CESifo Working Papers
www.cesifo.org/wp

The Elasticity of Taxable Income and Income-Shifting: What is "Real" and What is Not?

Jarkko Harju
Tuomas Matikka

CESifo Working Paper No. 4905
Category 1: Public Finance
July 2014

CESifo *Working Paper No. 4905*

The Elasticity of Taxable Income and Income-Shifting: What is “Real” and What is Not?

Abstract

Previous literature shows that income taxation significantly affects the behavior of high-income earners and business owners. However, it is still unclear how much of the response is due to changes in effort and other real economic activity, and how much is caused by tax avoidance and tax evasion. This distinction is important because it affects the welfare implications and policy recommendations. In this paper we distinguish between real responses and tax-motivated income-shifting between tax bases. We show how the explicit inclusion of income-shifting affects the welfare analysis of income taxation. In our empirical example we find that income-shifting accounts for over two thirds of the overall elasticity of taxable dividend income among Finnish business owners. The large income-shifting response significantly decreases the marginal excess burden compared to the standard model in which the overall elasticity defines the welfare loss. However, in addition to income-shifting, we find that dividend taxation significantly affects the real behavior of owners.

JEL-Code: H240, H250, H320.

Keywords: elasticity of taxable income, tax avoidance, income-shifting, real responses.

Jarkko Harju
Government Institute for Economic Research
Helsinki / Finland
jarkko.harju@vatt.fi

Tuomas Matikka
Government Institute for Economic Research
Helsinki / Finland
tuomas.matikka@vatt.fi

July 1, 2014

1 Introduction

Income taxes are known to generate significant behavioral effects among high-income earners and business owners (see a survey by Saez, Slemrod and Giertz 2012). However, the interpretation of the behavioral response is often difficult because business owners and high-income earners have many margins in which they can respond to taxes. In addition to real responses (labor supply, effort etc.), they have many opportunities to legally avoid or illegally evade taxes. Although previous research shows that tax avoidance is a significant behavioral margin for these groups (see e.g. Slemrod and Gillitzer 2014), it is still unclear how much of the overall response is due to changes in real economic activity, and how much is due to avoidance.

Income-shifting is one of the most relevant tax avoidance channels for business owners and high-income earners (see e.g. Gordon and Slemrod 2000, Goolsbee 2000). Distinguishing between real responses and income-shifting between different tax bases is important because the nature of the response largely affects the welfare conclusions and policy recommendations (Slemrod 1995, Piketty, Saez and Stantcheva 2014). For example, real responses stemming from deeper behavioral parameters such as labor-leisure preferences are not under direct government control. In contrast, income-shifting can be governed more easily by re-designing the details of the tax system.

Traditionally, the elasticity of taxable income (ETI) quantifies the excess burden of the income tax (Feldstein 1995, 1999). However, income-shifting between tax bases is one of the most relevant issues that might overstate ETI as a measure of welfare losses. ETI with respect to its own marginal tax rate does not account for the fact that other tax bases might have positive tax rates. Thus income-shifting is not a full deadweight loss if the shifted income is also taxed (Saez 2004, Chetty 2009).

Our main contribution to the literature is to distinguish between real responses and income-shifting responses. We show how the explicit inclusion of income-shifting affects the welfare analysis of income taxation. Based on previous theoretical literature (e.g. Piketty et al. 2014), we build an empirically implementable model of ETI under income-shifting possibilities. Adding the difference of the net-of-tax rates on different tax bases to the standard ETI model enables identification of the average income-shifting elasticity and the average real elasticity. Furthermore, we demonstrate that different empirical specifications lead to different interpretations of the estimated parameters.

As an empirical example, we estimate both real responses and income-shifting responses for the owners of privately held corporations in Finland. This group faces large incentives and ample possibilities to shift income between different tax bases, which makes these owners a particularly suitable group for analyzing both income-shifting and real responses. In the Finnish dual income tax system, the owners of privately held corporations can withdraw income from their firm as a combination of wages and dividends, which are taxed with separate tax rate schedules and tax rules. There are only a few minor legal limitations on whether income is withdrawn as wages or dividends, and explicit tax rate differences induce clear incentives for tax-motivated income-shifting. To our knowledge, this paper is the first to explicitly estimate both real elasticity and income-shifting elasticity separately using a well-defined empirical model, and individual-level panel data and tax reforms.

We use extensive panel data of Finnish business owners. We link firm-level tax record information to the owner-level personal tax data, which is a novelty in the ETI literature. With this data set we are able to richly control for firm-level effects on the personal income trends of the owners. The comprehensive data along with the dividend tax reform of 2005 in Finland creates an interesting opportunity to study the role of both income-shifting and real income creation.

Our results show that the income-shifting responses are highly significant both statistically and economically. Over two thirds of the overall ETI among Finnish business owners is due to income-shifting. However, income-shifting does not appear to be the whole story, as we also find positive real elasticity estimates for dividends. In addition, real responses are present even when analyzing broader firm-level income components, such as turnover and profits. These are less subject to tax avoidance than wages and dividends withdrawn from the firm. The tax elasticities of these firm-level income components are also rarely analyzed in public finance literature.

Our results highlight that welfare evaluations based on standard ETI estimates might be misleading for individuals with income-shifting possibilities. For example, the marginal excess burden of dividend taxes decreases from 0.9 to 0.4 when we account for the fact that the shifted income is also taxed. The large income-shifting effect also affects policy recommendations. Even though dividends appear to be very responsive as a whole, dividend taxes do not induce substantial distortions in the real economy among the owners of privately held corporations in Finland.

The ETI literature began to expand after the pioneering studies by Lindsey (1987) and Feldstein (1995). Feldstein (1995) estimates the taxable income elasticity to be large in the US, ranging from 1-3 depending on the income group. Many subsequent studies focus on improving the identification of the ETI model. Along with the refinements, the estimates have decreased markedly. A wide range of studies report average elasticity estimates from 0 to 0.6. For example, the widely cited Gruber and Saez (2002) study finds ETI of 0.2 for mid-income earners, and 0.6 for high-income earners. A review of earlier empirical results is presented in the recent survey by Saez et al. (2012).

Recently, the literature has identified the behavioral response using income distributions around the discontinuous kink points of the marginal income tax rate schedule. Saez (2010) shows that excess bunching around kink points is proportional to the local ETI at the kink. Many studies show that the excess mass around kink points is larger for self-employed individuals (see Saez 2010, Chetty et al. 2011 and Bastani and Selin 2014). This indicates that the self-employed respond actively to income tax rates, and have more opportunities to adjust their behavior to them. As an additional analysis, we also estimate the local tax responsiveness of Finnish business owners using the bunching method. We find that business owners bunch actively at the dividend income tax rate kink point, which supports our main results.

Previous studies from different countries indicate that income-shifting between tax bases is substantial for high-income earners and business owners. For example, Gordon and Slemrod (2000) show evidence of active income-shifting between corporate and personal tax bases in the US. Devereux et al. (2014) show that income-shifting between corporate and personal tax bases is also active in the UK. In addition, Sivadasan and Slemrod (2008) find significant income-shifting responses for partners in partnership firms in India, and Romanov (2006) finds income-shifting between personal and corporate tax bases among high-income self-employed professionals in Israel.

Piketty et al. (2014) formulate a theoretical framework for analyzing tax avoidance effects as a part of the ETI of high-income earners. By distinguishing between different forms of behavioral responses (tax avoidance, real responses and bargaining channels), they study the implications of optimal income taxation at the upper end of the income distribution. They also provide empirical cross-country evidence which indicates that both the real and avoidance responses are small while bargaining effects dominate.

In the Nordic countries, le Maire and Schjerning (2013) derive a dynamic extension to the bunching method, and show that over half of the bunching effect among Danish entrepreneurs is due to intertemporal income-shifting. This result suggests that the excess burden calculated by using the baseline bunching method overestimates the welfare effect. By using panel data methods, Kleven and Schultz (2013) estimate the cross-tax elasticities of taxable earned income and taxable capital income components within the Danish tax system. In general, they find small substitutability between earned income and capital income, which, however, supports the view that income-shifting effects exist. In addition, Alstadsæter and Jacob (2012) show that income-shifting is active among Swedish corporate owners.

In Finland, Harju and Matikka (2012) show that absent any real effects, income-shifting between tax bases is active among the main owners of privately held corporations in Finland. Pirttilä and Selin (2011) show evidence of responses to the dual income tax reform in Finland in 1993. They report that entrepreneurs and business owners increased their relative share of capital income when capital income tax rates were decreased.

This paper is organized as follows: Section 2 presents the theoretical model. Section 3 presents our empirical model. Section 4 describes the Finnish income tax system and recent tax reforms. Section 5 discusses identification issues, introduces the data and presents the descriptive statistics. Section 6 presents the results, and Section 7 presents the robustness checks. Section 8 discusses the main findings and welfare implications.

2 Theoretical model

2.1 Taxable income model

Following Piketty et al. (2014), we assume a quasi-linear utility function of the form $u_i(c, z) = c - h_i(z)$, where c is consumption, z is taxable income, and $h_i(z)$ denotes the cost of effort to produce income for individual i. The cost function is assumed to be convex and increasing in z. Utility is maximized under the budget constraint $c = z(1-\tau) + R$, where $(1-\tau)$ is the net-of-tax rate (one minus the marginal tax rate) on a linear segment of a non-linear tax rate schedule. R denotes virtual income.

Optimization of the utility function with respect to the budget constraint results in individuals producing taxable income up to the point where $h_i'(z) = (1-\tau)$. Thus in the absence of income effects, individual taxable income supply is a function of $(1-\tau)$.

Next, consider a marginal change in $(1-\tau)$. The elasticity of taxable income (ETI) can be written as

$$e_z = \frac{(1-\tau)}{z}\frac{dz}{d(1-\tau)} \tag{1}$$

where e_z is the average ETI. In addition to changes in labor supply, e_z also covers changes in, for example, work effort and productivity. In addition, the average ETI covers tax avoidance and tax evasion.

The intuition behind this Feldstein (1999) framework is that all behavioral responses affect the excess burden of income taxation. Individuals increase z until its marginal cost equals the tax rate, and thus the overall inefficiency can be summarized with ETI. This requires that the marginal cost of effort, the marginal cost of tax avoidance and the marginal cost of tax evasion etc. all equal the net-of-tax rate. In other words, $h_i'(z) = (1-\tau)$ no matter how z is adjusted, and thus estimating e_z is all we need for welfare analysis.

2.2 Taxable income and income-shifting

The standard ETI in equation (1) implicitly takes into account any income-shifting to another tax base due to a change in $(1-\tau)$. However, among other previous papers that discuss the implications of tax avoidance in ETI analysis (e.g. Saez et al. 2012, and Chetty 2009), we argue that more precise modeling of income-shifting is needed. With regard to welfare analysis, this is essential if ETI is analyzed among individuals who have easy access to differently taxed tax bases.

Income-shifting can be very difficult for the average wage earner due to the lack of opportunities to alter her income composition. However, it can have a major impact for individuals who indeed have these possibilities. In general, high-income earners and business owners have more ways to affect the composition of their personal income. For example, in many countries business owners have opportunities to report part of their personal taxable income as corporate profits, or vice versa.

In particular, income-shifting opportunities are apparent within a dual income tax system where capital income and wage income are taxed differently with separate tax rules and regulations. In the Finnish dual income tax system, the most prominent income-shifting incentives lie between the wage and dividend income of the owners of privately held corporations. We discuss the Finnish system in more detail in Section 4.

We present a static taxable income model with income-shifting opportunities. Our model is similar to the elasticity of taxable corporate income model by Devereux et al. (2014), and the Piketty et al. (2014) model with tax avoidance in the top income bracket.[1]

We assume that there are two personal tax bases available, taxable wages z_W and taxable dividends z_D. We denote the total taxable income of the owner by $z_y = z_W + z_D$. In many tax systems, business owners have many different channels to withdraw income from their firm. Our model generalizes to any two differently taxed tax bases in which an individual can legally report income.

Wages are taxed at a tax rate τ_W, and dividends are taxed at τ_D. It is possible for the owner to shift income (at a cost) between the two types of income. The owner has an incentive to shift income

[1] Other previous papers also consider tax avoidance and income-shifting within the ETI framework, e.g. Saez (2004) and Chetty (2009).

from one tax base to another if the tax rate schedules differ from each other. Intuitively, income-shifting behavior describes the extent of changing the composition of income due to differences in τ_W and τ_D, while keeping the level of total taxable income constant.

For simplicity, let us assume for now that $t_W > t_D$. This is usually the case in most dual income tax systems. We assume that both tax rates are exogenous.[2]

The budget constraint can be written as

$$c = (1 - \tau_W)(1 - \alpha)z_y + (1 - \tau_D)\alpha z_y \tag{2}$$

where $0 \leq \alpha \leq 1$, and $(1 - \alpha)z_y = z_W$ is taxable wages denoted as a share of total taxable income. Similarly, $\alpha z_y = z_D$ is taxable dividends.

The utility function of an owner i is

$$u_i(c, z_y, \alpha) = c - \theta_i(z_y) - \phi_i(\alpha) \tag{3}$$

where $\theta_i(z_y)$ is the cost of effort to produce total taxable income, and $\phi_i(\alpha)$ is the cost of income-shifting between wages and dividends, i.e. changing the composition of total taxable income. We assume that both cost functions are convex and increasing in z_y and α, respectively.[3]

The owner chooses z_y and α to maximize utility, which gives the following first-order conditions:

$$(1 - \tau_W)(1 - \alpha) + (1 - \tau_D)\alpha = \theta_i^{'}(z_y) \tag{4}$$

and

$$(\tau_W - \tau_D)z_y = \phi_i^{'}(\alpha) \tag{5}$$

Equation (4) implies that total taxable income is an increasing function of the net-of-tax rates. Thus when α is assumed to be fixed, both tax rates affect the total taxable income, as we have two separately taxed tax bases with no income-shifting possibilities. Equation (5) implies that when keeping the amount of total taxable income (z_y) fixed, income-shifting is an increasing function of the tax rate difference. Thus the difference between the tax rates, $(\tau_W - \tau_D)$, determines the amount of income shifted from one tax base to another.

