Labor Responses and Asymmetric Effects of Transitioning from Flat to Progressive Taxation

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This Draft: January 13, 2024. **First and incomplete draft. Please do not quote.**

Abstract

Governments grapple with the intricate task of designing income tax systems that balance various trade-offs. Concerns about distortionary impacts on labor supply, tax evasion, and income redistribution have prompted many countries to abolish progressive income taxes, introduce flat-rate systems, and reintroduce graduated tax schemes over the last few decades. Despite its importance, compelling empirical evidence on behavioral responses to these tax reforms is scarce. This paper investigates the effects of transitioning from a flat to a progressive income tax system, utilizing a significant 2007 tax reform in Uruguay. Our research design employs cross-sectional variation in tax changes and administrative records to implement a difference-in-difference approach. Results reveal asymmetric responses to tax rate changes, with workers who experienced tax reductions (*winners*) reporting increases in labor earnings, while those who faced tax increases (*losers*) exhibited declines in earnings. We find indicative evidence that changes in labor earnings reflect reporting responses rather than real labor supply adjustments, particularly for winners. Additionally, workers adjust by increasing the probability of holding multiple jobs, with a stronger response for those experiencing a reduction in after-tax earnings. The study contributes empirical evidence on the impact of transitioning between tax systems, shedding light on behavioral responses to income tax reforms.

JEL classification: H24, H31, J21, J22
Key words: income tax reform, labor effects, asymmetric effects

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1 Introduction

Governments face the challenge of designing appropriate income tax systems to achieve different goals while navigating complex trade-offs. Progressive taxation has emerged as a natural tool in modern tax systems for addressing two important objectives: social insurance against life-cycle shocks that impact household consumption and redistributing income (Heathcote et al., 2017). At the same time, a concern with a graduated rate structure is the (potential) high distortionary effects on labor supply and the incentives to evade or avoid taxes, prompting proposals to flatten income tax structures (Peichl, 2014; Mohs, 2019).

All these trade-offs have sparked substantial debate in both academic and policy circles, leading to significant reforms in recent decades. For instance, many developing and transitioning economies have moved away from progressive taxation, opting for simpler and flat-rate tax regimes since the 1990s (Keen et al., 2008).[1] Moreover, several states in the United States have embraced this trend, opting to transition to flat-rate personal income tax structures (Walczak, 2022).[2] Recently, however, flat tax systems have raised concerns about their role in reducing inequalities or cushioning against economic shocks (Fuest et al., 2008), motivating several countries that adopted flat-rate income taxes to switch back to a progressive tax structure.[3] Despite the substantial debate and radical tax reforms in income taxation, empirical evidence on the impact of moving from a progressive to a flat tax system or switching from a flat tax regime to a progressive tax system is scarce (Peichl, 2014).

In this paper, we study the effects of transitioning from a flat income tax structure to a progressive tax system on individuals' outcomes in the labor market. We leverage the unique features of a significant tax reform in 2007 in Uruguay, which shifted from a flat-rate tax system on personal income to a progressive tax structure, to identify the impacts of changes in the personal income tax on workers' reported earnings and labor supply behavior. Specifically, before 2007, labor income was taxed under a flat-rate tax structure (*Impuesto a las Retribuciones Personales (IRP)*, in Spanish) with two rates that levied on workers whose total earnings fell into a low or high tax bracket above a tax-exemption threshold. Progressive taxation on labor income (*Impuesto a la Renta de las Personas Físicas-Trabajo or IRPF* in Spanish) was first introduced in Uruguay in 2007, as part of a comprehensive tax reform aimed at increasing the

[1] Flat tax schemes were adopted in Central and Eastern European countries in two distinct waves. The initial wave occurred in the 1990s and involved Baltic countries such as Estonia, Latvia, and Lithuania. The subsequent wave emerged in the 2000s, beginning with Russia and followed by Romania and Hungary

[2] As of 2023, eleven states currently implement flat-rate personal income taxes, and an additional two are poised to adopt this system in the coming years as a result of recently passed legislation.

[3] The reversion to progressive personal tax rates includes Baltic economies and nearly all economies in the second wave of flat-rate tax reforms.

relative weight of direct taxation. The IRPF structure was designed with a set of progressive (marginal tax) rates ranging from 10% to 25%, applied above a generous tax exemption threshold. As a consequence of the reform, the level of progressivity of the personal labor earnings tax scheme increased sharply. For instance, those in the upper part of the income distribution (top 10%) faced an average increase of 6.3 percentage points in the effective rate (equivalent to 105% of the pre-reform levels), while workers between the 36th and 89th percentiles experienced an average tax reduction of 2.6 percentage points (79% of the pre-reform levels) (see Figure 2).

Research design. Assessing behavioral responses to the transition from a flat-tax scheme to a progressive tax system poses challenges. Convincing identification requires exogenous variation in tax rates that differentially affect comparable groups of workers, a requirement that is difficult to fulfill in settings with national tax reforms. Additionally, one might need large, granular, and comprehensive datasets to properly evaluate responses in income reporting and labor supply. Our approach to addressing these challenges relies on two components. First, we leverage cross-sectional variation in the size of tax cuts and tax increases arising from switching a flat-tax rate structure to a graduated-tax schedule on earnings (see Figure 3). This feature of the tax reform resulted in a subset of workers –specifically, those in the proximity of the 89th percentile of pre-reform labor earnings– facing tax rates that remained mostly unchanged, akin to the flat tax regime, and thus was not expected to mostly respond to the tax reform. Meanwhile, other workers experienced larger tax changes in after-tax labor earnings and were expected to respond more strongly than the former group. More precisely, based on their pre-reform labor earnings, some workers experienced a tax reduction after the introduction of progressive taxation (hereinafter referred to as *winners*), while other workers encountered a tax rate increase due to the newly graduated tax-rate structure (hereinafter referred to as *losers*). We identify causal effects of the tax reform through the relation between the 'dose-response' in workers' labor market outcomes and the variation in the intensity of tax rate changes (Callaway et al., 2024). The second component of our approach is the available administrative records from the Social Security Administration, which include information to measure different labor market outcomes at the individual level in the period before and after the tax reform. Our research design, thus, exploits the rich administrative data in a difference-in-difference design that compares the evolution of labor market outcomes among workers with similar pre-reform earnings but who faced different tax incentives following the income tax system reform. The key identification assumption is that the outcome of interest would have followed a similar trajectory for both treated and control workers if the tax reform had not taken place. Compelling event-study evidence supports this assumption in our empirical setting.

Results. Our analysis of the behavioral responses to the introduction of a progressive tax structure yields four main results. First, we provide compelling evidence of responses in reported labor earnings, observed among workers who faced a reduction in their tax rates and those who experienced tax rate increases. Specifically, in line with theoretical expectations, the winners from the tax reform show an increase in their reported labor earnings, while losers exhibit a decline in this outcome after transitioning from a flat-tax scheme to a graduated-tax schedule. evidence that labor earnings respond asymmetrically to changes in the net-of-tax rate: responses to tax rate increases are substantially lower than responses to tax rate decreases. For instance, we find that the size of the intensive margin elasticity for the *winners* group is more than two times higher than the elasticity we estimate for the *losers* group (1.680 vs 0.737). We also document evidence that this asymmetric pattern persists over time. Third, when digging into the mechanisms driving the substantial labor earnings responses, we find indicative evidence that changes in earnings reflect reporting responses rather than *real* labor supply adjustments, particularly for *winners*. Using our difference-in-difference design, we find a modest labor supply response on average for *winners*, with an elasticity of hours worked of 0.278, representing slightly more than 15% of the relative response of labor earnings to the tax rate change. In turn, *losers* exhibit a hours worked elasticity of 0.324, accounting for about 44% of the estimated elasticity of labor earnings for this group of workers. Additionally, we use firm-level characteristics as proxies for evasion opportunities, such as firm size and industry, and find correlations consistent with the possibility that earnings effects may incorporate some form of reporting or tax avoidance response. Fourth, we investigate whether workers, who may face rigidities in their current jobs, adjust their labor earnings to the incentives of the tax reform by either changing jobs or holding multiple jobs. We observe an increase in the probability of multiple jobholding for both *winners* and *losers* due to the tax reform, although this response is significantly higher for those who experienced a reduction in after-tax labor earnings. Conversely, we do not find job switching to be a significant margin of adjustment in response to the incentives of the tax reform.

Related Literature and contributions. We contribute to several strands of the literature. First, our paper complements the empirical literature studying behavioral effects of income taxation (see the survey by Saez et al. 2012), attempting to quantify the magnitude of individual responses in reported income to changes in tax rates (see the meta-analysis by Neisser 2021). The most reliable evidence up to now comes from countries that modify existing progressive systems. However, scarce causal evidence has been reported on reforms that introduce flat tax systems or abolish them in favor of adopting a progressive rate schedule, despite several real-world reforms with these features observed since the 1990s. The arguments explaining this limited research usually revolve around identification issues and data limitations due to the

nature of these settings, such as a lack of high-quality (micro-)data for the pre-reform period or the comprehensiveness of such reforms (Peichl, 2014). Indeed, most of the empirical evidence is based on simulation studies on hypothetical flat (e.g., Bas et al. 2007) or progressive tax reforms (e.g., Barrios et al. 2020). A salient exception is Gorodnichenko et al. (2009), who employed micro-level data and a quasi-experimental approach to examine the effects of Russia's 2001 tax reform, which replaced the progressive tax system with a flat one. They found positive effects of the flat tax reform on reporting behavior, attributed to higher tax compliance rather than responses in terms of labor supply. In contrast to this study, our contribution lies in documenting behavioral responses in labor market outcomes following a reform that, instead of abolishing it, introduced a progressive income tax system. To our knowledge, this study represents the first attempt to investigate such tax reforms, leveraging a setting that circumvents identification issues and data limitations that have plagued previous research.

