

# TAXATION, INFORMATION AND WITHHOLDING: EVIDENCE FROM COSTA RICA\*

Anne Brockmeyer, Marco Hernandez

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## Abstract

In standard tax compliance models, tax withholding at source is irrelevant. In these models, tax compliance is determined by a combination of enforcement (via audits and penalties), social motives, and third-party reporting, which deters evasion by enabling the tax authority to verify self-reported liability. The fact that third parties may also withhold taxes at source – and the impact of withholding on compliance – has largely been ignored. Yet tax withholding is common around the world: withholding of the personal income tax by employers is almost universal, and withholding is also applied to firms, especially in low-income countries. We provide a simple framework to rationalize the use of tax withholding as a compliance mechanism and test its predictions using administrative data from Costa Rica. We find that doubling the tax withholding rate applied by credit-card companies increases sales tax remittance among treated firms by 39% and aggregate sales tax revenue by 8%, even though the statutory tax rate and third-party reporting requirements remain unchanged. The mechanisms are a default payment effect and a change in enforcement perceptions. Our findings contribute to a broader debate about the determinants of fiscal capacity among countries at different levels of economic development.

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\*Corresponding author: Anne Brockmeyer, [abrockmeyer@worldbank.org](mailto:abrockmeyer@worldbank.org), 1818 H Street NW, Washington DC 20433, +1-202-642-7214. We are exceedingly grateful to the Costa Rican Ministry of Finance and General Directorate for Taxation for their outstanding collaboration. We would also like to thank Pierre Bachas, Abigail Barr, Youssef Benzarti, Lorenzo Casaburi, Lucie Gadenne, François Gérard, Beata Javorcik, Henrik Kleven, Aart Kraay, Brigitte Madrian, David McKenzie, Joana Naritomi, Steven Pennings, Joel Slemrod, Eleanor Wilking and the seminar and conference participants at Oxford, Cambridge, Nottingham, the World Bank, the IMF, George Washington University, University of Michigan, LSE STICERD, Zurich PF Conference, NTA, PEUK, PacDev, ABCDE, IIPF, Oxford CBT, Oxford CSAE, AEA, and IFS for their helpful comments. Francisco Ilabaca, Juliana Londoño Vélez, Spencer Smith, Corinne Stephenson, and Gabriel Tourek provided excellent research assistance. The work was funded by the World Bank. The findings, interpretations, and conclusions expressed in this paper do not necessarily reflect the views of the Government of Costa Rica or of the World Bank, its Executive Directors, or the governments they represent. All errors are our own.

# I. INTRODUCTION

Standard tax compliance models regard tax withholding as irrelevant. In these models, tax compliance is determined by a combination of enforcement in the form of audits and penalties (Allingham and Sandmo 1972), the presence of third-party reported information about the taxpayer’s income (Kleven et al. 2011) and potentially social motives (Singhal and Luttmer 2014). The importance of third-party information has been particularly emphasized in the recent literature. Formal employment contracts (Kleven et al. 2011, Jensen 2016), modern accounting systems (Kleven, Kreiner and Saez 2016), and financial transactions (Gordon and Li 2009) all generate third-party information, which allow the tax authority to verify a taxpayer’s self-reported income and deter evasion. The fact that the third party may also withhold tax at source has been largely ignored.<sup>1</sup>

Yet, tax withholding schemes are widely used around the world. Withholding of the personal income tax by employers is applied almost universally and commonly credited with ensuring a high compliance with the personal income tax. Withholding can also be applied to firms’ transactions, to ensure compliance with corporate income and consumption taxes. In this case, the payer in a transaction withholds tax from the payee, remitting<sup>2</sup> the tax withheld to the tax authority as an advance tax remittance by the payee.<sup>3</sup> Over 60 countries employ this type of withholding scheme, particularly low-income countries with low tax compliance (Figure I). Large firms and financial institutions are common withholding agents.