Next, we derive elasticities separately for both tax bases. For both z_W and z_D, we assume no changes in the tax rate of the other tax base. Following Piketty et al. (2014) and Devereux et al. (2014), the

[2] Income-shifting from wages to dividends produces more total net income for the owner if $\tau_W > \tau_D$. Naturally, the opposite direction for income-shifting holds if $\tau_W < \tau_D$. If the tax rates are equal, we are back to the case of one common tax base.

[3] Alternatively, we could assume that both real wages and real dividends have separate convex cost functions that reflect real wage and real dividend income based on labor supply and effort, and the actual return on invested capital. This type of model gives qualitatively similar results as the model with one cost function for all income. In addition, we could assume that ϕ_i is fixed for each i, and does not depend on α. However, this does not change the welfare conclusions based on estimated average elasticities (see Section 2.3).

average net-of-tax rate elasticity for z_W is

$$\begin{aligned} e_{z_W} &= \frac{(1-\tau_W)}{z_W}\frac{\partial z_W}{\partial(1-\tau_W)} \\ &= \frac{(1-\tau_W)}{(1-\alpha)z_y}\frac{\partial z_y}{\partial(1-\tau_W)}(1-\alpha)+\frac{(1-\tau_W)}{(1-\alpha)z_y}\frac{\partial(1-\alpha)}{\partial(1-\tau_W)}z_y \\ &= e_W - e_{(1-\alpha)} \end{aligned} \tag{6}$$

where $e_W = dz_y/z_y * (1-\tau_W)/d(1-\tau_W)$, and $e_{(1-\alpha)} = d(1-\alpha)/(1-\alpha)*(1-\tau_W)/d((1-\tau_D)-(1-\tau_W))$.

Equation (6) implies that we can distinguish the income-shifting effect from the overall behavioral response e_{z_W}. The income-shifting elasticity $e_{(1-\alpha)}$ measures how the wage tax base reacts to changes in the difference of the net-of-tax rates. We refer to the other component e_W as the real elasticity. It denotes how total income changes as the wage tax rate changes. We discuss the practical limitations of interpreting e_W as an actual real effect in Section 3.

Similarly, we can express the average ETI of dividend income as

$$\begin{aligned} e_{z_d} &= \frac{(1-\tau_D)}{z_D}\frac{\partial z_D}{\partial(1-\tau_D)} \\ &= \frac{(1-\tau_D)}{\alpha z_y}\frac{\partial z_y}{\partial(1-\tau_D)}\alpha+\frac{(1-\tau_D)}{\alpha z_y}\frac{\partial\alpha}{\partial(1-\tau_D)}z_y \\ &= e_D + e_\alpha \end{aligned} \tag{7}$$

where $e_D = dz_y/z_y * (1-\tau_D)/d(1-\tau_D)$ is the real dividend elasticity, and $e_\alpha = d\alpha/\alpha * (1-\tau_D)/d((1-\tau_D)-(1-\tau_W))$ is the income-shifting elasticity for dividends.

In summary, equations (6) and (7) differ from (1) as they take income-shifting explicitly into account. As noted in Piketty et al. (2014), z_W and z_D are more responsive to changes in their own net-of-tax rates than without income-shifting possibilities (or with arbitrarily large costs for income-shifting). However, if income-shifting is not important in practice, $e_{(1-\alpha)}$ and e_α should be small or insignificant.

2.3 Welfare implications

Next, we compare the marginal excess burden in the traditional ETI model with a model that explicitly includes income-shifting. Our model for the marginal deadweight loss follows the one presented in Chetty (2009). We approximate the marginal excess burden by comparing behavioral responses caused by a tax rate change to a benchmark case which ignores behavioral responses. The same follows from assuming that the tax revenue collected from wage and dividend taxes is returned to the owner as a lump-sum transfer.

We use the following welfare function

$$w = \{(1-\tau_W)(1-\alpha)z_y + (1-\tau_D)\alpha z_y - \theta_i(z_y) - \phi_i(\alpha)\} + (1-\alpha)z_y\tau_W + \alpha z_y \tau_D \tag{8}$$

where individual utility is presented in curly brackets, and tax revenue collected by the government is denoted as the sum of the tax revenue from both tax bases. We again assume that $\tau_W > \tau_D$.

Let us first consider the standard deadweight loss analysis of wage taxation. Conceptually this refers to the simplified case where $\alpha = 0$. The same analysis can be carried out for dividends, but for the sake of brevity we only show the equations for taxable wage income.

Consider a marginal increase in the wage tax rate, $d\tau_W$. As the owner is assumed to optimize her utility, we can use the envelope theorem and denote that the tax increase has only a first-order effect on individual utility. The first-order effects of the owner's utility and the tax revenue of the government cancel each other out. Thus we can write the excess burden as

$$\frac{dw}{d\tau_W} = \tau_W \frac{\partial z_y}{\partial \tau_W} = z_y \frac{\tau_W}{(1-\tau_W)} e_{z_W} \tag{9}$$

where e_{z_W} denotes the overall elasticity of the wage tax base with respect to $(1-\tau_W)$. In equation (9), e_{z_W} refers to the standard ETI in the Feldstein (1999) framework. Intuitively, in equation (9), average ETI defines the scope of the marginal excess burden of the income tax.

Next, consider a more general case where the owner can shift part of her taxable wage income to the dividend tax base. This refers to the case where $0 \leq \alpha \leq 1$, and owners can adjust α. The deadweight loss is expressed as

$$\begin{aligned} \frac{dw}{d\tau_W} =& \frac{\partial z_y}{\partial \tau_W} \left((1-\alpha)\tau_W + \alpha\tau_D\right) + z_y \frac{\partial(1-\alpha)}{\partial \tau_W} (\tau_W - \tau_D) \\ =& z_y \left[\frac{(1-\alpha)\tau_W + \alpha\tau_D}{(1-\tau_W)} e_W + (1-\alpha)\frac{(\tau_W - \tau_D)}{(1-\tau_W)} e_{(1-\alpha)} \right] \end{aligned} \tag{10}$$

where e_W denotes the average real elasticity, and $e_{(1-\alpha)}$ is the average income-shifting elasticity.

The key difference between equations (9) and (10) is the income-shifting response. Assume that we observe an overall decrease in taxable wage income due to an increase in the wage tax rate, $e_{z_W} > 0$. Assume further that part of this response comes in the form of income-shifting, $e_{(1-\alpha)} > 0$, and part of the response is due to changes in real economic behavior, $e_W > 0$. If we ignore the income-shifting response and use the standard equation (9) to assess the marginal excess burden, the welfare effect is approximated to be too large when $0 < \tau_D < \tau_W < 1$ and $0 \leq \alpha \leq 1$.

The size of the marginal excess burden in equation (10) depends on the following factors: (1) the size of the income-shifting elasticity ($e_{(1-\alpha)}$), (2) the size of the real elasticity (e_W), (3) the difference of the net-of-tax rates ($\tau_W - \tau_D$), and (4) the initial size of the tax bases $(1-\alpha)$. Intuitively, a large $e_{(1-\alpha)}$ relative to e_W implies that a large fraction of the overall response is due to income-shifting, with different efficiency implications. For a given $e_{(1-\alpha)}$, a small $(\tau_W - \tau_D)$ implies that income-shifting has only a small effect on efficiency, and vice versa. In addition, the relative size of the tax bases further scales the significance of the income-shifting response. To summarize, if there are large incentives for income-shifting, equation (10) highlights that it is important to estimate elasticities for both the real component and the income-shifting component in order to more accurately analyze the welfare loss of income taxes.

Equation (10) shows that income-shifting and real responses have different welfare consequences even within the standard excess burden framework when the shifted income is also taxed. Applying the envelope theorem in the welfare model above implicitly assumes that individuals optimize such that the marginal costs equal the associated net-of-tax rates (see the first-order conditions (4) and (5) above). Thus equations (9) and (10) hold if individuals optimize as in the standard Feldstein (1999) framework. However, it is possible that these standard assumptions do not hold in practice, especially when considering the welfare effects of income-shifting.

Chetty (2009) shows that the Feldstein (1999) formula for the deadweight loss does not hold if the marginal *social* cost of income-shifting does not equal the tax rate. For example, as noted by Chetty (2009), a notable share of the costs related to income-shifting might be payments to tax consultants, who usually report at least part of this original cost as their own taxable income. Thus the costs might include transfers between different agents in the economy, and this fiscal externality is not taken into account in the standard framework. In the extreme, if income-shifting inflicts no real social costs, the marginal excess burden reduces to the real effect of taxation, denoted by the first term on the right-hand side of equation (10). We further discuss this and the empirical magnitude of the deadweight loss among Finnish business owners in Section 8.

3 Empirical methodology

3.1 Empirical ETI model

A usual approach to estimate ETI with individual-level panel data and tax reforms is to use a difference-in-differences approach and a first-differences estimator.[4] This method allows time-invariant unobserved individual characteristics that affect income growth to be canceled out. This is appealing as these characteristics (for example, innate ability) are correlated with the progressive marginal tax rate.

Following Saez et al. (2012), the standard empirical ETI equation can be characterized as

$$\triangle ln(z)_{t,i} = e_z \triangle ln(1-\tau)_{t,i} + \triangle ln(\eta)_{t,i} + \triangle ln(\varepsilon)_{t,i} \tag{11}$$

where t is a subscript for time and i denotes the individual, and $\triangle$ denotes the difference between time $t+k$ and t. z denotes taxable income, $(1-\tau)$ is the net-of-tax rate, and e_z is the (average) elasticity of taxable income. η denotes potential income, i.e. income without taxes, and ε is the error term, including the transitory income component.

There are many issues that need to be taken into account when defining the actual empirically implementable version of equation (11). First, the net-of-tax rate and transitory income shocks are mechanically correlated within a progressive tax system, as a positive income shock results in a lower net-of-tax rate. This means that a valid instrument for the net-of-tax rate is required in order to have a causal interpretation for e_z.

[4] For a more detailed discussion on empirical ETI estimation, including cross-sectional models, see Saez et al. (2012). We discuss the local estimation of ETI using distributions of taxable income and bunching around the kink points of the tax rate schedule in Section 7.

Non-tax-related changes in potential income also need to be taken into account. In other words, differential income growth trends for different types of individuals need to be controlled for. The usual approach is to add a matrix of individual characteristics in base year t to the estimable equation.

3.2 ETI and income-shifting

In this subsection we specify ways of distinguishing income-shifting from the overall response using micro-level panel data and tax reforms. For now we assume that valid net-of-tax rate instruments exist, and that we can perfectly control for other individual characteristics that affect the growth of taxable income. These issues will be discussed in detail in Section 5.

First, in order to identify different elasticity components, we need to have differential variation in marginal tax rates among otherwise similar individuals. This variation is needed for all relevant tax bases. In the case of Finnish business owners, we need variation in both the wage and dividend tax rates.

By utilizing exogenous variation in the net-of-tax rates on both wages and dividends, we can write the estimable version of the elasticity of taxable wage income as

$$\triangle ln(z_W)_{t,i} = e_W \triangle ln(1-\tau_W)_{t,i} - e_{(1-\alpha)} \triangle (ln(1-\tau_D) - ln(1-\tau_W))_{t,i} + \triangle ln(\eta_W)_{t,i} + \triangle ln(\varepsilon)_{t,i} \quad (12)$$

where $(1-\tau_W)$ is the net-of-tax rate for taxable wage income, and $(1-\tau_D)$ is the net-of-tax rate for dividend income.

Equation (12) includes the responsiveness of taxable wage income with respect to income-shifting incentives, namely $\triangle(ln(1-\tau_D) - ln(1-\tau_W))_{t,i}$. Regressing $\triangle ln(z_W)_{t,i}$ with both $\triangle ln(1-\tau_W)_{t,i}$ and $\triangle(ln(1-\tau_D) - ln(1-\tau_W))_{t,i}$ enables us to estimate separately both the real elasticity e_W and the income-shifting component $e_{(1-\alpha)}$, along with the associated standard errors. A similar model can also be written for dividend income. For the sake of brevity, we only cover the wage income model in this section.

The income-shifting effect can also be estimated by simply adding $\triangle ln(1-\tau_D)_{t,i}$ to the standard ETI model for taxable wages. After adding dividend tax rates, we get the following expression

$$\triangle ln(z_W)_{t,i} = e_{z_W} \triangle ln(1-\tau_W)_{t,i} - e_{(1-\alpha)} \triangle ln(1-\tau_D)_{t,i} + \triangle ln(\eta_W)_{t,i} + \triangle ln(\varepsilon)_{t,i} \quad (13)$$

Importantly, adding $\triangle ln(1-\tau_D)_{t,i}$ to the standard ETI model does not change the interpretation of the baseline ETI parameter e_{z_W}, which captures *both* real responses and the income-shifting effect. If income-shifting behavior is significant, the estimated sum of these elasticity components might not be very informative. Therefore, the standard ETI model alone or even conditional on the net-of-tax rates in other tax bases might be misleading when assessing the welfare consequences of income taxation. Nevertheless, in terms of identifying the income-shifting response, both equations (12) and (13) define the same income-shifting elasticity parameter $e_{(1-\alpha)}$.

Another possibility to separate out the income-shifting response is to study the elasticity of total taxable income $z_y = z_W + z_D$ with respect to the net-of-tax rate on wages. In the earlier literature this type of income has in many cases been referred to as broad income (see e.g. Gruber and Saez 2002). The model for the total taxable income can be written as

$$\triangle ln(z_y)_{t,i} = e_W \triangle ln(1-\tau_W)_{t,i} + \triangle ln(\eta_y)_{t,i} + \triangle ln(\varepsilon)_{t,i} \tag{14}$$

The elasticity coefficient in equation (14) only includes the real response component, as any income-shifting is canceled out by definition. In other words, if an increase in the wage tax rate induces only a pure income-shifting effect, total taxable income remains unchanged. Thus regressing $\triangle ln(z_y)_{t,i}$ with $\triangle ln(1-\tau_W)_{t,i}$ allows us to identify the real elasticity component, which can then be compared with the taxable wage income elasticity in order to outline the relevance of income-shifting behavior.[5]

To summarize, how well we can estimate both e_W and $e_{(1-\alpha)}$ depends on the data we have. We can outline real responses with total income data including all the relevant tax bases. In order to analyze both e_W and $e_{(1-\alpha)}$, we need information on the wage tax base separately. Also, differential and independent variation in both marginal tax rates is necessary for identifying $e_{(1-\alpha)}$ separately. In addition, in order to analyze underlying differences in the responsiveness of the wage and dividend tax bases, we need to estimate the dividend tax base elasticities as well. As we meet all the conditions mentioned here with our data set, we can study how different specifications affect the estimates in our empirical example. These conditions are also applicable to other tax systems in other countries.

