

The Polish business “flat” tax and its effect on reported incomes: a Pareto improving tax reform?

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Abstract

Introducing a flat-rate income tax is a popular reform proposal. The 2004 tax reform in Poland implemented an optional broad-base low-rate “flat” tax for business incomes. Taxpayers selecting the flat tax treatment had to give up most tax preferences (thereby generating variation in incentives to adopt) but benefited from the lower tax rates. For the highest income taxpayers, the marginal tax rate fell from 40% to 19%. Relying on a large panel of individual tax return data, I demonstrate massive increases in reported incomes that result in small tax revenue consequences despite large reductions in tax rates. Conservative estimates indicate that a suitably designed flat tax option would increase revenue. The responses are most likely operating through reduction in tax avoidance or participation in the gray economy and imply that when the avoidance margin is responsive, a reform involving base-broadening combined with marginal tax rate reductions that allows taxpayers to self-select can be Pareto improving. The paper also highlights empirical issues involved in estimating responsiveness of taxable income and suggests that violations of exclusion restrictions due to heterogeneous earnings dynamics may be responsible for the “sensitivity” of results claimed elsewhere in the literature.

1 Introduction

In the last 15 years, a number of Central and Eastern European countries introduced so-called “flat taxes.”¹ Proponents of this type of taxation appeal to its significant benefits due to improved work and economic activity incentives, reduced tax evasion and the size of informal economy. Opponents highlight adverse equity implications due to reduction in progressivity of the tax code. More generally, flat tax reforms combine broadening of the tax base and tax rate reductions: a combination that can in principle reduce distortions, simplify the tax system and have limited tax revenue consequences both due to base expansion and due to behavioral response to lower marginal tax rates and base-broadening. Despite the significant popularity that this type of taxation has enjoyed, including calls for considering similar changes in developed countries, evaluation of its effects has been limited (exceptions are Ivanova et al., 2005; Gorodnichenko et al., 2009).

Poland introduced a limited form of such taxation was in 2004. The reform offered to individuals engaged in business activity the choice between filing according to the regular progressive schedule or choosing proportional taxation.² The benefit of relying on the flat rate schedule was a low marginal tax rate: the flat tax rate was 19%, while the three-bracket progressive schedule involved three rates of 19%, 30% and 40%, with the top rate applying beginning at 74,048zł in 2004.³ At the same time, electing the flat tax rate involves a trade-off due to the elimination of tax deductions and credits, including elimination of an income averaging opportunity for married individuals. I discuss the reform in more details in what follows.

The limited scope of the reform provides a unique opportunity to identify the impact of the flat tax on individual behavior. This is so because individuals who are otherwise similar may be affected differently depending on their personal tax situations. For example, it is more costly for individuals with a high-income spouse to choose the flat tax regime due to the elimination of the possibility for joint filing and resulting tax averaging.⁴ Similarly, the change did not apply to all types of income and hence provides an opportunity for identification based on comparing behavior of taxpayers with different income streams. As the result, one does not have to rely solely on the time variation or differences across income groups, but can further take advantage of the natural experiment that generates cross-sectional variation in the change in tax incentives.

The business income “flat tax” that was introduced in Poland is characterized by low marginal tax rate and broad tax base. I will not try to carefully distinguish between the effect of those two dimensions of differences. Kopczyk (2005) pursues an empirical strategy that attempts to separate

¹The flat income taxes of the type introduced in many CEE countries combine broad tax base and single tax rate. While similar in terms of simplicity and rate structure, they differ from “the” flat tax suggested by economists in the United States (e.g. Hall and Rabushka, 1995) that additionally attempt to implement a consumption tax base.

²A similar proposal has been suggested by John McCain during the 2008 campaign.

³The threshold for the top rate is of the order of \$20,000 using the exchange rate in 2004 (1zł appreciated from 0.25\$ to 0.33\$ over the course of that year). The average salary in 2004 in Poland was 2,289zł per month or 27,468zł annually.

⁴There is no separate tax schedule for married individuals, instead the tax code allows for income averaging across spouses with tax liability of each spouses computed using individual schedule based on the half of joint taxable income.

the impact of base change from the impact of marginal tax rate changes for the 1980s tax reforms in the United States, but his approach relies on the existence of rich variation in both rate and base changes that is not present in the Polish case. As a result, this paper focuses on estimating the joint impact of these two qualitative changes in the tax code.

The objective in this work is to evaluate the impact of flat taxes on reported taxable income and try to infer the source of response. The paper contributes to better understanding of the responsiveness to tax incentives in a number of ways. It provides estimates of responsiveness of reported income in Poland but the results are of interest more generally. This is the first taxable income study applying to a middle-income country and one of the very few applying to a situation with a significant informal economy.⁵ Hence, the estimated responses are likely to be a better approximation of responsiveness in contexts with high tax evasion than other results in the literature. Naturally, other middle and lower income countries are one such example, but there are also similarities to taxation of entrepreneurial income in advanced economies. For example, according to the IRS estimates of the tax gap in 2001, underreporting of business income accounts for approximately half of the individual income tax gap, corresponding to the underreporting rate of the order of 40% and exceeding 50% for non-incorporated businesses (underreporting rate for all sources of income is estimated at 11%⁶). Hence, finding a significant reaction to changes in taxation of entrepreneurial income in a high-evasion environment is also of potential relevance for policy makers in high-income countries.

The paper also contributes to the literature on the responsiveness of taxable income more generally.⁷ By focusing on a context with explicitly and cleanly defined treatment and control groups, it is possible to get a better insight into the nature of econometric problems plaguing this literature (see Saez et al., 2012, for a discussion) and evaluate the credibility of the alternative identification strategies. I pursue a “graphical” approach to illustrate the effects and highlight the problems, in particular those related to the omitted variables problem such as mean reversion. While such an approach may not easily generalize to contexts that cannot be described by a binary treatment variable, it is very useful for illustrating the nature of the problems and shedding a light on the common claim in the taxable income literature that the results are “sensitive:” I argue

⁵A very recent paper by Kleven and Wassem (2011) estimates taxable income elasticity using data from Pakistan.

⁶Between \$83 and \$99 out of the 2001 estimated individual income gap of \$150-187 billion (http://www.irs.gov/pub/irs-utl/tax_gap_facts-figures.pdf; misreporting rates based on http://www.irs.gov/pub/irs-news/tax_gap_figures.pdf, accessed on 9/15/2010).

⁷The approach in this paper is related to that introduced by Feldstein (1995) who focused on estimating the responsiveness of taxable income to changes in the tax rates. Studies that relied on the US data initially found large responsiveness (Lindsey, 1987; Feldstein, 1995; Auten and Carroll, 1999), but more recent work in this area has shown that this finding is not robust to better accounting for non-tax related income distribution widening and mean reversion and that the actual elasticities are moderate (Gruber and Saez, 2002; Kopczuk, 2005), except for the very top. While findings for other countries are broadly consistent with those for the US (for example Sillamaa and Veall, 2001; Aarbu and Thoreson, 2001; Bianchi et al., 2001; Kleven and Schultz, 2011), there are enough differences to support the argument of Slemrod and Kopczuk (2002) that taxable income elasticities are not in fact primitive parameters having its source in preferences and technology but they also reflect administrative aspects of the tax code. For that reason, analysis in additional countries and additional contexts is of interest not only when one is interested in these particular countries but because it helps in understanding the nature and determinants of such responses more generally.

that sensitivity is often a consequence of violations of (in practice, implicit) assumptions behind the identification strategy and poor understanding of the data. For example, I show that mean-reversion patterns for entrepreneurs and wage-earners are very different, so that a strategy that relies on treatment correlated with self-employment status needs to take into account the presence of such differences or else is bound to effectively confuse them with a tax response. Similar problems are likely to arise in other situations where empirical strategy relies on comparison of groups with different earnings dynamics, for example when different income groups are compared.

The structure of the paper is as follows. In Section 2 I describe the data and Section 3 contains a brief background about the Polish tax system. Section 4 presents basic summary statistics suggesting that the reform likely had an important effect on reported income. In section 5, I provide causal estimates of the reform. I proceed in two ways. First, following suggestions of Saez (2004) and Saez et al. (2012) I employ the repeated cross-sectional analysis. I conclude that while it illustrates the impact of the reform, it is inadequate for precisely estimating its effect due to the rank-reversal problem (taxpayers change their position in the distribution as the result of the reform). Second, exploiting the panel dimension of the data, I pursue a number of instrumental variables strategies relying on pre-determined characteristics of the spouse or an individual. I provide graphical evidence showing that several a priori appealing instruments (such as owning a business or having a high-income spouse) violate the exclusion restrictions that translate into “sensitivity” of the results to specification. When I focus on a more homogeneous sample of consistent business owners, there is no longer evidence of the relationship of several plausible instruments such as spousal income or spousal business ownership to earnings dynamics and the results are consistent and stable. I find that the effects of the reform on reported incomes are very large and the effects on tax liability are nonlinear (varying with income level). In the final section 6, I discuss implications of the results for tax revenue.

My preferred estimate of the effect of the reform is 0.39 log-point increase in the log of reported income by individuals affected by the tax reform (Table 4). This estimate is identified off the variation in spousal circumstances that affects incentives to take up the flat tax and that is operative for high but not very high incomes. Estimates in Section 5.1 are instead identified off very high income population that experienced higher tax rate changes and are larger (0.73). When estimating tax elasticities directly, all strategies lead to net-of-tax elasticities in the neighborhood of 1.⁸

These elasticities are large although not unheard of in the taxable income literature that originally found very large responses (Lindsey, 1987; Feldstein, 1995; Auten and Carroll, 1999) for high income population (although some of these results have been substantially challenged Saez et al. 2012). By themselves, such large elasticities raise the possibility of the economy being on the wrong side of the Laffer curve. The estimates are not large enough to indicate that the marginal tax rate overall should be reduced but they are large enough to imply that introducing such an *optional* flat rate schedule might increase revenue.

⁸Estimates of tax elasticities come with a number of caveats because the reform involved both base and rate changes. They likely understate the impact of the reform, in particular they result in bigger revenue losses than direct estimates of the impact of the reform.

The baseline results imply that revenue has slightly declined as the result of the *actual* tax reduction (although revenue increases are within the range of estimates). Conservative calculations that account for the impact of changes in tax rates (but likely do not fully account for the revenue gains due to other aspects of the reform such as tax base adjustments) change suggest that the flat tax rate that would result in no revenue consequences relative to the pre-reform schedule is between 24% and 31%. Given an elective nature of the reform, setting tax rate at the level would have been Pareto improving (at least in the partial equilibrium context) and the actual reform did not fall far from that.

2 Data

The empirical approach takes advantage of individual tax return data from the Polish Ministry of Finance. The data covers the period from 2002 to 2005 and includes all individual tax returns filed during that time by approximately 1.8 million individuals and their spouses (to the extent that they could be identified based on filing a joint income tax return), altogether a little bit over 10 million returns. Individuals (not returns) are sampled. Sampled individuals were selected randomly from among those who filed at any time during the period (the likelihood of being selected did not depend on the number of returns or the number of times that one filed). This procedure corresponds to selecting a random sample of the population and then limiting it to those who filed at least once during the period.

Following the selection of the taxpayers, joint tax returns filed during 2002-2005 were used to identify spouses. All tax returns of spouses identified in that way were added to the dataset. Taxpayers who divorced or widowed and then remarried can have multiple spouses in the dataset and returns for each spouse will be available for all years. On the other hand, filing jointly is a choice and not a requirement so that not all couples can be identified and it is not possible to distinguish changes in election of how to file from divorces or deaths. Furthermore, and importantly given the reform studied, the flat tax does not allow for joint filing so that information about spouses of taxpayers who report business income only and use the flat tax schedule is not directly available in 2004 and 2005 (but to reiterate, 2004 and 2005 tax returns of their spouses with whom they filed jointly in 2002 or 2003 are still available).

As usual with tax data, the dataset is rich in details from tax returns (most of the line-items from tax returns are reflected in the dataset) but scarce on demographic information (gender, age are included; the presence of children and marital status are available to the extent that tax returns reveal that information).

For the analysis that follows, we aggregate information from all tax returns filed by a given individual in a given year. All personal information has been removed from the dataset so that taxpayers cannot be identified. Furthermore, numerical variables have been blurred to preserve confidentiality of the taxpayers. The blurring procedure was performed by selecting for each tax return a random number from a uniform distribution between 0.9 and 1.1 and multiplying all the

monetary variables on a given tax return by that number. This procedure retains additivity of variables (for example, the sum of all income sources still aggregates to the total income) and preserves means of all variables in expectations. Multiplicative transformation also guarantees that the blurring procedure affects the logarithms of variables in a straightforward way. For the most part, I ignore this issue and proceed as if using the actual undistorted information. In footnote 20, I discuss the results of a simple Monte Carlo experiment that suggests that the effect of blurring on the empirical results is trivial.

3 Polish tax system

The structure of the regular income tax in Poland has been in effect since the early 1990s and has a fairly typical progressive structure. Moreover, the basic rate structure of the tax remained fairly stable since the late 1990s. During the period of interest, there were three tax brackets with marginal tax rates of 19%, 30% and 40%. A non-refundable tax credit was available to everyone and it effectively implemented an exemption from tax for low levels of income. Between 2002 and 2006, the tax brackets were fixed in nominal terms, at 37,024 zł and 74,048 zł. The tax credit was equal to 518.16zł in 2002 and adjusted to 530.08zł for 2003-2006.

The option to choose between the progressive rate rate schedule and the flat rate (19%) for non-agricultural business activity was made effective as of 1 January 2004. The fixed rate option was available for individuals who had already been conducting business activity. In order to take advantage of this flat rate system, an individual had to inform the appropriate tax office about the choice by January 20th. The option was also available to new businesses starting in 2004. Those who intended to provide services to their last-year employers could not choose this form of taxation. The choice made by the taxpayer was effective in subsequent years, unless revoked by the taxpayer by informing the appropriate tax office.⁹

A taxpayer who had both business and other types of income and who chose to elect the flat-tax regime, would have to file two (or more) separate tax forms corresponding to different types of income, with taxation of business income and taxes imposed on other types of income computed independently.

Taxation of business income in Poland depends on the organizational form of the business. Sole proprietorships and partnerships without limited liability are pass-through entities with all income allocated to owners and subject to income taxation. Partnerships with limited liability and corporations are subject to the corporate income tax (CIT). The CIT rate was 28% in 2002, it was reduced to 27% in 2003 and subsequently reduced to 19% in 2004 (at which level it stayed since).

Capital income, including dividends from firms subject to CIT, is subject to a flat 19% rate and is taxed separately from other types of income (the tax was introduced in 2001). Hence, opting for a standard limited liability structure closes the option of taking advantage of the flat tax

⁹The taxpayer can switch a form of taxation every year as long as (s)he declares it in advance. Given that the data used here covers only two first years after the form, it is not possible to study the extent of this behavior but, as discussed later, there are few taxpayers who gave up flat tax filing between 2004 and 2005.

and exposes income to double taxation through both CIT and capital income tax. Nevertheless, reductions in the CIT rate in 2004 should have led to a reduction in business income reported on individual income tax returns, and bias against finding an effect of the reform.^{10,11} Poland entered the European Union in May of 2004. This event had of course far-reaching implications and affected many different aspects of economic activity (although the process of integration of Polish economy and law with EU had been going on for years). It is not possible to directly control for all implications of this event, but I will argue that identification strategies employed in the paper made it unlikely that the results are spurious consequences of this event.

Choosing the flat tax system has some important costs for the taxpayer. It eliminates joint taxation with the spouse and preferential taxation for single parents. It also eliminates tax preferences other than deduction of contributions for social and health insurance (unless these they were included as costs of business activity). Opting for the flat rate eliminated the possibility of claiming the otherwise universal nonrefundable tax credit. These taxpayers could no longer benefit from continued deductions obtained in previous years such as construction expenses and student employment deductions as well as special privileges in special economic zones).

To summarize the incentives for switching to a flat tax regime, the reform introduced in 2004 involved trade-offs. It reduced the marginal tax rates from as much as 40% to 19% but did so at the cost of eliminating tax preferences. Hence, individuals who would otherwise be subject to the lowest 19% tax rate under the regular income tax, had no incentive to opt for the flat tax treatment. Those in higher tax brackets may or may not chose to do so depending on their individual circumstances. Elimination of the universal tax credit and joint filing had infra-marginal effects for high income individuals (they corresponded to, bounded from above, tax savings on income subject to lower marginal tax rates due to these provisions) and for taxpayers with high enough incomes the reduction in marginal tax rate dominated, so that the flat tax schedule became more attractive. While various kinds of tax preferences were important for taxpayers in general, all of them were either capped or small enough so that in practice sufficiently high income taxpayers clearly benefited from shifting to the flat tax schedule, even assuming no behavioral response.

Figure 0 illustrates the mechanical (assuming no behavioral response) effect of the reform on

¹⁰The tax law appears to link business income associated with limited liability with taxation under CIT, seemingly implying that only income from businesses that are not accorded limited liability can be subject to the flat tax. In practice, however, this is not the case. Polish law allows for a hybrid form of an organizational structure called “spółka komandytowa.” This type of structure requires that some partners have limited liability and some do not. Critically for tax purposes, it acts as a pass-through entity with all income allocated and taxed at the partners’ level. Income of an individual who is a limited liability partner in a firm of that kind can be still taxed using the flat tax schedule. Furthermore, the full liability partner can hold a minor stake in the business (e.g., 1%) and be another firm itself, for example a limited liability partnership. Hence, this kind of structure effectively allows for complete limited liability (if the full liability partner is a limited liability entity itself) with the majority of income being subject to personal income tax as business income (in particular allowing for the flat tax election).

¹¹Since the early 1990s, there have been two additional ways of taxing businesses called *karta podatkowa* (tax card) and *ryczalt* (presumptive tax) that were fairly limited in their reach and applied to very small businesses of particular kinds specified by the law. The “*tax card*” is essentially a lump-sum tax in the amount specified by the local tax authorities. *Ryeczalt* is a proportional tax applicable to receipts from certain types of business activity. The rate depends on the type of business. This type of taxation does not allow for deducting business costs or for taking advantage of any deductions.

the tax liability and corresponding incentives for switching to the flat tax. The thresholds for the tax free amount and the tax brackets are marked. The red line shows the regular progressive tax schedule. The blue line shows the new flat tax schedule. Taxpayers in the first tax bracket face lower tax liability when selecting the progressive tax schedule. This applies to some taxpayers in the second tax bracket as long as the benefit of the reduced marginal tax rate does not compensate for the lost tax free amount (the break-even point is at 41,735zł). The dashed red line shows the impact of deductions. For illustration, it assumes that a taxpayer is eligible for a deduction of 10% of gross income (about the average in the sample). Switching to the flat tax corresponds to giving up this preference and hence increases the level of income at which the flat tax schedule starts to dominate (to 57,385zł). Finally, the black line shows the effect of marital deduction. It shows tax liability for a couple with one spouse working. A couple benefits from tax averaging so that its marginal tax rate remains at 19% up until income is equal to twice the threshold for the second bracket (which happens to be equal to the threshold for the third bracket). Hence, to benefit from the flat tax, the sole earner has to have income exceeding 74,048zł (the exact break-even point is at 83,469zł). I will exploit this variation in incentives to switch depending on individual situation in the empirical analysis.