Our paper also contributes to the growing literature examining the presence of (a)symmetric effects of changes in prices and taxes on various outcomes. Most prior studies have taken a macro-level approach, analyzing whether national income responds similarly to tax increases and reductions. Studies like Jones et al. (2015) reveal that tax changes have different effects on growth in the United States and the UK. Meanwhile, Hussain and Malik (2016) find positive responses to tax reductions and no responses to increases, emphasizing the role of the personal income tax channel in influencing growth rates through altered aggregate consumption. Our study explores this question from a different perspective, contributing to the very limited quasi-experimental micro evidence on (a)symmetric behavioral responses to taxation. While some papers present compelling micro-evidence that prices respond asymmetrically to the direction of tax rate changes (see e.g., Benzarti et al. 2020 for the case of value-added taxes), our paper complements this evidence by documenting asymmetric and persistent labor earnings responses to income tax rate changes.

The paper is structured as follows. Section 2 explains in detail the tax reform to be exploited. Next, section 3 presents the data and provides some descriptives of the chosen sample. In section 4 the research design is described. Section 5 presents the main results obtained. Finally, section 6 concludes.

2 Context

2.1 Pre-reform regime: The Flat Tax System (IRP)

Act No. 15,294 of June 23, 1982, establishes the IRP in Uruguay.[4] The tax was characterized by setting rates proportional to all sources of labor income. Initially, it defined two income brackets with differential tax rates: 1% for total labor income up to three national minimum wages (NMW) and 2% for earnings exceeding this threshold. Over the years, the flat tax regime underwent several modifications, including changes in the number and size of income brackets and the size of tax rates. The last modification to this regime occurred through Decree No. 270/004 of July 30, 2004, which introduced three income brackets and their corresponding tax rates: a tax-exemption threshold with a zero tax rate (for labor incomes from zero to three NMW), a low-income bracket with a 2% tax rate (for labor incomes from three to six NMW), and a high-income bracket with a 6% tax rate (for labor incomes above six NMW). Importantly, the IRP system did not allow expenses to be deducted from taxpayers gross income to computing the final total tax liability.

2.2 Post-reform regime: The Progressive Labor Income Tax System (IRPF)

The introduction of the IRPF in Uruguay dates back to 2007 in a context of a broader tax reform aiming to enhance the prominence of direct taxation (Law No. 18,083 of January 18, 2007).[5] The PLIT taxes all sources of individual labor income, and applies to both wage earners and self-employed workers.[6] Unlike the IRP, the IRPF presents a schedule of marginal tax rates and tax liability increasing in line with a taxpayer's total annual (*gross*) labor income. Table 1, reports the income brackets and the marginal tax rates applied to labor income for the year 2007. There are six income brackets, which are annually adjusted by CPI. The marginal tax rates associated with these brackets range from 0% (the exemption threshold) to 25%.

The total gross labor income undergoes the progressive tax scheme to calculate the *labor income tax part*. The IRPF allows taxpayers reduce their effective tax burden through a series

[4] Article 25 of Act No. 15,294 of June 23, 1982. Available at: shorturl.at/npDL3

[5] Direct tax collection comprises five components: (i) dual personal income tax, which taxes labor and capital income separately, (ii) corporate income tax, (iii) property tax, (iv) retirement income tax, and (v) non-resident personal income tax. The primary components of direct taxation are personal and corporate income taxes, collectively constituting approximately three-quarters of total direct tax collections in equal proportions.

[6] Labor income definition does not include any type of capital income, which is taxed in a separate regime at proportional tax rates.

of (*itemized* and *non-itemized*) deductions (see table A.1, which, once passed through a progressive deduction rate schedule (see table A.2) constitute the *tax deduction part*. The final tax liability is calculated as the difference between the labor income tax part and the tax deduction part. Figure 1 plots the effective and marginal tax rates under the IRP and IRPF regimes and the gross labor income distribution.

2.3 The impact of the tax reform on the distribution of the tax burdens

As this reform has a broad impact that varies across income groups, it is intriguing to simulate how the change in the tax scheme would have affected the tax burden for each income percentile. To conduct this analysis, we project the annual income for individuals in 2006 to June 2007 (IRPF begins to apply) using the National Average Wage Index (IMS). Subsequently, we calculate the tax burden under each regime, namely IRP and IRPF. For the IRP, the taxpayer's burdens is derived simply by multiplying their gross annual income by the corresponding tax rate. Conversely, calculating the total amount to be paid under IRPF involved two steps. First, the annual gross income underwent the progressive scheme of marginal rates presented in Table 1. Then, deductions were calculated based on the marginal rates outlined in Table A.2. Only social security contributions were considered as deductible items, and these were computed using the rates in Table A.1.

Figure 2 depicts the average change in the effective IRP and IRPF rates, expressed as a percentage of annual labor earnings (left panel) and as a percentage of IRP (right panel), by pre-reform labor earnings percentiles. This figure reveals three key features of the transition from a flat tax scheme to a progressive tax system. First, its broad scope: approximately two-thirds of registered workers experienced changes in the tax rates and tax liability they faced. Second, the group of workers located below the 40th pre-reform labor earnings percentile remained mostly unchanged, as their labor income would have stayed below the tax-exemption threshold under both the IRPF and IRP schemes. Third, the progressive nature of the tax reform affected workers in the middle to high part of the pre-reform labor earnings distribution. For instance, the group of workers located around the 89th labor earnings percentile was unaffected by the tax reform. Instead, workers below this threshold experienced reductions of up to 100% of what they would have paid under the IRP scheme, while workers above this cut-off faced increases in their tax liability that, in some cases, exceeded 100% of what they would have paid under the IRP regime. In the empirical analysis, we rely on variation in the intensity to rate changes due to the tax reform based on pre-reform labor earnings for the group of workers belonging to the highest income quartile (described next).

3 Data and sample definition

3.1 Data and variable definitions

The empirical analysis uses administrative records from the SSA (*Banco de Previsión Social*). The data comprises matched employer-employee work histories, compiled from the monthly payroll tax forms submitted by businesses to the SSA. These records encompass the universe of registered workers who reported positive earnings to the SSA for at least one month between 1997 and 2013. The dataset includes monthly information on workers' gross earnings, hours worked, weekly hours worked, and days worked in the month. It also contains firm-level information, such as firm identifiers, activity sector, and whether workers are firm owners, among other variables. Although the SSA records contain information on a monthly basis, it was aggregated to obtain one observation per individual semester.

In this paper, we explore behavioral responses in four outcomes of interest:
(i) Total labor earnings. Total labor-related income for the respective semester comprising the regular salary, the 13th salary (dispersed half in July and half in December), and any additional payments made to the worker after the termination of the employment relationship. Finally, we deflated the labor earnings variable using the CPI provided by Uruguay's National Institute of Statistics. It is worth noting that this variable refers to gross income (before deductions) and not to taxable income (after deductions). Therefore, when relating labor earnings responses to changes in marginal tax rates, we obtain an estimation of the elasticity of gross income (EGI) rather than an elasticity of taxable income (ETI).
(ii) Hours worked. We define the hours worked as the average monthly hours in the corresponding semester.
(iii) Firm switching. This variable indicates whether the worker changes firms during the period. To construct this variable, several steps are taken. First, months in which an individual worked for more than one firm were excluded. This simplifies the analysis of mobility by eliminating cases of multi-employment, as well as records of those in the process of switching firms, where they might temporarily have records in both firms in a single month. Second, a dummy variable is created, taking the value of one if the firm in the current month is different from the previous record and zero otherwise. Finally, this variable is aggregated at the semester level, with a value of one if the individual registered a switch in at least one month of the semester.
(iv) Multiple jobholding. We classify a worker as holding multiple jobs if he works in more than one firm for more than two months in the respective semester.

3.2 Sample and restrictions

We restrict the sample to the period 2004-2011. This choice yields a sufficient number of semesters before and after the tax reform to set up the dynamic Difference in Difference specification in the empirical section. Furthermore, setting this time period for our analysis avoids potential confounding effects from modifications to the IRP (before the reform) and IRPF systems (after the reform).

To analyze a sample of comparable workers facing different tax rates, we impose two restrictions. First, we focus on workers belonging to approximately the highest pre-reform labor income quartile—specifically, those whose labor earnings exceeded $170,000 in the year before the tax reform. While the reform also introduced variation in the lower part of the distribution, we exclude the analysis of this population due to the amendment introduced by Law No. 18,314 one year after its creation, which increased the IRPF tax-exemption threshold. Second, we narrow down the analysis to those workers who, based on their pre-reform income levels (year 2006), fell into one of the following categories: (i) experienced a reduction in the effective tax rate greater than 2 percentage points (*winners*); (ii) had changes in the effective tax rate of less than 1 percentage point (*controls*); or (iii) saw their tax rate increase by more than 2 percentage points (*losers*).[7]

We impose additional data restrictions to arrive at the final analysis sample. First, we keep workers who report positive earnings for all semesters before the reform (2004-2006). This eliminates individuals with limited attachment to the labor market (e.g., seasonal workers) before introducing the IRPF. Second, we restrict the sample to those who work as salaried employees during the semester. Third, we exclude public sector employees from the analysis. Finally, we consider workers between the ages of 24 and 59 to minimize the issue of simultaneous decisions between school choices or early retirement. Our final dataset comprises 65,765 individuals, resulting in a total of 846,754 individual-semester observations for the period 2004-2011. Table 2 provides descriptive statistics for the analysis sample.

[7] As detailed in section **??**, the primary treatment involves increases/reductions of more than 3 percentage points in the effective rate. However, to study heterogeneous responses at the income level, those who win/lose between 2 and 3 percentage points are included in the analysis.

4 Empirical Strategy

4.1 Research Design and Identification

Convincingly identifying behavioral responses to a national tax change, such as the 2007 tax reform in Uruguay, is challenging.[8] The widespread impact on almost the entire registered labor force population it had makes it difficult to find a valid control group that mimics what would have occurred in its absence. However, the distinctive nature of this reform, which introduces a nonlinear tax schedule over the linear tax system, leads to significant differences in both the magnitude and direction of changes in after-tax labor earnings. For instance, among workers located in the upper quartile of the pre-reform labor earnings distribution, the tax reform resulted in some facing reductions in their after-tax labor earnings, others experiencing increases in their tax burdens, while for some, the tax rates they faced remained mostly unchanged (see the discussion in Section 2.3 and Figure 2).

These different 'doses' of tax cuts and tax increases with which Uruguay's labor force was treated offer a natural source of variation to identify behavioral responses, provided that they generate differential responses. We leverage these features in a difference-in-difference (DiD) research design that relates the differential intensity at which workers' after-tax labor income was affected by the tax reform and their labor supply and reporting responses.