We are particularly interested in estimating the effect of tax rates on real behavior, in relation to income-shifting effects. In other words, we want to exclude any other forms of tax avoidance (or evasion) when estimating e_W. Therefore we use gross wage and gross dividend income subject to taxation as dependent variables when estimating the models. These income measures do not include potential changes in deduction behavior. Instead, in the Finnish context, taxable income is defined as gross income subject to taxation minus deductions and exemptions. Thus taxable income also takes into account changes in deduction behavior, which presumably also include changes in tax avoidance activity.

Despite using changes in gross income as the left-hand side variable, interpreting e_W as a true real response includes an implicit assumption that income-shifting and tax deductions are the only possible margins of tax avoidance. However, other possibilities to avoid taxes might be included in the estimated real response. For example, if tax rates increase, owners could increase their consumption within the firm (e.g. in the form of more office amenities). Also, owners might increase fringe benefits, which are in many cases not fully included in gross income subject to taxation. Finally, owners might illegally evade taxes, for example through intentional underreporting of income.

One of the most common examples of other tax avoidance channels affecting e_W is intertemporal (or dynamic) income-shifting. For example, dividend income can be rather easily shifted across periods using retained earnings. In the Finnish context, Kari et al. (2008) show evidence that Finnish corporations

[5] If we include changes in both net-of-tax rates in equation (14), we cannot identify both real responses and income-shifting responses separately. The estimated coefficients would be a mixture of both real and income-shifting components of wage and dividend taxes, as before in the standard ETI model (equation (11)). Therefore, we examine real responses by estimating total income regressions separately for both net-of-tax rates, which allows us to identify the real response component for both net-of-tax rates.

anticipated the 2005 dividend tax increase by increasing dividend payments just before the reform. Anticipation was feasible as the content of the reform was published already in late 2003. Mostly due to this anticipation possibility, our baseline empirical analysis utilizes a longer time period of 2002-2007.

Furthermore, in order to assess the real component in a more diverse manner, we estimate the net-of-tax rate responses for more broadly defined income components at the firm level. One example of these is net profits before wages. We define net profits as turnover plus other income of the firm minus all costs except wages. Compared to wages and dividends withdrawn from the firm, this type of income is not as easily manipulated using various tax avoidance activities. In addition to wages and dividends, net profits also includes retained earnings. Intuitively, changes in net profits due to changes in net-of-tax rates reflect the real effort of the owner.

In addition, we estimate net-of-tax rate elasticities for the turnover of the firm. Turnover measures the overall sales revenue of the firm, which also reflects real effort and productivity.[6] We futher discuss the details of these estimations in Section 6.2.

3.3 Estimable equation

We estimate different variations of the following equation using a two-stage least squares estimator:

$$\triangle lnTI_{t,i} = \alpha_0 + e\triangle ln(1-\tau^p)_{t,i} + \alpha_1 f(lnTI)_{t,i} + \alpha_2 B_{t,i} + \alpha_3 F_{t,i} + \triangle\varepsilon_{t,i} \quad (15)$$

In equation (15), $\triangle lnTI_{t,i}$ is the log change in income between t and $t+k$. The income concept varies across different specifications. First, we analyze the responsiveness of gross wage income and gross dividend income subject to taxation with respect to own net-of-tax rates and income-shifting incentives. Thus in these cases we set $TI_{t,i} = (z_W)_{t,i}$ for wages, and $TI_{t,i} = (z_D)_{t,i}$ for dividends. In addition to the two separate tax bases, we also regress the change in total income $TI_{t,i} = (z_W + z_D)_{t,i}$ with changes in the instrumented net-of-tax rates. We also estimate alternative models for real responses, where we regress broader firm-level income components, namely turnover and net profits, with changes in the instrumented net-of-tax rates.

$\triangle ln(1-\tau^p)_{t,i}$ is the instrumented change in the log net-of-tax rate (we discuss the instruments in detail in Section 5). Thus e is the coefficient of interest, the average elasticity with respect to the net-of-tax rate. When studying income-shifting responses, we add the difference of the log net-of-tax rates of wages and dividends into the estimable equation.

Following Gruber and Saez (2002), we add a 10-piece base-year income spline $f(lnTI)_{t,i}$ to the model. Base-year income controls for unobserved heterogeneity in income growth. We also control for observed individual effects with available background variables in the tax return data. Matrix $B_{t,i}$ includes age, age squared, ownership share of the firm, and county and gender of the owner. In addition, firm-level data allow us to control for firm-level effects. The firm-level controls $F_{t,i}$ include total assets, turnover, profits, industry, number of employees and county of the firm.

[6] Harju and Kosonen (2013) study the tax responsiveness of turnover among the owners of unincorporated firms in Finland. They find small real responses for this group.

In our baseline model, we analyze a single difference between 2002 and 2007. As is common procedure in the literature, we focus on the owners at the intensive margin whose firms are their primary source of income. We limit the analysis to observations where base-year total income (wages + dividends) is above 25,000 €. In addition, individuals whose absolute change in total income between 2002 and 2007 is above 50,000 € are dropped from the sample in order to avoid unnecessarily high influence by outlier observations. We perform several robustness checks on these sample restrictions in Section 7.

All the estimates are weighted by the total income of the owner. When considering the welfare consequences of income taxation, income-weighted uncompensated average ETI is the parameter of main interest (see Gruber and Saez 2002). However, as in Gruber and Saez (2002), we censor the weights at 200,000 € in order to avoid giving unreasonably large weight to a few very high-income individuals in the data.

In addition to first-differences estimation, we also use the distributions of z_W and z_D and the kink points in the marginal tax rate schedules to estimate ETI locally. We discuss this bunching estimation in more detail in Section 7.

4 The Finnish income tax system and recent tax reforms

In our empirical example we analyze the owners of privately held corporations in Finland. Privately held corporations are defined as corporations that are not listed on a public stock exchange (cf. public or listed corporations). In the Finnish tax system, dividends from listed and privately owned corporations are taxed at different tax rates and under different tax regulations. Also, the taxation of privately held corporations is different from that of other types of private businesses (sole proprietors and partnerships). Furthermore, we focus on tax reforms that occurred in 2002-2007, as we use the same time period in our baseline analysis.

Since 1993, Finland has applied a dual income tax system where earned income (wages, pensions, fringe benefits etc.) and capital income (interest income, capital gains, dividends from listed corporations etc.) are taxed separately. Earned income is taxed on a progressive tax rate schedule (0-56% in 2007), whereas the capital income tax rate is flat (28% in 2007).[7] A typical feature of the Nordic dual income tax system is that the top marginal tax rate on earned income is much higher than the flat tax rate on capital income. The lower flat tax rate on capital income was justified on various grounds, for example broadening the tax base and decreasing the scope for tax arbitrage, and increased global capital mobility.

Within the Finnish dual income tax system, wage income and dividend income from privately held corporations are taxed with separate tax rules and tax rates. In general, owners of these firms can freely choose the income composition of wages and dividends, and income-shifting between these tax bases is legitimate. There are only a few minor legal limitations on whether income is withdrawn as wages or dividends from a privately held corporation in Finland. Therefore, for example, reporting more dividend income at the expense of wages induces no fines or penalties.

[7] As a whole, the Finnish income tax system follows the principle of individual taxation. The income of a spouse or other family members does not affect the marginal income tax rate of an individual. However, some tax deductions and social security benefits depend on the total income of the household.

However, wages cannot be paid without a work contribution for the firm, or else wages may be considered as veiled distribution of profits. In addition, dividends can be paid only if the firm has distributable assets. These include, for example, accumulated profits and non-tied equity. Nevertheless, in contrast to wages and dividends, other alternatives for withdrawing income from the firm are restricted. These include, for example, shareholder loans and share repurchases. In summary, as income-shifting responses between wages and dividends are largely unrestricted among the owners of privately held corporations in Finland, analyzing this group provides an intuitive empirical example to study the significance of both income-shifting and real behavioral incentives.

4.1 Dividend taxation and the dividend tax reform of 2005

The Finnish dual income tax system includes specific rules for the dividend taxation of the owners of privately held businesses. Dividends are categorized into two parts according to the net assets (assets-liabilities) of the firm:[8]

- The amount of dividends corresponding to an imputed 9% return on the net assets of the firm are subject to a flat tax rate. The imputed rate of return on net assets is set by the government, and it is the same for all owners.
- Any dividends exceeding the imputed return are taxed progressively.

For example, with net assets of 400,000 € and the imputed rate of return set at 9%, the maximum amount of dividends taxed at the flat tax rate is 36,000 € (0.09*400,000=36,000). In other words, any dividends from the firm up to 36,000 € are taxed at the flat tax rate. Any dividend income *exceeding* this amount is taxed according to the progressive tax rate schedule.

Furthermore, the taxation of dividends exceeding the imputed return is not similar to that of wage income. Dividends are subject to corporate taxes whereas wages are not. Also, some tax deductions are only allowed on wage income, whereas dividends are not subject to firm-level social security contributions.

Before the 2005 tax reform, a full imputation system of corporate taxes was in place. Within the full imputation system, corporate taxes paid on distributed dividends were credited back to the shareholder, which led to the effective single taxation of dividend income. Thus, before 2005, both flat-tax and progressively taxed dividends were only subject to individual-level taxes.

The reform of 2005 changed the principle of dividend taxation, as the full imputation system was replaced by double taxation of dividends. After the reform, all dividends became subject to the 26% corporate tax rate. In addition to corporate taxes, all dividends are in principle also taxed at the individual level. However, only 70% of dividend income was subject to individual taxation after the reform.

Nevertheless, single taxation of dividend income was partly retained. Dividends below the imputed 9% return on net assets and below 90,000 € remained single-taxed (at the flat 26% corporate tax rate).

[8]The net assets of the firm are calculated using the asset and debt values in the year before. The individual net asset share of the owner is calculated based on the ownership share of the firm. Also, there are some individual adjustments to the net assets. For example, if the owner or her family members live in a dwelling which is owned by the firm, the value of this dwelling is not included in net assets when calculating the imputed return.

Therefore, only dividends exceeding the imputed return or 90,000€ were subject to the double taxation rule.

The reform changed the marginal tax rates (MTR) differently for different types of owners. In general, changes in the MTR on dividends depend both on the amount of dividends and the net assets of the firm. Table 1 presents the main changes in the MTR on dividends for different types of owners.

Effective marginal tax rates on dividends (D)		
	Before (2002)	After (2007)
Type (I): D $\leq$ Imputed return and D $\leq$ 90,000€	29%	26%
Type (II): D $\leq$ Imputed return and D $>$ 90,000€	29%	40.5%
Type (III): D $>$ Imputed return		
min	0%	26%
max	55%	54%

Table 1: Effective marginal tax rates on dividends before (2002) and after (2007) the reform of 2005 for different types of owners

The first type of owners (Type (I)) are those who have dividend income below the 9% imputed return on net assets and below 90,000 €. For these owners the effective flat tax rate on dividends decreased from 29% to 26%. Before the reform, dividends below the imputed return were not subject to the corporate tax rate, and were taxed only at the flat personal capital income tax rate of 29%. After the reform, these dividends are only subject to the 26% corporate tax rate, and are not taxed at all in individual taxation.

Type II owners are those who have dividend income below the imputed return on net assets and above 90,000 €. Before the reform, these dividends were taxed at the flat capital income tax rate. After the reform, 70% of dividends above 90,000 € are regarded as taxable capital income in personal taxation, in addition to the flat corporate tax rate of 26%. This results in an effective flat tax rate of 40.5% for these dividends after the reform, compared to 29% before the reform.

Type III owners are those who have dividend income above the imputed return on net assets. Before the reform, these dividends were only taxed as personal earned income, subject to a progressive tax rate schedule (0-55%). After the reform, 70% of dividends above the imputed return are regarded as taxable earned income, in addition to the flat corporate tax rate of 26%. Therefore, the reform significantly increased the MTR on small dividends exceeding the imputed return, but the changes in the MTR were small for large dividends above the imputed return on net assets.

In summary, owners with larger net assets were more likely to be faced with a decrease in their dividend tax rate. In contrast, owners with smaller net assets were more likely to face an increase in their marginal dividend tax rate. Therefore, otherwise similar owners who differ only in the net assets of the firm were faced with different changes in the marginal tax rate on dividends. This implies that the change in the MTR on dividends is not directly related to the amount of dividend income, which alleviates the usual identification issues in the literature. We discuss these in more detail in Section 5.1.

Figure 5 in Appendix A presents the effective marginal tax rates on dividends in 2002 and 2007 with two levels of net assets, 0 and 250,000 € (approximately the average net assets in the estimation sample before the reform). The figure shows that most of the MTR increases occur on low and middle dividend income exceeding the imputed return. Also, the Figure shows the 3 percentage point drop in the flat tax rate on dividends below the imputed return and 90,000 €.

Plans to abolish the single taxation of dividend income were widely discussed already in 2002, and more formal propositions were published by the Finnish Government in late 2003. Thus it was possible for owners to anticipate the shift to the double taxation system. Therefore, the years right before and right after the reform are not suitable for empirical analysis that aims at identifying longer-run behavioral parameters.[9] Also, in 2005, special transition rules were applied which alleviated the partial double taxation of dividends. Thus, in our empirical analysis, we exclude the years 2003-2006 from the regression, and focus on the medium-run effect of the tax reform using a single difference of 2002-2007.

Finally, the main motivation behind the reform of 2005 was not the economic and fiscal conditions in Finland. The pre-reform full imputation credit was granted only to domestic shareholders whose firms operate in Finland. This violated European Union rules on the equal tax treatment of all EU citizens. Thus Finnish legislators were more or less forced to change the tax system towards more unified treatment of domestic and international shareholders. Therefore, the tax reform of 2005 can be considered exogenous from the point of view of domestic shareholders.