4 Effect of the reform on business activity and taxable income - descriptive evidence

4.1 Summary statistics

To begin, I illustrate that taxpayers did take up the flat tax schedule in an economically predictable fashion. Figure 1 shows the likelihood of choosing the flat tax in 2004 and 2005 conditional 2002 income level, with the two vertical lines corresponding to the brackets of the progressive income tax schedule. Figure 2 shows the same information for the subset of individuals who claimed business income in all years between 2002 and 2005. As expected, reliance on the flat tax does not begin until the first income threshold is crossed and taxpayers are in the 30% marginal tax rate — this is natural as benefiting from the flat tax requires being in one of the higher tax bracket and income is strongly correlated across years. Reliance on the flat tax increases quickly afterwards. In particular, for high income business owners it is close to uniform. Figures 3 and 4 show similar information (take up of the flat tax in 2005) but instead conditional on the rank in various years. The figure for the full distribution is restricted to the top decile and it makes it clear that the flat tax is a very high income phenomena: over 40% of 2005 filers in the top percentile rely on this type of taxation, while the corresponding number even as close as the the 97th percentile is below 10%. Again, limiting the sample to business owners reveals though that this is not a niche tax treatment for that group as the tax is relied upon by a broad swath of that group — 50% of business owners at the 80th percentile of the distribution are on the flat tax schedule in 2005.

The take up of the flat tax in 2005 increases monotonically with income in any of the prior years but the relationship is stronger in 2004 and 2005 than before. While this is expected given

that incomes vary over time, it also appears that individuals at the top of the distribution in 2004 are significantly more likely to claim the flat tax in 2005 than those at the top in 2002 and 2003. In fact, there is not much difference between the effect of rank in 2004 and 2005 which raises the possibility that the main reason for the difference between these lines is not general earnings dynamics but rather the effect of earnings associated with the reform: that is, the reform may lead to re-ranking individuals in the distribution.

To provide more direct evidence of re-ranking, Figure 5 shows the number of business owners conditional on the rank in the income distribution (limited to the top 10%) for all years between 2002-2005. A striking feature of that figure is that the composition of the top percentile — precisely where the take up of the flat tax is widespread — has shifted significantly toward business owners between 2003 and 2004. This is suggestive of business owners moving up the income distribution as the result of the reform (although it leaves open the possibility of conversion from other types of income to business type). It also suggests that the composition of the top group potentially changes as the result of the reform. This is important, since identification of tax responses based on the repeated cross-sectional analysis advocated by Saez et al. (2012) requires that there is no rank reversal. Much of the following analysis will rely on the subsample of individuals who consistently reported business income to eliminate that margin. Taxpayers may choose to start a business when incentives for reporting business income improve. However, the number of individuals actually reporting business income slightly declined between 2003 and 2004.¹² While this is not definitive evidence, it suggests that the apparent strong responses discussed before do not have their main source at this margin.

Table 1 provides summary statistics about basic variables reported on tax returns. It shows information for the three taxable income categories corresponding to the thresholds in the tax schedule.¹³ For married individuals, taxable income is defined as the average of taxable incomes of the two spouses to approximate the actual tax treatment. There is no evidence of any significant changes in the structure of incomes in the lowest bracket. There is however clear evidence of a very large decline in the average business income in the intermediate bracket taking place between 2003 and 2004. Also, the number of individuals who are in the second bracket increases. Most interestingly, business income reported in the highest bracket increases by 50% and the number of individuals in that category also increases by about 50%. At the same time, the average wage in that bracket actually declines. This can correspond to conversion of wages into business income but it may also be an artifact of the changing composition of that group. Reliance on deductions among the highest income taxpayers drops precipitously, again consistently with the effect being driven by flat-rate schedule that eliminates most deductions. Taken together, these patterns suggest important changes in the level and composition of incomes in intermediate and high income tax brackets.

¹²The number of individuals reporting business income in the dataset in 2002-2005 was 72883, 72206, 71518 and 71072 respectively.

¹³This is not a direct match to the progressive code: data is aggregated across all different tax returns including flat tax, capital income, tax card and ryczałt.

Table 2 shows basic variables for taxpayers who *chose* to take advantage of the flat tax schedule in 2004 and 2005, as well as those who only did so in one of those years. Approximately 12,500 out of 1.4 million regular filers present in the data chose to file a flat tax return in 2004 and additional 3,600 did so in 2005. While this is only about 1% of all taxpayers, these are predominantly very high income taxpayers. The average gross income of those who filed the flat tax form in both 2004 and 2005 was already 120,000zł in 2003 — well above the threshold for the top tax bracket (although below the average income in that bracket). The average gross income for that group in 2005 was over 200,000zł and about equal to the average in the top bracket. Between 2003 and 2004, business income of these taxpayers increased by almost 60% and it increased by another 8% in 2005. A similar jump, but from a lower base, is also evident between 2004 and 2005 for those who chose to file according to the flat tax schedule in 2005 only. A small group of taxpayers who were on the flat tax schedule only in 2004 did not experience much of an increase between 2003 and 2004 and actually show a decline in their incomes in 2005 — these may be taxpayers who ex post realized that the flat tax option is not the right one or those who experienced a decline in their incomes for other reasons or those who decided to switch reduce/eliminate their business income reliance (which would be consistent with an *increase* in their reported wages).

These patterns are suggestive of the reform having an effect on reporting, but of course they do not prove the existence of a causal effect of the reform. It is plausible that business income for taxpayers who chose to file according to the flat tax schedule started increasing even before the reform while their wage income had already been declining. Taxpayers who are on an increasing income trajectory may be more likely to have higher income in the future and therefore more likely take advantage of new provisions that are beneficial to taxpayers with high income. This effect could produce an association between taking advantage of the reform and income growth that is not a causal relationship. The analysis in the following sections attempts to demonstrate the causal effect.

In Table 3, I eliminate one source of selection into the flat tax by focusing on individuals who owned a business throughout the whole period. 22% of this group switched to a flat tax in 2004 and the additional 6% did so in 2005. The same temporal pattern of reported business income as before is evident for the whole group, suggesting that selection into business-related activity is not driving it (although this is still a selected sample: these are individuals who were able to stay in business throughout the period).

The bottom panels of the table shows some information about the spouses. The middle panel shows information based on joint tax returns. Because taxpayers who are relying on a flat tax can no longer file jointly (unless they have other sources of income), spousal variables after 2003 taken directly from tax returns would be based only on those who continued to file jointly. The following panel uses an alternative definition of the spousal variables. Instead of relying on the current joint filing, the spouse is defined as a person with whom a joint tax return was filed in both 2002 and 2003, regardless of whether a joint return was filed in 2004 or 2005. Business income reported by spouses has increased as well and so did wage income. This suggests that, as the first pass, the

bulk of the response did not have to do with reallocation of income between spouses. It is also interesting to point out here that the election of the flat tax may change the marginal tax rate face by the spouse (especially, lower income spouse) and affect the behavior of the spouse through that channel.

One way of getting further insight into a possible effect of the reform is to compare income distributions before and after the reform. Figure 6 shows the distribution of income between 2002 and 2005. The bulk of the distribution is located far below the first threshold and while it appears to have been changing somewhat, this change is unlikely to be related to the reform that did not apply at such low income levels. More interestingly, the distributions for 2004 and 2005 appear to lie a little bit above those for 2002 and 2003, beginning around the threshold for the first bracket. Figure 7 zooms in on the population of (consistent) business owners and provides stronger evidence of an effect consistent with the reform having an impact. There is a decline in 2004-2005 in the mass of individuals below and around the first threshold and a sizable increase in the number of individuals well above the second threshold. The mode of all the distributions is located close to the first income tax threshold, consistent with the kink of the tax schedule having an effect on reported income. The mass at that mode declines after 2003. A potential caveat to the interpretation of this figure is that all the figures are nominal to facilitate the presentation of (almost constant in nominal terms) tax incentives. In Figure 8, income is adjusted for inflation and real GDP growth. The price level increased by 6.3% between 2002 and 2005 and real GDP increased by 12.5% (3.8% in 2003, 5% in 2004 and 3.2% in 2005). This modification eliminates the impression of movements in the distribution well below the first threshold but still indicates a significant shift of the mass roughly from the second tax bracket to the top of the distribution where the progressive tax schedule imposes the marginal rate of 40%.

Figures 9 and 10 illustrate that changes in the income distribution are indeed associated with flat tax taxpayers: they show the distribution of income among (consistent) business owners by whether they are on the flat tax schedule in 2005. There are minor movements with no obvious temporal pattern of the income distribution for those who chose not to use the flat tax by 2005 but the income distribution moves significantly and in a way very consistent with the reform for those who chose to use flat tax in 2005.¹⁴

5 Estimating the causal effect of the reform

5.1 Repeated cross-section

A simple approach to estimating the effect of a tax reform, advocated by Saez (2004) and Saez et al. (2012) is to ignore the individual panel aspect of the data and instead rely on comparing the same slices of income distribution across years, in effect a difference-in-difference based on repeated cross-section. Figure 11 shows the change in gross income accruing to various percentiles

¹⁴Interestingly, the modes of the two distributions appear to coincide very nicely with the kinks in the progressive income tax schedule.

of the income distribution for subsequent pairs of years between 2002 and 2005 by percentile of the income distribution (the graph is limited to the top decile for clarity). In other words, a point corresponding to percentile p shows the change in mean of log gross income in that percentile of distribution from year t to $t+1$ (the percentiles are defined for each year separately so that different individuals constitute the given percentile in different years).

There is a striking pattern of an increase in incomes between 2003 and 2004 at the very top of the distribution, with no major variation in 2002-2003 and 2004-2005. This is of course nicely associated with the pattern of reliance on the flat tax evidenced on Figure 3. Digging a bit deeper, there may be a little bit of evidence of slower growth in incomes toward the top between 2002-03 and faster growth between 2004-05, possibly consistent with delaying 2003 income until 2004 and the effects of the reform continuing to phase in also in 2005. Figure 12 confirms these findings for consistent business owners only, thereby eliminating the effect of compositional change and relaxing the effect of occupational changes.¹⁵ Figure 13 shows the effect on business incomes only and, unsurprisingly, shows similar patterns.

A natural question to ask about is the consequences of these responses for tax revenue. This is investigated in Figures 14 and 15. The growth in tax liability was higher in 2003-2004 and 2004-2005 than in 2002-2003 but the effect is nonlinear: revenue increase is much slower for the top percentile and, when focusing on business owners, the revenue actually declines at the high end. To understand why this might be the case, note that with the marginal tax rate declining from 40% to 19%, the taxable income of individuals who are far into the top bracket would have to double in order to compensate for lost revenue and the responses of income do not appear to be nearly this large. On the other hand, lower down the distribution where marginal tax rates fell by less as the result of switching to the flat tax and infra-marginal effects are more important, one may expect revenue increases even with lower responses and that indeed appears to be the case. To analyze the overall effect of the reform one needs to combine these different effects.

The results here strongly suggest the presence of a response and could be converted into the precise effect of the statutory tax changes, via a difference-in-difference like approach with groups defined by position in the income distribution. There are three assumptions behind such an approach though, all of which are questionable. First, such an approach would compare different income groups and hence is subject to potential criticism that it confounds changes in income distribution with the effect of policy. Second, the original reason of Saez (2004) and Saez et al. (2012) for suggesting this approach is to deal with mean reversion: the assumption is that the distribution is ergodic — individuals at a given point of the distribution have the same characteristics every year. This is a hard to test assumption and one that may be particularly troublesome in a transition economy. Third, and relatedly, the key assumption here is that there is no rank reversal that is

¹⁵This figure also shows that incomes of individuals at the bottom of the distribution of taxpayers with business incomes were increasing between 2002 and 2003 and declining between 2004 and 2005 perhaps corresponding to broader inequality trends but more likely due to the selective nature of the sample (because taxpayers are supposed to have business incomes for four years, only those who are relatively successful after 2002 stay in the sample). This type of earnings dynamics will be controlled for in the panel data analysis.

caused by the reform, i.e. that there are no groups that permanently shift in the income distribution. This assumption is dubious as it is precisely business owners that are affected by the policy change and, in fact, as the discussion in the previous section strongly suggests, their representation at the very top of the distribution significantly increases. This concern of course is alleviated if one considers only business owners as the sample of interest, but even among them it is natural to expect that the reform likely had heterogeneous effect on behavior, so that the assumption of no rank reversals appears very strong. For example, if one of the sources of response has to do with reduced tax avoidance or reduced reliance on earning income in the informal economy, one would suspect that the strength of this effect would vary with the nature of business activity and the preferences of the business owner.

Having said that, it is simple to provide illustrative results of the effect of the reform implied by this strategy, and to illustrate the source of bias. Using the full sample while treating 98th percentile as the control group and the 99th percentile as the treatment group, implies the diff-in-diff estimate¹⁶ of the change in the logarithm of gross income between 2002 and 2005 of 0.359 (the ratio of the differences in changes in incomes in the two groups - 0.254 and 0.149 respectively, as seen on Figure 11, divided by the difference in the take up of the flat tax by 2005 in the two groups - 0.454 and 0.161, respectively, as seen on Figure 3) tightly estimated with the standard error of 0.021. In other words, this strategy implies that the take up of the flat tax is associated with an increase in gross income by 0.359 log points. Using the full sample is questionable given the importance of rank-reversal problems: the composition of the top group is changing as business owners are entering it in the aftermath of the reform. Figure 5 illustrates that the composition of the top group between business owners and salaried workers has changed significantly in the aftermath of the reform. That implies that the growth rate of 0.254 in the top percentile is understated — the 10% or so of additional business owners in that group would have been in lower percentiles ex post if not for the reform. Similarly, the growth rate of 0.149 in the lower percentile is likely overstated since ex post it includes relatively high income salaried workers who were pushed out of the top group. Consequently, the estimate of 0.359 is a lower bound for the effect of the reform. The presence of rank-reversal is inherent here because the reform has affected only some taxpayers. However, rank reversal problems are also likely present for reforms that nominally affect everyone because different subgroups may have different elasticities of response (in particular, the literature tends to find that self-employed and salaried workers do indeed respond differentially to taxation). Hence, the solution advocated by Saez (2004) and Saez et al. (2012) is very likely to understate responsiveness to taxation here and in other context as well, unless one takes rank-reversal seriously.

The simplest way to adjust for rank-reversal is by focusing on the subgroup where it is less of an issue — in the current context, it is the group of taxpayers with business incomes. Applying

¹⁶The regression implementation corresponds to regressing log of gross income on take up of flat tax with year and percentile dummies included, using the interaction of 2005 and being in the top percentile as an instrument for take up. The repeated cross-sectional sample includes those above the 98th percentile of the income distribution in each particular year. Income distribution trend, rank reversal and lack of ergodicity are potential sources of violation of the exclusion restriction.

the same strategy to the population of business owners while comparing the top decile to the ninth one¹⁷ yields the estimate of 0.735 (with the standard error of 0.059).¹⁸ This is the preferred estimate using the cross-sectional strategy.

Finally, by making the strong assumption that the reform reflects purely the tax change, one can also use this strategy to obtain the difference-in-difference estimate of the *tax elasticity*, that is instead of estimating the overall impact of the reform, convert the results to the effect of the marginal tax rate change, using the dummy for the reform as an instrument for the tax change. This estimate of the tax elasticity is 1.290 and it is tightly estimated with the standard error of 0.103.¹⁹

Concluding, there is strong suggestive evidence here that the incomes of taxpayers at the top of the income distribution have increased significantly in the aftermath of the tax reform. This effect appears driven by the income groups that have taken up the flat tax (business owners with high enough incomes). The patterns in the data appear strongly supportive of the presence of a strong positive causal effect but repeated cross-sectional strategy requires making strong assumptions to estimate its strength. In the following section, I propose an alternative strategy that relies on a different source of identification and exploits cross-sectional variation that is not directly income-related.

5.2 Panel

I begin exploiting the panel information by showing changes in income growth rates by the initial (2002) gross income. Figure 16 shows the growth rate of incomes by the initial (2002) level of gross income. The two vertical lines correspond to the thresholds for the tax brackets. The most striking initial impression is the decline between 2002-03: this is a well-known mean reversion of incomes, a phenomenon that is unrelated to the tax reform. It is also one of the main complications in the work on taxable income elasticity. It is clear from this graph that this effect is non-linear and hence unlikely to be controlled for using just a linear term, thereby illustrating why controlling for nonlinearity via splines advocated by Gruber and Saez (2002) makes a significant difference in practice when estimating taxable income elasticities. On the other hand, growth rates for 2003-2004 and 2004-05 no longer show a significant income gradient suggesting that mean-reversion need no longer be an issue once we condition on data at least a year apart (as has been explored by

¹⁷Take up of the flat tax within the top decile is 93% so that there is little variation in the treatment within that group; take up in the ninth decile is 68%. The estimate obtained by comparing 98% to 99% percentile is 0.803 with a large standard error reflecting the fact take up of flat tax in the 98% percentile of business owners in 2005 is almost universal — 99.26% (in the 99% percentile it is 99.76%).

¹⁸This estimate can be also directly derived by dividing the differences in income growth rates underlying Figure 12 by the difference in propensity to take up the flat tax in 2005 on Figure 4.

¹⁹The regression implementation is estimated on the sample consisting of the top two deciles in 2002 and 2005, using specification $\ln(y_{it}) = \gamma \cdot \ln(1 - t_{it}) + \beta_1 \cdot I(r_{it} > 0.9) + \beta_2 \cdot I(t = 2005) + \varepsilon_{it}$ i.e., a regression of income on the actual tax net-of-tax rate, a dummy for being in the top decile (rank satisfying $r_{it} > 0.9$) and the 2005 year dummy (the diff-in-diff estimate of the effect of the reform is obtained analogously with the dummy for taking up the flat tax used in place of the tax rate). The interaction of the 2005 dummy with the dummy for the rank being in the top decile is used as an instrument to obtain the diff-in-diff estimate (and address endogeneity of the tax rate).

Kopczuk (2005)). As expected given previous analysis, there is a visible increase in the gross income growth rate in 2003-04 for people with sufficiently high incomes. It should be noted that the top percentile of taxpayers corresponds roughly to the third bracket so that sharp (but noisy) income increases between 2003-2004 visible on the right-hand side of the graph corresponds to the activity within the top 1%. The difference-in-difference strategy discussed in the previous section focuses on comparison of that group with individuals who are in the neighborhood of the threshold for the third bracket.

Figure 17 contains analogous results for (consistent) business owners. The main patterns are similar: a mean-reversion decline for 2002-03 and apparent increase at the top between 2003-04. It is worth noting however that the income gradient of the 2002-03 change has a very different shape than for the whole population. It suggests that imposing the same mean reversion controls for business and non-business owners may not control for these effects appropriately.

In order to estimate the effect of the reform, I exploit cross-sectional (non-income driven) variation in its impact. I will estimate specifications of the form:

$$\Delta \ln(y_{it}) = \alpha \Delta L_{it} + \beta X_{it} + \Delta \varepsilon_{it}$$

where y_{it} is the variable of interest, for example gross income or business income, L_{it} is a dummy variable for being subject to the flat tax regime and X_{it} is the set of controls. The equation is already expressed in a first-differenced form. This is analogous to specifications estimated elsewhere in the taxable income literature with the dummy for being subject to the new tax regime replacing the marginal tax rate. The key variable is L_{it} and it is of course endogenous. I will pursue a simple IV strategy based on constructing an indicator for a group that is likely to take advantage of the reform and that is arguably pre-determined. The error term in this first-differenced specification, ε_{it} , is in general complicated and reflects a variety of factors not modeled here. In particular, it contains individual-specific but unobservable characteristics that are likely to influence the desire to take advantage of the reform (such as for example, risk aversion). Including individual fixed effects or first-differencing eliminates this source of bias if it is constant over time. The error term is also likely to reflect individual earnings dynamics and possibly autocorrelated. This earnings-dynamics component of the error term may be correlated with the likelihood of taking advantage of the reform: for example, individuals who have temporarily high income may take advantage of the reform, thereby introducing correlation between the variable of interest and potential instruments that are constructed based on income information.

I seek instruments that would influence the likelihood of taking advantage of the flat tax regime while not being related to the error term $\Delta \varepsilon_{it}$. I will rely on pre-determined variables as of 2002.