Treatment assignment. The determination of treatment intensity in our setting relies on the differential changes in after-tax labor earnings that stem from the transition from a flat tax-rate structure to a graduated tax rate scheme. Since the outcomes of interest (e.g., reported labor earnings) and the tax rates are simultaneously defined, creating thus an endogenous relation, we assign treatment based on pre-reform labor earnings. Specifically, treatment assignment is based on the change in the tax rate that individuals would have experienced if they had maintained the same annual income as in the year 2006 after the reform.[9] Section 2.3 describes the exact way we compute projected labor earings and how we compute the tax rate changes the workers would have faced after the reform. Our analysis focuses on workers within the

[8] For a comprehensive summary and analysis of the empirical literature regarding labor supply and taxable income elasticities see, e.g., Saez et al. (2012).

[9] It is worth mentioning that the choice of the income interval to be considered for treatment assignment is not trivial. For example, using only 2006 annual revenues runs the risk that part of the effect found in our estimates is due to mean reversion issues. However, taking longer time windows presents some difficulties. On the one hand, although we adjust income for IMS, the calculation of the change in the tax rate becomes less credible, since it considers income from several years prior to the reform. On the other hand, considering larger windows reduces the sample size. Following the vast majority of empirical works, this study focuses exclusively on the year prior to the reform.

highest quartile of pre-reform labor earnings –i.e., whose annual labor earnings in 2006 were above roughly $ 170.000–. In this quartile, workers located near the 89th pre-reform labor earnings percentile experienced minimal changes in their after-tax earnings following the reform. However, for those below (above) the 89th percentile, the reform resulted in a reduction (increase) in the tax burden compared to their situation under a flat-tax rate. Figure 3 zooms in on the highest quartile of pre-reform labor earnings (see also the discussion in Section 2.3 and Figure 2). In the main analysis, we employ two treatment groups and one control group. The first group, labeled *winners*, includes workers who experienced a reduction of more than 3 percentage points in the tax rate. The second group, *losers*, comprises workers who faced an increase in the tax rate by more than 3 percentage points. Meanwhile, the control group consists of workers who experienced a tax change lower than 1 percentage point.

Identifying assumption. Giving this setting, our empirical strategy for estimating the effects of the 2007 tax reform compares the labor supply responses of workers who faced an increase (decrease) in their after-tax labor earnings with those who almost did not experience tax changes over time. The key identification assumption is that the outcomes of the treated and control groups would have evolved similarly without the introduction of the progressive tax system. We provide several pieces of evidence supporting this assumption.

4.2 Empirical Models

Intensive margin. The outcome variables in the analysis of intensive margin responses are reported (gross) labor earnings and hours worked. To estimate the reduced-form responses in these outcomes to progressive tax reform, we start by using a dynamic difference-in-difference (DiD) specification, which formally reads:

$$\log(y_{i,t}) = \alpha + \sum_{\substack{t=1 \\ t\neq 7}}^{t=16} \beta_t treat_i \times time_t + \delta_1 treat_i + \delta_2 X_{i,t} \times treat_i + \delta_3 X_{i,t} \times t + \lambda_t + u_{i,t} \qquad (1)$$

where $y_{i,t}$ is the outcome variable for individual i in semester t, $Treat_i$ is an indicator function that represents whether the individual experienced, alternatively, an increase or decline in the tax rate based on pre-reform labor earnings (treatment status), *time* is a collection of *dummy* variables equal to 1 for semester t, and λ_t represents time fixed effects to control for time-related factors affecting all workers. The first semester of 2007 ($t = 7$) is omitted to serve as the base period. The coefficients of interest, denoted as β_t, identify the dynamic reduced-form effects of the tax reform on the outcome variables. We estimate this equation separately

for *winners* and *losers* to explore (a)symmetric responses to the tax reform. The regression is estimated in a flexible manner by including controls for individual characteristics, the firms where individuals are employed, and the interaction of controls with time and treatment indicators. This specification allows for differential effects of the covariates as a function of time and treatment status. Ultimately, this greater flexibility aims to isolate the effect of the tax reform as much as possible from any other contemporaneous shocks. The error term is denoted by $u_{i,t}$. We use individual-level clustering of standard errors to accommodate arbitrary correlations over time in the error term.

While we primarily use specifications 1 to establish flat pre-trends and explore dynamic responses to the tax reform, we employ a generalized DiD model to estimate intensive margin elasticities. This model relates differential responses in outcomes to the differential increase/decrease in after-tax wages generated by the progressive tax reform. Specifically, we follow the standard approach in the elasticity of taxable income literature (e.g., Auten and Carroll (1999); Gruber and Saez (2002); Kleven and Schultz (2014)), and estimate the following model using two-stage least-squares (2SLS) regression:

$$\log(y_{i,t}) = \alpha + \epsilon \log(1 - T_{i,t}(y_{i,t})) + \delta_1 X_{i,t} \times treat_i + \delta_2 X_{i,t} \times t + \lambda_t + + u_{i,t} \tag{2}$$

where $1 - T_{i,t}(.)$ is the net-of-tax rate of the individual i in the semester t. A key issue is that $T_{i,t}(.)$ in our setting is the effective tax rate instead of the marginal tax rate as usual in this literature. The main reason for that decision is the reform modified the way in which the tax is computed, moving from a proportional scheme (where the marginal and effective rates coincide) to a progressive one. In a setting like this, we expect individuals' decisions to be guided to a greater extent by changes in effective rates (see, e.g., Ito, 2019). To overcome the identification issues from the endogenous relation between changes in the net-of-tax rate and the outcome variable (e.g.labor earnings), we exploit the quasi-exogenous variation generated by the 2007 reform by instrumenting $\log(1 - T_{i,t}(y_{i,t}))$ with the interaction term $Treat_i \times Post$ from the generalized DiD version of specification 1, where *Post* takes the value of one for years after the reform. This 2SLS strategy allows the coefficient ϵ to identify the elasticity (e.g., of labor earnings) to the net-of-tax rate change.

Lastly, it is worth noting that the treatment affects all units simultaneously, helping to avoid interpretation problems associated with Two-Way Fixed Effects models. This issue has been highlighted in recent Difference-in-Differences (DiD) literature, particularly in cases linked to staggered reforms (Goodman-Bacon, 2021; Roth and Sant'Anna, 2021; De Chaisemartin and D'Haultfoeuille, 2022)

Extensive margin. We use two outcome variables in the analysis of extensive margin responses. The first captures workers' mobility across firms, while the second reflects whether the workers hold multiple jobs. As with the intensive margin, we start by estimating a dynamic DiD model similar to equation 1 but using the extensive margin outcome variables. For instance, when estimating the effect of the progressive tax reform on the probability of a worker's mobility across firms, we use the following model:

$$1(j_t \neq j_{t-1}) = \alpha + \sum_{\substack{t=1 \\ t\neq 7}}^{t=16} \mu_t \times treat_i \times time + \delta_1 X_{i,t} \times treat_i + \delta_2 X_{i,t} \times t + \lambda_t + treat_i + u_{i,t} \quad (3)$$

Where j_t (j_{t-1}) refers to the firm to which the worker belongs in semester t ($t-1$). The coefficients μ_t are the parameters of interest, measuring the differential evolution of the probability of moving across firms over time among workers with an increase (decline) in after-tax labor earnings compared to workers with almost no change in the tax rate they faced. To identify the extensive margin (semi-)elasticity (e.g., of the probability of job switching) to the net-of-tax rate change, we rely on the same 2SLS approach explained in the intensive margin section, leveraging tax rate variation created by the tax reform as an instrument for the log net-of-tax rate. We follow the same estimation strategy when focusing on the outcome variable of multiple employment.

5 Results

5.1 Reported labor earnings

Main results. Figure 4 plots the results of the estimation of the dynamic DiD model based on equation (1), where the reported labor earnings serve as the outcome variable. We conduct separate estimations for winners and losers, but the combined results are presented in the figure. Each point estimate ($\hat{\beta}$) represents the difference between treated and control groups, using the first half of 2007 as the base period, and includes confidence intervals at 95% for all semesters in the period.

Three key findings emerge from this figure. Firstly, the set of pre-reform coefficients testing for parallel trends reveals no significant differences in reported labor earnings, confirming the plausibility of this assumption in our setting. Secondly, workers who experienced either a tax increase or tax cut exhibited noticeable responses to the 2007 progressive tax reform in

their reported labor earnings. Specifically, those facing a tax increase reduced their reported labor earnings relative to the counterfactual, while those with a tax reduction increased reported labor earnings. This result aligns with previous theoretical expectations and empirical evidence. Thirdly, the impact on reported labor earnings extends beyond the tax reform year and increases (in absolute value) over time.

The intensity of the treatment was considerably different between winners and losers (see Figure 3). While the former faced reductions of between 3.0 and 3.6 p.p. in the effective rate, the latter experienced increases of between 3.0 and 14.3 p.p. In order to make proper comparisons regarding the magnitude in which both groups respond to the tax reform, Table 3 presents estimates of the elasticity of labor earnings relative to the change in the net-of-tax rate. Each entry in the table, corresponding to a specific column and row, represents one regression estimate. The rows present elasticity estimates and their two components: the reduced form and first-stage estimations, arranged in descending order. The elasticity is essentially the ratio of the reduced form to the first stage, estimated using 2SLS in equation (2). The columns provide estimates for the winners (column 1) and losers (column 2). The first stage, presented in the middle row, with the outcome variable being the log net-of-tax-rate, is estimated at 0.033 and -0.063 for winners and losers, respectively. This result indicates that the tax change faced by losers generated almost double the tax incentives experienced by winners. However, the elasticity estimates suggest that those facing a tax cut react more in terms of reported labor earnings than those whose rates increased. Specifically, the elasticity estimate for winners is 1.680, while for losers, it is 0.737 –both highly statistically significant at the 1% level–. These estimates imply that a 10% increase (decrease) in the net-of-tax rate causes labor earnings to increase by almost 17% (7%) on average, reflecting asymmetries in reported income responses based on the direction of the tax rate change.

Heterogeneity. We analyze heterogeneous responses based on (1) income level, (2) gender, (3) age-cohort (24-40/41-59 years), and (4) worker mobility. Estimated results are presented in Table 4, while Figure A.3 in the Appendix provides graphical evidence.