4.2 Wage income taxation and variation in wage tax rates

In Finland, there are three levels of wage income taxes: central government (or state-level) income taxes, municipal income taxes and mandatory social security contributions. The central government income tax rate schedule is progressive, whereas municipal tax rates and social security contributions are proportional by nature. Municipal tax rates vary between different municipalities.[10] Social security contributions include, for example, unemployment insurance payments.

During 2002-2007, there was a general decline in central government income tax rates throughout the income distribution. Marginal tax rates decreased almost every year in most income classes within central government taxation. In contrast, municipal tax rates have changed differently in different municipalities. On average, every fifth municipality changed its tax rate in each year. Yearly municipal tax rate changes vary from -1 to +1.5 percentage points, which accounts for roughly 1-10% changes in the overall net-of-tax rate. On average, the municipal tax rate increased from 17.8% in 2002 to 18.5% in 2007.

Because of different tax rate changes in different municipalities, the marginal wage tax rates of owners have changed differently. Also, municipal tax rate changes are determined only by the municipality of residence, not by the income level of an individual owner. Furthermore, since municipal taxation is residence-based, the marginal wage tax rate of the owner is not determined by the municipality in which the firm is physically located or registered.

Figure 6 in Appendix A describes the MTR on wage income. The left-hand side of the figure shows

[9] Kari, Karikallio and Pirttilä (2008) provide empirical evidence of anticipation effects before the tax reform of 2005 for privately held corporations.

[10] There are 336 municipalities in Finland (in 2012). Each democratically elected municipal council decides on the municipal tax rate on an annual basis. Municipalities can choose their tax rates freely. However, certain legislative municipal-level duties need to be financed mainly by municipal taxes (e.g. basic health care and primary education).

that average marginal wage tax rates decreased throughout the income distribution in 2002-2007. The right-hand side of Figure 6 shows the actual marginal tax rates calculated using our data set for the year 2007, highlighting the fact that individuals with the same income level face different marginal tax rates due to municipal-level tax rate differences. In addition, owners with the same income level face different changes in the MTR on wages due to different changes in municipal tax rates. This improves the identification of the elasticity parameter, since a notable part of the variation in wage tax rates is not directly based on taxable income.

We do not include mandatory pension and health insurance contributions as a direct tax on wages in this study. The insurance contributions of the owners of privately held corporations are not levied on actual wage income if the ownership share is above 50%, and the shareholder holds an executive position in the firm. These owners are termed YEL owners. YEL owners report a self-selected YEL income from which the insurance payments are accumulated. The reported YEL income can be above or below the actual wages paid without implications or sanctions.[11]

In contrast, insurance contributions are based on actual wage income from the firm for owners whose ownership share is less than 50% (similarly as in the case of paid workers with no ownership share). These owners are termed TEL owners. Thus for TEL owners, insurance contributions increase or decrease based on the wage income withdrawn from the firm. However, it is not clear whether insurance contributions are fully regarded as taxes, since owners directly benefit from them in terms of future pensions or in case of illness. Nevertheless, it is plausible that insurance payments levied on actual wage income decrease the incentives to pay wages to TEL owners, compared to YEL owners whose insurance contributions do not depend on wages withdrawn from the firm. We discuss how we apply this variation in our empirical analysis in Section 5.1.[12]

4.3 Tax incentives for income-shifting

The Finnish tax system creates noticeable income-shifting incentives for the owners of privately held corporations. As the tax rate schedules for wages and dividends differ from one another, owners can minimize income taxes by choosing an optimal combination of wages and dividends as their personal compensation from the firm. Harju and Matikka (2012) show that the owners of privately held corporations are active in minimizing tax payments through income-shifting between wages and dividends.

The 2005 tax reform affected the income-shifting incentives of many owners. In the light of our analysis, it is significant that the reform changed the income-shifting incentives differently among otherwise similar owners. Owners with dividends below the imputed return on net assets and 90,000 € faced only modest changes in their income-shifting incentives. For these owners, the flat tax rate on dividends decreased by 3 percentage points, inducing a small change in incentives to increase dividend compensation at the expense of wages. In contrast, owners with dividends exceeding the imputed rate of return on

[11] However, there are both lower and upper limits for YEL income, which are both also independent of actual wage income. Nevertheless, as insurance payments determine pensions after retirement as well as many income-bound social benefits, YEL owners have incentives to report a realistic YEL income that reflects the actual earnings potential.

[12] There were no relevant changes in TEL or YEL insurance payment rates in the time period we study. The average rate for TEL payments is 21.1% in both 2002 and 2007, and 20.8% in 2007 and 21.1% in 2002 for YEL payments. Insurance contributions are fully deductible from taxable income.

net assets faced an increase in dividend tax rates, as these dividends became double-taxed. For many of these owners, the MTR on dividends became larger than the MTR on wages, inducing notable changes in the incentives to shift income between wages and dividends.

Table 4 in Appendix A presents the marginal tax rates on wages and dividends at different levels of firm net assets. The table highlights that owners with different net assets have different MTRs on dividends, and faced different changes in marginal tax rates and income-shifting incentives from the 2005 tax reform.[13]

5 Identification and data

5.1 Net-of-tax rate instruments

In a progressive income tax rate schedule, the marginal tax rate increases as taxable income increases. Therefore, an increase in taxable income mechanically decreases the net-of-tax rate, causing the tax rate variable to be endogenous in the empirical model. Thus a valid instrumental variable for the net-of-tax rate is required.

A common strategy in the ETI literature is to simulate predicted (or synthetic) tax rates and use them as instruments for the net-of-tax rate (NTR) (see Gruber and Saez 2002). The basic structure of the predicted NTR variable is the following: Take pre-reform income in base-year t, and use it to predict the net-of-tax rates for $t + k$ by using the post-reform tax legislation in $t + k$. The predicted tax rate instrument is then defined as the difference between the actual NTR in t and the NTR calculated with income in t and the tax law for $t + k$. Intuitively, the predicted NTR instrument describes the change in tax liability caused by changes in tax legislation, ignoring any behavioral effects via taxable income responses.

In this study we use the predicted NTR instrument with a few modifications. First, we need to address the development of net assets when defining the net-of-tax rate instrument for dividends. Net assets are a key factor determining the marginal tax rate on dividends (see Section 4). As shown in Tables 5 and 6 in Appendix A, average net assets increase in time both in the whole data set and our estimation sample. Thus we need an estimate for net assets in $t + k$ when defining the NTR instrument for dividends. Otherwise we would be predicting the effect of the dividend tax rate change incorrectly for a large number of owners.

We predict net assets after the reform for each owner using exogenous pre-reform characteristics in 2000-2003. We use the same exogenous individual and firm-level variables as in the baseline ETI regression. These variables include, for example, age, age squared, gender, turnover, total assets and industry and location dummies. Intuitively, counterfactual net assets take into account the development of net assets not related to the tax reform of 2005. The R-squared statistic for the net assets prediction using OLS is 0.73.

[13] Harju and Matikka (2012) provide a more detailed discussion on income-shifting incentives within the Finnish dual income tax system.

Second, predicted NTR instruments are better predictors of exogenous tax rate variation within a single tax base and a single tax bracket of the progressive tax rate schedule. Intuitively, predicted NTR instruments perform better for changes in income that are relatively close to the original income level in the base period. However, available income-shifting opportunities might cause substantial changes in taxable income, as income-shifting may lead to "jumping" across tax brackets. Therefore, the predicted net-of-tax rate instruments might be too weak if income-shifting is active.

Therefore, we might need additional instruments to more robustly estimate ETI for individuals with income-shifting possibilities. The purpose of additional instruments is to capture the incentives to change the composition of income, which are not necessarily taken into account when using only the predicted NTR approach.

We use the pension insurance status of the owner as an additional instrument in the wage regression. Pension insurance status is defined based on the ownership share of the firm, and the official working status of the owner of the firm. Individuals who work in their own firm in an executive position and own 50% or more of the firm alone or together with immediate family members are termed YEL owners. They can choose the amount of reported YEL income on which mandatory insurance payments are levied. In contrast, individuals who own less than 50% of the firm pay pension insurance payments based on the actual wages paid from the firm. These owners are called TEL owners. YEL/TEL status cannot be freely chosen. Owners satisfying the YEL conditions in a given year cannot change their status to TEL owners, or vice versa.

We assume that TEL owners who cannot choose the level of insurance payments would not increase their wage compensation after the reform as much as YEL owners, for whom wages do not legally affect the level of the insurance contribution. In other words, the YEL/TEL status affects the incentives to shift income from dividends to wages because of insurance payments, which are not captured by the predicted net-of-tax rate instrument. The exclusion restriction behind this instrument is that the YEL/TEL status is not itself correlated with transitory income shocks, conditional on various observed individual and firm-level characteristics.

An essential issue in identifying ETI is the variation in marginal tax rates. With both wages and dividends, changes in the marginal tax rates vary across the income distribution. This is important because non-tax-related changes in income are potentially problematic when identifying the elasticity parameters (see Saez et al. 2012). If the shape of the income distribution varies independently of tax reforms, the analysis of behavioral responses to tax rate changes might be biased if this variation cannot be properly taken into account. Non-tax-related changes in the income distribution are especially problematic if the variation in MTR is focused only on a certain part of the income distribution, for example the tax rate cuts or increases in the top income bracket. The fact that both dividend and wage tax rate variation occurs in all income classes alleviates the potential problems associated with these issues.

Furthermore, the fact that changes in both the MTR on wages and dividends are not direct functions of income improves the exogeneity of the instrument. As discussed in the recent ETI literature, there is no proof that the predicted NTR instrument is exogenous in all cases (Blomquist and Selin 2010, Weber

2014). It is unlikely that the instrument is correlated similarly with both parts of the transitory income component $(\varepsilon_{t+k,i} - \varepsilon_{t,i})$ if the NTR is a direct function of income (even conditional on base-year income splines and other controls).[14] This is lessen of an issue in our empirical example, as changes in the MTR on both dividends and wages also depend on net assets and the municipality of residence, respectively.

5.2 Data

Our data are from the Finnish Tax Administration, and include information on the financial statements and tax records of Finnish businesses. The data include tax record information on both the firm and its main owner from the year 2000 onward. Another unique characteristic of the data is that they include all Finnish businesses (all public and private corporations, partnerships, sole proprietors etc.). In this study we focus on the main owners of privately held corporations.

The data set contains all important information for our analysis, for example wages and dividends paid to the owner by the firm, and income earned by the owner from other sources. These, together with other tax record information, enable us to define the marginal tax rates for both the relevant personal tax bases, wages and dividends. By linking the owner-level and the firm-level data together, we can control for various individual and firm-level effects in the empirical estimation. This type of detailed business owner data are rarely used in ETI analysis.

For this study we construct a balanced panel data set for the years 2002-2007. The main owner data include only those individuals who received positive dividends from the firm during a tax year. Tables 5 and 6 in Appendix A describe the data and the key variables we use from both 2002 and 2007. Table 5 shows the statistics for the whole data, and Table 6 for our baseline estimation sample.

5.3 Descriptive statistics

Figure 1 describes the means of wage, dividend and total income (wages+dividends) from 2000 to 2009 for all owners of privately held corporations. The figure shows that mean wages, mean dividends and mean total taxable income all increased from 2000 to 2009. Importantly, the figure indicates that the share of wage income relative to total income has increased from 2005 onwards. This suggests that the tax reform of 2005 and the abolition of the single taxation of dividends affected the composition of total income, which gives us the first preliminary evidence that income-shifting might be significant. However, based on Figure 1, it remains unclear whether the tax rate changes also induced real responses.

In addition, Figure 1 shows that mean dividends and mean total income increased in the year before the reform, and decreased right after the implementation of the reform of 2005. Plans to abolish the single taxation system were publicly discussed already in 2002, and more formal propositions were published by the Finnish Government in late 2003. The early discussions also included a proposal to increase tax rates on dividends below the imputed return, which, however, eventually remained single-taxed after

[14] Blomquist and Selin (2010) use income in the middle year of the difference $((t + k + t)/2)$ as the base period when imputing the predicted tax rates for both $t + k$ and t. Weber (2014) proposes an instrument which exploits years before k as the base period. Both of these approaches aim at reducing the covariance between the instrument and the transitory error component. However, both of these strategies provide more or less weaker instruments than the Gruber and Saez (2002) approach, which might also bias the estimated parameter of interest.

the reform. Nevertheless, from the point of view of business owners, various proposals and active public discussion increased the uncertainty surrounding the details of the 2005 tax reform.[15]

For owners with progressively taxed dividends, there were large incentives to withdraw extra dividend income from the firm before the double taxation came into effect in 2005. However, many owners with flat-tax dividends also increased dividend payouts before 2005. This was presumably caused partly by the uncertainty about the actual implementation of the new dividend tax system. Nevertheless, most owners faced at least some intertemporal incentives to increase dividend payments before the reform, as larger dividend payments became subject to higher marginal tax rates after the reform.

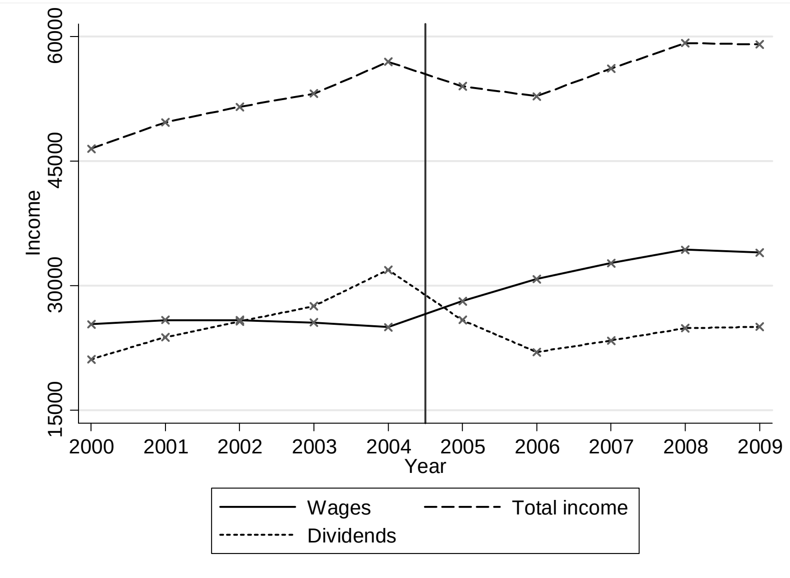


Figure 1: Means of wage, dividend and total income in 2000-2009 (in 2000 euros)

Next, we describe how tax incentives affect income withdrawn from the firm. Figure 2 shows the proportional changes in dividends (left-hand side) and total income (right-hand side) for two groups: those who faced a modest dividend tax decrease or no changes in the dividend tax rate, and those who faced a dividend tax increase. These groups are defined based on the predicted tax rate change due to the reform of 2005, calculated using the income information in 2002.[16] In the figure, the light-gray dashed lines denote the anticipation period (2003-2005). The black dotted lines within 2003-2005 characterize the development of dividends and total income ignoring the anticipation period.