This paper studies the surprising power of withholding and its mechanisms. In our application in Costa Rica, credit- and debit-card companies<sup>4</sup> report retailers’ card-machine sales, withhold a fraction of the transaction amount, and remit this to the tax authority as an advance on the retailers’ sales tax. As withholding applies to transactions that are also third-party reported to the tax

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<sup>1</sup>An exception is Slemrod (2008), who discusses the importance of withholding extensively but only qualitatively.

<sup>2</sup>We use the term “remittance” rather than “payment” to refer to transfers from taxpayers or other economic agents to the tax authority. The purpose of this term is to distinguish these transfers from transactions between economic agents and to avoid confusion between the transfer of money to the tax authority and bearing the burden of the tax (Slemrod and Brockmeyer 2017).

<sup>3</sup>In some countries, the payee also withholds from the payer, adding the withheld tax to the invoice. More generally, the term “withholding” can refer to any circumstance in which the agent responsible for remitting the tax is different from the statutory bearer of the tax.

<sup>4</sup>Henceforth referred to as credit-card companies for simplicity.

authority, and as the withheld tax is fully creditable against a taxpayer's final tax liability, standard models would suggest that withholding should be irrelevant to tax compliance. However, our empirical evidence rejects these models. We use variation in the presence of third-party-reported information to show that information reporting increases the taxpayer's reported tax liability, but does not yield full compliance. Some taxpayers still underreport, even when information on their income is reported by third parties. We then exploit quasi-experimental variation in the withholding rate, keeping the government's information set and statutory tax rates constant, to document that tax withholding narrows these compliance gaps. Doubling the withholding rate increases sales tax remittance among treated firms by 39%. This is because tax withholding at source establishes a compliance default and because it makes tax enforcement salient, hence reducing misreporting.<sup>5</sup>

To motivate our study, we extend a simple tax evasion model with third-party information reporting based on [Allingham and Sandmo \(1972\)](#). We allow the third party to both report a taxpayer's sale and withhold a share of the transaction amount as an advance tax remittance for the taxpayer. If audits are targeted at taxpayers that misreport sales compared to third-party reports, third-party reporting puts a lower bound on the reported tax liability among taxpayers that correctly perceive the audit function. Withholding is irrelevant to taxpayers' compliance decisions if the tax withheld can be fully and costlessly reclaimed and if withholding does not affect taxpayers' perceptions of enforcement. If we relax these two assumptions, however, withholding can increase tax remittance through two channels: incomplete reclaiming of the tax withheld and a reduction in misreporting.

To test our model's predictions, we exploit various sources of quasi-experimental variation in the Costa Rican tax system and a ten-year panel of administrative tax records. We construct the Costa Rican tax register from the universe of registration and deregistration records since 2006. We then match the register with income and sales tax records from 400,000 firms, including both self-employed individuals and corporations. We also match these data with over 20 million third-party reports to the tax authority regarding firms' economic activities. These reports come from three sources: (i) firms are required to report transactions with suppliers and clients when the

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<sup>5</sup>Withholding in this context does not reduce transaction costs for the taxpayer, as withholding is incomplete and most taxpayers still have an outstanding tax liability to remit. Withholding reduces administrative costs for the tax authority, which may be a reason for the attractiveness of withholding schemes, but this cannot explain why withholding increases compliance, as we show in this paper.

annual transaction amount exceeds a given threshold; (ii) state institutions are required to report all purchases from the private sector; and (iii) credit-card companies are required to report all sales executed through card machines.

Our analysis is divided into three parts. First, we provide novel evidence on the impact of third-party information reporting on firm compliance. We conduct an event study exploiting within-firm changes over time in the coverage by third-party reporting. We find that a firm's reported tax liability increases by up to 50% after the first third-party report by another firm, by 25% after the first report by a credit-card company, and by 22% after the first report by a state institution. These effects emerge sharply at the time of the event after otherwise parallel trends between the event and control groups, and thus cannot be explained by a pure growth effect. The event study results are corroborated by the heterogeneity of bunching at kinks and notches, a proxy for misreporting,<sup>6</sup> across subsamples of firms with different degrees of information reporting coverage. In the second part of our analysis, we show that despite the presence of third-party information and its targeted use in tax enforcement in Costa Rica, compliance gaps remain widespread and sizable on all margins. About 50% of tax-liable firms fail to file their income tax declarations, 22% of income tax liability among third-party-reported firms remains undeclared, and a non-negligible fraction of firms remit their taxes after a significant delay.