Income level. One important result from the previous section is that losers are more inelastic to changes in the tax rate than the winners. A priori, this would indicate that the responses to a tax reduction are not symmetrical in magnitude to those to an increase. However, this difference could be attributed not only to variations in the direction of the tax change but also to disparities in income levels. In other words, it is possible that the *top incomes* exhibit different characteristics from the rest, explaining the lower elasticity. Quantifying the contribution of both factors becomes a particularly complex task since we do not observe individuals who win and lose simultaneously. However, constructing more homogeneous income subgroups

could shed some light on this issue. This strategy could help determine whether, conditional on being a loser or a winner, the elasticity changes with the level of income. Additionally, subdividing the sample enables the comparison of winners and losers with similar incomes, allowing us to isolate, at least partially, the role of the "income level". Columns (1) and (2) of panel (c) in Table 4 present the estimates of the elasticity of labor earnings across five income brackets. Concerning the losers, it becomes evident that the overall estimate conceals distinct behaviors within this group. Consistent with Saez (2004), those guiding the response among losers are those belonging to the top 1% of income (0.809), while the 93-97 and 97-99 percentiles exhibit reduced elasticities (0.226 and 0.146, respectively), statistically significant only at the 10% level. Regarding the winners, both subgroups show considerably higher reported income responses than those who lose. This substantial difference reinforces the hypothesis of asymmetric responses based on tax increases/reductions. In fact, focusing on the closest income subgroups, namely, 79-82 and 93-97, reveals that the former present an elasticity more than 6 times greater than the latter.

Gender. Columns (1) and (2) of panel (d) in Table 4 present the estimates of the elasticity of men and women. For both winners and losers, the response in reported income is greater in men than in women, which contrasts with previous findings from the literature (e.g., Chetty et al. (2011)).

Age. We should expect lower responses in younger workers than in older ones. For career reasons, younger workers may be less able to adjust their labor supply. Furthermore, older individuals are expected to have more knowledge of the tax scheme, making it easier for them to reduce their taxable income. Columns (1) and (2) of panel (e) in Table 4 present the estimates, splitting the sample into workers aged 24-40 and 41-59. The evidence on this margin is ambiguous: among the winners, older workers respond more (elasticity of 1.895 vs. 1.523), while among the losers, younger workers respond more (1.102 vs. 0.555).

Worker mobility. To analyze responses on this margin, workers were classified into two groups: (1) *switchers* and (2) *stayers*. The first group comprises those who register at least one change of firm in the semesters after the reform, while the second group consists of those who remain in the same firm. Columns (1) and (2) of panel (f) in Table 4 present the elasticity estimates for both groups. As expected, *switchers* are the ones who respond the most to the tax reform. Although the estimates for *switchers* are less precise due to a smaller number of observations, they indicate that this group of workers responded around three times more than those who remained in the firm. This pattern holds for both winners and losers.

5.2 Labor supply or reporting responses?

So far, we have provided convincing graphical and regression evidence of labor earnings responses to the progressive tax reform. A natural follow-up question revolves around discerning whether workers respond through adjustments in real labor supply or employ mechanisms related to tax avoidance/evasion. While disentangling those mechanisms is challenging, we present some pieces of evidence to shed light on this question.

Hours worked. First, we examine whether workers adjust their hours worked in response to tax cuts or increases as a proxy measure for *real* work effort. Figure 5 presents graphical evidence obtained from an estimation using equation (1). We observe stable trends in hours worked before the tax reform, with only marginal significance in the two years following the reform, particularly among winners. A more pronounced reduction occurs subsequently for workers who experienced a tax increase. The reasons for the observed delay in hours worked responses among the losers are still unclear. In columns (1) and (2) of table 5, we provide the results for the elasticity of hours worked relative to the change in the net-of-tax rate. While these elasticity estimates are statistically significant for both winners and losers, they are of a lower magnitude compared to the estimated elasticity of labor earnings (see table 3). For instance, for winners, slightly more than 15% of the relative response of labor earnings to the net-of-tax rate change is explained by adjustments in hours worked, whereas it is 44% for losers.

We next explore whether labor earnings responses could be explained by reporting behavior. Indeed, some related studies for developing countries, such as Brazil (Feinmann et al., 2023) and Uruguay (Bergolo et al., 2020, 2021) have shown evidence of labor income underreporting. Unfortunately, the elusive nature of this phenomenon and the limited number of variables included in our data prevents us from observing evasion (or avoidance) behavior directly. For this reason, and guided by correlations found in previous studies, we use various firm-level characteristics as proxies for evasion opportunities, such as firm size and industry (e.g., Kleven et al. (2011); Best et al. (2015); Kreiner et al. (2016); Bergolo et al. (2021). The results of estimating equation (2) are presented in Table 4, while Figure A.3 in the Appendix provides graphical evidence of the responses in the reduced form.

Firm size. First, we divided the sample into two groups based on the size of the firms where workers are employed: those with 100 or more workers and those with fewer than 100.[10]

[10] Bergolo et al. (2021) divided firms into two groups based on the median sales, while (Best et al., 2015) also divided them based on the median number of workers. Workers in the highest income quartile tend to work in larger firms, with approximately half of the individual-semester observations belonging to firms with 200 or

We anticipate that smaller firms may face less scrutiny from the tax agency, providing more opportunities for their workers to evade taxes. Consistent with this expectation, columns (1) and (2) of panel (a) of Table 4 reveal lower elasticities of labor earnings for those employed with larger firms. This difference is particularly pronounced for losers: individuals working in smaller firms exhibit an elasticity 4.5 times greater than those in larger firms. This aligns with the literature that examines income responses primarily driven by evasion, where studies observe a negative correlation between the magnitude of the response and the size of the firm.

Activity sector. Sectors presented in Table 2 were categorized into two groups: goods-producing firms and the service sector. The underlying hypothesis for this analysis posits that firms in the goods sectors are more likely to undergo scrutiny from the tax agency compared to those in the services sector, attributed to the increased registration and control of transactions in the former. Consequently, a higher magnitude of responses is expected for workers employed with firms in the services sector. Indeed, Columns (1) and (2) of Panel (b) in Table 4 effectively illustrate a greater elasticity in the latter, both for winners and losers.

Taken together, these results suggest that labor earnings responses to tax reform may be driven, at least partially, by real labor supply changes. However, our findings are also consistent with the possibility that earnings effects may incorporate some form of reporting or tax avoidance response, particularly among workers who face a tax increase.

5.3 Additional margins: job switching and multiple jobholding

The previous sections documented important responses in labor earnings to tax reform. While part of those responses come from workers who hold jobs with flexible remuneration and hours structures or with high evasion/avoidance opportunities, another part may come from workers with low-flexible jobs but who are able to overcome this restriction. For instance, workers facing constraints in their current employment can opt to switch jobs to align their labor earnings with a new desired level. Alternatively, individuals may decide to engage in secondary employment (commonly known as *moonlighting*) as a means of overcoming limitations in work flexibility. Given that our data differentiate between the jobs that workers hold, we utilize this feature to investigate multiple job holdings and primary job changes as potential adjustment margins.

more workers. We chose a threshold of 100 to strike a balance, ensuring the value is not too high to compare relatively small vs. large firms and obtaining a sufficiently large sample size in each group (setting thresholds at 10 or 50 would result in less precise estimates for individuals in small firms).

Job switching. To capture the effects on this margin, we aim to address whether the treated group switches jobs across firms more or less frequently than the control group after the reform. If this is the case, we would expect to observe a higher rate of switching for winners and a lower rate for losers. To evaluate whether a worker changes firms, we exclusively examined observations of those who worked at a single firm each month. The outcome variable is an indicator function for switching firm in at least one month of the semester. Panel (a) of Figure 6 presents graphical evidence of the reform's impact on the probability of changing firms, while columns (3) and (4) of Table 3 provide a summary of the regression analysis results. For the losers, the estimated parameter of interest is not statistically significant at the usual levels. This implies that the increase in the tax rate did not affect firm switching in this group. As for the winners, a significant effect is observed in the probability of switching firms, but with the opposite sign than expected: a 1% increase in the net-of-tax rate reduces the probability of switching firms by 0.11 percentage points. However, it is important to note that the magnitude of this effect is very small.

multiple jobholding. The number of jobs represents another margin that individuals can adjust in response to changes in the tax burden (Duncan and Sabirianova Peter, 2010). Potentially, losers might reduce the number of jobs, while winners might decide to increase it. We classify workers as multiple jobholders if they worked in more than one firm for at least three months in the semester. This criterion allows us to distinguish between those who effectively work in more than one firm and those who are changing firms and may temporarily have registrations in both in a given month. Panel (b) of Figure 6 provides graphical evidence of the response on this margin, while columns (5) and (6) of Table 4 present the regression results. Although the elasticity is statistically significant for both winners and losers, the response of the winners is almost four times greater: a 1% increase in the net-of-tax rate generates an increase of 0.322 percentage points in the probability of multiple jobholding for winners and 0.090 for losers. Thus, a significant part of the increase in labor earnings reported by the winners after the tax reform appears to be explained by the rise in multiple jobholding. Indeed, this margin also seems to explain a good part of the observed increase in hours worked by the winners. If we exclude those who work in more than one firm from the analysis, the elasticity in the hours worked of this group is reduced to almost half (0.142).

6 Preliminar Conclusions

The complex nature of designing income tax systems that balance social insurance and income redistribution goals, while addressing potential distortions and evasion concerns, has spurred considerable debate among academics and policy makers globally. This study delves into the intricate realm of income taxation, focusing on the transition from a flat income tax structure to a progressive system and its impacts on individuals' labor outcomes.

Examining a massive tax reform in Uruguay in 2007, we find that the shift from a flat-rate tax system to a progressive one had discernible effects on reported labor earnings and labor supply behavior. Our key findings reveal that the shift in the tax system resulted in those who experienced tax cuts increasing their reported income, while those who faced a reduction in the after-tax income reporting less income. Moreover, workers exhibited asymmetric behaviors in reported labor earnings: the magnitude of responses to tax rate changes was notably higher for those facing a reduction in tax rates compared to those facing an increase. Indeed, the elasticity of gross income of the winners is twice that of the losers, being six times higher when comparing similar income groups.