Figure 2 highlights the following issues: First, when comparing dividends in the pre-reform (2000-2002) and post-reform (2006-2009) periods, we can see that dividends decreased among owners who faced a predicted dividend tax increase. In comparison, dividends increased among owners with no tax rate changes or a dividend tax decrease. This indicates that owners responded to the dividend tax reform according to changes in tax incentives. Second, dividends increased in both groups in a similar fashion before 2003, which indicates that there were no significant differences in pre-reform income trends. Third,

[15] Kari et al. (2008) discuss the various proposals and their details more thoroughly.

[16] The predicted tax rate changes are defined similarly as the net-of-tax rate instruments (see Section 5.1 above). Owners with no changes in tax incentives include those with a change below 5% in the net-of-tax rate on dividends (in either direction). Owners with a dividend tax increase include owners with a positive change above 5%, and owners with a dividend tax decrease include owners with a negative change above 5% in the predicted net-of-tax rate.

both groups anticipated the reform by notably increasing dividends before the reform. This behavior is consistent with short-run intertemporal income-shifting incentives.

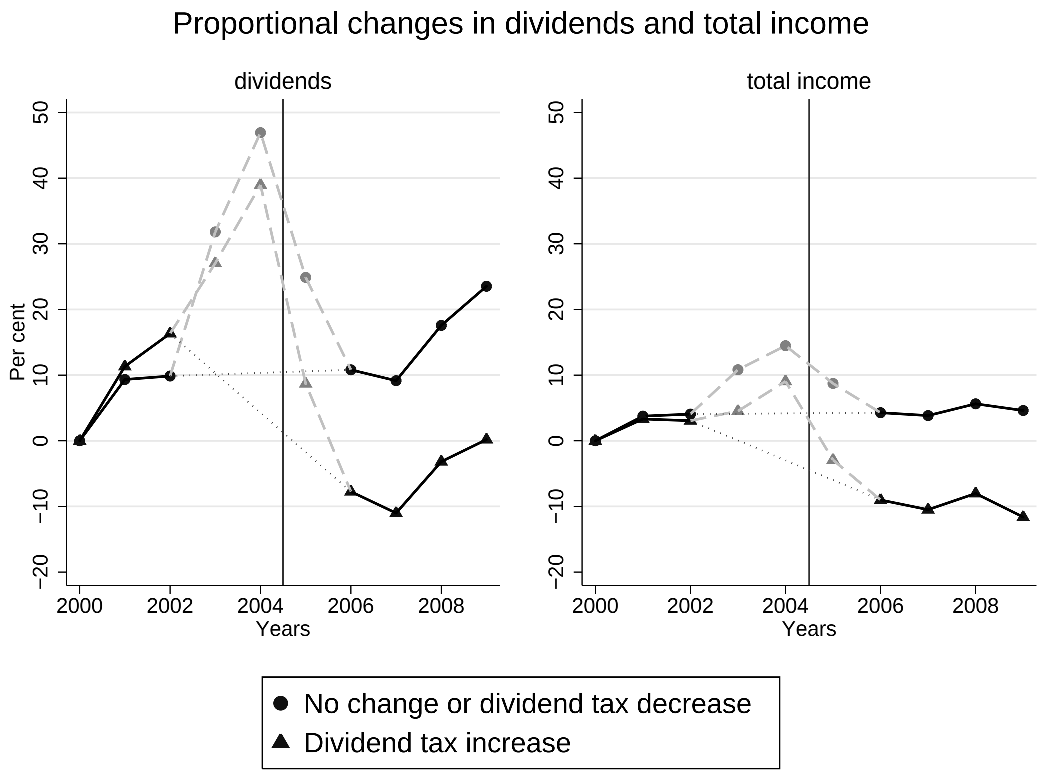


Figure 2: Proportional changes in dividends and total income by tax incentives (estimation sample)

The right-hand side of Figure 2 shows that total income increased very similarly in both groups before the anticipation period (2000-2002). This ensures that our estimation results are not biased by differing income trends before the reform. Second, both groups anticipated the future increase in dividend taxation by increasing total income withdrawn from the firm in 2003-2004. Third, compared to owners with no tax changes or a dividend tax decrease, owners with a dividend tax increase decreased their total income after the reform. This implies that the dividend tax reform also affected the total income withdrawn from the firm.

In summary, Figure 2 indicates that owners responded to the dividend tax reform of 2005 according to the tax incentives. Dividends and total income decreased among those who faced a predicted dividend tax increase, compared to owners with no changes or a dividend tax decrease. Changes in dividends could be caused by both real responses and income-shifting. However, changes in total income suggest that at least part of the effect stemmed from real responses. Nevertheless, in order to identify real responses and income-shifting separately, we need to estimate the model with simultaneous changes in both income-shifting and real-term incentives.

6 Main results

6.1 ETI and income-shifting

Table 2 presents ETI estimates for wage income and dividend income (gross income subject to taxation) for a single difference between 2002-2007. Columns (1)-(3) show the results for dividends, and columns (4)-(6) present wage income elasticities with the full set of control variables.

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	lnZ_D	lnZ_D	lnZ_D	lnZ_W	lnZ_W	lnZ_W
$ln(1-t_W)$		-1.468***		0.042	0.316	-0.093
		(0.376)		(0.306)	(0.355)	(0.300)
$ln(1-t_D)$	1.649***	1.989***	0.521*		-0.409***	
	(0.123)	(0.163)	(0.297)		(0.139)	
$[ln(1-t_D)-ln(1-t_W)]$			1.468***			-0.409***
			(0.376)			(0.139)
Income spline	Yes	Yes	Yes	Yes	Yes	Yes
Base-year controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm controls	Yes	Yes	Yes	Yes	Yes	Yes
1st stage F-test for $ln(1-t_W)$		163.69		226.97	172.00	172.00
1st stage F-test for $ln(1-t_D)$	877.02	601.02	601.02		548.66	
1st stage F-test for $[ln(1-t_D)-ln(1-t_W)]$			334.74			333.09
Observations	14,003	14,003	14,003	12,135	12,135	12,135

Notes: Robust standard errors in parentheses. Estimates weighted by total income.*** p<0.01, ** p<0.05, * p<0.1

Table 2: ETI estimates for wages and dividends, 2002-2007

For dividends, the standard ETI model in column (1) gives average net-of-tax rate elasticity of over 1.6, which can be considered large. However, as income-shifting possibilities between dividends and wages are particularly relevant for owners of privately held corporations in Finland, we need to add the net-of-tax rate of wages into the model in order to more rigorously analyze tax responsiveness.

Columns (2) and (3) imply that a significant part of the overall behavioral response of dividends is due to income-shifting between the tax bases. Column (2) shows that the cross-elasticity of dividends with respect to the net-of-tax rate on wages is almost -1.5 and statistically significant. However, simply adding the tax rate of another tax base to the ETI model for dividends does not change the baseline interpretation of its own net-of-tax rate elasticity, which still reflects both real and income-shifting responses.

Adding the difference of the instrumented net-of-tax rates to the model changes the interpretation of the dividend tax rate parameter. Now the coefficient for dividend net-of-tax rate only includes the real response, which is estimated to be 0.5 and weakly significant. In terms of identifying the income-shifting response, columns (2) and (3) use the same tax rate variation, which gives the same estimates for the income-shifting component. The main difference in the two approaches is the separate estimate for the real response in column (3).

For wages, columns (4)-(6) show that the only statistically significant effect is the income-shifting response, which is estimated to be around -0.4. The wage net-of-tax rate coefficient is insignificant in every specification. The results for the wage income regressions highlight that a tax base might be responsive to tax rates in other tax bases even when its own tax rate elasticity is zero or insignificant.[17]

In summary, the results in Table 2 show that income-shifting can have substantial impact on the behavior of individuals with income-shifting possibilities. This result is in line with previous studies from both the US (e.g. Slemrod 1995, Gordon and Slemrod 2000, Saez 2004) and the Nordic Countries (e.g. Pirttilä and Selin 2011, le Maire and Schjerning 2013). In addition, we find that different tax bases react differently to tax rate changes, both in terms of real and income-shifting responses. We further interpret and discuss our results in Section 8.

6.2 Real response estimations

As discussed before in Section 3, the estimated real response components in Table 2 might not fully reflect the actual real effort or the productivity of the owner. Real responses in the ETI model might be "contaminated" with other tax avoidance measures, such as private consumption within the firm or fringe benefits.

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	$ln(Z_D + Z_W)$	$ln(Z_D + Z_W)$	*ln(net profit)*	*ln(net profit)*	*ln(turnover)*	*ln(turnover)*
$ln(1 - t_W)$		0.086		0.206		0.178
		(0.172)		(0.345)		(0.313)
$ln(1 - t_D)$	0.694***		0.335**		0.293*	
	(0.076)		(0.169)		(0.151)	
Income spline	Yes	Yes	Yes	Yes	Yes	Yes
Base-year controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm controls	Yes	Yes	Yes	Yes	Yes	Yes
1st stage F-test for $ln(1 - t_W)$		183.29		407.85		409.66
1st stage F-test for $ln(1 - t_D)$	805.69		850.48		791.86	
Observations	14,010	14,010	13,507	13,507	13,018	13,018

Notes: Robust standard errors in parentheses. Estimates weighted by total income.*** p<0.01, ** p<0.05, * p<0.1

Table 3: Real response estimations, 2002-2007

We estimate the net-of-tax rate elasticities for income components that are broader than the separate tax bases for wages and dividends in order to assess the real component in a more diverse manner. First, we analyze the elasticity of total income (wages + dividends). The conclusions based on the estimates in columns (1) and (2) in Table 3 are similar as before. Dividends also appear to affect real behavior, whereas the real elasticity of wages is close to zero and insignificant. The point estimate for dividend tax elasticity is 0.7, which can be considered relatively large.

However, there are still various ways in which owners can affect the amount of reported total income subject to taxation. For example, as shown in Figure 2 above, owners anticipated the dividend tax increase in 2005 by increasing both reported dividends and total income before the reform. Therefore,

[17] We also study the heterogeneity of the results across income groups. Following the approach of Gruber and Saez (2002), we divide the sample to four equal-sized quantiles based on base-year wages and dividends. In summary, we find that the real elasticity is smaller and income-shifting elasticity is larger for high-income owners, and vice versa. However, due to the relatively small number of observations in the subsamples, these elasticity estimates are imprecisely measured.

we also estimate the tax elasticities of firm-level income components that are arguably less subject to tax avoidance and intertemporal shifting of reported income.

First, we estimate the elasticity of net profits with respect to both net-of-tax rates. Net profits are defined as turnover plus other income of the firm minus all costs except wages. Thus net profits include, for example, sales, capital gains and irregular earnings. Second, we estimate the net-of-tax rate elasticity of the turnover of the firm. Importantly, compared to total income withdrawn from the firm, both net profits and turnover also include retained earnings and other income not withdrawn from the firm in the current period.

Both of these variables reflect the real effort of the owner. The firms in our estimation sample are relatively small in terms of the number of employees (median no. of employees is 3 in 2007). Thus the owner contributes significantly to the overall output of the firm. Furthermore, the tax elasticities of these types of firm-level income components with respect to owner-level tax rates are rarely analyzed in public finance literature.

Net profits are significantly responsive to dividend taxes, but the point estimate is half the size of the total income elasticity (column (3)). The point estimate for wage tax elasticity increases, but it is still statistically insignificant (column (4)). Columns (5) and (6) present the elasticity estimates for the turnover of the firm. The estimates are similar, but somewhat smaller than before with net profits. This indicates that dividend taxes affect the productivity of the firm and the effort of the owner in a statistically significant manner, whereas wage taxes do not.

However, it is worth noting that the size of the income component might also affect the estimates. As the underlying tax rate variation is the same in all specifications, broader tax bases have smaller elasticities if the absolute behavioral response is the same for different income components. Thus differences in the elasticity estimates for different income types might not be solely driven by differences in the opportunities to avoid taxes.

Overall, the results imply that even though income-shifting between tax bases accounts for a large proportion of the elasticity, the responses along the real margin might still be non-negligible at the same time. Thus for the policy maker, this requires weighting the possible advantages (or disadvantages) stemming from real responses with the costs of avoiding taxes by income-shifting.

Finally, in addition to effort responses, dividend and wage taxes might affect firm-level real investment decisions. Investment responses might cause additional welfare effects, which are not included in our model of the excess burden. However, in order to thoroughly analyze the welfare effects of investments, we would need a well-defined dynamic model. Nevertheless, we address this issue by characterizing investment responses. Similarly as in Table 3, we regress the change in the fixed assets of the firm[18] with the changes in the net-of-tax rates on wages and dividends. In the fixed assets estimations, the coefficient for dividend taxes is positive and statistically significant (0.33 (0.17)). For wage taxes, the estimate is very close to zero and insignificant (0.04 (0.37)). These results are well in line with the turnover and net profits estimations, and highlight that dividend taxes might also significantly affect the real economic

[18]Fixed assets include, for example, machinery and equipment, plants and buildings, and research and development expenses and other long-term expenses.

decisions of the owners.