These findings suggest a role for tax withholding at source, which we evaluate in the third part of the analysis. We exploit a reform to the withholding-rate schedule applied by credit-card companies, which doubled the tax-withholding rate for some firms and left it unchanged for others. Firm-specific withholding rates are determined each semester based on each firm's reported value-added rate from two semesters prior, which means there is no scope for firms to manipulate treatment-group assignment at the time of the reform. Firms that did not experience a rate change or that did not use a credit-card machine were unaffected by the reform; these firms serve as the control group for a difference-in-difference estimation. Their pre-reform trend in key outcome variables is identical to the treatment-group trend, even in terms of seasonal fluctuations. The reform allows us to isolate the impact of withholding from other determinants of compliance, as

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<sup>6</sup>Previous studies have shown that bunching is largely driven by misreporting rather than real responses (e.g. [Best et al. 2015](#) for the minimum tax kink in Pakistan, [Almunia and Rodriguez 2015](#) for an enforcement notch in the Spanish corporation tax).

the statutory tax rate did not change, and the information reporting environment was unaffected. Specifically, credit-card companies were required to report all card transactions both before and after the reform, and card machine usage hardly responded to the reform.

We find that doubling the withholding rate leads to a 39% increase in total sales tax remittances from taxpayers subject to the rate change. In the aggregate, the withholding-rate reform increased sales tax revenue by over 8%.<sup>7</sup> Using detailed information from all line items on the sales tax return, we decompose the main treatment effect into its mechanisms. We find that the impact is driven in equal proportions by (i) a default remittance effect caused by firms that do not reclaim the tax withheld, and (ii) an increase in reported tax liability among firms that do reclaim the tax withheld. This reporting response is not driven by the bunching of reported tax liabilities at the amount of tax withheld, nor by a change in enforcement parameters. We argue instead that withholding changes enforcement *perceptions*, particularly among reclaimers, and provide evidence consistent with this.

Our paper contributes to several strands of the literature. First, we contribute to a large body of work on tax compliance surveyed in [Slemrod and Yitzhaki \(2002\)](#) and [Andreoni, Erard and Feinstein \(1998\)](#). Previous studies have identified the key drivers of tax compliance as (i) audits and other enforcement mechanisms ([Allingham and Sandmo 1972](#)), (ii) third-party reporting and information trails more generally ([Kleven et al. 2011](#)), and (iii) social motives, such as the desire to conform to social norms ([Singhal and Luttmer 2014](#)). We present withholding as an empirically important compliance mechanism which has been missing in the literature. Withholding is not only less costly to implement than audits or other forms of enforcement, but it is also conceptually distinct from standard enforcement, as it abandons the idea of incentivizing taxpayers to correctly report their income, and instead establishes a default tax remittance, based on a proxy of the tax liability (sales in our context). Firms play an important role in tax enforcement in general, as highlighted by [Kopczuk and Slemrod \(2006\)](#), and by acting as withholding and remittance agents in particular, as discussed in [Slemrod \(2008\)](#). Related empirical evidence from a study of diesel taxation ([Kopczuk et al. 2016](#)) shows that the identity of the remitting agent matters for tax incidence, with remitters at higher levels in the value-chain, and lower propensity for evasion,

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<sup>7</sup>Overall, withholding agents collected 10% of corporate income tax revenue and 20% of sales tax revenue in 2014.

achieving higher compliance and pass-through down-stream. A few policy reports ([Samanamud 2013](#), [OECD 2009](#)) and legal documents ([Soos 1990](#)) anecdotally describe the relationship between withholding and tax compliance among small firms, and an empirical study by [Carrillo, Emran and Rivadeneira \(2012\)](#) examines bunching at a withholding-rate kink, which the authors interpret as evidence of a (perceived) discontinuity in the audit function.<sup>8</sup> Our study, however, is the first to estimate the impact of withholding on compliance and identify the mechanisms through which this works.