Delving deeper into the mechanisms driving the observed labor earnings responses, we discern that changes in earnings primarily reflect reporting responses rather than substantial adjustments in real labor supply. The limited adjustment in labor supply witnessed, along with the incorporation of firm-level characteristics as indicators of potential tax avoidance, suggest non-real responses and highlights the intricate interplay between tax policy and reporting behavior. Furthermore, our exploration into the underlying mechanisms, particularly the increased probability of multiple jobholding, adds a scarcely explored dimension to the literature. While both winners and losers exhibited an uptick in multiple jobholding, the response was significantly higher for those experiencing a reduction in after-tax labor earnings.

Our contributions extend to filling critical gaps in the literature. We offer empirical evidence on the behavioral responses to a tax reform that introduces a progressive income tax system, a relatively unexplored territory compared to studies focusing on abolishing or modifying existing progressive structures. Additionally, our study adds micro-level evidence to the limited body of literature exploring asymmetric effects of tax changes on individual outcomes, complementing existing macro-level perspectives. As governments worldwide grapple with the challenge of designing effective and equitable income tax systems, our findings contribute valuable insights to the ongoing debate on the progressivity versus flatness of the income tax systems.

References

Auten, G. and R. Carroll (1999). The Effect of Income Taxes on Household Income. *The Review of Economics and Statistics 81*(4), 681–693.

Barrios, S., V. Ivaškaitė-Tamošiūnė, A. Maftei, E. Narazani, and J. Varga (2020). Progressive tax reforms in flat tax countries. *Eastern European Economics 58*(2), 83–107.

Bas, J., R. A. De Mooij, and K. Folmer (2007). Analyzing a flat income tax in the netherlands. Technical Report 1890.

Benzarti, Y., D. Carloni, J. Harju, and T. Kosonen (2020). What goes up may not come down: asymmetric incidence of value-added taxes. *Journal of Political Economy 128*(12), 4438–4474.

Bergolo, M., G. Burdin, M. De Rosa, M. Giaccobasso, and M. Leites (2021). Digging Into the Channels of Bunching: Evidence from the Uruguayan Income Tax. *The Economic Journal 131*(639), 2726–2762.

Bergolo, M., M. Leites, R. Perez-Truglia, and M. Strehl (2020). What makes a tax evader? Working Paper 28235, National Bureau of Economic Research.

Best, M. C., A. Brockmeyer, H. J. Kleven, J. Spinnewijn, and M. Waseem (2015). Production versus revenue efficiency with limited tax capacity: theory and evidence from pakistan. *Journal of political Economy 123*(6), 1311–1355.

Callaway, B., A. Goodman-Bacon, and P. H. Sant'Anna (2024). Difference-in-differences with a continuous treatment. Technical report.

Chetty, R., J. N. Friedman, T. Olsen, and L. Pistaferri (2011). Adjustment costs, firm responses, and micro vs. macro labor supply elasticities: Evidence from danish tax records. *The quarterly journal of economics 126*(2), 749–804.

De Chaisemartin, C. and X. D'Haultfoeuille (2022). Two-way fixed effects and differences-in-differences with heterogeneous treatment effects: A survey. Technical report, National Bureau of Economic Research.

Duncan, D. and K. Sabirianova Peter (2010). Evidence from the russian tax reformdoes labour supply respond to a flat tax? *Economics of Transition 18*(2), 365–404.

Feinmann, J., R. Hsu Rocha, and M. Lauletta (2023). Payments under the table: Employer-employee collusion in brazil. Technical Report 5023, National Bureau of Economic Research.

Fuest, C., A. Peichl, and T. Schaefer (2008). Is a flat tax reform feasible in a grown-up democracy of western europe? asimulation study for germany. *International Tax and Public Finance 15*(5), 620–636.

Goodman-Bacon, A. (2021). Difference-in-differences with variation in treatment timing. *Journal of Econometrics 225*(2), 254–277.

Gorodnichenko, Y., J. Martinez-Vazquez, and K. Sabirianova-Peter (2009). Myth and reality of flat tax reform: Micro estimates of tax evasion response and welfare effects in russia. *Journal of Political Economy 117*(3), 504–554.

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

Heathcote, J., K. Storesletten, and G. L. Violante (2017, 06). Optimal Tax Progressivity: An Analytical Framework. *The Quarterly Journal of Economics 132*(4), 1693–1754.

Hussain, S. M. and S. Malik (2016). Asymmetric effects of exogenous tax changes. *Journal of Economic Dynamics and Control 69*, 268–300.

Jones, P. M., E. Olson, and M. E. Wohar (2015). Asymmetric tax multipliers. *Journal of Macroeconomics 43*, 38–48.

Keen, M., Y. Kim, and R. Varsano (2008). The 'flat tax(es)': Principles and experience. *International Tax and Public Finance 15*(6), 712–751.

Kleven, H. J., M. B. Knudsen, C. T. Kreiner, S. Pedersen, and E. Saez (2011). Unwilling or unable to cheat? evidence from a tax audit experiment in denmark. *Econometrica 79*(3), 651–692.

Kleven, H. J. and E. A. Schultz (2014). Estimating Taxable Income Responses Using Danish Tax Reforms. *American Economic Journal: Economic Policy 6*(4), 271–301.

Kreiner, C. T., S. Leth-Petersen, and P. E. Skov (2016). Tax reforms and intertemporal shifting of wage income: Evidence from danish monthly payroll records. *American Economic Journal: Economic Policy 8*(3), 233–57.

Mohs, J. (2019). Evaluating flat tax theory: A conceptual framework. *Journal of Business and Economic Policy 6*(4), 13–16.

Neisser, C. (2021). The elasticity of taxable income: A meta-regression analysis. *The Economic Journal 131*(640), 3365–3391.

Peichl, A. (2014). Flat-rate tax systems and their effect on labor markets. *IZA World of Labor 61*.

Roth, J. and P. H. Sant'Anna (2021). Efficient estimation for staggered rollout designs. *arXiv preprint arXiv:2102.01291*.

Saez, E. (2004). Reported Incomes and Marginal Tax Rates, 1960-2000: Evidence and Policy Implications. NBER Working Paper 10273, National Bureau of Economic Research.

Saez, E., J. Slemrod, and S. H. Giertz (2012). The Elasticity of Taxable Income with Respect to Marginal Tax Rates: A Critical Review. *Journal of Economic Literature 50*(1), 3–50.

Walczak, J. (2022). States inaugurate a flat tax revolution. https://taxfoundation.org/blog/flat-tax-state-income-tax-reform/. Tax Foundation Blog. Accessed on: December 10, 2023.

7 Figures and Tables

Table 1: Rate scale for calculating primary personal income tax

ANNUAL TAXABLE INCOME	**MARGINAL TAX RATE**
Less than non-taxable minimum (NTM) of 60 BPC (USD 4,183)	Exempt
More than NTM (USD 4,183) & less than 120 BPC (USD 8,366)	0.10
More than 120 BPC (USD 8,366) & less than 180 BPC (USD 12,550)	0.15
More than 180 BPC (USD 12,550) & less than 600 BPC (USD 41,832)	0.20
More than 600 BPC (USD 41,832) & less than 1,200 BPC (USD 83,664)	0.22
More than 1,200 BPC (USD 83,664)	0.25

Table 2: Descriptive statistics. Year 2006

	Controls	Losers	Winners
Panel a. Characteristic			
Age	41.33	43.07	39.84
Men (%)	0.65	0.69	0.59
Capital City (%)	78	84	74
Firm size	863	777	842
Panel b. Activity sectors (%)			
Agriculture and Mining	2.45	2.44	3.43
Manufacturing Industry	30.13	30.30	29.21
Electricity, Gas and Water	0.33	0.28	0.01
Construction	0.92	1.03	1.26
Commerce, Restaurants and Hotels	14.59	17.36	16.58
Transport and Communications	15.87	11.01	12.05
Services to companies	7.98	10.99	7.94
Community, social and personal services	27.74	26.59	29.52
Panel c. Income, hours and effective rate			
Annual gross income ($)	270,401	597,321	190,378
Average monthly hours	175.04	178.48	171.90
Effective rate variation (p.p)	-0.09	5.18	-2.92
Individuals	16,372	21,403	21,290

Note: 2006 annual salary adjusted to Jul-2007 by National Average Wage Index. From this income, the effective rate that would have been paid under IRP and IRPF was calculated. The variation (p.p) arises from making the difference between both rates.
Source: Own elaboration based on work histories - BPS.

Table 3: Estimates on reported income

	Income	
	Winners	Losers
	(1)	(2)
2SLS $\left(\frac{d\log(y)}{d\log(1-\tau)}\right)$	1.680***	0.737***
	(0.134)	(0.073)
Reduced form ($d\log(y)$)	0.056***	-0,047***
	(0.004)	(0.003)
First stage ($d\log(1\text{-}\tau)$)	0.033***	-0.063***
	(0.000)	(0.000)
Controls	Yes	Yes
Observations	382,102	482,155

Note: Estimates on winners and losers were made separately, estimating the model of equation (2) by 2SLS. The third row presents the estimates of the first stage, the second those of the reduced form and, finally, in the first stage the elasticity is presented. The dependent variable is reported gross annual income. The control variables were interacted with by *time* and *treat*. In the group of winners are those who faced reductions in the effective rate greater than 3 p.p and who have annual income greater than 170 thousand Uruguayan pesos. The losers are those who faced an increase of more than 3 p.p. in the effective rate and, finally, the controls are made up of individuals for whom the effective rate would have changed less than 1 p.p. Clustered standard error at individual level. *** p<0.01, ** p<0.05, * p<0.1.
Source: Own estimates based on employment histories - BPS.