7 Alternative specifications and robustness checks

7.1 Bunching at kink points

Examining taxable income distributions near the kink points of the piecewise linear income tax schedule provides a visual and robust method to analyze the overall ETI. The bunching method provides a local alternative to the first-differences approach, and allows us to estimate behavioral responses using cross-sectional variation in tax rates. This avoids some of the critical issues in first-differences estimation and net-of-tax rate instruments, such as potential mean reversion. Intuitively, similar general conclusions from the bunching analysis would support our main results based on panel data regressions.

A seminal contribution by Saez (2010) shows that under normal preferences, we should observe an excess mass of individuals clustering at the point in the income distribution where the marginal tax rate exhibits a discontinuous jump if significant behavioral responses occur. More formally, Saez (2010) shows that the local ETI is proportional to the excess density mass around the kink point:

$$e \backsimeq \frac{b(k)}{k * ln((1-\tau_1)/(1-\tau_2))} \tag{16}$$

In equation (16), $b(k)$ is the excess mass at the kink point k, and $(1-\tau_1)$ and $(1-\tau_2)$ denote the net-of-tax rates below and above k, respectively. Empirically, $b(k)$ is estimated by comparing the observed income distribution at the kink point to a counterfactual income distribution, representing the shape of the distribution in the absence of a change in the marginal tax rate at k.

Intuitively, given the size of the change in the net-of-tax rate around the kink point, the implied elasticity is larger the more behavioral responses occur and more bunching is observed at the kink. Also, with given excess bunching, the elasticity is smaller the bigger is the difference between the tax rates on both sides of the kink. A more detailed theoretical background for the bunching approach and the estimation procedure are presented in Appendix B.

Figure 3 shows the distributions of dividend income around the kink point of flat-taxed dividends in 2002 and 2007. The figure presents dividend income relative to the kink for each owner within +/- 5,000 € of the kink in bins of 100 €. Dividend income below the kink is taxed at the flat tax rate. Dividends exceeding the kink are taxed progressively. Thus for many owners, the flat-tax kink point induces large changes in the marginal tax rate on dividends. On average, the increase in the MTR on dividends at the kink is 13 percentage points in 2002, and 19 percentage points in 2007.

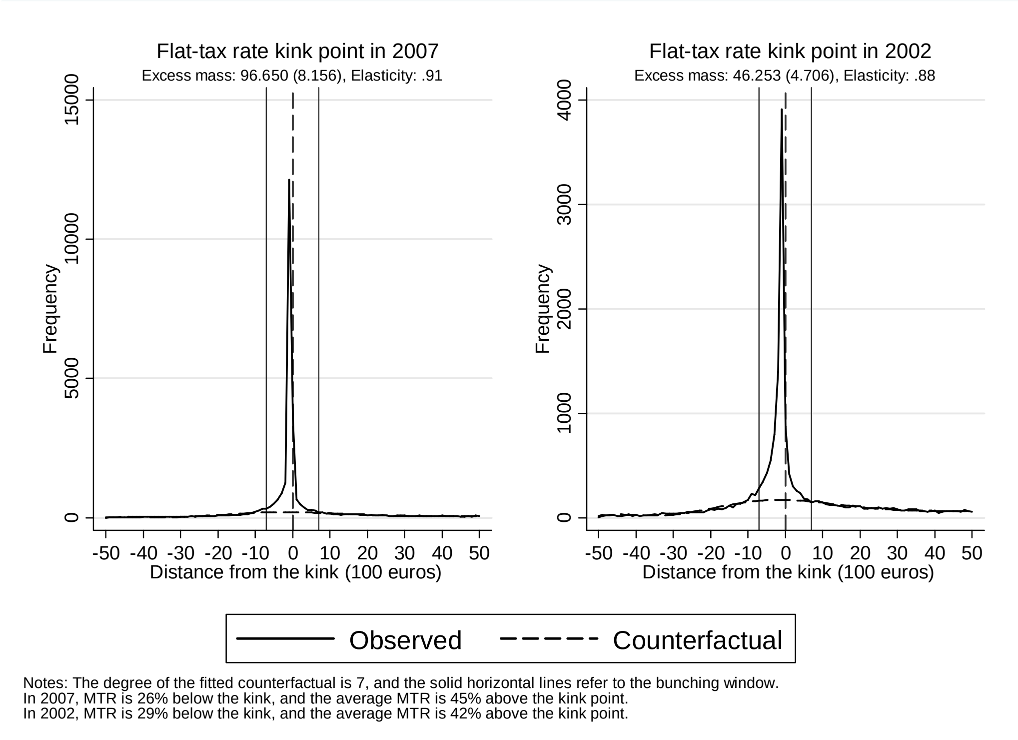


Figure 3: Dividend income distribution around the flat-tax rate kink point, years 2007 (left) and 2002 (right)

Figure 3 indicates clear bunching at the flat-tax kink point. A large proportion of the owners are located very close to or exactly at the kink point. This strongly supports the earlier conclusions that owners are responsive to marginal tax rates on dividends, and that the dividend tax base is clearly responsive to its marginal tax rate. We approximate the local ETI of dividend income at the kink point using the average marginal tax rate above the kink for owners within the bunching window. We estimate the ETI to be around 0.9 and statistically significant both in 2002 and 2007.

There are a few aspects that are worth noting when interpreting Figure 3. First, the flat-tax kink point is not the same for all owners in terms of euros, as the amount corresponding to the 9% imputed return on the net assets of the firm obviously varies among different owners. However, Figure 3 implies that owners are very aware of their individual kink points, as there is no other explicit reason to locate at the kink except the discontinuous change in the tax rate. Second, the size of the change in the marginal tax rate on dividends at the kink point also varies among owners, as the marginal tax rate on dividends exceeding the kink depends on the total sum of progressively taxed income (wages and earned income from other sources).

The bunching method identifies the overall effect of the increase in the MTR on dividends close to the kink, not taking into account potential changes in behavior elsewhere in the income distribution or in other tax bases. Therefore, the bunching approach does not enable us to explicitly identify separate estimates for real elasticity and income-shifting. Nevertheless, the bunching evidence clearly shows that dividend tax rates induce notable behavioral responses among owners.

In addition, we conduct an indirect bunching analysis for wages. The exact location in the taxable income distribution is what matters in terms of bunching at kink points. Thus it is not relevant to analyze only the distribution of wages from the firm, as other progressively taxed income also affects the location of the owner in the taxable income distribution. For simplicity, in the bunching analysis, we only include owners who do not receive wages or other earned income outside the firm. Nevertheless, the results are similar when we include all the owners in the data set.

Figure 4 presents the distributions of earned income relative to different kink points in the marginal tax rate schedule for 2002 and 2007 (+/- 5,000 € in bins of 100 €). The figure shows that there is no statistically significant excess bunching at the kink points of the earned income tax schedule. For the sake of brevity, Figure 4 presents only 3 kink points in both years, but the result of no significant bunching holds for all kink points.

The evidence from the wage tax rate kink points suggests that owners do not react actively to marginal wage tax rates, which is in line with the low wage elasticity estimates presented before. Compared to the first-differences analysis, the cross-sectional bunching approach is not sensitive to the size of the change in the marginal tax rate between t and $t + k$. As changes in wage tax rates over time have been modest in 2002-2007, this might affect the results in Section 6.1. Nevertheless, both of these methods suggest low responsiveness of wage income to the marginal tax rate on wages.

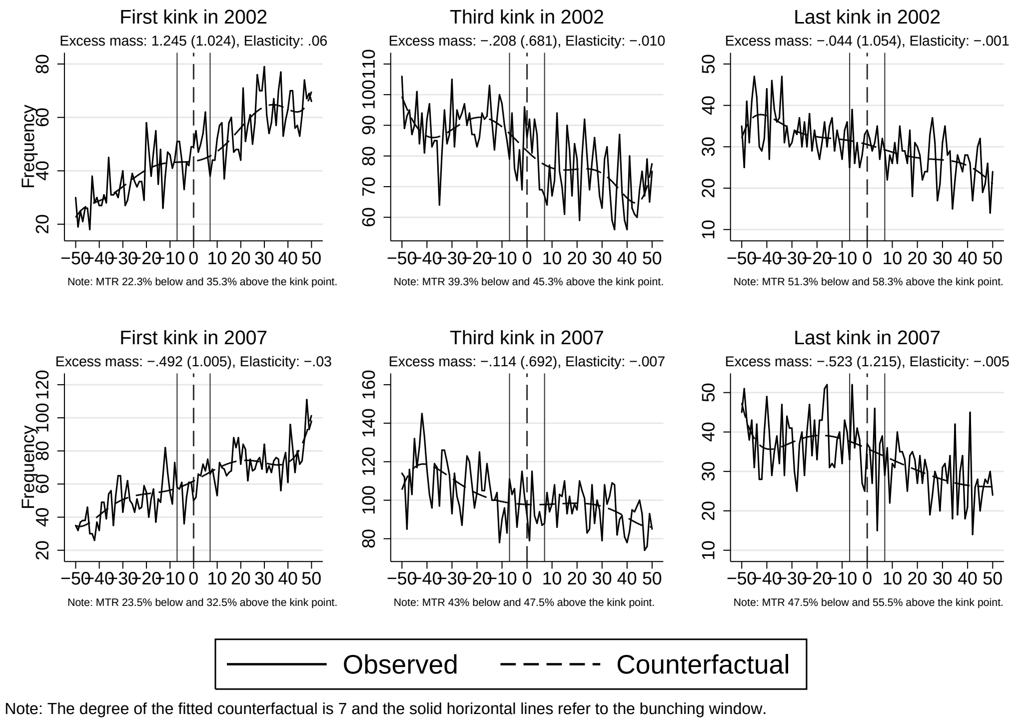


Figure 4: Taxable earned income distributions relative to different kink points, years 2002 (above) and 2007 (below)

In summary, the bunching analysis supports the result that dividends are more responsive to tax rates than wages. We find clear bunching at the flat-tax kink point for dividends, whereas the earned income tax rate schedule appears not to induce significant behavioral responses. However, studying excess bunching of dividends and wages does not give explicit information on the extent of income-shifting between the tax bases. Nevertheless, the bunching evidence indicates that owners are very aware of the flat-tax kink point. Given the ample possibilities to shift income between wages and dividends, this tentatively suggests that the dividend tax kink also affects wage income and the overall composition of total income.

7.2 Robustness checks and sensitivity analysis

We estimate several different specifications of our estimable equation (15) in order to assess the robustness and sensitivity of our baseline results. The results for these estimations are presented in Tables 7 and 8 in Appendix A. In general, our results and main conclusions are robust to changes in the empirical specification.

In column (1) of Table 7 we estimate the model for dividends, wages and the turnover of the firm without any control variables. The results without controls are approximately similar to those with controls. This tentatively indicates that non-tax-related changes in income do not significantly bias the results. In other words, identification appears not be very sensitive to the selected individual and firm-level controls.[19]

Following Gruber and Saez (2002), our baseline estimates are weighted by total income. Column (2) in Table 7 shows the unweighted estimates, which are very similar to the weighted estimates. Columns (3)-(6) show the results with different variations of income cut-offs. All of these results are statistically equivalent to our baseline model. However, the point estimates vary somewhat depending on the income cut-offs.

Column (7) presents the OLS results, which indicate that the mechanical correlation between income and the net-of-tax rates is notable. All of the OLS estimations give counterintuitive results with large negative own net-of-tax rate elasticities. Column (8) shows the results from the reduced-form model, i.e. the regression of the change in income on the net-of-tax rate instrument and all controls. For example, for dividends, these results indicate that the predicted changes in net-of-tax rates based on pre-reform characteristics affect real dividends, and also significantly affect income-shifting. Thus these results are in line with the two-stage least squares model.

In addition, we test how our modifications to the predicted NTR instrument affect our results. First, including the YEL/TEL dummy variable as an additional instrument in the wage regression does not have a significant effect on the point estimates. However, it improves the precision of the estimation. Second, the prediction of firm net assets based on pre-reform observed characteristics affects the main results for dividends, compared to NTR instruments defined with fixed net assets from the base year 2002. Without predicting the net assets, the F-test for the NTR instrument is very low. This indicates that the NTR instrument poorly predicts the changes in tax incentives without taking into account the

[19] As an additional robustness check, we add 10-piece splines of firm-level income and asset variables as control variables in order to more rigorously control for the possibility that changes in individual income and firm-level characteristics are connected. This might be a concern because firm net assets, which also reflect the size of the firm, greatly affect changes in the marginal tax rates on dividends. However, adding firm-level splines does not significantly affect the results. Nevertheless, adding additional splines increases precision.

(counterfactual) growth of net assets, which greatly affects the realized MTR on dividends.

Finally, Table 8 shows the results for longer-run effects, namely for the years 2002-2008 and 2002-2009. The estimates suggest that the income-shifting effect somewhat decreases in the longer run. Otherwise the results are similar to those in our baseline model. This also implies that anticipation of the 2005 tax reform does not significantly affect the results, as the estimates for longer time periods imply qualitatively similar results as our baseline model.

8 Discussion

In this paper we show how including income-shifting between tax bases in the widely-used elasticity of taxable income (ETI) framework affects the interpretation of ETI as the overall measure of tax efficiency. Based on previous ETI literature, we build an empirical model that identifies both real responses and income-shifting. As an empirical example, we analyze real responses and income-shifting between wages and dividends among the owners of privately held corporations in Finland. To our knowledge, this paper is the first to explicitly separate these elasticities using a well-defined empirical model and detailed micro-level panel data and tax reforms.

As shown by Feldstein (1995, 1999), ETI summarizes the overall deadweight loss of income taxation. The source of the behavioral response is irrelevant as long as individuals optimize such that the marginal cost of "creating" taxable income through different margins equals the net-of-tax rate of the tax base.

However, tax avoidance through income-shifting might distort this line of thought for at least two reasons. First, if part of the behavioral response is due to income-shifting between tax bases, the shifted income is usually also taxed. Thus not all of the overall response is necessarily a deadweight loss. Second, the real social costs associated with income-shifting might be low, for example due to fiscal externalities related to payments to tax consultants. This further decreases the efficiency loss. In the extreme case in which income-shifting induces no social costs at the margin, the income-shifting response is only a re-allocation of resources between individuals and the government with no welfare losses (Chetty 2009).

