alpha\Theta\right] dt_i \qquad 13$$

which I rewrite as

$$\mathrm{d(VLI))} = \frac{2}{\mathrm{n}}\sum_{i=1}^{n}(\log(NI_i) - log\tilde{\mu})\, \frac{(1-t_i)}{(1-\pi_i)}^{-1}\left[\left(\varepsilon_{y_i} - \pi_i\varepsilon_E\right)\left(\frac{1-t_i}{t_i}\right) - (1 - \pi_i) + \alpha\Gamma_i\right] dt_i \qquad 14$$

where $\Theta = \sum_{i=1}^{N}\left[\left(y_i^*\varepsilon_{y_i} - E_i\varepsilon_E\right) + \left(y_i^* - E_i\right)\right]$, $\frac{\mathrm{y_i^*}}{\mathrm{NI_i}} = \frac{1}{(1-\mathrm{t_i})(1-\pi_\mathrm{i})} = \frac{(1-\mathrm{t_i})}{(1-\pi_\mathrm{i})}^{-1}$, $\Gamma_\mathrm{i} = \frac{\Theta}{\mathrm{y_i^*}}$, and $\pi_\mathrm{i} = \frac{\mathrm{E_i}}{\mathrm{y_i^*}}$.

Assuming that $\alpha$ is unaffected by the tax change, the sign of the transfer effect term $\alpha\Gamma_i$ depends on which section of the Laffer curve the country is on. If an increase in tax rates leads to an increase in tax revenues then the term is positive. As indicated in the text, taxing individuals earning below mean income increases inequality while raising taxes on those earning above mean income reduces inequality. The transfer effect reduces these distributional impacts; i.e., it reduces the dis-equalizing effect of taxing the poor and reduces the equalizing effect of taxing the rich. The other effects –direct and indirect – are the same as in the main text.

[31] Assuming that each individual receives the same share of transfers implies that transfers are pro-poor. That is, transfers as a share of income decreases with income.