Table 4: Heterogeneity of responses in reported income

	2SLS DiD $\frac{d\log(y)}{d\log(1-\tau)}$		Reduced form $d\log(y)$		First stage $d\log(1\text{-}\tau)$		Obs.	
	Win	Los	Win	Los	Win	Los	Win	Los
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel a. Firm size								
$\geq$ 100 employees	1.563***	0.369***	0.052***	-0.023***	0.033***	-0.063***	251,066	319,960
	(0.143)	(0.082)	(0.005)	(0.005)	(0.000)	(0.000)		
$<$ 100 employees	1.724***	1.646***	0.057***	-0.105***	0.033***	-0.064***	131,036	162,195
(0.253)	(0.141)	(0.005)	(0.005)	(0.000)	(0.000)			
Panel b. Activity sector								
Goods	1.411***	0.532***	0.047***	-0.034***	0.033***	-0.063***	258,420	156,950
	(0.224)	(0.109)	(0.007)	(0.007)	(0.000)	(0.000)		
Services	1.775***	0.878***	0.059***	-0.055***	0.033***	-0.063***	254,363	325,205
	(0.163)	(0.095)	(0.005)	(0.006)	(0.000)	(0.000)		
Panel c. Income percentiles								
76-79	1.680***		0.056***		0.033***		382,102	
	(0.134)		(0.004)		(0.000)			
79-82	1.414***		0.036***		0.026***		388,455	
	(0.166)		(0.004)		(0.000)			
93-97		0.226*		-0.009*		-0.038***		394.428
		(0.120)		(0.005)		(0.000)		
97-99		0.146*		-0.010*		-0.071***		347.525
		(0.077)		(0.005)		(0.000)		
Top 1%		0.809***		-0.084***		-0.104***		269,791
		(0.100)		(0.010)		(0.000)		
Panel d. Sex								
Women	1.270***	0.616***	0.042***	-0.038***	0.033***	-0.061***	142,851	154,807
	(0.212)	(0.123)	(0.007)	(0.008)	(0.000)	(0.000)		
Men	1.892***	0.816***	0.063***	-0.052***	0.033***	-0.064***	239,251	327,348
	(0.176)	(0.092)	(0.006)	(0.006)	(0.000)	(0.000)		
Panel e. Age								
24-40 years old	1.523***	1.102***	0.050***	-0.065***	0.033***	-0.059***	178,544	183,721
	(0.210)	(0.143)	(0.007)	(0.008)	(0.000)	(0.000)		
41-59 years old	1.895***	0.555***	0.063***	-0.036***	0.034***	-0.065***	203,558	298,434
	(0.167)	(0.087)	(0.006)	(0.006)	(0.000)	(0.000)		
Panel f. Mobility								
Switchers	3.614***	1.720***	0.119***	-0.106***	0.033***	-0.062***	67,865	70,931
	(0.409)	(0.260)	(0.014)	(0.016)	(0.000)	(0.000)		
Stayers	1.377***	0.500***	0.046***	-0.031***	0.033***	-0.063***	285,594	353,747
	(0.133)	(0.074)	(0.004)	(0.005)	(0.000)	(0.000)		
Controls	Yes	Yes	Yes	Yes	Yes	Yes		

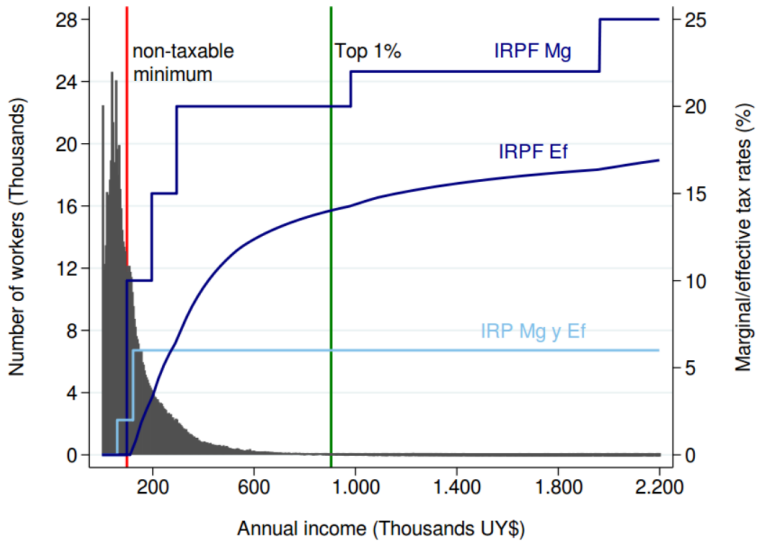
Note: The estimates on winners and losers were made separately, estimating by 2SLS the model of the equation (2). The dependent variable is (log) gross reported annual income. The control variables were interacted with by *time* and *treat*. They were classified in the goods sector to the firms that belong to: Agriculture, mining and manufacturing industry; On the other hand, in services are those of the sectors: electricity, gas and water, construction, commerce, restaurants and hotels, transport and communications, social and personal services. The *switchers* are those who changed firms at least once in the post-reform period, while the *stayers* are those who remain in the same. The winners are the ones that faced a reduction in the effective rate greater than 3 p.p and have annual income greater than 170 thousand Uruguayan pesos. The losers are those who faced an increase of more than 3 p.p. in the effective rate and, finally, the controls are those individuals for whom the effective rate has changed less than 1 p.p. Standard errors clustered at the individual level in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.
Source: Own estimates based on employment histories - BPS.

Table 5: Estimates on real margins

	Hours		P(*Switch*)		P(Multi-employment)	
	Winners	Losers	Winners	Losers	Winners	Losers
	(1)	(2)	(3)	(4)	(5)	(6)
2SLS DiD $\left(\frac{dy}{d\log(1-\tau)}\right)$	0.278***	0.324***	-0.110**	-0.013	0.322***	0.090**
	(0.099)	(0.049)	(0.045)	(0.018)	(0.190)	(0.036)
Reduced form (dy)	0.009***	-0.020***	0,004***	0.001	0.011***	-0,006***
	(0.003)	(0.003)	(0.001)	(0.001)	(0.002)	(0.002)
First stage ($d$log(1-τ))	0.033***	-0.063***	0.033***	-0.063***	0.033***	-0.063***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	382,102	482,155	364,253	439,461	382,102	482,155

Note: The estimations on winners and losers were made separately, estimating by 2SLS the model of the equation (2) for the hours and the one of the equation (**??**) for the probability of changing firms and multiple jobs. The third row presents the estimates of the first stage, the second those of the reduced form and, finally, in the first row the elasticity is presented. The dependent variable of columns (1) and (2) is the number of average monthly hours worked in the semester and the gross annual income reported; the dependent variable of columns (3) and (4) is equal to one if the worker changed firms in the semester and equal to zero otherwise; while that of columns (5) and (6) takes the value one if the worker has worked in more than one firm for more than 2 months in the semester and zero otherwise. The control variables were interacted with *time* and *treat*. In the group of winners are those who faced reductions in the effective rate greater than 3 p.p and who have annual income greater than 170 thousand Uruguayan pesos. The losers are those who faced an increase of more than 3 p.p. in the effective rate and, finally, the controls are made up of individuals for whom the effective rate would have changed less than 1 p.p. Clustered standard errors at the individual level. *** p<0.01, ** p<0.05, * p<0.1.
Source: Own estimates based on employment histories - BPS.

Figure 1: Effective and Marginal tax rates of IRP and IRPF

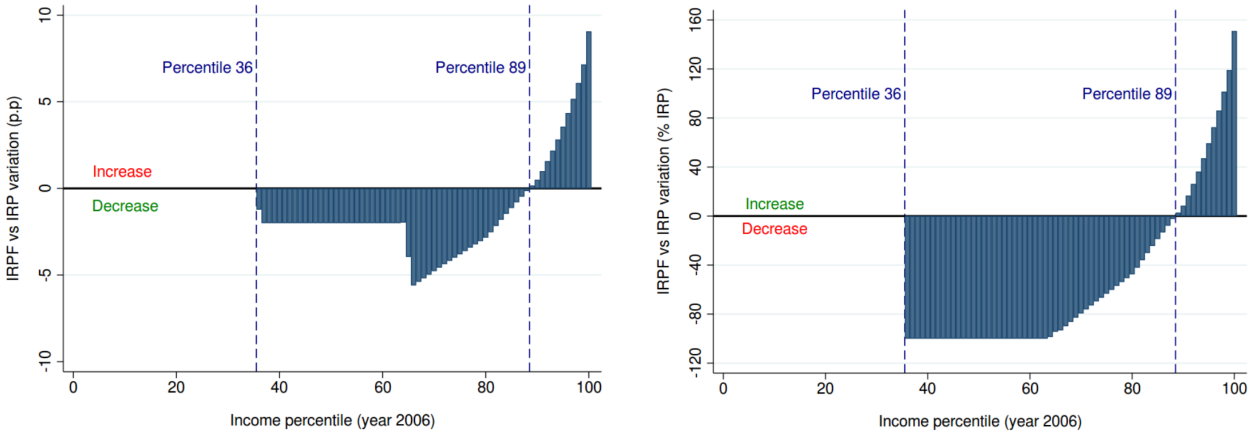


Note: 2006 annual salary adjusted to Jul-2007 by National Average Wage Index. The effective and marginal rates of the IRP coincide. The effective rate of personal income tax was calculated as follows. In the first place, the annual gross income was passed through the progressive scheme of marginal rates present in table 1. Then, the deductions were calculated following the scale of marginal rates shown in table A.2. Only social security contributions were used as items that could be deducted, which were calculated based on the rates in table A.1. Ultimately, the effective rate arises as the ratio between the amount of income tax and the total gross income.
Source: Own elaboration based on work histories - BPS.