Our results show that income-shifting accounts for a large proportion of the overall behavioral response among the owners of privately held businesses in Finland. Over two thirds of the overall dividend income response is due to income-shifting. For wages, the only statistically significant response comes from the income-shifting margin.

What do the results from our empirical example case imply in terms of the excess burden analysis? Applying the welfare loss formulas (9) and (10) presented in Section 2.3, we can evaluate the marginal excess burden both in the standard ETI framework and the income-shifting model. We approximate the marginal excess burden using the average real and income-shifting elasticities, and the average marginal tax rates on dividend income and wage income (using post-reform values for the whole data set).

Using the standard ETI framework and the point estimate for the average overall dividend elasticity in column (1) of Table 2, we approximate the marginal excess burden of dividend taxation to be around 0.9. When separating the income-shifting effect and using the average estimates in column (3) of Table 2, the marginal excess burden halves to 0.4. Thus the standard ETI analysis for the dividend tax base notably overestimates the deadweight loss, and simply taking into account the fact that the shifted income is also taxed significantly decreases the evaluated efficiency loss.

Furthermore, if we assume that income-shifting is purely transferring resources in the economy with zero social costs, the marginal excess burden of dividend taxes reduces to the welfare loss induced solely by the real behavioral effect. Using the estimate for real responses in the dividend tax base model in column (3) of Table 2, we approximate the marginal deadweight loss to be around 0.3.

However, our estimate for the real response in the single tax base model might be upwards-biased. The real response estimate might include other tax avoidance channels. For example, owners can shift reported personal income intertemporally between different time periods using retained earnings.

We use broader firm-level income components (turnover and net profits) that are less subject to tax avoidance in order to examine the real effects more diversely. In addition to income withdrawn from the firm by the owner, turnover and net profits include retained earnings, and therefore capture the effect of tax rates on effort and productivity in a more comprehensive manner. The results show that both net profits and the turnover of the firm appear to be responsive to dividend taxes, which supports the view that the real responses are non-negligible. In contrast, the effect of wage taxes does not statistically differ from zero.

Overall, we find that the dividend tax base is more responsive to taxes than the wage tax base. Also, firm-level income components are more responsive to dividend taxes compared to wage taxes. There are plausible explanations for these findings. First, the variation in tax rates is larger for dividends, both over time and between income tax brackets. If there are underlying optimization frictions, the owners would respond more to larger changes in tax rates (see e.g. Chetty 2012 and Kleven and Schultz 2013).

Second, there might be practical differences between the two income tax bases. Decisions on dividend distributions are usually made only once or a few times within a year. In contrast, wages are normally paid on a monthly or weekly basis. The infrequent nature of the decision-making process might make dividend income more responsive to taxes. Also, owners might be more aware of the dividend tax rate and the dividend tax rate kink points in the Finnish system, as long as they are aware of the net assets of their firm. In contrast, the effective marginal wage tax rate schedule including many deductions and tax credits might be less transparent.

Third, the return on invested income could be inherently more elastic than the compensation for working. This implies that dividends are simply more responsive to tax rate changes, given the size of the change in incentives and the transparency of the tax system.

In summary, this paper highlights the importance of separating different ways of responding to changes in income tax rates. In terms of welfare analysis, we show that the distinction between income-shifting and real elasticity components can have substantial effect on policy conclusions. This approach is applicable to many other reforms in other countries. For example, the Tax Reform Act of 1986 in the US drastically decreased marginal personal tax rates of high-income earners, and induced notable incentives to shift income from the corporate tax base to the personal tax base. With separate real and income-shifting elasticities, we could outline the true welfare effect of reducing personal income tax rates in the US.

In the empirical part, we show that income-shifting and real elasticities can be estimated separately by including the difference of the relevant tax rates into the model. In addition to clear income-shifting responses, our analysis highlights that it is important to estimate elasticities separately for all relevant tax bases and tax rates. In theory, we have no explicit reason to assume symmetric responses between different tax bases or tax rates. In fact, we find that in Finland the dividend tax base is notably more elastic than the wage tax base, both at the real and income-shifting margin.

Furthermore, the government cannot easily affect the real response margin of individuals, as real responses reflect deeper behavioral parameters, such as the opportunity cost of working (Piketty et al. 2014, Slemrod 1995). However, opportunities for tax avoidance are more under the control of the policy maker. For example, limiting the legal possibilities to avoid taxes presumably decreases income-shifting activity. In the extreme case, setting $\tau_D = \tau_W$ removes all income-shifting incentives in our example, and the government can set tax rates based on real responses alone (assuming no other forms of tax avoidance or evasion).

However, there are also reasons not to set equal tax rates. Within a simple Ramsey framework, it would be optimal to tax less the tax base with the larger elasticity (Piketty et al. 2014). Based on our results, this would imply that the optimal policy is to set $\tau_D < \tau_W$, at least when income-shifting possibilities are absent or restricted.

Nevertheless, it might be that different tax rates and the possibility to shift income between tax bases increase overall entrepreneurial activity and effort in the long run. Theoretically, this refers to a model in which the cost functions of real effort and income-shifting are not separable, and thus separate elasticity parameters for income-shifting and real behavior cannot be empirically identified in our framework. In this generic case, the policy maker needs to balance between the inefficiency and revenue losses induced by income-shifting, and the potential long-run efficiency gains induced by setting differential tax rates and allowing for income-shifting.

Acknowledgments

Many thanks to Leon Bettendorf, Essi Eerola, Seppo Kari, Martin Jacob, Tuomas Kosonen, Jani-Petri Laamanen, Rick van der Ploeg, Jukka Pirttilä, Doina Radulescu, Håkan Selin, Robert Ullman and Roope Uusitalo for their useful comments and discussion. We also thank the participants at many conferences and seminars for their helpful comments. All remaining errors are our own. The authors gratefully acknowledge funding from the Nordic Tax Research Council, the Finnish Cultural Foundation, the OP-Pohjola Group Research Foundation and the Emil Aaltonen Foundation.

References

[1] Alstadsæter, A. and M. Jacob. (2012). Dividend Taxes and Income Shifting. FAccT Center Working Paper No. 07/2012.

[2] Bastani, S. and H. Selin. (2014). Bunching and non-bunching at kink points of the Swedish tax schedule. Journal of Public Economics, 109: 36-49.

[3] Blomquist, S. and H. Selin. (2010). Hourly wage rate and taxable labor income responsiveness to changes in marginal tax rates. Journal of Public Economics, 94(11-12): 878–889.

[4] Chetty, R. (2012). Bounds on elasticities with optimization frictions: A synthesis of micro and macro evidence on labor supply. Econometrica, 80(3): 969–1018.

[5] Chetty, R. (2009). Is the taxable income elasticity sufficient to calculate the deadweight loss? The implications of evasion and avoidance. American Economic Journal: Economic Policy, 1(2): 31–52.

[6] Chetty, R., J. Friedman, T. Olsen and L. Pistaferri. (2011). Adjustment costs, firm responses, and micro vs. macro labor supply elasticities: Evidence from Danish tax records. Quarterly Journal of Economics, 126(2): 749-804.

[7] Devereux, M., L. Liu and S. Loretz. (2014). The elasticity of corporate taxable income: New evidence from UK tax records. American Economic Journal: Economic Policy, 6(2): 19-53.

[8] Feldstein, M. (1999). Tax avoidance and the deadweight loss of the income tax. Review of Economics and Statistics, 81(4): 674–680.

[9] Feldstein, M. (1995). The effect of marginal tax rates on taxable income: A panel study of the 1986 Tax Reform Act. Journal of Political Economy, 103(3): 551–572.

[10] Goolsbee, A. (2000). What happens when you tax the rich? Evidence from executive compensation. Journal of Political Economy, 108: 352–378.

[11] Gordon, R. and J. Slemrod. (2000). Are 'real' responses to taxes simply income shifting between corporate and personal tax bases?, in J. Slemrod (ed.), Does Atlas Shrug? The

Economic Consequences of Taxing the Rich. New York: Russell Sage Foundation and Harvard University Press, 2000: 240–280.

[12] Gruber, J. and E. Saez. (2002). The elasticity of taxable income: evidence and implications. Journal of Public Economics, 84: 1–32.

[13] Harju, J. and T. Kosonen. (2013). The impact of tax incentives on the economic activity of entrepreneurs. CESifo Working Paper Series 4259.

[14] Harju, J. and T. Matikka. (2012). Entrepreneurs and income-shifting: Empirical evidence from a Finnish tax reform. Government Institute for Economic Research Working Papers 43.

[15] Kari, S., H. Karikallio and J. Pirttilä. (2008). Anticipating tax changes: Evidence from the Finnish corporate income tax reform of 2005. Fiscal Studies, 29(2): 167-196.

[16] Kleven, H. and E. Schultz. (2013). Estimating taxable income responses using Danish tax reforms. Forthcoming, American Economic Journal: Economic Policy.

[17] Lindsay, L. (1987). Individual taxpayer response to tax cuts: 1982-1984, with implications for the revenue maximizing tax rate. Journal of Public Economics, 33(2): 173–206.

[18] le Maire, D. and B. Schjerning. (2013). Tax bunching, income shifting and self-employment. Journal of Public Economics, 107: 1–18.

[19] Piketty, T., E. Saez and S. Stantcheva. (2014). Optimal taxation of top labor incomes: A tale of three elasticities. American Economic Journal: Economic Policy, 6(1): 230-271.

[20] Pirttilä, J. and H. Selin. (2011). Income shifting within a dual income tax system: Evidence from the Finnish tax reform of 1993. Scandinavian Journal of Economics, 113(1): 120–144.

[21] Romanov, D. (2006). The corporation as a tax shelter: Evidence from recent Israeli tax changes. Journal of Public Economics, 90(10-11): 1939-1954.

[22] Saez, E. (2010). Do taxpayers bunch at kink points? American Economic Journal: Economic Policy, 2(3): 180-212.

[23] Saez, E. (2004). Reported income and marginal tax rates, 1960-2000: Evidence and policy implications. NBER Working Paper 10273.

[24] Saez, E., J. Slemrod and S. Giertz. (2012). The elasticity of taxable income with respect to marginal tax rates: A critical review. Journal of Economic Literature, 50(1): 3–50.

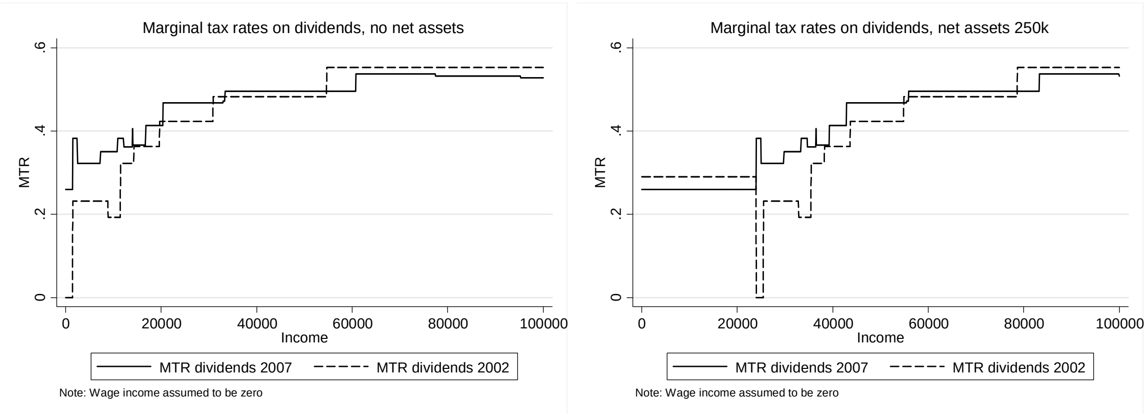
[25] Sivadasan, J. and J. Slemrod. (2008). Tax law changes, income-shifting and measured wage inequality: Evidence from India. Journal of Public Economics, 92(10-11): 2199-2224.

[26] Slemrod, J. (1995). Income creation or income shifting? Behavioral responses to the Tax Reform Act of 1986. American Economic Review Papers and Proceedings, 85(2): 175–180.

[27] Slemrod, J. and Gillitzer, C. (2014). Tax systems. Cambridge: The MIT Press, 2014.

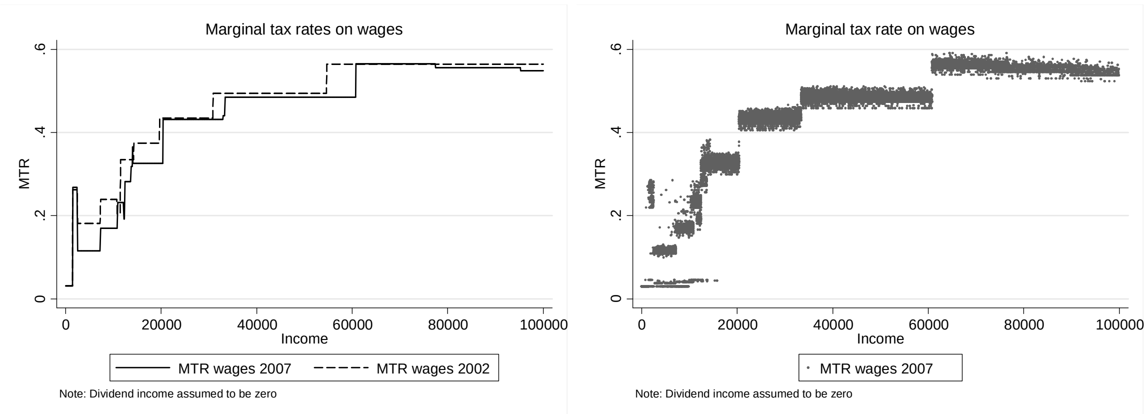
[28] Weber, C. (2014). Toward obtaining a consistent estimate of the elasticity of taxable income using difference-in-differences. Forthcoming, Journal of Public Economics.

Appendix A



Notes: MTR on dividends includes corporate taxes paid on withdrawn dividends (after 2005) and all automatic deductions and allowances on dividend income. Dividends exceeding the imputed return on net assets include central government taxes and average municipal taxes.