In what follows I consider a few different instruments that give rise to different results. The reason is didactic. It turns out that some a priori reasonable instruments — such as whether one owned a business as of 2002 — violate an exclusion restriction in a way not previously recognized in the taxable income literature: they correspond to very different mean-reversion pattern. It is an often-repeated claim that taxable elasticity estimates are “sensitive” to specification and my

purpose for presenting “failed” specification is to show that this is the wrong message to draw from this literature. Sensitivity is usually due to mis-specification or lack of credible variation and amounts to mixing up bad and good strategies as if they were all equally believable. Here, I provide an example of “sensitivity,” trace its cause and then follow up with strategies that produce consistent and robust results.

5.2.1 Aside: instrumental variables that interact with earning dynamics patterns

In the first strategy, I will use as an instrument an indicator for owning a business in 2002. It is natural to expect that ownership of a business prior to the reform would influence the likelihood of taking advantage of the flat tax: owning a business after the reform is one of the necessary conditions for claiming the flat tax. Being a business owner is an endogenous decision and factors that influence that decision are likely to enter the error in the income equation, ε_{it} . Many of such factors may be reasonably expected to be constant characteristics of an individual and hence eliminated by first-differencing. However, owning a business is a decision that may change over time and may influence earnings dynamics, hence introducing correlation between owning a business and income changes in the future. Following the taxable income literature (Moffitt and Wilhelm, 2000; Gruber and Saez, 2002; Kopczuk, 2005) that stressed the importance of controlling for mean reversion and other sources of transitory income dynamics (and also motivated by the earnings dynamics visible on Figures 16 and 17, I will include flexible function of the log of 2002 gross income (piecewise linear splines) to proxy for such transitory effects. While the literature sometimes makes a distinction between controlling for the transitory dynamics and overall trends in earnings inequality, the approaches that have been proposed require multiple lags of income to control for it and, given the short span of the panel, are not feasible here (although a limited attempt will be discussed later).

Conceptually, this approach corresponds to a very simple difference-in-difference strategy where individuals who owned a business in 2002 are considered the treatment group and those who did not are considered the control group. Consider a three-year difference with the change in income between 2005 and 2002 used as the left-hand side variable. In a reduced-form regression, this change would be regressed on owning a business in 2002, corresponding to a difference-in-difference estimate of the “intent to treat” effect. Switching to a flat tax is the actual realized treatment and the IV strategy attempts to estimate the effect of this treatment. Using the presence of a business in pre-period as an instrument amounts to using individuals with only other types of income as the control group.

Appendix Table A.1 relies on this instrument and provides estimates of the effect on gross income, using both the full sample and the sample limited to married individuals only. The effects on gross income are very precise and indicate a 20% increase in the level of income occurring in between 2002-05. However, separating the effect by year generates unexpected results: gross income appears to have started growing already in 2002-03. Appendix Figure A.1 illustrates the mechanics of this approach. It shows the gross income change between 2002 and 2005 and probability of filing

for the flat tax in 2005 as a function of gross income. The strategy works by comparing the parts of the distribution where there is sizable difference in flat tax filing to those where the difference is small. The maintained assumption is that there should be no difference if not for the flat tax — in that case, the flexible function of gross income can control for non-tax related variation in growth rates across distribution. Inspection of the figure casts doubt on this assumption. Earnings dynamics in the group of business owners appears very different than among the remaining group. While in principle this could reflect the effect of the reform given that the dependent variable is the change in income between 2002 and 2005, figures 16 and 17 show that the difference in the shape of the conditional change in income is driven primarily by the first year (2002-2003). This is likely reflecting the fact that business incomes are bound to be much more volatile than employment earnings. Controlling for these differences is not straightforward, because the group indicator needs to be excluded in order to be used as an instrument.

The other instrumental variables I will pursue rely on characteristics of the spouse. First, I use the dummy for the spouse being located in one of the higher tax brackets. The idea here is that the benefit of income splitting depends on the income of the spouse (and will be elaborated on in what follows). As shown in Table A.2, this strategy leads to unrealistic estimates (the estimate of about 2.2 corresponding to income increasing by the factor of 9) that are large and significant in all years. The reason for it is again easy to explain graphically: as shown on Figure A.2, there is a big difference in the rate of income growth between the groups throughout the distribution that is therefore correlated with the instrument but unlikely to be related to the treatment. The final strategy relies on the spouse owning a business. If that is the case, one might expect that the likelihood of switching to the flat tax may be higher both due to lost averaging possibilities if the spouse switches and because of higher likelihood of exposure to this form of taxation. It turns out that the spouse owning a business is indeed strongly correlated with taxpayer's own business ownership, but similar problems as before persist with sizable and wrongly sized effects on tax liability before the reform and apparent growth in incomes throughout the period, not just when the reform took place (as with other specifications considered so far, the problem here too can be graphically traced to the differential earnings dynamics).

These results could be interpreted as showing that the elasticity of taxable income is sensitive to the specification and hence difficult to estimate — arguably reasonable instruments produce unrealistic and widely varying results. Indeed, this is the tone of many authors including, prominently, the survey by Saez et al. (2012). However, figures A.1 and A.2 show that differential mean reversion effects between control and treatment groups are the likely culprit here. The approach imposes an identical earnings process for the treatment group (which by construction should have more business owners) and control group (tilted toward other types of incomes) and it is not realistic to expect that this should be always the case. The assumption that earnings dynamics is uncorrelated with instruments is implicit in the taxable income literature but never tested and, as shown here, it is violated when business and other types of income are compared (and likely in many other cases). One could attempt to explicitly allow for heterogeneity in earnings dynamics but it makes

identification difficult, because this source of heterogeneity is related to the instrument.

5.2.2 IV using sample with homogeneous earnings dynamics

An alternative way around this problem is to pursue analysis of a more homogeneous group where the assumptions about homogeneity of the earnings process are more likely to hold. In what follows, I will pursue an analogous approach using the subsample of individuals who reported business income in all four years.

Table 4 contains the results that are based on using an indicator for having a spouse in the high tax bracket as an instrument. Before analyzing these results, it is worthwhile to investigate the effect graphically as before. Figure 18 shows the effect of the instrument on the probability of filing under the flat tax system and its relationship to the tax saving. First, it is clear that the instrument affects the probability of filing under the flat tax regime in 2005 for a significant part of the distribution. Second, this effect reflects potential tax savings: conditional on the income of a taxpayer, those with the spouse in a high tax bracket benefit from higher tax savings when they'd otherwise fall in the second bracket or beyond and it corresponds to increased likelihood of relying on a flat tax. This effect reverts for very high incomes but at that point tax savings are large enough so that almost everyone relies on the flat tax anyway.

The effect on reported income is illustrated in Figures 19-23 that show growth rate changes between 2002-05, 2002-03, 2003-05, 2003-04 and 2004-05 respectively. It is comforting to see that the income gradient is in fact very similar for the two groups and that the difference between income growth in 2002-05 occurs primarily where there is also an effect on flat tax filing. Generally speaking, the conclusion that the instrument is associated with higher growth rates in the part of the distribution where it affects flat tax claiming holds for sub-periods as well: there is no impact pre-reform (2002-03), evidence of an impact afterwards (2003-05), and the effect is concentrated in 2003-04 rather than 2004-05. Hence, it appears that the necessary conditions for this instrument to be valid are likely to hold. These figures illustrate the IV strategy. They show that the instrument operates in the middle of the distribution where the take up of flat tax for the treatment and control groups is diverging. They also show that similar divergence in taxable income occurs in roughly the same region and that it takes place between 2003 and 2004, exactly when the reform took place. There is no indication that there are sizable effects either pre- or after the reform, which serves as both evidence against the presence of important re-timing effects and (absent those) as a placebo test corroborating that the results are not spuriously present in years not affected by the reform.

It is also interesting to observe that the sizable growth in income well into the top bracket *is not* the source of identification as it occurs past the range of incomes where treatment and control groups have different propensities to rely on the flat tax. Therefore, identification here stems mostly from groups further down the income distribution. Thus, putting methodological differences aside, this approach complements repeated cross-sectional analysis in Section 5.1, by providing an estimate based on the lower income groups. Furthermore, because identifying variation here corresponds to the second tax bracket, changes in tax rates that are behind it are smaller than those experienced

by the very top of the distribution that was relied on in the cross-sectional analysis, and hence estimates of the overall impact of the reform (but not tax elasticities) are likely to be smaller.

Turning to the estimates in Table 4, one can see that they present the picture that is broadly consistent with the repeated cross-sectional evidence discussed before. The estimate of the overall effect of the reform is 0.397: being subject to the flat tax leads to an increase in income by 48% ($e^{0.391}$).²⁰ As suggested by graphical analysis, this effect is concentrated in 2003-04.

These estimates correspond to the effect on the overall income of taxpayers, aggregating all sources. The response of business incomes themselves is of course stronger, both because overall income includes some inelastic components and possibly because of shifts across different tax bases. Log business income is estimated to increase by 0.716 log points (growth rate of 104%), again mostly concentrated in 2003-04 but extending slightly to 2004-05. The estimated effect appears to stem mostly from revenue rather than costs, although costs start increasing in 2004-05. This pattern of responses is consistent with the initial response being driven by reporting rather than real activity: an immediate increase in revenue without an increase in associated costs is hard to explain as the real response. The response in 2004-05 allows for the possibility of the real effect with both revenue and costs increasing at the same time.

The final panel contains sensitivity analysis. Using a linear log-income effect rather than splines leads to higher but not much higher estimates. This is consistent with the income gradient on Figure 19 being approximately linear. Controlling for spousal income kills identification and eliminates significance in the first stage — this is not surprising, because when spousal income is controlled for, the definition of high-bracket spouse varies independently of regressors only due to functional form restrictions. The alternative IV strategy presented below is not subject to this problem. Finally, I try a simple approach to control for both transitory effects and potential distributional changes by focusing on the 2003-05 change and simultaneously including splines in 2002 incomes (to control for inequality changes) and splines in the income change between 2002-03 (to control for transitory effects), as previously suggested by Kopczuk (2005). Adding these extra controls makes little difference to the estimates.

Table 5 shows estimates based on using the indicator for the spouse owning a business as an instrument. The results for gross income, business income, cost and revenue are broadly consistent with those reported before. The baseline effect is actually slightly stronger than before (0.425 rather than 0.391). The effect on business revenue and costs are more in line with each other leaving open the possibility of the response on the real margin (although it hard to believe that an increase in business income by over 40 percent between 2003 and 2004 could reflect a real response).

²⁰As mentioned in Section 2, the original data is blurred by the multiplicative factor uniformly distributed on the interval $[0.9, 1.1]$. Given that I use gross income to define the binary instrument, accurate adjusting for the impact of this artificial noise is a bit more complicated than simply treating it as the classical errors-in-variable problem. To shed some light on the potential quantitative importance of this issue, I implemented a simple Monte Carlo experiment: I executed 1000 times a procedure that introduced *additional* noise of the same kind to my data, reconstructed the relevant variables and re-estimated the baseline specification in the first panel of Table 4. The baseline estimate in Table 4 is 0.391. The mean estimate based on the Monte Carlo procedure was 0.395, the median 0.399: as expected, the introduction of the noise had a very small effect (the standard deviation was just 0.011 and the range for all 1000 estimates was $[0.3792, 0.4361]$).

Table 6 contains an attempt to decompose the effect of the flat tax reform into the effects of the parameters of the tax system. The reform changed the marginal tax rate, tax liability and the definition of the tax base. I construct changes in the marginal tax rate and the change in virtual income.²¹ This strategy attempts to decompose the effect of the reform into the effect of those two parameters, ignoring the effect of the tax base change (see Kopczuk, 2005, for an attempt to estimate the effect of changes in the tax base). I show the results relying on a few different instruments. In the first panel, I use the tax bracket of the spouse as the instrument for the tax price. The estimated tax price elasticity is 0.952: this is at the high end of the elasticities estimated in the literature but consistent (possibly even smaller) than estimates obtained above. The log net-of-tax-change for the highest income tax payers was $.30 = \ln(1 - .4) - \ln(1 - .19)$ (the drop from .4 to .19 marginal tax rate) and the estimate of the effect of the reform of 0.391 in Table 4 are consistent with the elasticity above one. In the second panel, I control for the income effect using predicted virtual income change as an instrument. The estimate of the income effect is negative, relatively small and actually increases the estimated price effect. In the final panel, I switch to using the predicted tax price change as an instrument for the tax price and obtain a bit smaller, but still overwhelmingly significant, tax price elasticity.

Recall that the repeated cross-section estimate of the overall effect of the reform based on the top decile of the business owners distribution reported in Section 5.1 was as high as 0.73, and the corresponding estimates of the net-of-tax elasticity of gross income obtained by focusing on the same sample of consistent business owners was 1.290. The estimate of the impact of the reform using cross-sectional strategy was higher than approximately 0.4 using panel data, but recall that cross-sectional strategy relies on the very top for identifying variation and hence tax changes behind the 0.73 estimate are larger than those behind the 0.4 estimate.²² The estimates of tax elasticity are all reasonably similar and in the neighborhood of 1.

Hence, the two strategies provide estimates that are somewhat but not dramatically different which is remarkable given that they rely on very different sources of variation. The repeated cross-sectional strategy relies on variation due to differences in incomes — it pitches the top 10% of business owners against the following 10%. The panel approach relies on the differences in tax rates correlated with instruments. In the preferred specification, the instrument is the presence of the spouse in high income tax bracket and, as illustrated in Figure 19 the instrument is correlated with the take up of the flat tax in the range of log gross income between about 10.0 and 12.0 in 2002, it corresponds to the range of approximately between the 35th and 95th percentile of the

²¹I follow the approach in Gruber and Saez (2002) and most of the literature by evaluating both the marginal tax rate and tax liability using the same 2002 information for both pre-reform and post-reform law (including prediction for whether an individual elects the flat tax). This procedure yields predicted change in the log of net-of-tax rate and the predicted change in log virtual income that are then used as instruments for the actual changes. These constructed variables depend on 2002 information only (and the tax law). Progressive tax liability depends on individual own income as well as spousal income and these factors (interacted in a non-linear way with the effect of the law) drive variation in the instrument. The regressions control for splines in 2002 income so that effectively spousal information and its interactions with taxpayer's income transformed by the reform are the main source of identification.

²²In fact, the $\frac{\log(1-.4)-\log(1-.19)}{\log(1-.3)-\log(1-.19)} \approx 2$ so that estimates of 0.73 and 0.4 that rely primarily of the changes from the top tax rate of 0.4 and 0.3 respectively are in line.

business owners distribution. Hence, identification does not rely on the income increases at the very top of the distribution but rather on within-income group variation at lower levels of income. Similarity of the results using these two different strategies relying on a different type of variation provides further comfort that they are not spurious.

6 Revenue implications and conclusions

The Polish 2004 reform introduced a low-rate broad-base option for reporting income by business owners. I found that there was a dramatic increase in the amount of reported business income that occurred as a result. The estimates are large. The baseline estimate of the effect of the reform using variation generated by spousal incentives is the 0.391 log point increase in gross income or an increase by 48%. The identification of this effect relies on the differential take up of the flat tax by taxpayers originally around the middle bracket of the tax code that applies starting at about 95th percentile of the income distribution and extending to the border of the top percentile²³ — high-but not an extremely-high income group, who predominantly experienced a change in the tax rate from 0.3 to 0.19. The estimate of the effect using an alternative strategy in Section 5.1 that is based on the very top of the distribution — taxpayers who experience the drop in tax rate from 0.4 to 0.19 — is even higher. The baseline estimate using variation generated by differential incentives between the very high (top decile business owners) and slightly lower (second decile of business owners) incomes is 0.73 or an increase by 108%. When converted to tax elasticities, these estimates correspond to the elasticity of about one (although tax elasticity estimates may understate the effect of the reform by not accounting for its non-tax-rate aspects).

This increase reflects the behavior of existing business owners who report more income on their tax returns. It remains an open question whether it reflects business activity or increased compliance.²⁴ The effects are large enough to make it unlikely that they stem from real activity alone. In fact, the response of business revenue appears to be generally smaller than that of overall income, suggesting that business owners report higher margins than before. In some specifications, it also seems that the early response is driven by revenue increases without associated cost increases which seems consistent with some response occurring on the real margin.

To shed further light on the implications of these results and draw broader conclusions from the analysis, it is useful to push further on the revenue implications of the reform. The effect of the reform on tax liability involves nonlinear response: decreases in revenue at the top of the distribution and increases further down, consistent with the combined effect of the tax cuts and

²³Figure 19 illustrates the difference in take up of the flat tax conditional on the instrument (spouse in the high tax bracket) vanishes at very high levels of income.

²⁴Feldstein (1995) argument implies that welfare evaluation does not hinge on this distinction although as Slemrod (1998) and Chetty (2009), among others, point out this statement requires a number of assumptions including the lack of income shifting and revenue losses from other sources and no direct effect on other individuals. Understanding the source of response is of interest when the assumptions do not hold. Also, as Slemrod and Kopczuk (2002) stress, different sources of response are likely to have implications for what the optimal setting of policy instruments other than tax rates should be. Furthermore, distinguishing between real and avoidance responses is of intrinsic interest for many non-tax related questions.

elimination of infra-marginal preferences. As discussed before (and evident on Figures 14 and 15), tax liability effects are ambiguous in theory. Tax liability should increase for the taxpayer who absent behavioral response would pay the same taxes under the two system (given the lower marginal tax rate under the flat tax regime, it's optimal to switch and report higher income). On the other hand, for the very high income taxpayers behavioral response would have to be massive to compensate for the change in the marginal rate from 40% to 19% (for very high income taxpayers, average and marginal tax rates are likely to be similar as the importance of deductions falls with income).

Table 7 contains the results of several exercises intended to evaluate the effect of the reform on tax revenue. First, it shows information about the distribution of taxpayers who switched to the flat tax in 2005.²⁵ Obviously, this is a high income population, with incomes placing them in the second bracket or above. The second row shows tax the corresponding tax liability (under the flat tax and accounting for spousal income). The average tax liability is 56,477zł for married couples and 47,083zł for everyone. The following scenario shows tax liability if there was no behavioral response, i.e., applying the progressive tax schedule to incomes reported on the flat tax schedule in 2005: obviously, the flat tax collects much less revenue, as much as 37% less. This is of course an unrealistic scenario and the following rows rely on prior estimates to account for behavioral response. The following three rows contain the results of a simple counterfactual exercise to obtain an estimate of tax revenue from the same individuals if the flat tax was not in place. To do so, I simply assume that log taxable income²⁶ of everyone who switched to the flat tax would instead be reduced by the baseline estimates obtained using my panel strategy in Tables 4 and 5 (0.391 and 0.425) or by the estimate of the impact of the tax reform obtained in Section 5.1 (0.735). It is assumed that this would be in fact taxable income of the taxpayer. Focusing first on everyone and the first two estimates, the tax liability increases to 50,030zł and 51,632zł, respectively, or a flat tax losing between 6 and 9% of revenue from the affected individuals. These losses are smaller for married individuals (because joint filing reduces tax revenue when no flat tax is used), with the estimate loss of revenue of 5 and 2% respectively. The estimate of 0.735 is sufficiently stronger to change the qualitative answer: under that estimate, the reform has actually increased the overall revenue by as much as 25%.

The estimates of the tax liability under these counterfactual scenarios are potentially overstated (and, hence, gains from the flat tax understated) because they assume that taxable income would be equal to reported income. However, taxpayers under the regular income tax can take advantage of a number of preferences and deductions. To account for these effects, I compute the mean ratio of taxable to gross income for the same taxpayers in 2002 (0.964), adjust *gross* income for behavioral response as before and multiply by 0.964 to obtain taxable income. The average tax

²⁵In all calculations, I use a "household" as a unit: I account for tax liability of the spouse for taxpayers who are married. This facilitates the comparison with counterfactuals that allow for joint filing with the spouse. I use the sample of taxpayers who report business income in all years for these calculations.