Figure 2: Simulation of the impact of the reform along the income distribution

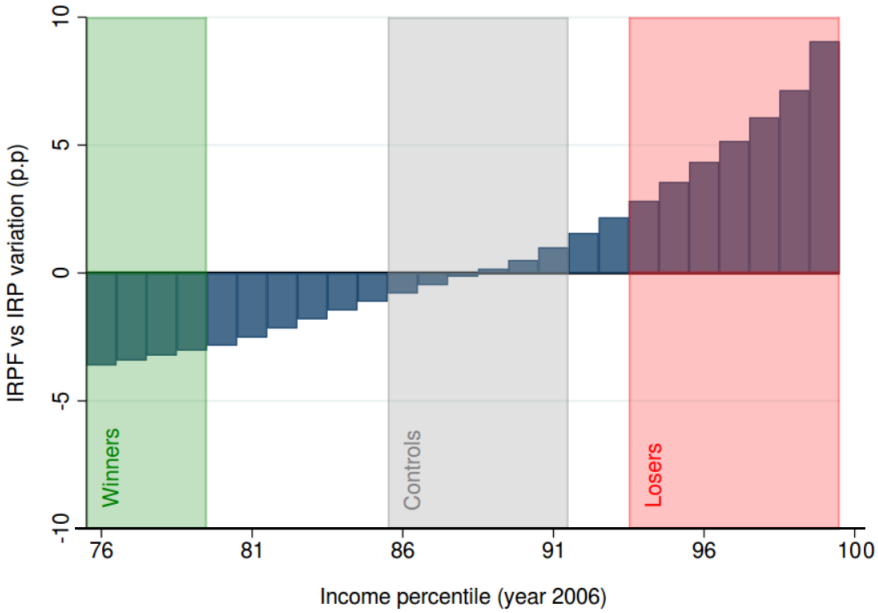
(a) As a percentage of annual income

(b) As a percentage of IRP



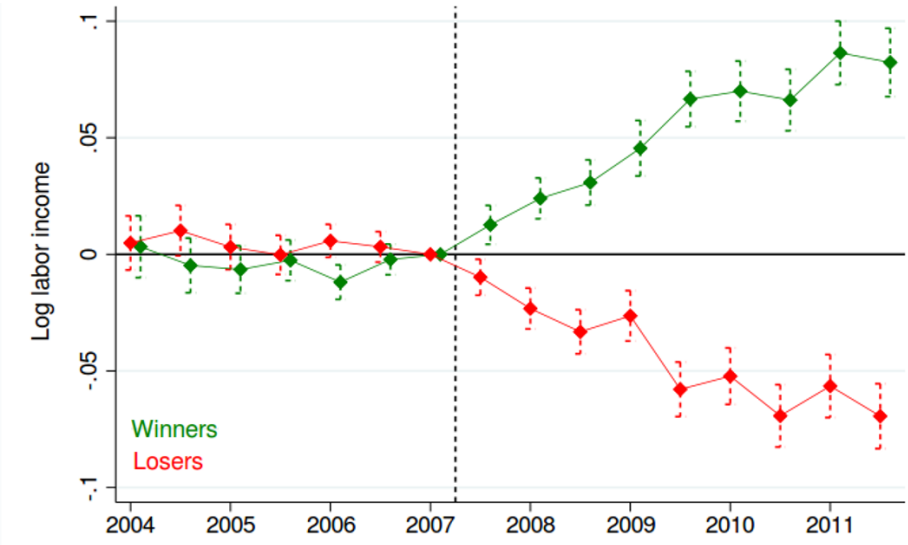
Notes: Each bar represents the average change in the effective rate (in p.p) that workers in that income percentile would have experienced. 2006 annual salary adjusted to Jul-2007 by National Average Wage Index. From this income, the effective rate that would have been paid under IRP and IRPF was calculated. The variation (p.p) arises from making the difference between both rates.
Source: Own elaboration based on work histories - BPS.

Figure 3: Treated and controls



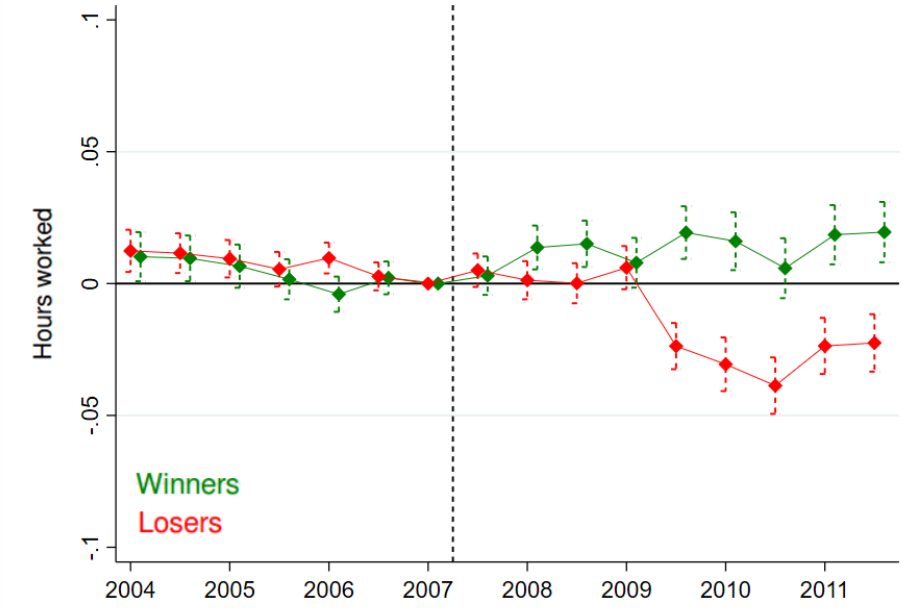
Note: Each bar represents the average change in the effective rate (in p.p) that workers in that income percentile would have experienced. Annual income corresponds to the sum of monthly income for 2006 updated by IMS to July 2007. From this income, the effective rate that would have been paid under IRP and IRPF was calculated. The variation (p.p) arises from making the difference between both rates. In the group of winners are those who faced reductions in the effective rate greater than 3 p.p and who have annual incomes greater than 170 thousand Uruguayan pesos. The losers are those who faced an increase of more than 3 p.p. in the effective rate and, finally, the controls are made up of individuals for whom the effective rate would have changed less than 1 p.p.
Source: Own elaboration based on work histories - BPS.

Figure 4: Estimates on reported income



Note: Estimates of winners and losers were made separately, following equation (1). The dependent variable is reported gross annual income. The control variables were interacted with *time* and *treat*. Confidence intervals are at 95%. In the group of winners are those who faced reductions in the effective rate greater than 3 p.p and who have annual income greater than 170 thousand Uruguayan pesos. The losers are those who faced an increase of more than 3 p.p. in the effective rate and, finally, the controls are made up of individuals for whom the effective rate changed less than 1 p.p. Clustered standard error at individual level.
Source: Own estimates based on employment histories - BPS.

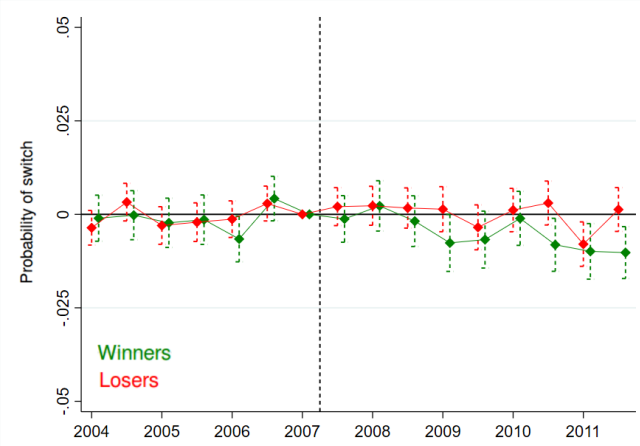
Figure 5: Responses in hours worked



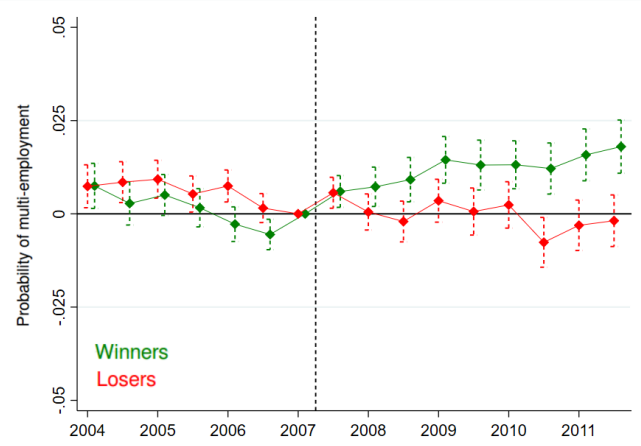
Note: Estimates of winners and losers were made separately, following a specification similar to that in equation (1). The dependent variable is the number of average monthly hours worked in the semester. The control variables were interacted with by *time* and *treat*. In the group of winners are those who faced reductions in the effective rate greater than 3 p.p and who have annual income greater than 170 thousand Uruguayan pesos. The losers are those who faced an increase of more than 3 p.p. in the effective rate and, finally, the controls are made up of individuals for whom the effective rate would have changed less than 1 p.p. Clustered standard errors at the individual level.
Source: Own estimates based on employment histories - BPS.

Figure 6: Responses linked to mobility

(a) Probability of switching firm



(b) Probability of multiple job-holding



Note: Estimates of winners and losers were made separately, following the equation (**??**). The dependent variable of the panel (a) takes the value one if the worker changed his firm in the semester and zero otherwise; while the one of panel (b) takes the value one if the worker has worked in more than one firm for more than 2 months in the semester and zero otherwise. The control variables were interacted with *time* and *treat*. In the group of winners are those who faced reductions in the effective rate greater than 3 p.p and who have annual income greater than 170 thousand Uruguayan pesos. The losers are those who faced an increase of more than 3 p.p. in the effective rate and, finally, the controls are made up of individuals for whom the effective rate would have changed less than 1 p.p. Clustered standard errors at the individual level.
Source: Own estimates based on employment histories - BPS.