Second, by identifying the default mechanism as one of the two channels through which withholding raises compliance, our study complements the behavioral economics literature on defaults, which shows that defaults can increase the adoption of desirable behaviors such as saving for retirement ([Chetty et al. 2014](#), [Thaler and Benartzi 2004](#), [Madrian and Shea 2001](#)) and enrolling for organ donation ([Johnson and Goldstein 2003](#)) – behaviors which agents that do not behave fully rationally may not adopt. Our setting differs from other default studies in that the agents we study (firms) are likely rational, and that the cost that discourages agents from abandoning the default may be a monetary rather than a psychological cost, although we cannot directly identify the cost. We thus show that a default can be used to induce a behavior such as tax compliance that even rational agents may not display.

Third, our study relates to the literature on taxation and development reviewed in [Besley and Persson \(2013\)](#).<sup>9</sup> It provides support for both the “information school of thought,” which argues that the expansion of information trails with development leads to a growth in tax revenue ([Kleven, Kreiner and Saez 2016](#)), as well as the “fiscal capacity school,” which argues that governments need to make conscious investments in fiscal capacity to grow their tax take ([Besley and Persson 2013](#), [Besley and Persson 2009](#)). The fiscal capacity school views the introduction of personal income tax withholding as one of the most important investments in fiscal capacity undertaken during the last two centuries, but provides only descriptive evidence to support this. We provide identified micro-empirical evidence on the importance of fiscal capacity in the form of tax withholding. Moreover, by showing that the particular type of withholding policy that we study, withholding on firms’ sales,

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<sup>8</sup>A large body of literature has analyzed personal income tax withholding, especially in the United States. These studies often focus on why individuals voluntarily over-withhold ([Barr and Dokko 2008](#), [Gandhi and Kuehlwein 2014](#), [White, Harrison and Harrell 1993](#), [Highfill, Thorson and Weber 1998](#)).

<sup>9</sup>Previous reviews of this literature include [Burgess and Stern \(1993\)](#) and [Ahmad and Stern \(1989\)](#).

is predominantly used in low- and middle-income countries, where other aspects of administrative capacity are weak, we extend the evidence in [Besley and Persson \(2013\)](#), [Gordon and Li \(2009\)](#) and [Keen \(2008\)](#) on the changing composition of tax instruments along the development path. We provide further evidence for the argument in [Best et al. \(2015\)](#) that it may be desirable in some low compliance contexts to distort production efficiency – which withholding on firms’ sales arguably does – to achieve higher revenue efficiency.

Finally, our study contributes to the literature on the role of third-party information in enhancing tax compliance. The theory that information trails help enforce taxes, proposed by [Kleven et al. \(2011\)](#) and [Kleven, Kreiner and Saez \(2016\)](#), is supported by empirical evidence from studies examining the value-added tax (VAT) in Chile ([Pomeranz 2015](#)), the Nota Fiscal Paulista program in Brazil ([Naritomi 2016](#)), and micro- and macro-level evidence on workforce formalization ([Jensen 2016](#)). Yet, while these papers show that information trails increases compliance, it remains unclear how far away from full compliance taxpayers remain. Other studies also highlight the limits of third-party information as a compliance mechanism, especially if firms can adjust less easily verifiable margins such as costs ([Carrillo, Pomeranz and Singhal 2017](#), [Slemrod et al. 2017](#)). We can reconcile these findings with empirical evidence from a novel setting by examining firms’ responses not to intensive-margin increases in information reporting (as in [Naritomi \(2016\)](#)), or to the use of preexisting reports (as in [Carrillo, Pomeranz and Singhal \(2017\)](#) and [Slemrod et al. \(2017\)](#)), but simply to the fact of being reported, which is arguably where the largest compliance response should be expected. As in [Carrillo, Pomeranz and Singhal \(2017\)](#) and [Slemrod et al. \(2017\)](#), we find that firms increase both sales and costs when reported for the first time, but we also show that their net tax liability increases sharply and substantially. We then proceed to show that, even in a context where third-party information is routinely used for enforcement, a non-negligible share of taxpayers remain non-compliant with these reports, suggesting a need for an alternative compliance mechanism.