²⁶Note that I am using taxable income rather than gross income: under the flat tax the two are very close (overall taxable income is 98.3% of gross income) but not identical. Under this first counterfactual exercise, I assume no further deductions.

liability under the two estimates of behavioral response is 49,932zł and 48,392zł, corresponding to losses in revenue from implementing the flat tax of 6% and 3% respectively, while the effect under the higher elasticity obtained in section 5.1 is also stronger corresponding to an increase by 28.5%. These gains from tax base cleaning are of the order of a few percent despite the tax base being quite comprehensive for this population to begin with.

This discussion focused on the average effect. However, as mentioned before, the effects are in fact highly nonlinear. The right-hand columns of Table 7 show the distributional impact: tax liability indeed increases very significantly at the lower end and it declines for the high income taxpayers. The overall effect is a combination of the effect of these different groups. Varying the relative number of very high-income to moderately high income taxpayers would put different weight on tax increases and decreases and hence produce different results (even dramatically different, ranging from strongly negative to massively positive). The estimates presented in Table 7 are for Poland in 2004 and even if one fixed behavioral response, they would need to be adjusted to apply to any other year or country in order to reflect differences in the shape of income distribution. Nevertheless, they illustrate the potential for a reform of this kind to result in small revenue effects despite large tax changes.

There are many limitations of this exercise. It assumes that the response and reliance on deductions is the same for everyone. If, for example, higher income taxpayers respond more strongly (with average response held constant), gains from the flat tax reform would be amplified since they correspond to higher overall increases in reported income taxed at a flat rate (while holding benefits from removing preferences about constant).

Turning to the welfare implications of these estimates, it is key to note that the reform is elective. Hence, by revealed preference argument, all taxpayers who chose to elect are made better off ex ante, holding other parameters of government policy constant. If revenue in fact stays constant or increases, this reform would correspond to a *Pareto improvement* (making a weak assumption that increased revenue does not stimulate changes in policy that hurt some taxpayers and ignoring the possibility that some taxpayers can be adversely affected by any general equilibrium consequences). As discussed above, although the preferred panel-data specifications fall short of revenue breaking even, no revenue impact is within the range of estimate. These estimates also do not account for the potential spillovers: part of the effect may reflect a loss of revenue from other tax bases (eg. corporate tax) but it may also correspond to increases in tax revenue from other bases (increased business costs may reflect higher employment and corresponding income tax revenue, shifts from informality may correspond to increased compliance with the value added tax).

One may also be interested in the question of what an optimal reform of that kind should look like. Rather than setting the flat tax rate at 19%, tax authorities could have decided to select some other tax rate t . In order to do analyze the consequences of varying tax rates, one needs to focus directly on the tax elasticity estimates. The final two rows of Table 7 contain revenue implications of assuming that the tax elasticity was either 0.964 (the baseline estimate based on panel specifications) or 1.290 (the baseline estimate based on repeated cross-section).

These exercises correspond to a larger revenue losses compared to simply using the direct impact of the tax reform. This is suggestive of the reform acting along the dimensions that are not captured by tax elasticity estimates: the reform also involved base adjustment and perhaps overall simplification — the effect of these additional aspects of the policy change should be reflected in the reform treatment effect but will be captured only partially by tax elasticity, to the extent that these effects happen to be correlated with tax changes. Nevertheless, given these estimates, one may ask about what the revenue maximizing tax rate should be. I proceed by constructing a counterfactual tax base for each of the flat tax taxpayers by (1) obtaining the marginal tax rate t^p under the progressive tax schedule assuming no behavioral response and (2) adjusting gross income to obtain the counter-factual if the flat tax was not present by $b \cdot e^{\gamma[\ln(1-t^p)-\ln(1-.19)]}$ where γ is the elasticity and (3) and setting $b = 0.964$ as before to adjust for base change. The result is a hypothetical taxable income under the progressive income tax schedule y^p . From that baseline, I consider the effect of changing the tax rate to t . This corresponds to (1) eliminating base adjustment (2) accounting for the behavioral response i.e., change in log net-of-tax rate of $\ln(1-t) - \ln(1-t^p)$ and (3) allowing for the (very small and inconsequential for the results) flat tax adjustments as observed in 2005 under the flat tax regime. The result is hypothetical taxable income $y(t)$. The final step is to recognize self-selection — I simply rule out “mistakes” i.e. the situations where reported income of $y(t)$ would result in lower tax liability under the progressive tax regime than under the flat tax with the rate t — such taxpayers are assumed to choose the progressive tax. Hence, if $t = 0.4$ (the highest bracket under the progressive system), everybody would be assumed to select the progressive system. As t falls from 0.4, the likelihood that taxpayers choose the flat tax increases and revenue at $t = 0.19$ approximates the empirical one.²⁷ Hence, the objective is to maximize $\int ty_i(t) \cdot S(t, i) + T(y_i^p) \cdot (1 - S(t, i)) dF(i)$ where $t \cdot y_i(t)$ is the hypothetical tax liability of the taxpayer under flat tax of t , $T(y_i^p)$ is the the liability of the taxpayer under the progressive tax, $S(t, i)$ is an indicator function for selecting the flat tax by person i when the rate is t and $F(i)$ is the c.d.f. of the actual flat tax payers in 2005. When $t = 0.4$, $S(t, i) = 0$ for everyone. If ex post mistakes were never made, $S(t, i) = 1$ when $t = 0.19$ (see footnote 27 for the discussion of mistakes that turn out to have small revenue consequences). If no progressive tax was present, the exercise would be simply to maximize $ty(t)$ and, given the assumed constant behavioral

²⁷For tax rates higher than 0.19, I assume that only taxpayers who claim the flat tax when the rate is 0.19 are candidates for claiming at $t > 0.19$. I do not model the effect of tax rates lower than 0.19 that would require accounting for self-selection into the tax by those who are not flat taxpayers in 2005 because the peak of the Laffer curve turns out to be above 0.19. At the tax rate of 0.19, the procedure predicts that about 23% of taxpayers who selected the flat tax would be in fact better off claiming under the progressive tax schedule. I assume that they indeed would do so but the implications are small — the extra revenue from such “mistakes” is 0.8% of the total. There are many reasons why mistakes may happen. First, the assumed deductions under the progressive tax are a constant fraction of income which may lead to overstating benefits of that schedule for some taxpayers. This adjustment is small so the implications are small (assuming no deductions under the progressive tax schedule, reduces the number of mistakes to 20%). Second, taxpayers make decisions under uncertainty (selecting into flat tax takes place at the beginning of the year) so that ex post they may indeed face higher liability under the flat tax regime. Third, the assumption of a uniform elasticity may not be correct. Fourth, some taxpayers may indeed make mistakes or their circumstances might change, as Table 2 shows about 7% of flat taxpayers in 2004 chose not to be on the flat tax in 2005.

elasticity of ε , the revenue-maximizing rate would be $\frac{1}{1+\varepsilon}$. Under the two baseline estimates of the behavioral elasticity of 0.952 and 1.290, the revenue-maximizing tax rates would then be 0.51 and 0.44 respectively. In the presence of the progressive tax that acts as the backstop, an increase in the flat tax rate has an additional adverse effect of some taxpayers switching from the flat tax to the progressive schedule indicating that the revenue-maximizing rate should be lower and perhaps lower than 0.4. That turns out indeed to be the case — the lack of the flat tax option is equivalent to having such a tax in place but with a prohibitively high tax rate of 0.4 and it turns out that such a rate is on the wrong side of the Laffer curve. Under the smaller elasticity of 0.952, the revenue maximizing rate is 35% while it is 31% if the elasticity is as large as 1.290. As a different measure of the revenue impact, under the same two assumptions the government raises the same revenue with the flat tax as without it if the flat tax rates were equal to 31% and 24% respectively. These results indicate that it is realistic to expect that a flat tax option may raise revenue, although they suggest that in the Polish case the 19% rate may be somewhat low from the revenue maximization standpoint (though, as mentioned before and evident in Table 7, focusing on tax elasticity estimates underestimates the revenue collected by the flat tax because it does not account for non-tax rate effect of the reform).

The conclusion that the reform might have corresponded to a near Pareto improvement in the Polish case does not imply that the results would be the same in other countries. Naturally, the magnitude of the response, details of the tax system and the magnitude of the tax change are likely to be reform- and country-dependent. Slightly more subtly, the key input in the revenue estimates is the distribution of taxpayers: the reform corresponds to revenue gains from taxpayers with lower incomes and revenue losses from taxpayers with high incomes. Depending on the shape of the income distribution, the effect on revenue can go either way, holding other parameters constant. Finally, this is an analysis of an elective flat tax. Across the board tax of this kind could have different consequences because it would target general population that has, arguably, lower behavioral response. A non-elective flat tax would also make the possibility of Pareto improvements unlikely. Nevertheless, the results imply that this type of a reform has a potential for being welfare-improving in real-life contexts.

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Table 1: Summary statistics by taxable income categories

(1) Variable	2002 (2)	2003 (3)	2004 (4)	2005 (5)
<i>Taxable income not greater than 37024zl</i>				
Number of observations	1591678	1575739	1560880	1550297
Wages	7403	7329	7415	7674
Business income	607	611	528	524
Deductions	87	90	88	122
Gross income	13199	13318	13615	14011
Taxable income	11645	11778	12075	12395
Tax liability	1734	1748	1798	1863
Share with business income	0.04	0.04	0.04	0.04
Share on flat tax	0.00	0.00	0.00	0.00
<i>Taxable income \in (37024, 74048]zl</i>				
Number of observations	54910	57315	61493	68960
Wages	37994	38018	39876	41093
Business income	10420	10093	7846	7284
Deductions	228	218	74	207
Gross income	55526	55312	55159	55587
Taxable income	48521	48395	48183	48263
Tax liability	9876	9820	9653	9668
Share with business income	0.23	0.22	0.20	0.19
Share on flat tax	0.00	0.00	0.05	0.06
<i>Taxable income greater than 74048zl</i>				
Number of observations	13386	13909	16982	19771
Wages	64161	64595	58330	58338
Business income	77808	79024	129131	130031
Deductions	1878	1779	171	335
Gross income	161110	159540	207760	211031
Taxable income	150250	148552	199028	201856
Tax liability	47618	46977	45065	45550
Share with business income	0.40	0.41	0.54	0.54
Share on flat tax	0.00	0.00	0.44	0.46

Table 2: Flat tax taxpayers

(1)	Variable	2002 (2)	2003 (3)	2004 (4)	2005 (5)
<i>Always observed individuals on flat tax in 2004 and 2005</i>					
	Number of observations	11869	11869	11869	11869
	Wages	8032	6998	6187	6517
	Business income	104827	116347	180971	190412
	Deductions	1607	1643	27	61
	Gross income	119786	128743	192163	209865
	Taxable income	111215	120453	186582	204188
	Tax liability	33116	35924	35755	39793
	Share with business income	0.91	0.95	1.00	1.00
<i>Always observed individuals on flat tax only in 2005</i>					
	Number of observations	4475	4475	4475	4475
	Wages	12301	11856	10310	8261
	Business income	27316	31769	48836	85387
	Deductions	372	361	106	61
	Gross income	44441	48529	64609	98628
	Taxable income	39345	43108	58957	93128
	Tax liability	8565	9359	13606	18060
	Share with business income	0.70	0.76	0.83	0.99
<i>Always observed individuals on flat tax only in 2004</i>					
	Number of observations	781	781	781	781
	Wages	11221	9648	10427	14299
	Business income	44782	47822	49679	16761
	Deductions	611	427	6	129
	Gross income	61300	62670	65681	38375
	Taxable income	55821	57116	61271	33857
	Tax liability	14301	14083	12041	7325
	Share with business income	0.80	0.88	0.99	0.56

Table 3: Individuals reporting business income for all years

Variable (1)	2002 (2)	2003 (3)	2004 (4)	2005 (5)
Number of observations	41492	41492	41492	41492
Wages	6435	6163	6380	6837
Business income	44851	48150	62938	68315
Deductions	529	551	59	122
Gross income	54516	57759	73384	79660
Taxable income	49104	52549	69000	75162
Tax liability	12016	13037	13126	14281
Share on flat tax	0.00	0.00	0.22	0.27
<i>Individuals with spouses defined based on 2002-2003 and present in all years</i>				
Number of observations	22935	22935	22935	22935
Wages	7502	7190	7460	7941
Spousal wages	12300	12597	13092	13725
Business income	43350	45782	57580	62255
Spousal business income	13643	13922	17802	19237
Deductions	524	551	73	147
Spousal deductions	250	270	69	129
Gross income	54227	56607	69080	74818
Spousal gross income	29439	30400	35128	37656
Taxable income	48726	51391	64697	70289
Spousal taxable income	25850	26873	31964	34350
Tax liability	11374	12176	12285	13355
Spousal tax liability	6026	6319	6139	6607
Share on flat tax	0.00	0.00	0.19	0.24
Share of spouses on flat tax	0.00	0.00	0.09	0.10
Spouse with business income	0.30	0.30	0.30	0.29

Table 4: The effect of flat tax reform on gross income, sample of consistent business owners only. Using spouse in high tax bracket as an instrument

Variable	Coefficient (1)	t-value (2)	Coefficient (3)	t-value (4)	N (5)
	OLS		IV		
Gross income					
First stage			0.134***	21.563	24024
2002-2005	0.695***	49.964	0.391***	3.830	24024
2002-2003	0.389***	35.489	-0.052	-0.628	24024
2003-2004	0.292***	23.930	0.361***	4.068	24024
2004-2005	0.014	1.171	0.082	0.917	24024
Business income					
First stage			0.134***	21.869	24660
2002-2005	0.751***	38.964	0.716***	5.108	24660
2002-2003	0.400***	27.520	0.023	0.212	24660
2003-2004	0.313***	20.911	0.493***	4.530	24660
2004-2005	0.039**	2.533	0.199*	1.772	24660
Business revenue					
First stage			0.134***	21.869	24660
2002-2005	0.391***	28.354	0.360***	3.594	24660
2002-2003	0.167***	19.530	0.000	0.007	24660
2003-2004	0.165***	21.844	0.187***	3.418	24660
2004-2005	0.059***	6.776	0.172***	2.731	24660
Business costs					
First stage			0.134***	21.744	24366
2002-2005	0.271***	17.404	0.289**	2.558	24366
2002-2003	0.108***	10.799	-0.023	-0.323	24366
2003-2004	0.114***	13.354	0.095	1.531	24366
2004-2005	0.049***	5.078	0.217***	3.107	24366
Sensitivity (gross income)					
	First stage		IV		
Log income	0.156***	23.652	0.574***	6.514	24024
Splines	0.134***	21.563	0.391***	3.830	24024
Spousal income controls	0.024	0.876	1.929	0.661	19060
2003-05	0.134***	21.563	0.443***	4.199	24024
2003-05, transitory	0.135***	22.297	0.414***	4.380	24024

Table 5: The effect of flat tax reform on gross income, sample of consistent business owners only. Using spouse owning a business as an instrument

Variable	Coefficient (1)	t-value (2)	Coefficient (3)	t-value (4)	N (5)
	OLS		IV		
Gross income					
First stage			0.115***	21.727	24024
2002-2005	0.695***	49.964	0.425***	4.209	24024
2002-2003	0.389***	35.489	-0.090	-1.093	24024
2003-2004	0.292***	23.930	0.366***	4.170	24024
2004-2005	0.014	1.171	0.148*	1.670	24024
Business income					
First stage			0.115***	22.036	24660
2002-2005	0.751***	38.964	0.485***	3.485	24660
2002-2003	0.400***	27.520	-0.114	-1.065	24660
2003-2004	0.313***	20.911	0.358***	3.331	24660
2004-2005	0.039**	2.533	0.241**	2.160	24660
Business revenue					
First stage			0.115***	22.036	24660
2002-2005	0.391***	28.354	0.270***	2.720	24660
2002-2003	0.167***	19.530	-0.026	-0.412	24660
2003-2004	0.165***	21.844	0.102*	1.887	24660
2004-2005	0.059***	6.776	0.193***	3.090	24660
Business costs					
First stage			0.115***	21.834	24366
2002-2005	0.271***	17.404	0.228**	2.030	24366
2002-2003	0.108***	10.799	-0.064	-0.883	24366
2003-2004	0.114***	13.354	0.105*	1.692	24366
2004-2005	0.049***	5.078	0.187***	2.701	24366
Sensitivity (gross income)					
	First stage		IV		
Log income	0.126***	22.286	0.540***	5.770	24024
Splines	0.115***	21.727	0.425***	4.209	24024
Spousal income controls	0.071***	11.527	0.440**	2.374	19060
2003-05	0.115***	21.727	0.515***	4.915	24024
2003-05, transitory	0.117***	22.570	0.465***	4.987	24024

Table 6: Estimates of tax elasticity and income effects

Variable	Tax price (1)	t-value (2)	Income effect (3)	t-value (4)	N (5)
IV: spouse in high bracket					
2002-2005	0.952***	3.611			24024
2002-2003	-0.126	-0.632			24024
2003-2004	0.878***	3.999			24024
2004-2005	0.200	0.914			24024
IV: spouse in high bracket and predicted income effect					
2002-2005	1.099***	5.028	-0.116	-1.298	22284
2002-2003	0.079	0.498	-0.019	-0.293	22284
2003-2004	0.893***	5.057	-0.085	-1.178	22284
2004-2005	0.128	0.744	-0.012	-0.172	22284
IV: predicted tax price and income effect					
2002-2005	0.720***	3.687	0.004	0.036	22284
2002-2003	0.257*	1.662	-0.075	-0.925	22284
2003-2004	0.512***	3.111	0.035	0.408	22284
2004-2005	-0.049	-0.301	0.044	0.512	22284

Table 7: Implied estimates of the effect on tax revenue, different scenarios

Average (1)	Married (2)	P10 (3)	P25 (4)	P50 (5)	P75 (6)	P90 (7)	P99 (8)
Gross income							
227310	256286	38199	69891	122864	225191	441422	1779780
Tax liability under the flat tax							
47083 0.0%	56477 0.0%	7059 0.0%	13083 0.0%	23595 0.0%	45430 0.0%	92392 0.0%	406301 0.0%
No flat tax: no behavioral response							
75228 -37.4%	81708 -30.9%	6563 7.6%	14404 -9.2%	31155 -24.3%	71351 -36.3%	156636 -41.0%	698220 -41.8%
No flat tax: taxable income reduced by 0.391, no base adjustment							
51632 -8.8%	59222 -4.6%	4463 58.2%	9382 39.5%	19852 18.9%	46786 -2.9%	107946 -14.4%	500629 -18.8%
No flat tax: taxable income reduced by 0.425, no base adjustment							
50030 -5.9%	57700 -2.1%	4303 64.0%	9054 44.5%	19098 23.5%	45133 0.7%	105107 -12.1%	488339 -16.8%
No flat tax: taxable income reduced by 0.735, no base adjustment							
37801 24.6%	46098 22.5%	3098 127.8%	6285 108.1%	13470 75.2%	32271 40.8%	79120 16.8%	395855 2.6%
No flat tax: gross income reduced by 0.391, and taxable/gross ratio of 0.964							
49931 -5.7%	57621 -2.0%	4305 64.0%	9029 44.9%	19049 23.9%	45029 0.9%	104880 -11.9%	487132 -16.6%
No flat tax: gross income reduced by 0.425, and taxable/gross ratio of 0.964							
48391 -2.7%	56158 0.6%	4147 70.2%	8673 50.8%	18297 29.0%	43297 4.9%	101887 -9.3%	470706 -13.7%
No flat tax: gross income reduced by 0.735, and taxable/gross ratio of 0.964							
36639 28.5%	45007 25.5%	2986 136.4%	6082 115.1%	12908 82.8%	31098 46.1%	76040 21.5%	384106 5.8%
No flat tax: tax elasticity of 0.952							
55984 -15.9%	63701 -11.3%	5924 19.2%	11943 9.5%	23502 0.4%	50511 -10.1%	115241 -19.8%	532798 -23.7%
No flat tax: tax elasticity of 1.29							
51171 -8.0%	59208 -4.6%	5785 22.0%	11161 17.2%	21350 10.5%	45229 0.4%	105333 -12.3%	488682 -16.9%

The sample used for constructing estimates in this table consists of those individuals who elected to switch to the flat tax. The alternative estimates reflect the counterfactual tax liability of these individuals if the flat tax was not introduced, varying assumptions about deductions and behavioral response. The table shows, for each scenario, the average tax liability for everyone, for married individuals, for particular quantiles and the percentage change of tax liability from switching to the flat tax relative to that under the relevant scenario.