8 Appendix

8.1 Deductions IRPF

Table A.1: Items subject to deduction – Active members of the BPS

Automatically calculated by the system	Personal contributions to the BPS (retirement contributions, health insurance, labor conversion fund)	15% If applicable: 3% 0.13%
Declared by the worker	Medical care of dependents Disabled or handicapped CJP Contributions CJP Reimbursements Solidarity Fund Additional Solidarity Fund	6.5 BPC per year 13 BPC per year Categories 1 to 10 Amount 1/2, 1 or 5/3 BPC Yes or No
Declared by the firm	Personal contributions to relief funds or conventional insurance Contributions to complementary funds of Social Security	Amount of each Amount of each

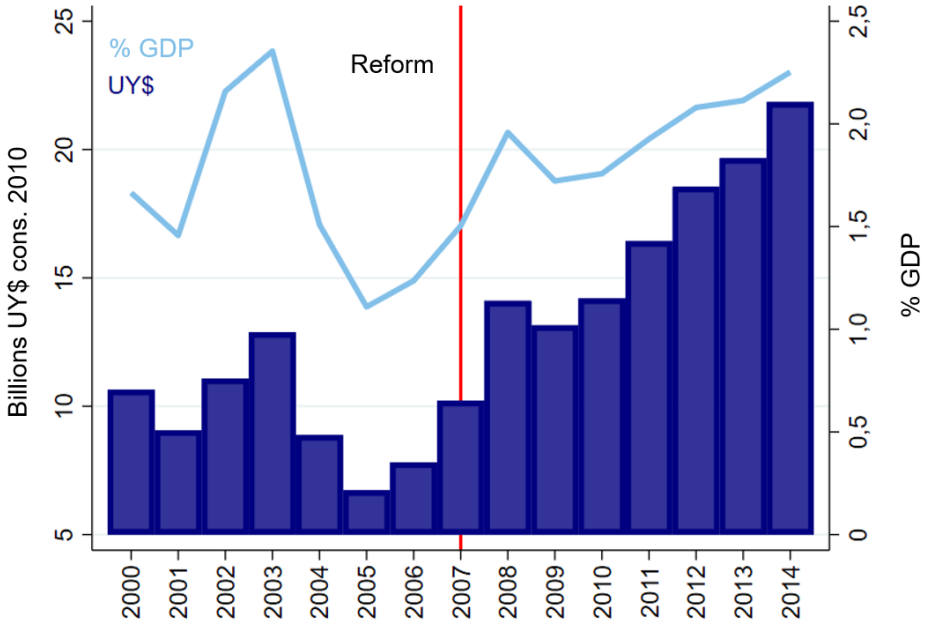
Table A.2: Scheme of rates for the calculation of the primary personal income tax

COMPUTABLE ANNUAL INCOME	**MARGINAL TAX RATE**
Up to 60 BPC (USD 4,183)	0.1
Over 60 BPC (USD 4,183) and up to 120 BPC (USD 8,366)	0.15
Over 120 BPC (USD 8,366) and up to 540 BPC (USD 37,647)	0.2
Over 540 BPC (USD 37,647) and up to 1,140 BPC (USD 79,477)	0.22
Over 1,140 BPC (USD 79,477)	0.25

8.2 Impact of the reform on personal tax collection

Although the reform was not conceived with the objective of increasing fiscal resources, the collection of personal labor income experienced continuous growth since the enactment of the law, in mid-2007. However, it is relevant to highlight the leading role of the strong economic growth that began in 2004. In this sense, Figure 3 shows that personal income tax collection, expressed as a percentage of GDP, exhibits a more moderate growth.

Figure A.1: IRP and IRPF II tax collection



Source: Contaduría General de la Nación (tax collection) y BCU (GDP).

8.3 Salience of the reform

Figure A.2: Propaganda against the income tax proposed by *Frente Amplio* (the party that implemented the reform), in the context of the 1999 national elections

(a) Criticism of income tax



(b) Defense of the middle class



(c) Interview to workers (I)



(d) Interview to workers (II)



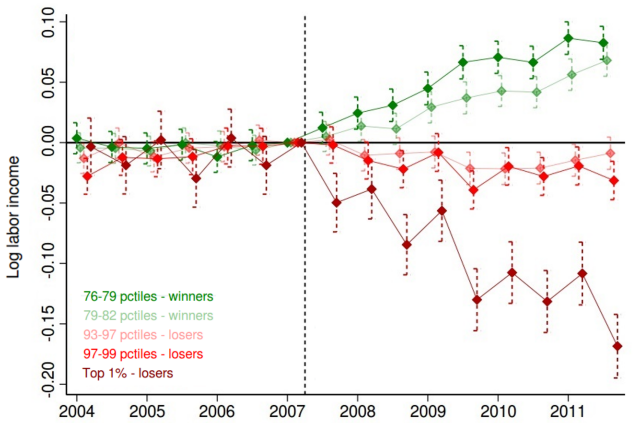
Note: Read: (a) "The income tax is paid by employees, pensioners, savers..." Followed by a detailed description of the tax increase and the expected collection; (b) "Because we want to protect it [the middle class], that's why we don't want a personal income tax"; (c) Interviewee: "Violent changes... tax reforms... I don't think they are the best solution"; d) Interviewee: "They [Frente Amplio] say that they are going to remove the salary tax, but they also say that they are going to create a personal income tax with triple the collection."
Source: https://www.youtube.com/watch?v=qz_pWO7BX8M&ab_channel=todoporlosvotoslibro, https://www.youtube.com/watch?v=HJij94TDrWc&ab_channel=TEVEREC, https://www.youtube.com/watch?v=gQ8WPQDCOcA&ab_channel=TEVEREC, y https://www.youtube.com/watch?v=qm_WCUwO4bM&ab_channel=TEVEREC.

8.4 Heterogeneous responses

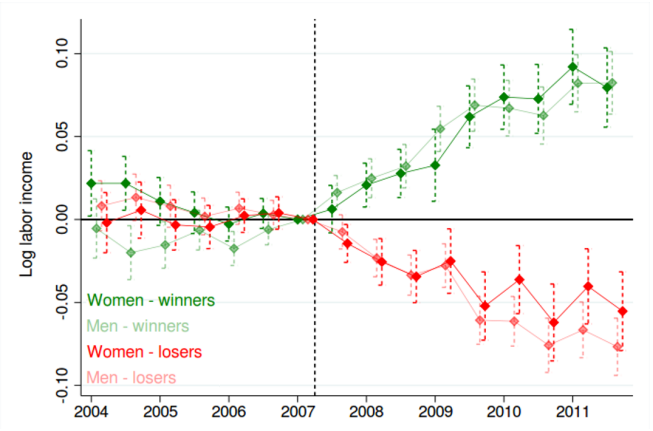
Figure A.3 presents the reduced form estimates using the dynamic Differences in Differences.

Figure A.3: Responses in reported income

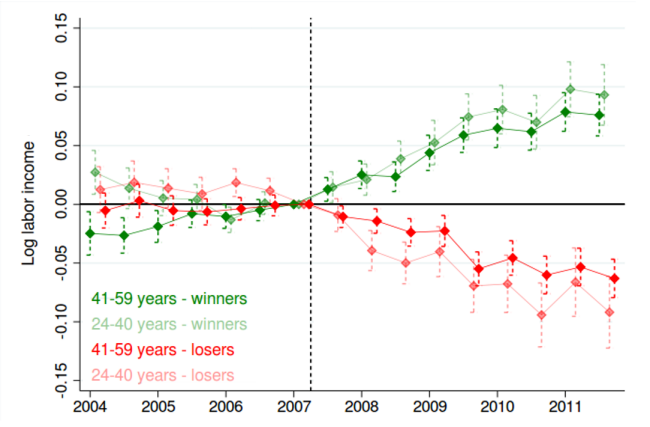
(a) Income



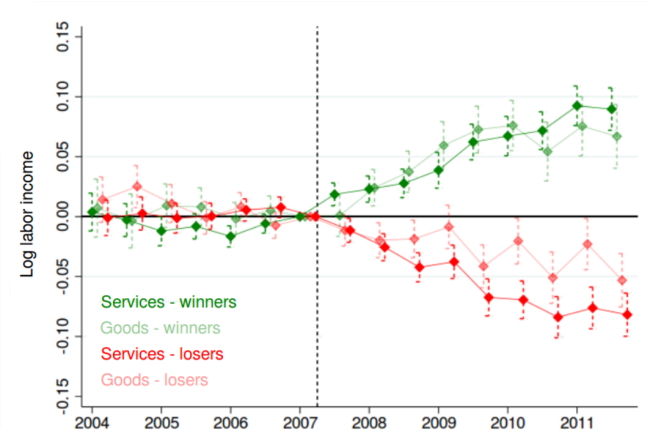
(b) Sex



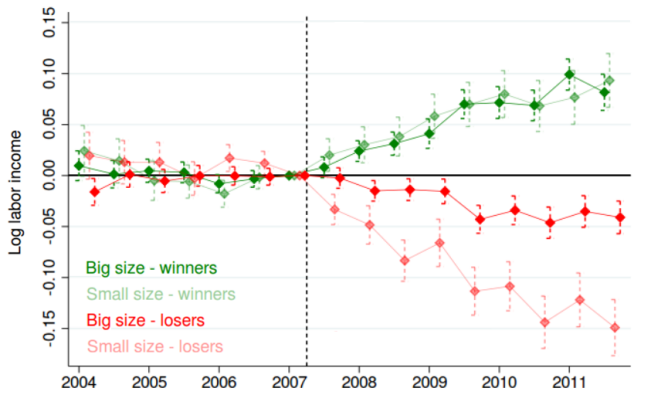
(c) Age



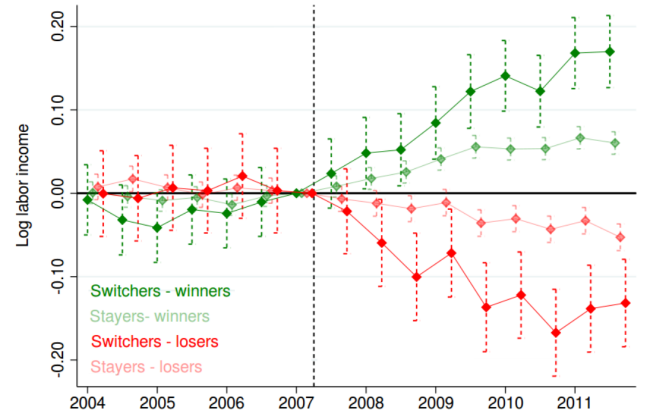
(d) Activity sector



(e) Firm size



(f) Mobility



Note: The estimates for winners and losers were made separately, following a specification similar to that of the equation (**??**). The control variables were interacted by *time* and *treat*. Firms belonging to: Agriculture and mining and manufacturing industry were classified in the goods sector; On the other hand, in services are those of the sectors: electricity, gas and water, construction, commerce, restaurants and hotels, transport and communications, services at expense and community, social and personal services. *switchers* are those who changed their firm at least once in the post-reform period, while *stayers* are the complement. In the group of winners are those who faced reductions in the effective rate greater than 3 p.p and who have annual income greater than 170 thousand pesos. The losers are those who faced an increase of more than 3 p.p in the effective rate and, finally, the controls are made up of individuals whose effective rate would have changed less than 1 p.p. Standard errors clustered at the individual level.
Source: Own estimates based on work histories - BPS.