The remainder of the paper is organized as follows. We start by describing a simple conceptual framework in Section [II.](#) Section [III.](#) describes the Costa Rican tax system and the administrative data used in the analysis. Sections [IV.](#), [V.](#) and [VI.](#) evaluate the impact of information reporting, the anatomy of compliance and the impact of withholding. Section [VII.](#) concludes.

## II. CONCEPTUAL FRAMEWORK

This section presents a simple conceptual framework for analyzing behavioral responses to third-party information reporting and withholding. The framework is based on the canonical tax-evasion model by [Allingham and Sandmo \(1972\)](#), extended by [Kleven et al. \(2011\)](#) and [Carrillo, Pomeranz and Singhal \(2017\)](#) to include third-party reporting for individuals and firms, respectively. We begin by describing the basic setup of the model with third-party reporting, then introduce withholding, and finally discuss two mechanisms through which withholding can impact compliance.

### *II.A. A Tax-Evasion Model with Third-Party Reporting*

The basic setup of our model follows [Carrillo, Pomeranz and Singhal \(2017\)](#). Firms have revenue  $R = R_T + R_S$ , where revenue can be either third-party-reported or self-reported, indexed by  $T$  and  $S$ , and firms declare  $\hat{R}$ . Firms have costs  $C = C_T + C_S$  and choose to report  $\hat{C}$ . The government levies tax at rate  $\tau$  on declared profits  $\hat{\pi} = \hat{R} - \hat{C}$ . The tax liability is  $T = \tau\hat{\pi}$ . With probability  $p$ , firms are audited, in which case any evasion is certain to be detected, and evaders pay a fine  $\theta$ , which is proportional to the evaded liability. Firms maximize expected utility over after-tax income in the audited and non-audited states  $Y_A$  and  $Y_N$ :<sup>10</sup>

$$EU = (1 - p)U(Y_N) + pU(Y_A) = (1 - p)U(\pi - \tau\hat{\pi}) + pU(\pi - \tau\pi - \theta\tau(\pi - \hat{\pi})).$$

To account for the tax authority's use of risk scores and third-party information to target audits, we again follow [Carrillo, Pomeranz and Singhal \(2017\)](#) by assuming that the audit probability is decreasing in the reported profit rate,  $p = p((\hat{\pi} + \varepsilon)/\hat{R})$  with  $p' < 0$ .<sup>11</sup> Misreporting against third-party information is automatically flagged and triggers the maximum audit probability:  $p = \bar{p} =$

<sup>10</sup>Similar to [Carrillo, Pomeranz and Singhal \(2017\)](#), we consider that modeling firms in a middle-income country context as risk-averse is reasonable, since more than half of the firms in our sample are unincorporated, and most firm owners are vulnerable to income volatility.

<sup>11</sup>The inclusion of  $\varepsilon$ , a small positive number, ensures that firms declaring zero profits on a large revenue base incur a higher audit probability than firms declaring zero profits on a small revenue base, thus differentiating the two corner cases where  $\hat{\pi} = 0$ .