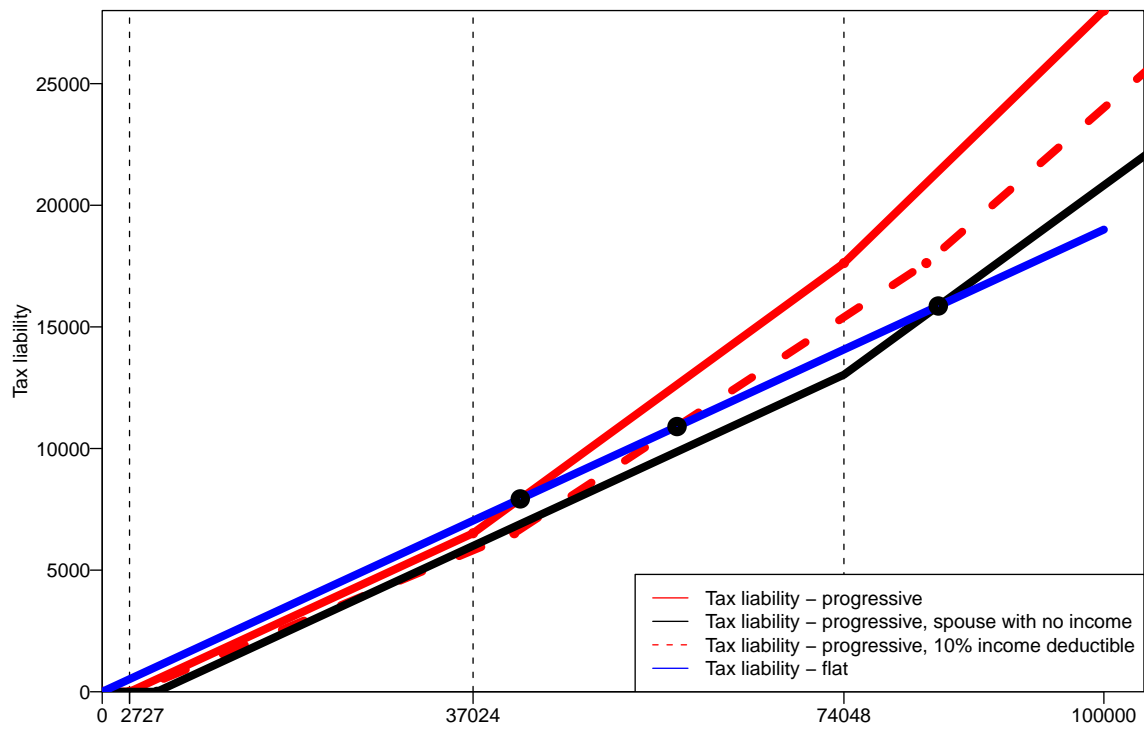


Figure 0: Pre- and post-reform tax schedules

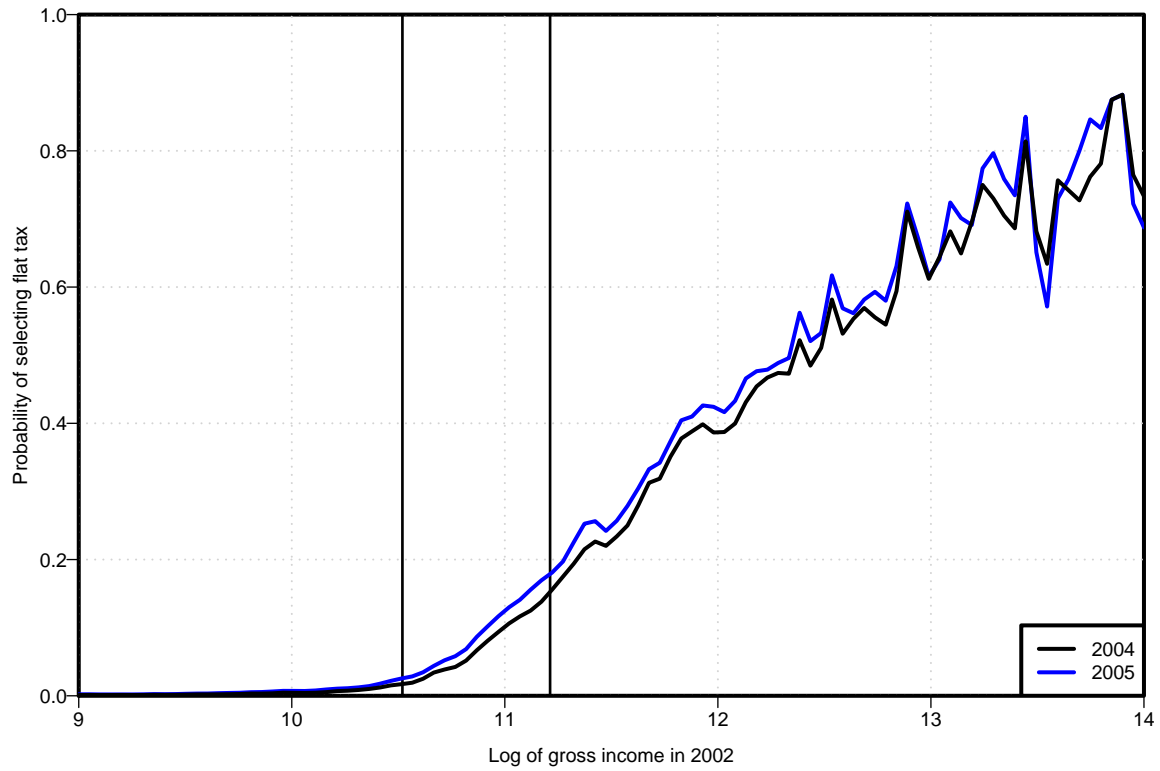


Figure 1: Selecting flat tax in 2004 and 2005, conditional on 2002 gross income (everyone)

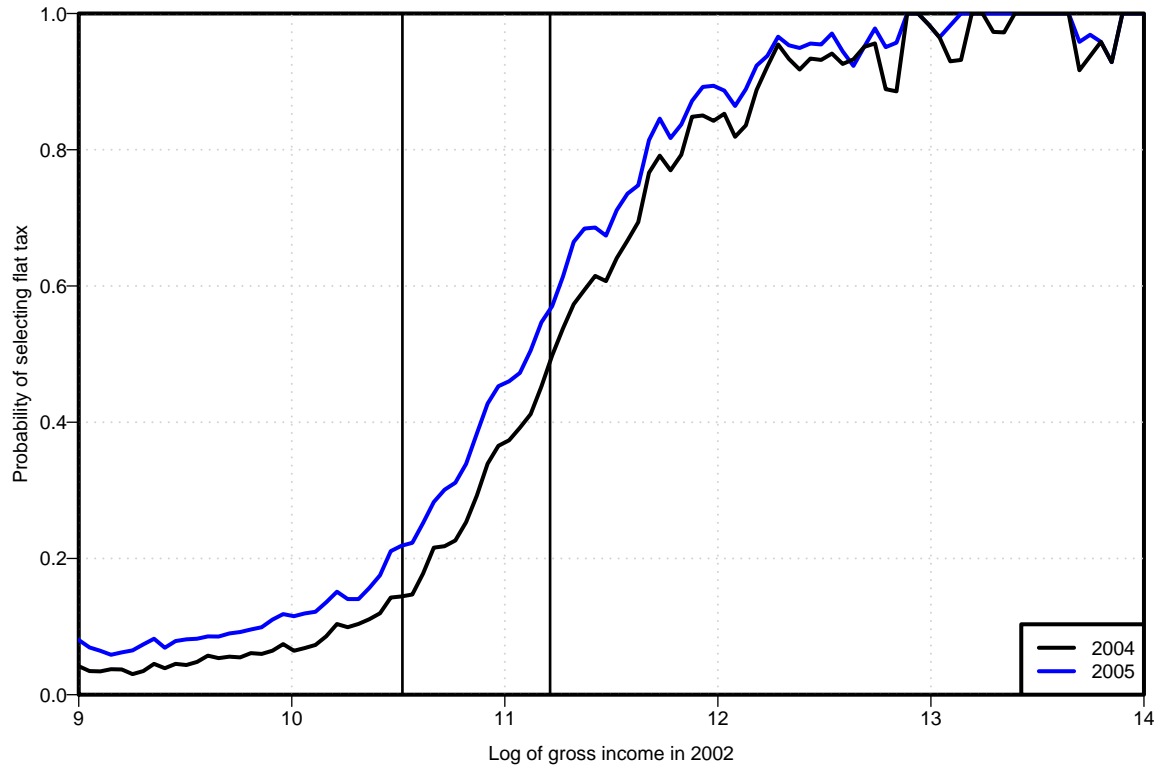


Figure 2: Selecting flat tax in 2004 and 2005, conditional on 2002 gross income (business owners)

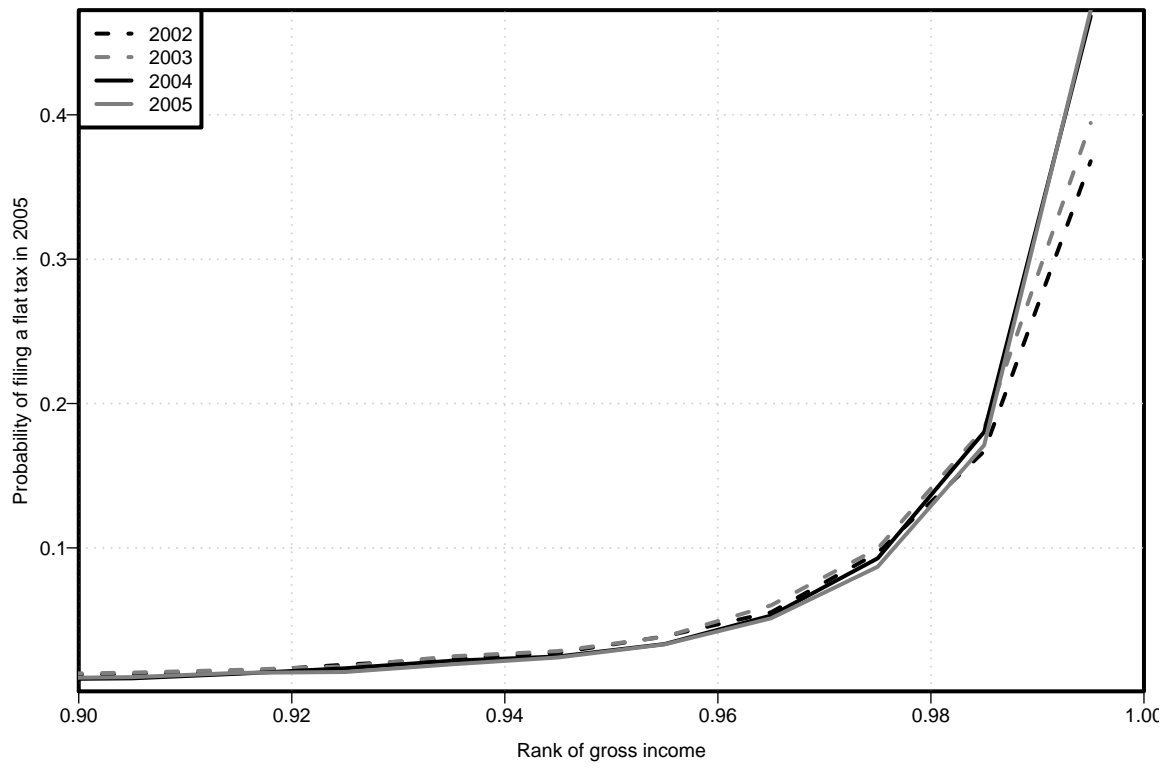


Figure 3: Probability of filing a flat tax in 2005 by location in the full income distribution in various years

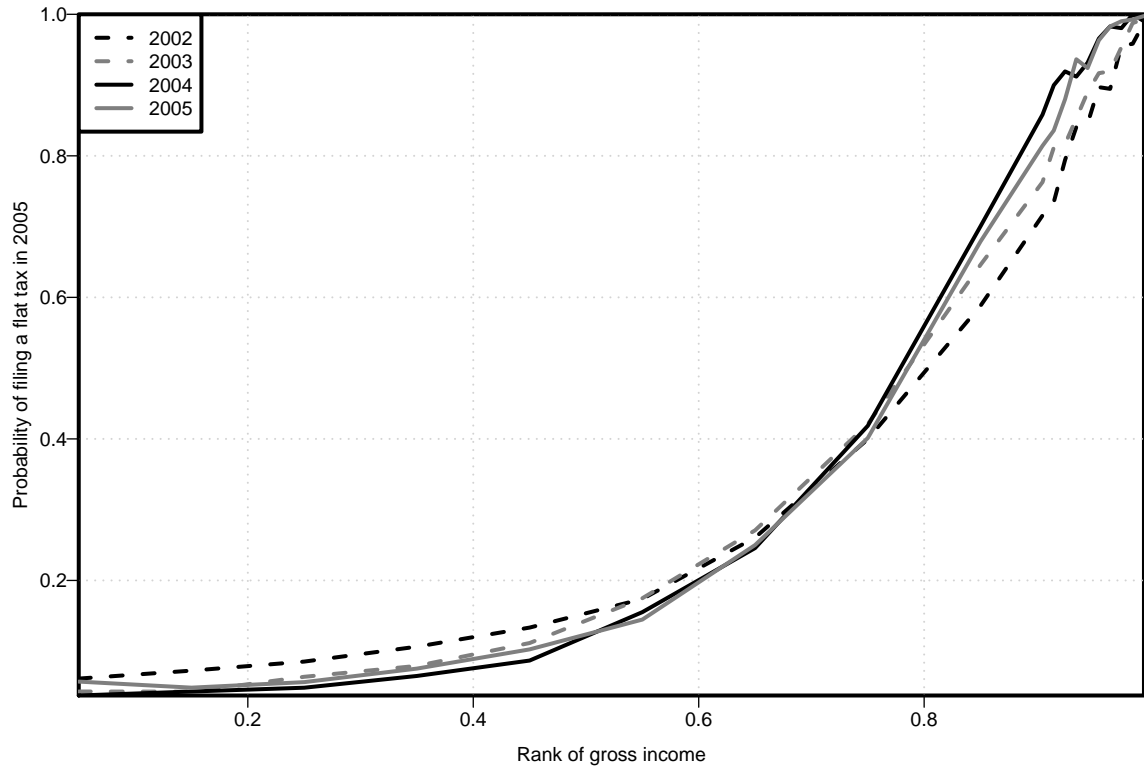


Figure 4: Probability of filing a flat tax in 2005 by location in the business owners distribution in various years

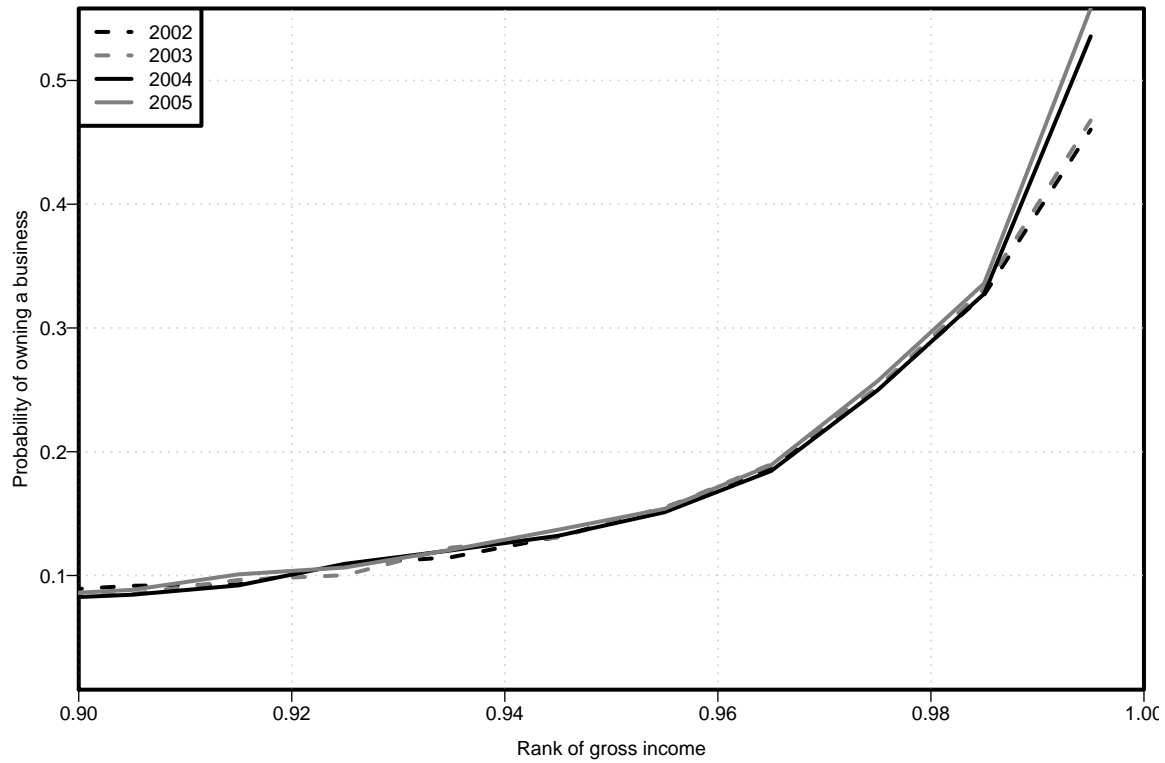


Figure 5: Probability of owning a business by location in the full income distribution