Figure 5: Average marginal tax rates on dividends in 2002 and 2007. No net assets (left-hand side), net assets of 250,000 € (right-hand side)



Notes:

Left-hand side: Average MTR includes central government taxes, average municipal taxes and all automatic tax deductions and exemptions. MTR also includes social security contributions levied on wage income as well as firm-level social security contributions.

Right-hand side: MTR includes central government taxes, individual municipal taxes and individual tax deductions and exemptions. MTR also includes social security contributions levied on wage income as well as firm-level social security contributions.

Figure 6: Average marginal tax rates on wages in 2002 and 2007 (left-hand side). Marginal tax rates on wages in 2007, including individual variation in the municipal tax rate (right-hand side)

	MTR on wages		MTR on dividends (no net assets)		MTR on dividends (net assets 250k)		MTR on dividends (net assets 1,000k)		MTR on dividends (net assets 5,000k)	
Income	*2002*	*2007*	*2002*	*2007*	*2002*	*2007*	*2002*	*2007*	*2002*	*2007*
5,000	18.1	11.6	23.1	32.3	29.0	26.0	29.0	26.0	29.0	26.0
10,000	23.9	17.0	19.3	35.1	29.0	26.0	29.0	26.0	29.0	26.0
15,000	37.4	32.6	36.3	36.6	29.0	26.0	29.0	26.0	29.0	26.0
20,000	43.4	32.6	42.3	41.3	29.0	26.0	29.0	26.0	29.0	26.0
25,000	43.4	43.1	42.3	46.7	0	32.3	29.0	26.0	29.0	26.0
30,000	43.4	43.1	42.3	46.7	23.1	35.1	29.0	26.0	29.0	26.0
35,000	49.4	48.5	48.3	49.5	19.3	36.2	29.0	26.0	29.0	26.0
40,000	49.4	48.5	48.3	49.5	36.3	41.3	29.0	26.0	29.0	26.0
45,000	49.4	48.5	48.3	49.5	42.3	46.7	29.0	26.0	29.0	26.0
50,000	49.4	48.5	48.3	49.5	42.3	46.7	29.0	26.0	29.0	26.0
55,000	56.4	48.5	55.3	49.5	48.3	46.7	29.0	26.0	29.0	26.0
60,000	56.4	48.5	55.3	49.5	48.3	49.5	29.0	26.0	29.0	26.0
65,000	56.4	56.5	55.3	53.7	.48.3	49.5	29.0	26.0	29.0	26.0
70,000	56.4	56.5	55.3	53.7	48.3	49.5	29.0	26.0	29.0	26.0
75,000	56.4	56.5	55.3	53.7	48.3	49.5	29.0	26.0	29.0	26.0
80,000	56.4	55.6	55.3	53.2	55.3	49.5	29.0	26.0	29.0	26.0
85,000	56.4	55.6	55.3	53.2	55.3	53.7	29.0	26.0	29.0	26.0
90,000	56.4	55.6	55.3	53.2	55.3	53.7	29.0	32.3	29.0	40.5
95,000	56.4	55.6	55.3	53.2	55.3	53.7	29.0	35.1	29.0	40.5
100,000	56.4	54.8	55.3	52.8	55.3	53.2	23.1	36.2	29.0	40.5

Notes: MTR on wages is calculated with dividend income equal to zero, and vice versa. MTRs on wages include average municipal taxes, central government income taxes, automatic tax deductions and tax credits and average firm-level social security contributions (3%). MTR on wages does not include pension and health insurance contributions or any deductions based on insurance contributions. MTRs on dividends include corporate taxes on withdrawn dividends (after 2005). MTRs on dividends include all automatic tax deductions and tax credits. MTR on dividends exceeding the imputed return on net assets include average municipal taxes and central government income taxes.

Table 4: Marginal tax rates (MTRs) on wages and dividends with different levels of firm net assets, 2002 and 2007 (in nominal euros)

	2002				2007			
Variable	Mean	Median	SD	N	Mean	Median	SD	N
Wages	25,860	21,305	34,687	39,104	30,779	25,615	40,962	52,045
Dividends	25,696	8,750	101,722	39,104	22,015	7,523	83,456	52,045
Total income	51,556	35,242	110,043	39,104	52,798	38,458	95,632	52,045
MTR dividends	0.38	0.37	0.11	39,104	0.36	0.26	0.11	52,045
MTR wages	0.47	0.51	0.11	39,104	0.42	0.47	0.13	52,045
YEL	0.35	0	0.48	39,104	0.54	1	0.50	52,045
Ownership share	0.80	0.70	0.35	39,104	0.73	0.80	0.27	52,045
Male	0.82	1	0.38	39,104	0.82	1	0.38	52,045
Age	48.47	49	10.46	39,104	50.42	51	10.78	52,045
Turnover	1,022,725	232,099	5,847,782	39,104	1,064,023	224,399	8,153,712	52,045
Total assets	697,755	167,336	4,410,689	39,104	855,857	196,591	6,140,952	52,045
Net assets	431,001	93,075	3,836,671	39,104	524,072	108,413	4,034,409	52,045
No. of employees	10.74	3	47.76	39,104	9.74	3	51.52	52,045

Table 5: Descriptive statistics, data (in 2002 euros)

	2002				2007			
Variable	Mean	Median	SD	N	Mean	Median	SD	N
Wages	27,302	25,000	21,208	14,010	28,992	26,546	24,237	14,010
Dividends	21,026	11,301	32,882	14,010	22,251	11,878	33,858	14,010
Total income	48,328	40,738	38,153	14,010	51,243	44,050	41,118	14,010
MTR dividends	0.40	.42	0.10	14,010	0.37	0.26	0.11	14,010
MTR wages	0.48	0.51	0.09	14,010	0.43	0.47	0.12	14,010
YEL	0.62	1	0.49	14,010	0.62	1	0.49	14,010
Ownership share	0.77	0.80	1.02	14,010	0.76	0.85	0.26	14,010
Male	0.84	1	0.37	14,010	0.84	1	0.37	14,010
Age	47.4	48	9.28	14,010	52.4	53	9.27	14,010
Turnover	764,243	265,622	2,652,620	14,010	852,451	267,531	2,732,651	14,010
Total assets	453,014	190,734	1,686,850	14,010	650,201	250,470	2,612,920	14,010
Net assets	268,201	113,133	837,243	14,010	399,598	154,933	1,634,324	14,010
No. of employees	8.91	4	21.32	14,010	8.84	3	23.21	14,010

Table 6: Descriptive statistics, baseline estimation sample (in 2002 euros)

Years 2002-2008								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	lnZ_D	lnZ_W	$lnTI$	$lnTI$	*ln(turnover)*	*ln(turnover)*	*ln(net profit)*	*ln(net profit)*
$ln(1-t_w)$		-0.043		-0.015	0.110		0.295	
		(0.261)		(0.157)	(0.294)		(0.342)	
$ln(1-t_D)$	0.625**		0.687***			0.207		0.178
	(0.250)		(0.083)			(0.161)		(0.182)
$[ln(1-t_D)-ln(1-t_W)]$	1.408***	-0.359**						
	(0.315)	(0.149)						
Observations	12,859	11,012	12,867	12,867	11,840	11,840	12,373	12,373

Years 2002-2009								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	lnZ_D	lnZ_W	$lnTI$	$lnTI$	*ln(turnover)*	*ln(turnover)*	*ln(net profit)*	*ln(net profit)*
$ln(1-t_w)$		0.283		-0.128	0.228		0.215	
		(0.292)		(0.163)	(0.309)		(0.362)	
$ln(1-t_D)$	0.396*		0.487***			0.329*		0.339*
	(0.225)		(0.081)			(0.170)		(0.195)
$[ln(1-t_D)-ln(1-t_W)]$	0.831***	-0.402**						
	(0.292)	(0.156)						
Observations	11,843	9,933	11,851	11,851	10,712	10,712	11,325	11,325

Notes: Robust standard errors in parentheses. Estimates weighted by total income. *** p<0.01, ** p<0.05, * p<0.1

Columns (1)-(8) include all individual and firm-level controls

Table 8: Robustness checks: Years 2002-2008 and 2002-2009

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	No controls	No weights	Small inc limit	Large inc limit	Small △inc limit	Large △inc limit	OLS	Reduced-form
Variable	lnZ_D	lnZ_D	lnZ_D	lnZ_D	lnZ_D	lnZ_D	lnZ_D	lnZ_D
$ln(1-t_D)$	0.595*	0.542*	0.860***	0.436	0.753**	0.581**	-1.291***	0.389**
	(0.317)	(0.290)	(0.259)	(0.331)	(0.307)	(0.293)	(0.048)	(0.152)
$[ln(1-t_D)-ln(1-t_W)]$	1.722***	1.481***	1.359***	1.364***	1.059***	1.535***	0.040	0.312**
	(0.399)	(0.369)	(0.333)	(0.418)	(0.397)	(0.369)	(0.045)	(0.150)
Observations	14,003	14,003	16,935	9,888	10,988	14,879	14,003	14,003
Variable	lnZ_W	lnZ_W	lnZ_W	lnZ_W	lnZ_W	lnZ_W	lnZ_W	lnZ_W
$ln(1-t_W)$	-0.274	-0.123	-0.193	-0.158	-0.315	0.011	-2.117***	-0.162
	(0.308)	(0.299)	(0.273)	(0.347)	(0.296)	(0.298)	(0.074)	(0.184)
$[ln(1-t_D)-ln(1-t_W)]$	-0.691***	-0.420***	-0.423***	-0.391***	-0.594***	-0.328**	0.653***	-0.144***
	(0.162)	(0.141)	(0.136)	(0.149)	(0.143)	(0.138)	(0.034)	(0.047)
Observations	12,135	12,135	14,342	8,535	9,611	12,870	12,135	12,135
Variable	*ln(turnover)*	*ln(turnover)*	*ln(turnover)*	*ln(turnover)*	*ln(turnover)*	*ln(turnover)*	*ln(turnover)*	*ln(turnover)*
$ln(1-t_D)$	0.357**	0.291*	0.297**	0.411**	0.217	0.281*	-0.254***	0.114*
	(0.160)	(0.149)	(0.143)	(0.171)	(0.169)	(0.146)	(0.045)	(0.060)
Observations	13,018	13,018	15,720	9,134	10,252	13,817	13,018	13,018
Variable	*ln(turnover)*	*ln(turnover)*	*ln(turnover)*	*ln(turnover)*	*ln(turnover)*	*ln(turnover)*	*ln(turnover)*	*ln(turnover)*
$ln(1-t_w)$	0.148	0.156	0.266	0.136	0.460	0.042	-0.658***	0.108
	(0.329)	(0.306)	(0.272)	(0.360)	(0.337)	(0.305)	(0.067)	(0.189)
Observations	13,018	13,018	15,720	9,134	10,252	13,817	13,018	13,018

Notes: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1 Small income limit (column(3)) = 10,000 € of total income in base-year.

Large income limit (4) = 40,000 € of total income in base-year. Small limit in change of income (5) = 25,000 €. Large limit in change of income (6) = 75,000 €.

Columns (2)-(8) include all individual and firm-level controls.

Table 7: Robustness checks: Different specifications, 2002-2007

Appendix B

Bunching at kink points

The intuition behind the bunching analysis is the following: Consider a small increase in the marginal tax rate, $d\tau$, at a point $z = k$. Below the kink point k taxable income z is taxed at a tax rate τ_1, and above the kink point the tax rate is τ_2, such that $\tau_1 < \tau_2$. Assuming individuals with standard preferences as before in Section 2, we can denote the fraction of individuals bunching as $B(dz) = \int_k^{k+dz} h_0(z)dz$, where $h_0(z)$ is the pre-reform smooth density function of taxable income. Individuals located within the income interval $(k, k + dz)$ before the tax rate change bunch at k due to the introduction of the kink point. Individuals further up in the income distribution $z > k + dz$ or below k do not move to the kink point. The bunching approach implicitly assumes that individuals in the neighborhood of k are otherwise similar except that they face a different slope in the budget set.

Empirically, the excess mass at the kink point $b(k) = B(dz)/h_0(k)$ is estimated by comparing the actual density around the kink point to a smooth counterfactual density. The counterfactual density describes how the income distribution at the kink would have looked without a change in the tax rate. Due to imperfect control and uncertainty about the exact amount of income in each year, the usual approach is to use a "bunching window" around k to estimate the excess mass (see Saez 2010 and Chetty et al. 2011). In other words, we compare the density of taxpayers within an income interval $(k - \delta, k + \delta)$ to an estimated counterfactual density within the same income range.

We use the approach of Chetty et al. (2011) and estimate the counterfactual density non-parametrically. To do this, we fit a flexible polynomial function to the observed density function, excluding the region around the kink point $[k - \delta, k + \delta]$ from the regression.

First, we group individuals into small income bins, and estimate a regression of the following form

$$c_j = \sum_{i=0}^{p} \beta_i (z_j)^i + \sum_{i=k-\delta}^{k+\delta} \eta_i \cdot \mathbf{1}(z_j = i) + \varepsilon_j \tag{17}$$

where c_j is the count of individuals in bin j, and z_j denotes the income level in bin j. The order of the polynomial is denoted by p.

The counterfactual density function is estimated by omitting the bunching window from the regression, $\hat{c}_j = \sum_{i=0}^{p} \beta_i (z_j)^i$. Thus we can express bunching around k as $\hat{B} = \sum_{i=k-\delta}^{k+\delta} (c_j - \hat{c}_j)$.

Finally, the excess mass is calculated as

$$\hat{b}(k) = \frac{\hat{B}}{\sum_{i=k-\delta}^{k+\delta} \hat{c}_j / (2\delta + 1)} \tag{18}$$

As in the earlier literature, parameters δ and p are determined visually and based on the fit of the model. We use a seventh-order polynomial and a bunching window of +/-700 € from the kink point in our baseline estimations. Our conclusions are not very sensitive to the choice of the bunching window δ or the degree of the polynomial p. As in Chetty et al. (2011), standard errors for $\hat{b}(k)$ are calculated using a bootstrap procedure where we generate a large number of income distributions by randomly resampling the residuals from equation (17). The standard errors are defined as the standard deviation in the distribution of $\hat{b}(k)$.