$\max(p)$  if  $\hat{R} < R_T$ .<sup>12</sup>

We allow perceptions of the enforcement environment to vary across firms without imposing any structure on how these perceptions are formed. Consider first firms whose perceptions of the enforcement environment correspond to the truth, that is  $\tilde{p} = p()$  and  $\tilde{R}_T = R_T$ . As  $\varepsilon \rightarrow 0$ , a firm with  $R_T = 0$  sets  $\hat{R}^* = \hat{\pi}^*$  to satisfy the first order condition and  $\hat{C}^* = 0$ . The firm thus underreports revenue and does not even claim costs reported by a third party. When the information environment changes to  $R_T > \hat{\pi}^* > 0$ , for instance because a client starts reporting the firm's sales to the tax authority, the firm adjusts to  $\hat{R}^* = R_T$  and sets  $\hat{C}^* \geq C$  to satisfy the first-order condition. If the audit function is sufficiently steep, or the firm is sufficiently risk averse, the increase in  $\hat{C}$  is smaller than the increase in  $\hat{R}$ , and the firm increases its reported tax liability  $\hat{\pi}$ . We test this prediction in our event study of firm behavior after receipt of the first third-party report.

Now, consider firms that misperceive the enforcement environment, so that  $\tilde{p}() \geq p()$  and  $\tilde{R}_T \geq R_T$ . This is reasonable for many firms, as audits are rare events and the audit function is not public knowledge. Besides, third-party reporting mechanisms usually require third parties to report transactions to the tax authority, but not directly to the taxpayer, so taxpayers may be unaware of the exact value of  $R_T$ . Our second prediction suggests that, in this context, firms with  $\tilde{R}_T < R_T$  underreport sales compared to third-party reports, i.e.  $\hat{R}^* \leq \tilde{R} < R_T$ . We test this prediction in our anatomy of compliance by comparing firms' self-reports to third-party reports of sales and costs.

## II.B. Modeling Withholding

We introduce withholding into the model by assuming that tax is withheld at a rate  $\mu$  on third-party reported revenue  $R_T$ . The information reporting agent thus also acts as withholding agent. As revenue  $R_T$  is already reported to the tax authority, the introduction of withholding leaves the government's information set unchanged. We assume that the tax withheld can be fully reclaimed upon filing. This means that firms' net tax liability and hence tax remittance is  $P = T - \mu R_T$ , where the tax withheld is deducted from the gross tax liability. There are no restrictions on the sign of  $P$ ,  $P \geq 0$ , so that firms can request a refund if the reported tax liability is smaller than the tax withheld. In this model, firms' after-tax income in the audited and non-audited state of the

<sup>12</sup>As is standard in the literature, we ensure that the second-order condition on the firm's maximization problem is met and avoid non-concavities by imposing  $p'' \geq 0$ .

world are identical to after-tax income in the model without withholding:

$$\bar{Y}_N = \pi - \mu R_T - [\tau \hat{\pi} - \mu R_T] = Y_N ,$$

$$\bar{Y}_A = \pi - \mu R_T - [\tau \pi - \mu R_T] - \theta[(\tau \pi - \mu R_T) - (\tau \hat{\pi} - \mu R_T)] = Y_A .$$

Withholding should thus be irrelevant to firms' evasion decisions. This naive prediction, at odds with our empirical results, relies on two assumptions which we relax in the next section.

### *II.C. Withholding Impact Mechanisms*

This section examines firm behavior when relaxing the assumption of a full reclaim of tax withheld, and the (implicit) assumption that the perceived enforcement environment is unaffected by withholding.

*Default Mechanism.* If some taxpayers do not (fully) reclaim the withheld tax, withholding establishes a default which, *ceteris paribus*, increases total tax remittances. We distinguish three cases of non-reclaimers. The first are non-filers and late-remitters, i.e. tax-liable agents that do not file their tax declaration or delay remittance of reported liabilities. For these agents, withholding mechanically increases (the present value of) tax remittances. Second, consider tax-filers whose tax liability is less than the amount of tax withheld,  $T < \mu R_T$ . To fully reclaim the withheld tax, these agents must request a cash refund from the government, which often triggers a desk audit. Consequently, only firms that are otherwise fully compliant request a refund, and the default mechanism is triggered for previously non-compliant firms. Finally, consider tax-filers with a tax liability greater than the amount of tax withheld,  $T > \mu R_T$ . A fixed reclaiming cost can be enough to deter some of these firms from reclaiming the withheld tax.