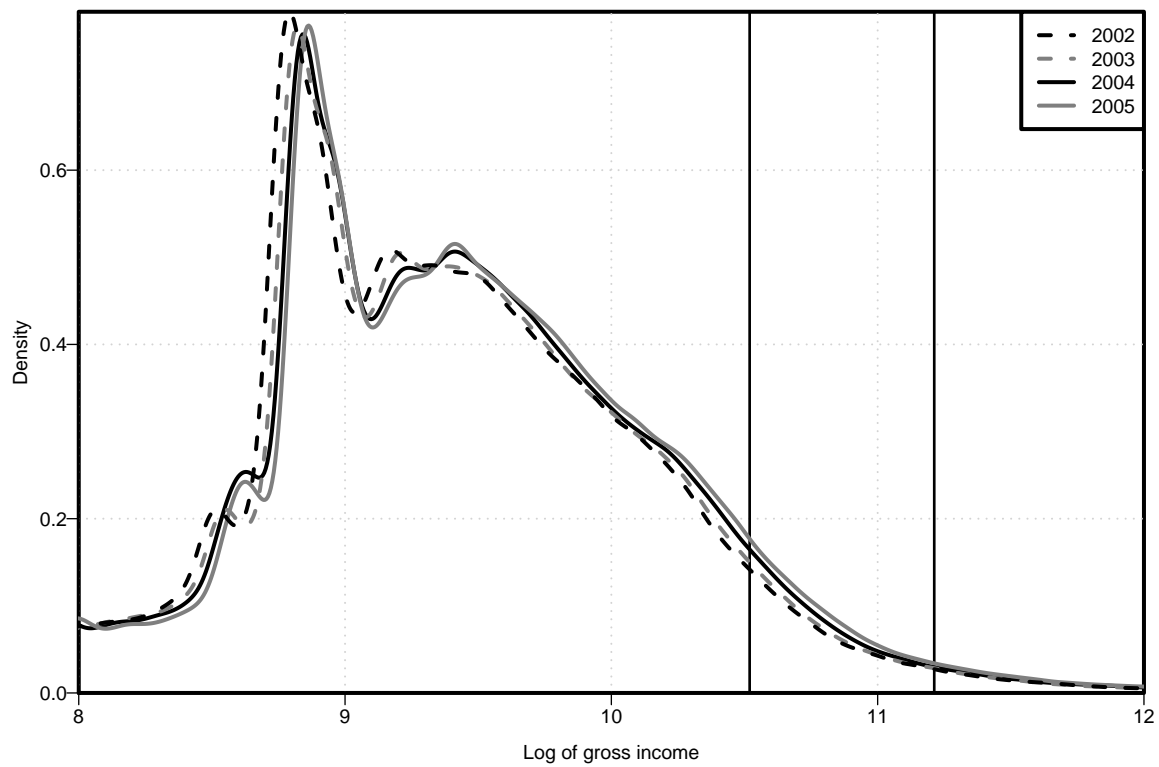


Figure 6: Distribution of gross income (everyone)

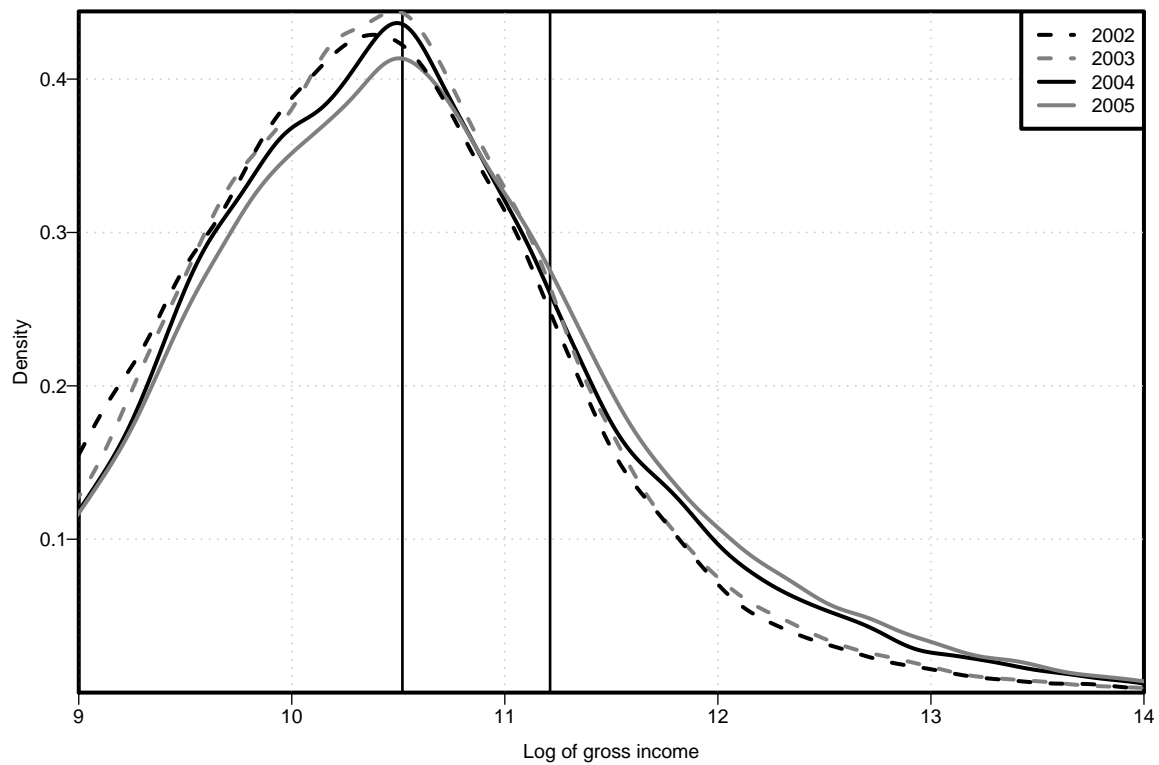


Figure 7: Distribution of gross income (business owners)

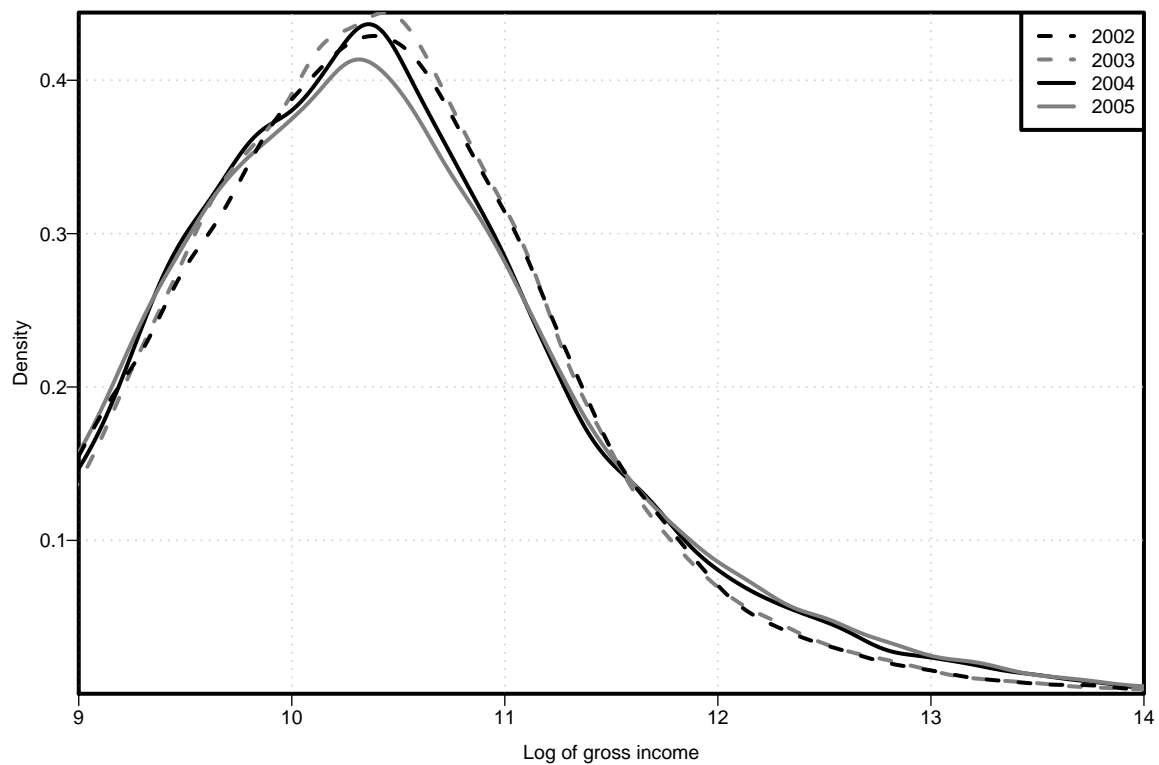


Figure 8: Distribution of gross income inflation/GDP adjusted (business owners)

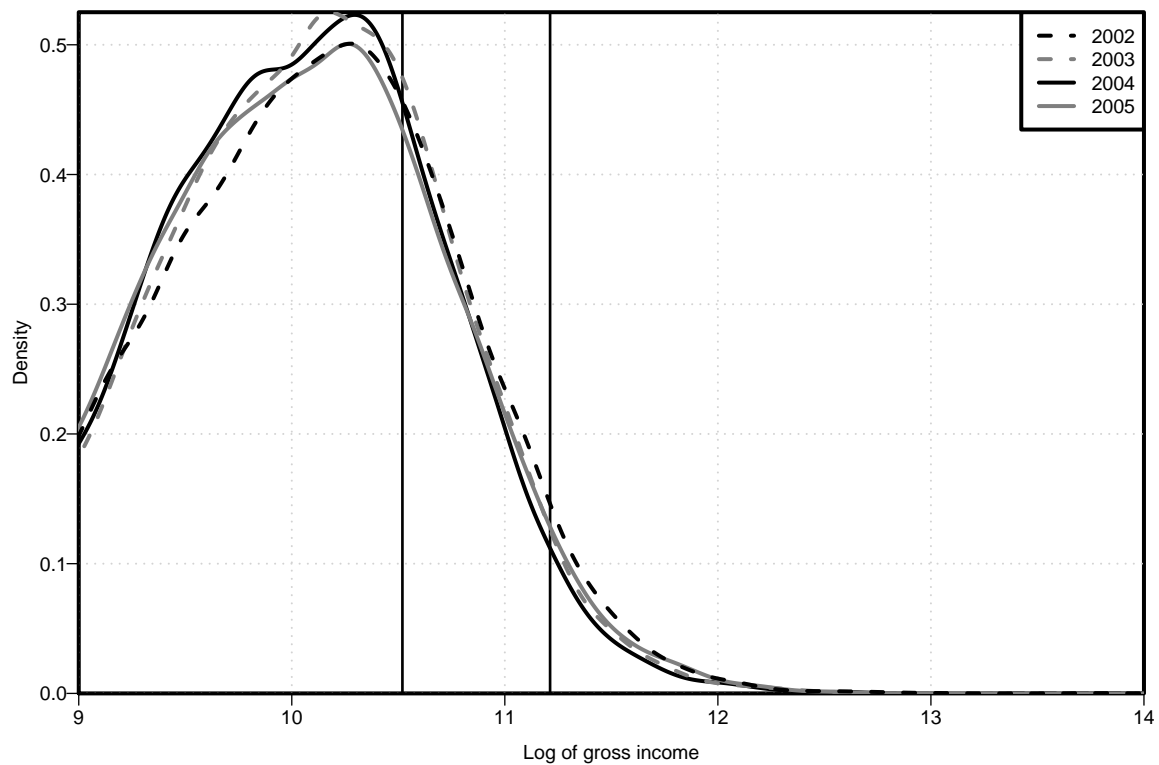


Figure 9: Distribution of gross income — business owners not on flat tax in 2005

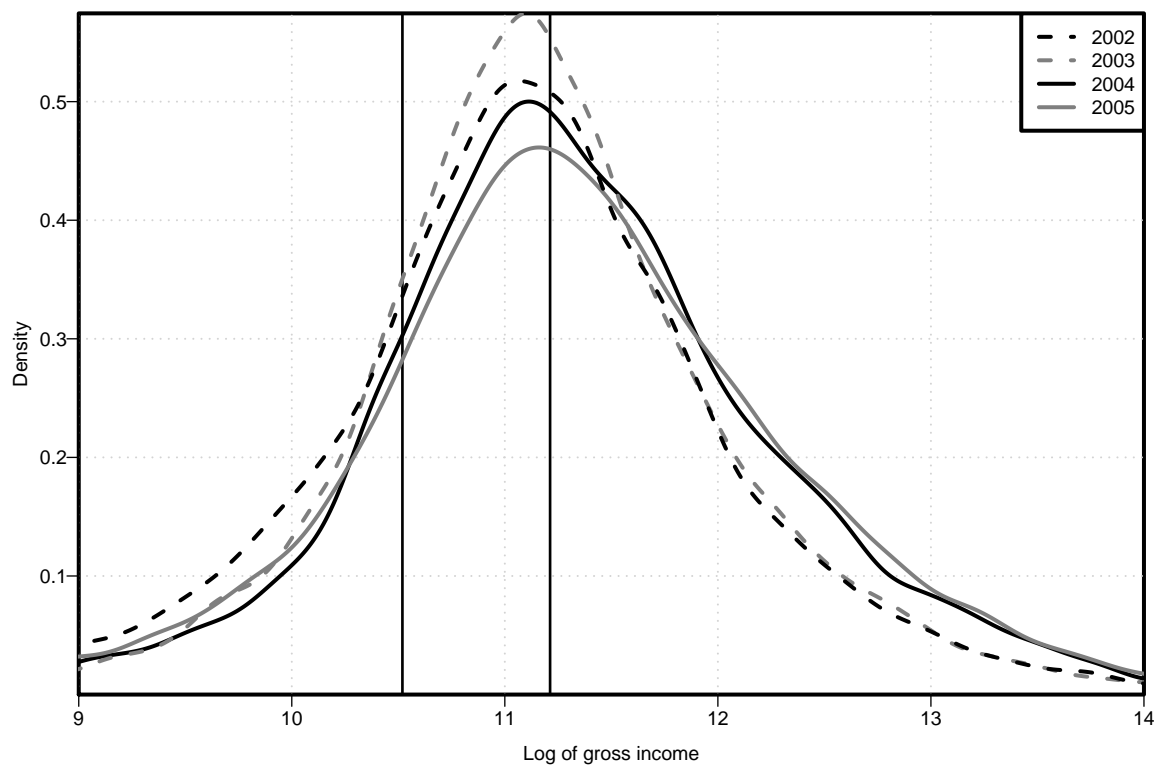


Figure 10: Distribution of gross income — business owners on flat tax in 2005

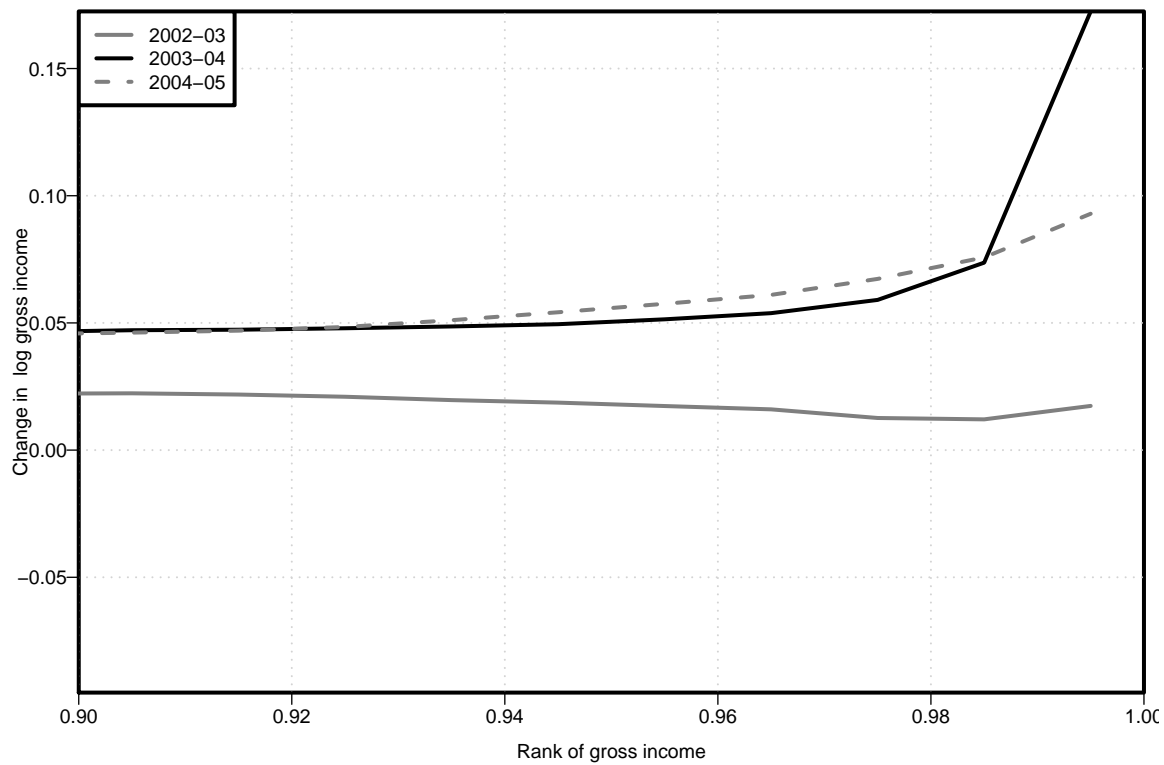


Figure 11: Change in log gross income 2002-05 by percentile of the full income distribution

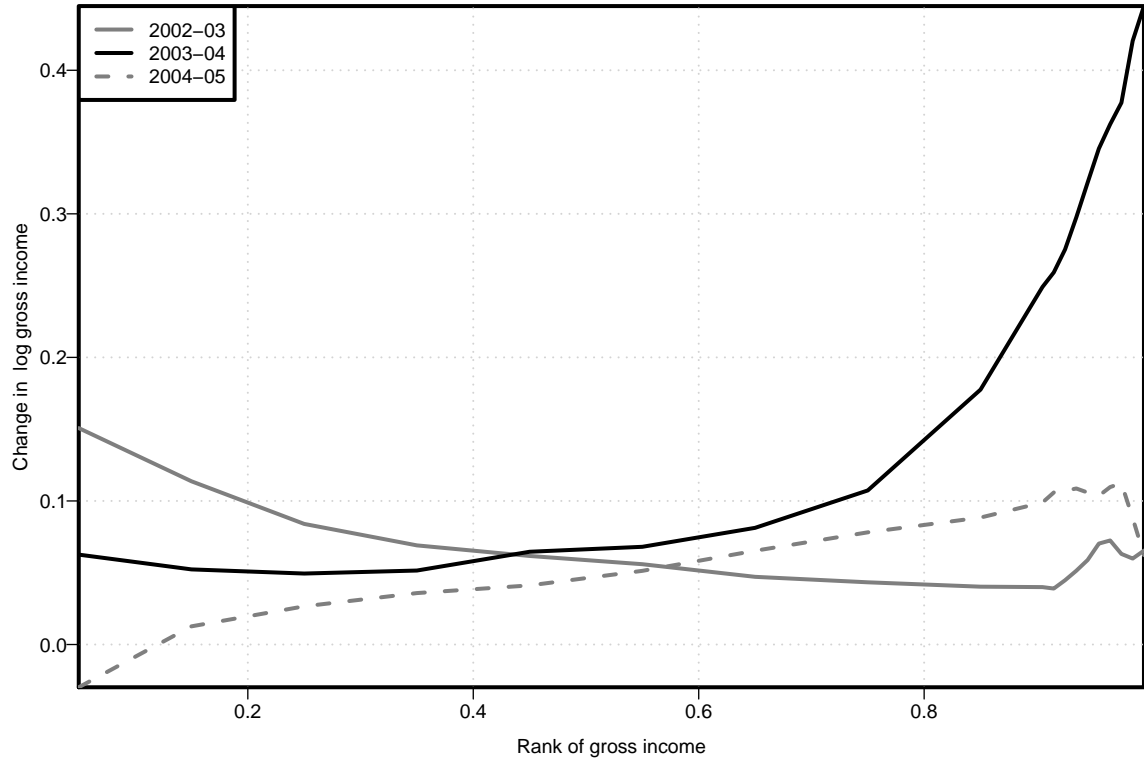


Figure 12: Change in log gross income 2002-05 by decile (percentile in top 10%) of the business owners distribution

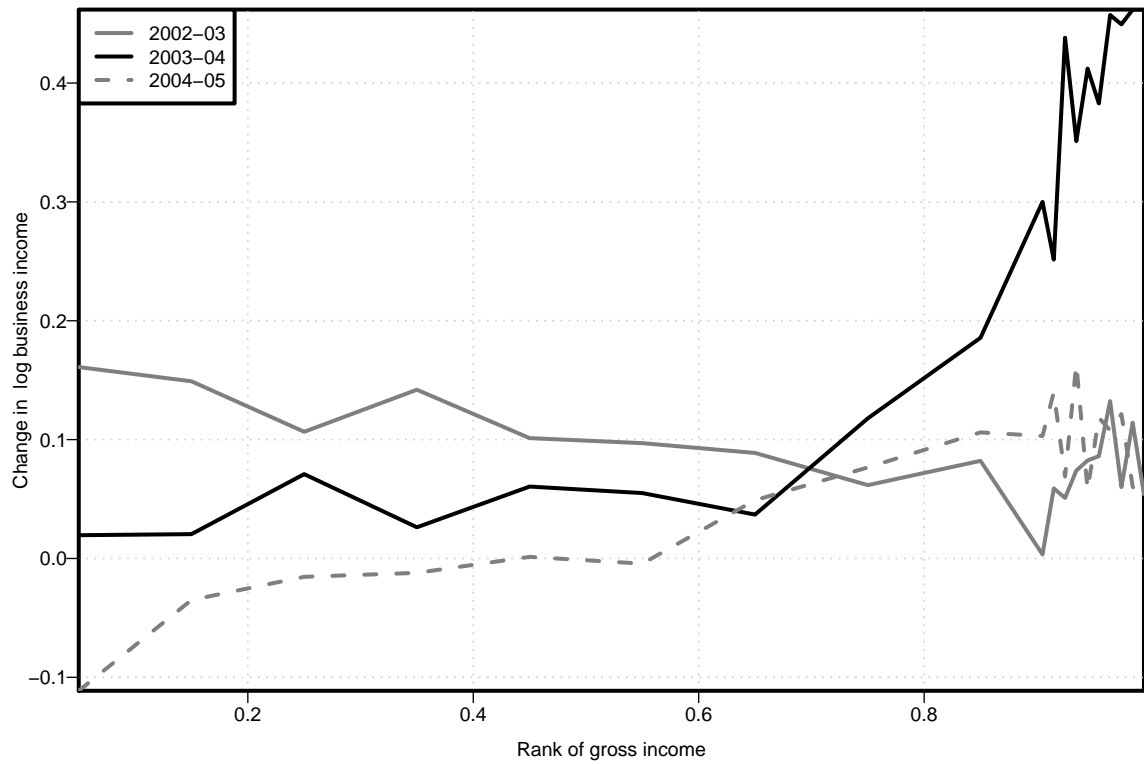


Figure 13: Change in log business income 2002-05 by decile (percentile in top 10%) of the business owners distribution

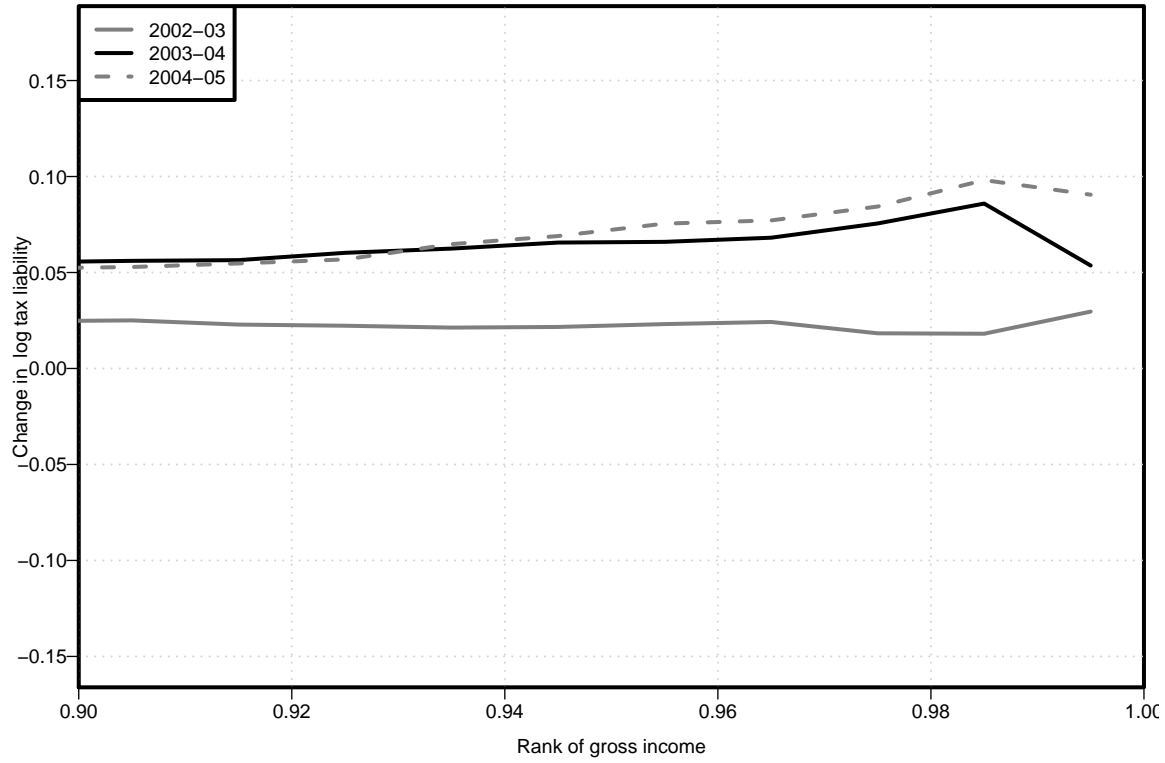


Figure 14: Change in log tax liability 2002-05 by percentile of the full income distribution

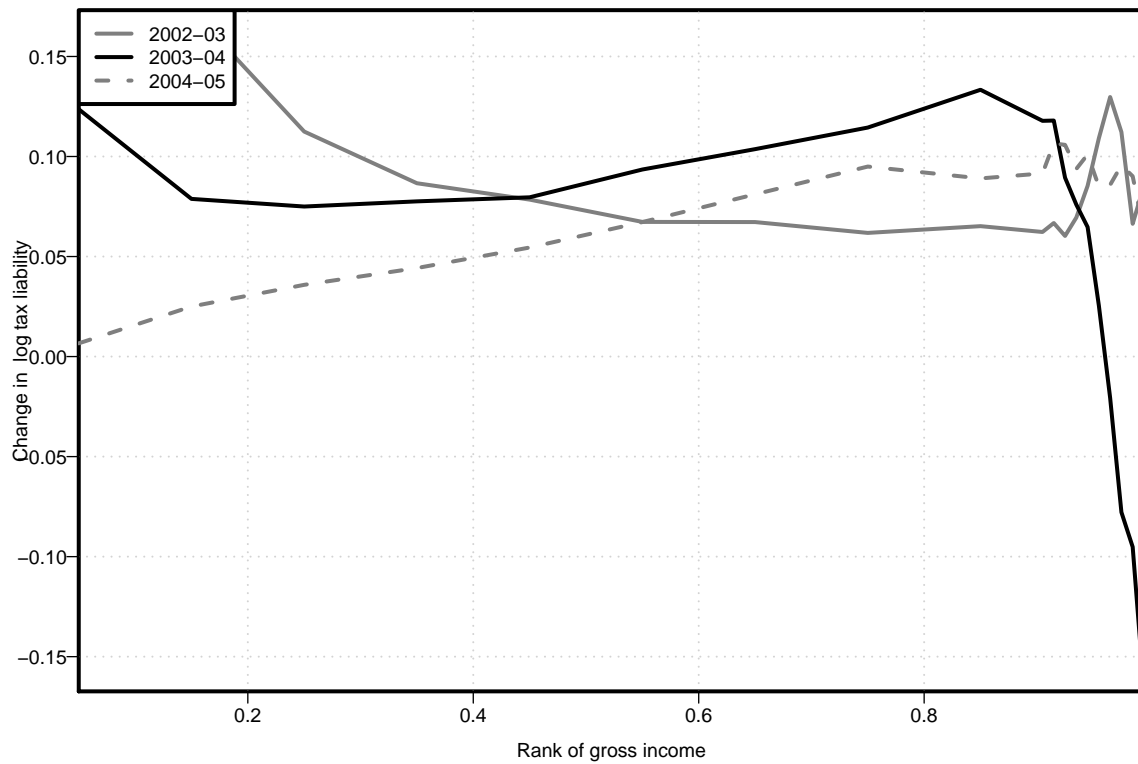


Figure 15: Change in log tax liability 2002-05 by decile (percentile in top 10%) of the business owners distribution

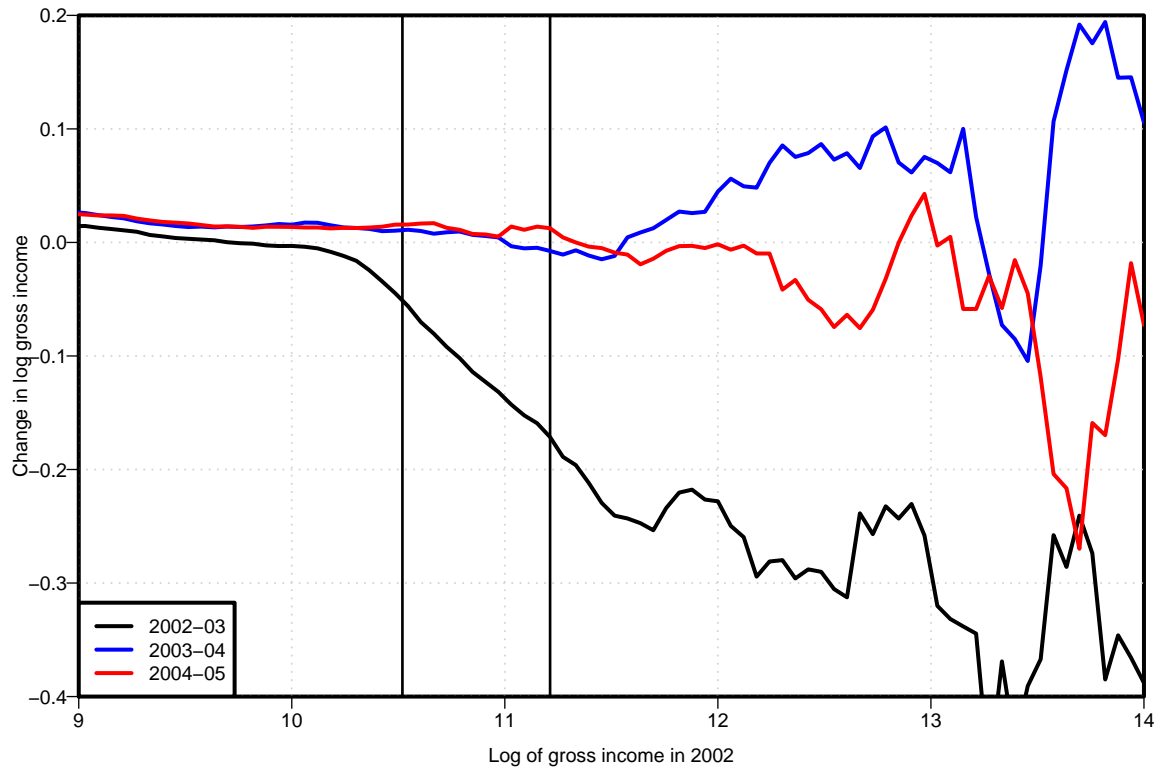


Figure 16: Changes in gross income in 2002-2005, everyone

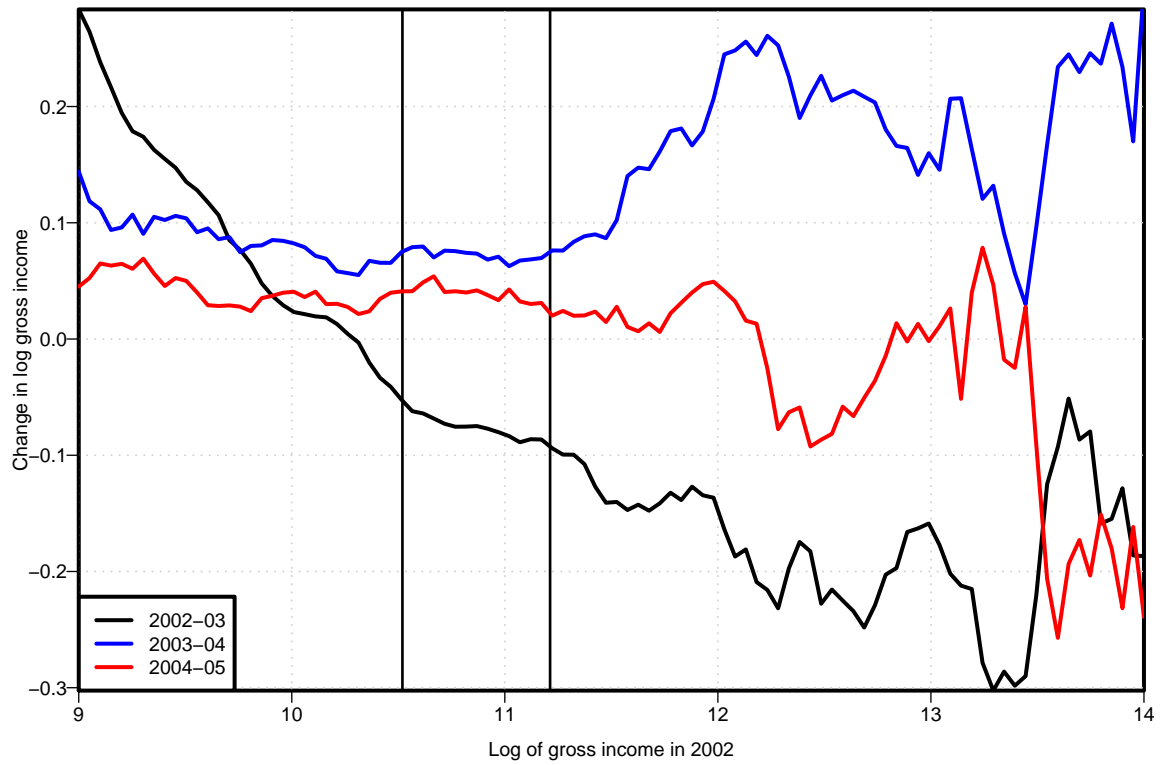


Figure 17: Changes in gross income in 2002-2005, business owners

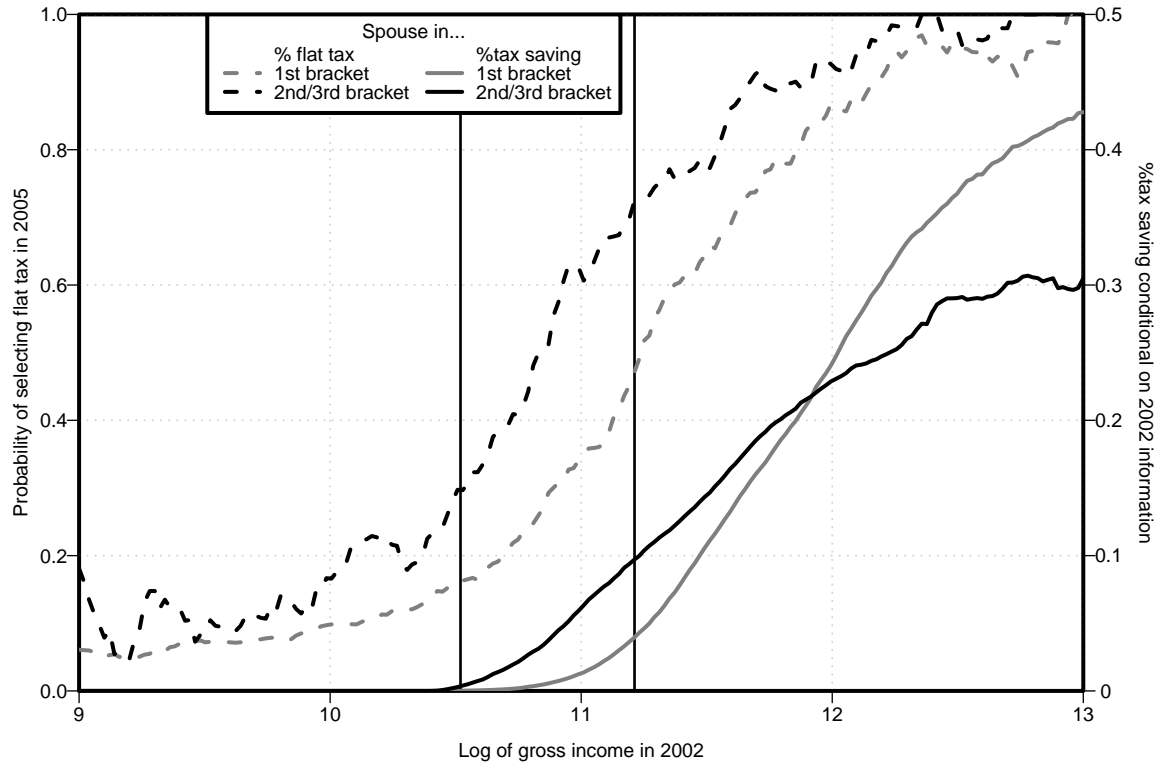


Figure 18: Flat tax in 2005 and potential tax savings as of 2002, conditional on having spouse in a high tax bracket in 2002, business owners

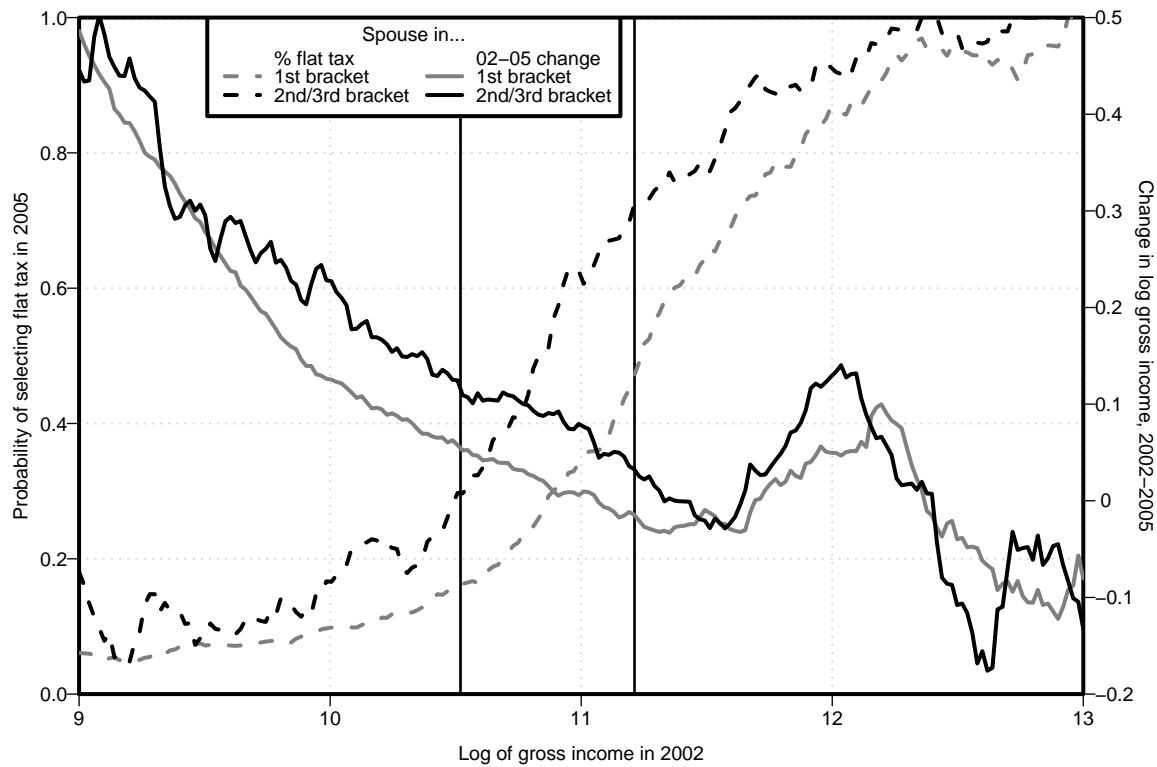


Figure 19: Flat tax and gross income change 2002-2005, conditional on having spouse in a high tax bracket in 2002, business owners