To model this, assume that firms incur a firm-specific fixed cost  $f_i$ , which is distributed according to the cumulative distribution function  $H(f)$ , to reclaim the tax withheld  $\mu R_T$ . We are agnostic about the nature of this fixed cost. It could represent the administrative or mental cost of tracking how much tax has been withheld during each transaction and then adding up those amounts when preparing the tax return, or it could represent the (monetized) moral cost of reclaiming withheld tax while simultaneously misreporting tax liability.<sup>13</sup> The presence of the fixed cost generates a cutoff

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<sup>13</sup>In our setting, as long as firms do not request a refund from the government, the audit probability does not change discontinuously with a reclaim.

$\bar{f} = \mu R_T$  such that firms with  $f_i < \bar{f}$  reclaim the tax withheld, and firms with  $f_i \geq \bar{f}$  do not reclaim. This yields the testable predictions that (i) reclaiming of the tax withheld is incomplete if reclaiming costs are sufficiently high,  $H(\bar{f}) < 1$ , and (ii) firms with larger amounts of withheld tax (either due to higher  $R_T$  or higher  $\mu$ ) are more likely to reclaim,  $\partial H(\bar{f})/\partial R_T > 0$  and  $\partial H(\bar{f})/\partial \mu > 0$ .<sup>14</sup>

*Enforcement-Perceptions Mechanism.* Our baseline model implicitly assumes that taxpayer perceptions of enforcement,  $\tilde{R}_T$  and  $\tilde{p}()$ , are not affected by withholding. Yet withholding agents must inform the taxpayer of the amount of tax withheld to enable the taxpayer to reclaim it. For instance, credit-card companies provide client firms with a monthly statement listing the volume of transactions processed, the commission due, and the tax withheld, if any.<sup>15</sup> Such a statement can prompt taxpayers to update their enforcement perceptions either by providing new information or by making known information more salient (Chetty, Looney and Kroft 2009, Finkelstein 2009). Specifically, the statement conveys that an amount  $\mu R_T$  of tax was withheld and remitted to the tax authority, hence the value of  $R_T$  was communicated to the tax authority, and the tax authority employs credit-card companies for tax compliance purposes. Even though  $R_T$  and  $p()$  do not change, withholding can thus lead taxpayers to update  $\tilde{R}_T$  and  $\tilde{p}()$  and increase reported sales  $\hat{R}_T$  and tax liability  $\hat{\pi}$  accordingly.

For example, for taxpayers that are initially unaware of third-party reporting, the introduction of withholding raises  $\tilde{R}_T$  from 0 to  $R_T$  and moves reported profits from  $\hat{\pi}^*(0)$  to  $\hat{\pi}^*(R_T)$ , where  $\hat{\pi}^*(R_T) > \hat{\pi}^*(0)$  if  $\tilde{p}' \neq 0$ . Other taxpayers may have a perceived audit probability of  $\tilde{p}$ , which is an increasing function of the number of times they have witnessed tax enforcement in practice, either by observing an audit or receiving a communication from the tax authority. Taxpayers would then revise  $\tilde{p}$  upwards when confronted with tax withholding and increase  $\hat{\pi}$ .

In any case, updating is more likely among firms that have previously misreported their taxable

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<sup>14</sup>The reclaiming cost may also affect taxpayers' reporting behavior. Absent any behavioral response, firms that reclaim withheld taxes experience a decrease in their after-tax income of  $f_i < \mu R_T$  in both states of the world. Firms that do not reclaim withheld taxes experience a decrease of their after-tax income of  $\mu R_T$  in the non-audited state only; in the event of an audit, the tax withheld is re-credited by the tax authority against any outstanding liability. Under an assumption of decreasing absolute risk aversion, as in Allingham and Sandmo (1972), reclaiming firms declare  $\hat{\pi}_R$  and non-reclaimers declare  $\hat{\pi}_{NR}$  with  $\hat{\pi}_R > \hat{\pi}^* > \hat{\pi}_{NR}$ , where  $\hat{\pi}^*$  is the taxpayers' optimum in the baseline model without any reclaiming cost. For reclaiming firms, the increase in reported tax liabilities should be driven by a decrease in  $\hat{C}$  rather than an increase in  $\hat{R}$ , as the latter would simultaneously increase the audit probability. In our empirical application the increase in reported tax liabilities is driven by an increase in  $\hat{R}$ , with no change in  $\hat{C}$ , suggesting that the reporting change is not due to the fixed reclaiming cost.