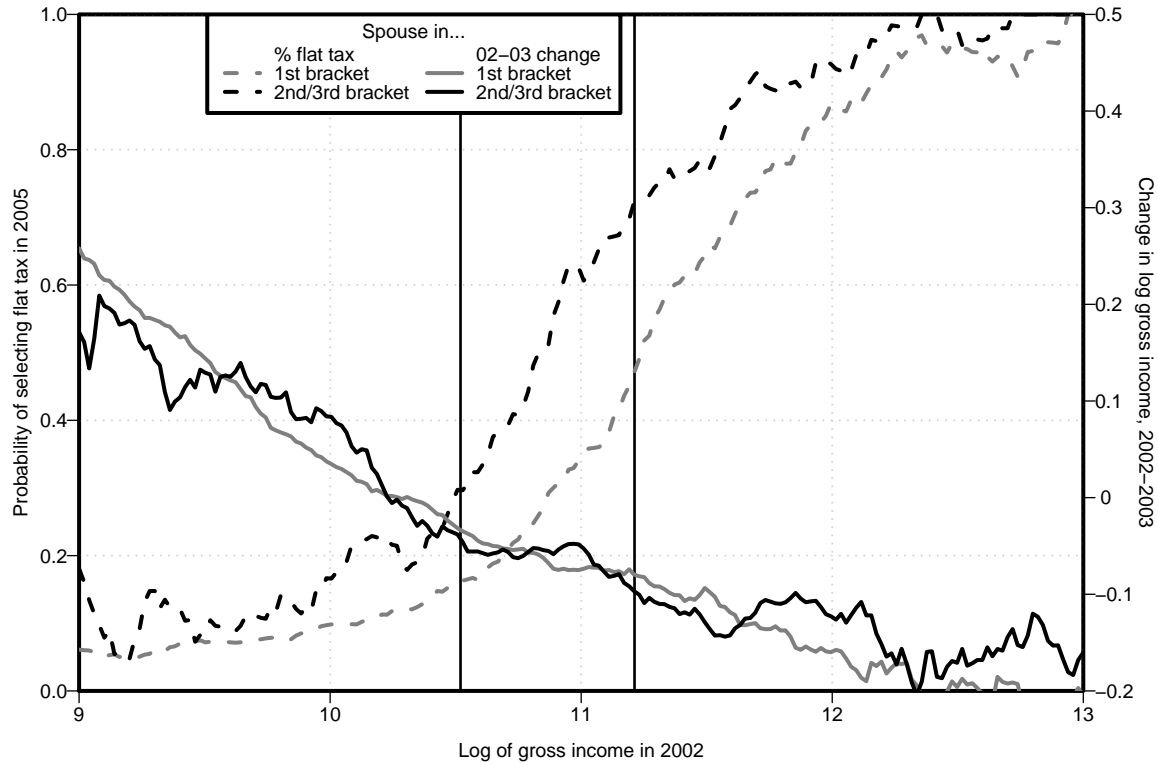


Figure 20: Flat tax and gross income change 2002-2003, conditional on having spouse in a high tax bracket in 2002, business owners

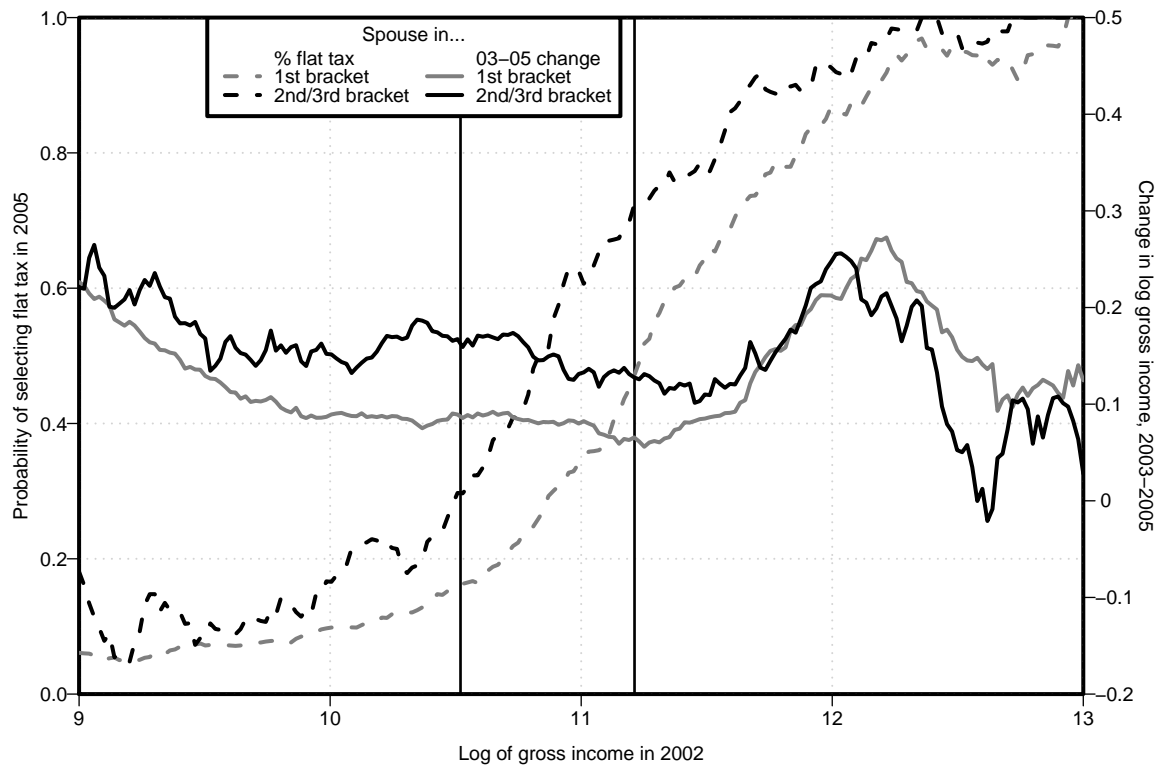


Figure 21: Flat tax and gross income change 2003-2005, conditional on having spouse in a high tax bracket in 2002, business owners

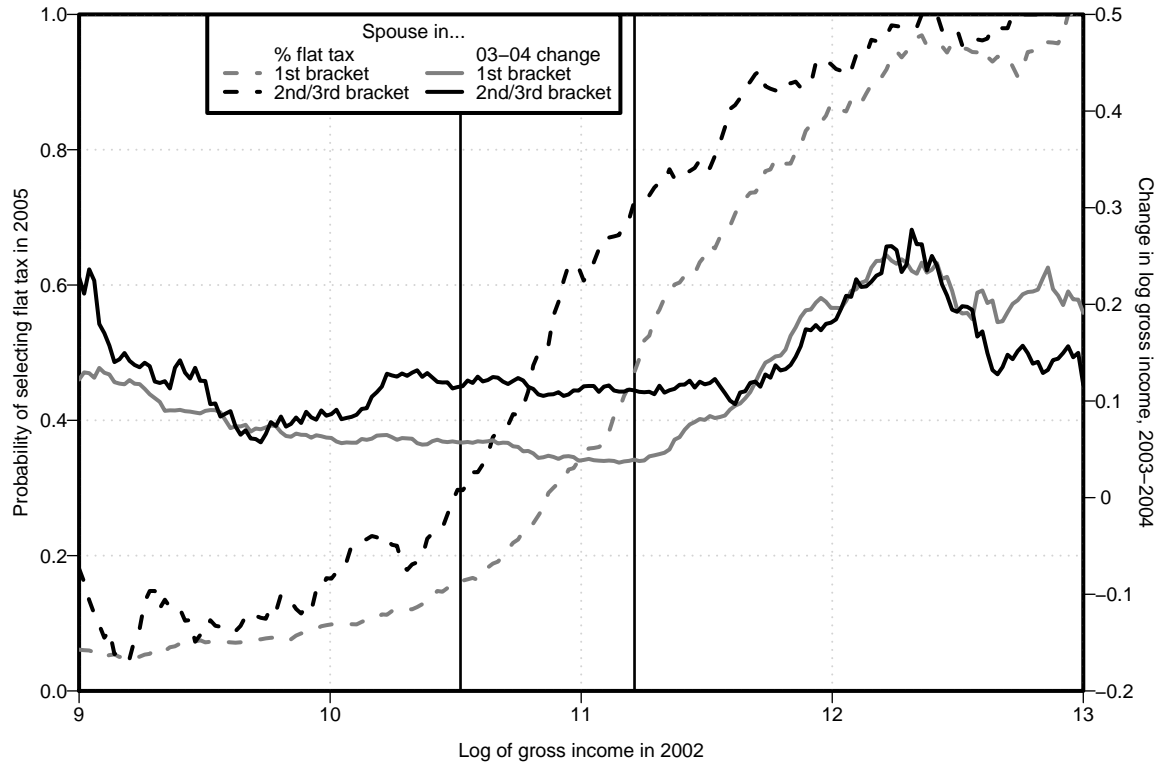


Figure 22: Flat tax and gross income change 2003-2004, conditional on having spouse in a high tax bracket in 2002, business owners

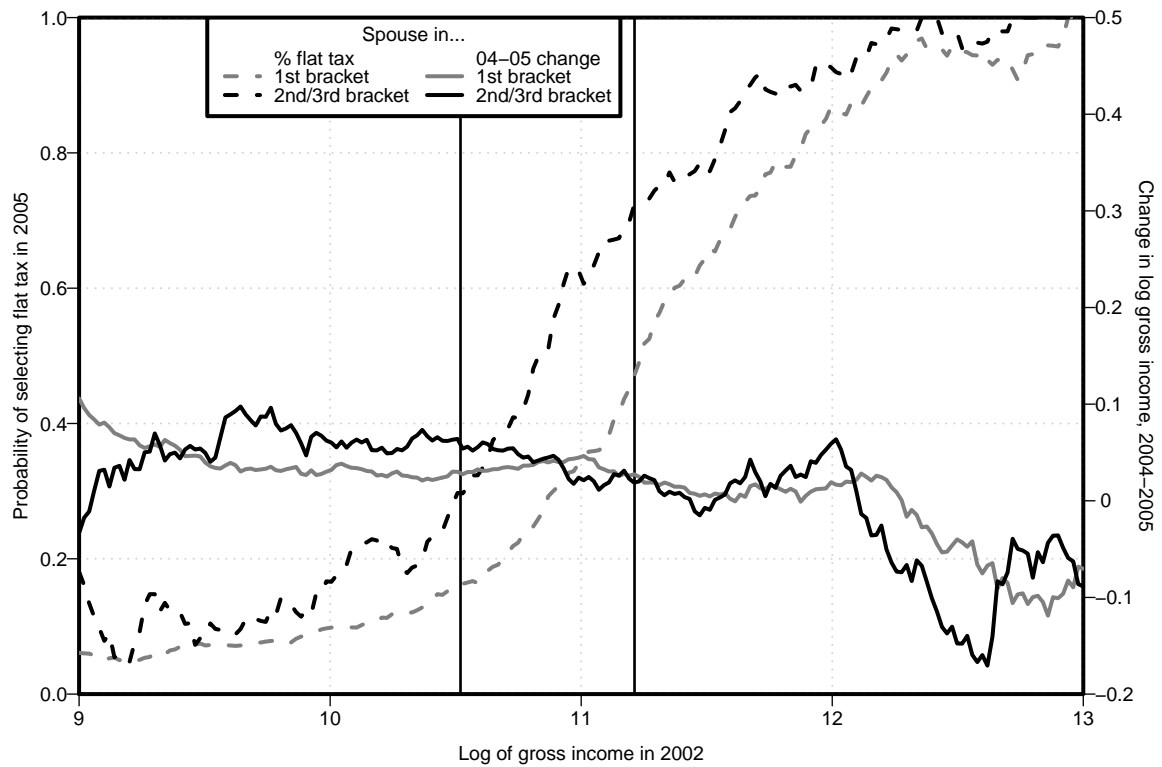


Figure 23: Flat tax and gross income change 2004-2005, conditional on having spouse in a high tax bracket in 2002, business owners

A Appendix tables and figures

Table A.1: The effect of flat tax reform on gross income, using owning a business in 2002 as an instrument

Variable	Coefficient (1)	t-value (2)	Coefficient (3)	t-value (4)	N (5)
	OLS		IV		
	Everyone				
First stage			0.169***	403.217	1233349
2002-2005	0.663***	132.763	0.254***	17.346	1233349
2002-2003	0.309***	82.410	0.113***	10.280	1233349
2003-2004	0.290***	72.694	0.160***	13.710	1233349
2004-2005	0.064***	15.264	-0.019	-1.556	1233349
	Married individuals only				
First stage			0.179***	273.898	492741
2002-2005	0.615***	92.551	0.276***	15.073	492741
2002-2003	0.294***	60.693	0.146***	10.969	492741
2003-2004	0.279***	53.522	0.152***	10.579	492741
2004-2005	0.042***	7.593	-0.022	-1.438	492741

Table A.2: The effect of flat tax reform on gross income, using spouse-based instruments

Variable	Coefficient (1)	t-value (2)	Coefficient (3)	t-value (4)	N (5)
	Using spouse in high tax bracket as an instrument				
First stage			0.024***	39.755	471848
2002-2005	0.610***	88.877	2.230***	17.755	471848
2002-2003	0.296***	59.158	0.803***	9.162	471848
2003-2004	0.280***	51.946	1.051***	11.014	471848
2004-2005	0.034***	5.873	0.377***	3.805	471848
	Using spouse owning a business as an instrument				
First stage			0.071***	96.997	471848
2002-2005	0.610***	88.877	0.856***	17.403	471848
2002-2003	0.296***	59.158	0.254***	7.100	471848
2003-2004	0.280***	51.946	0.458***	11.846	471848
2004-2005	0.034***	5.873	0.144***	3.517	471848

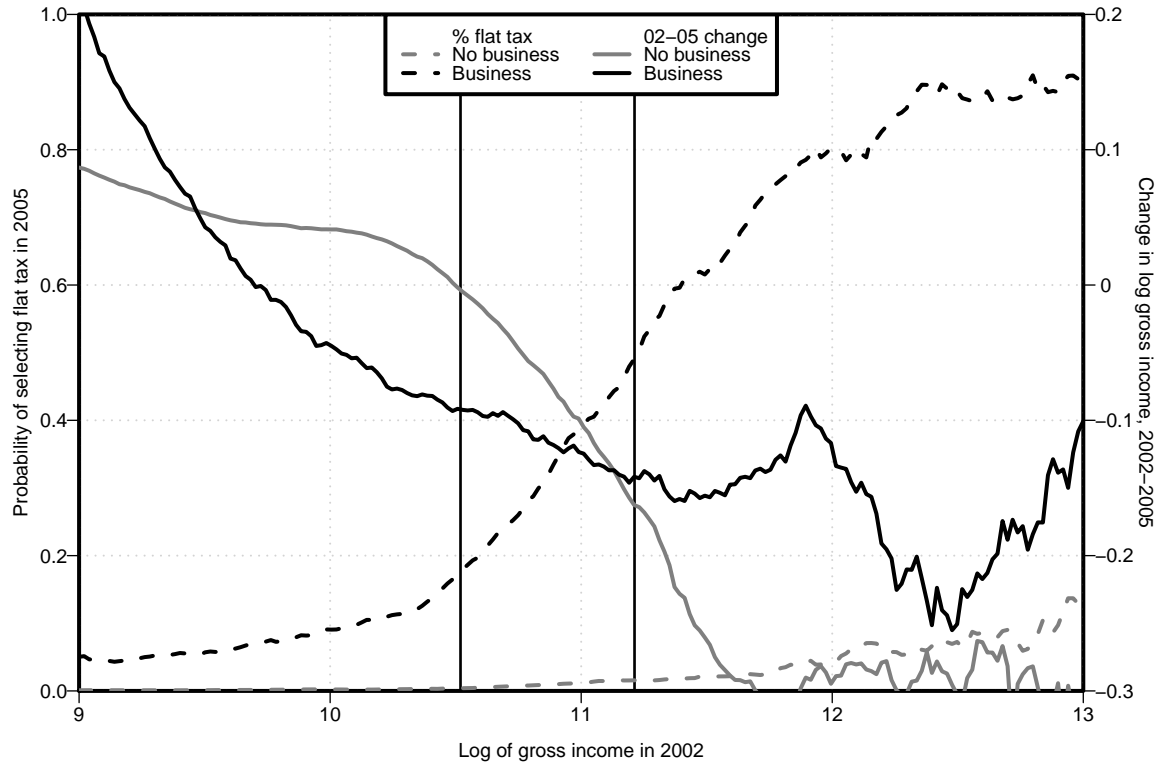


Figure A.1: Flat tax and gross income change 2002-2005, conditional on owning business in 2002, everyone

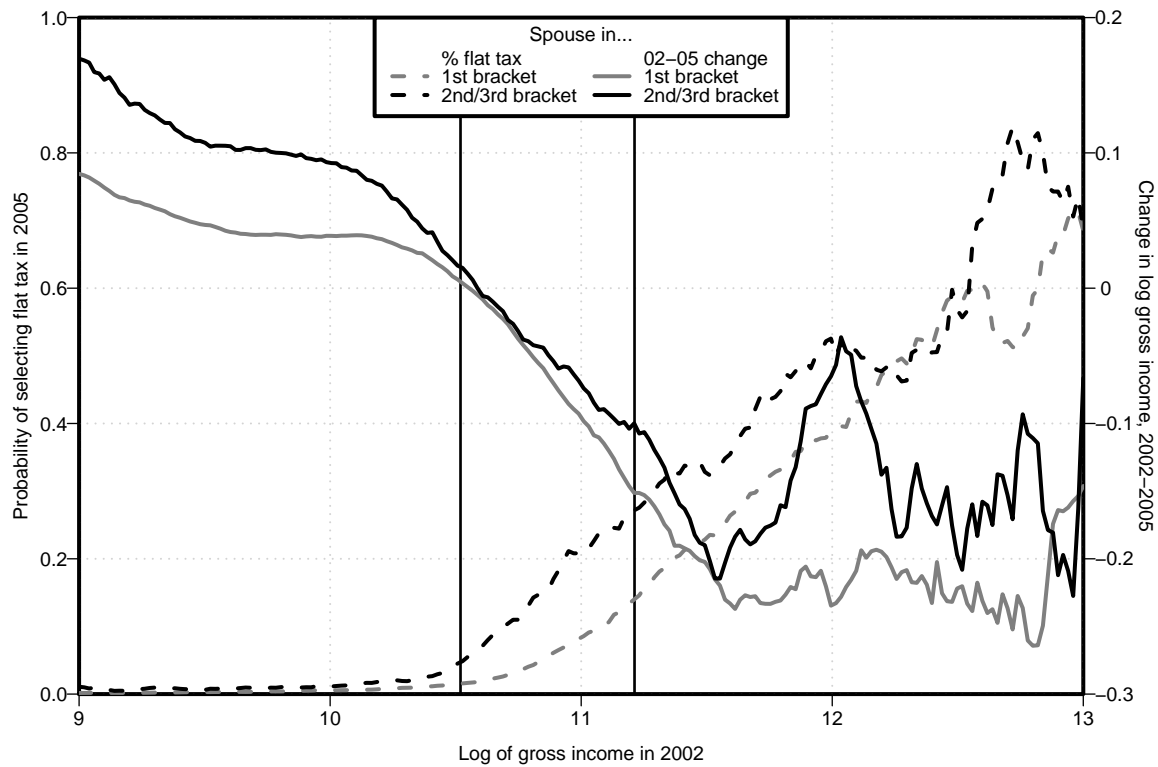


Figure A.2: Flat tax and gross income change 2002-2005, conditional on having spouse in a high tax bracket in 2002, everyone