<sup>15</sup>See Figure AII and section III.C. for more details on reporting requirements.

income compared to third-party reports  $R_T$  (and hence must misperceive  $p()$  or  $R_T$ ), firms that are subject to withholding for the first time (and hence experiencing tax remittance through a credit-card company for the first time), and firms that reclaim the tax remitted (and hence must have taken note of the information on the credit-card statement). We thus test the predictions that (i) an increase in the withholding rate prompts firms to increase their reported tax liability, and (ii) that this effect is larger among the aforementioned subsamples.

### III. CONTEXT AND DATA

We test the predictions of our conceptual framework using policy variation and administrative tax records from Costa Rica, where tax revenue is predominantly derived from income taxes on firms and a VAT-style sales tax. This section describes Costa Rica’s income and sales tax regimes, examines the compliance mechanisms used to enforce taxes, and details the administrative data used in the analysis.

#### *III.A. Income Tax*

For all firms, income tax is levied on taxable profits. Tax declarations are filed annually by December 15, with three quarterly advance remittances due in March, June, and September.<sup>16</sup> While all firms use the same tax declaration, the tax-rate schedule differs between corporations and self-employed individuals (i.e., unincorporated firms). Self-employed filers face a standard kinked tax schedule on profits with five tax brackets. As Table I shows, the location of all the kinks is adjusted annually to reflect the expected inflation rate. The marginal tax rates that apply to incomes in the five brackets are 0%, 10%, 15%, 20%, and 25%, respectively. These rates did not change over the 2006-2015 period.

Corporations face a notched tax schedule on revenue with three tax brackets and no exempt amount. A firm’s revenue determines its average tax rate, which is then applied to profits. As above, notch locations are adjusted annually for inflation, and the average tax rates of 10%, 20%,

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<sup>16</sup>Fiscal year  $t$  in Costa Rica starts on October 1 in year  $t - 1$  and ends on September 30 in year  $t$ . Taxpayers can request to remit taxes according to a different fiscal schedule, which we account for in our analysis. Each quarterly advance remittance is a quarter of either the previous year’s tax liability or the average liability over the last three years, whichever is higher.

and 30% were unchanged during the 2006-2015 period.<sup>17</sup> The annual adjustment of kink and notch locations generates 60 different thresholds over the period – all but three at non-round numbers – facilitating the identification of bunching driven by tax-rate changes.

### *III.B. Sales Tax*

Costa Rica levies a monthly sales tax, which is effectively a VAT with an invoice-credit system, i.e. deductability of tax paid on inputs, but with a narrow base. The tax base includes most goods and some retail services (e.g. hotels and tailors), but it excludes professional services (e.g. lawyers and doctors). Only firms remitting tax on their sales can deduct tax paid on their inputs. The sales tax rate was constant at 13% for the entire period of our study, with reduced rates of 10% and 5% levied on wood and residential electricity, respectively.

Retailers in certain sectors and below certain size thresholds<sup>18</sup> can opt into a simplified regime that unifies income and sales taxes. This regime levies taxes on inputs at sector-specific rates that vary from 3% to 9.8%. Firms file and remit tax quarterly and are not subject to tax withholding by credit-card companies.

### *III.C. Compliance Mechanisms*

The Costa Rican tax authority uses third-party information reporting and withholding to enhance tax compliance among firms. Under this system, a third-party informant submits one “informative declaration” for each transaction partner specifying the tax identification numbers of both the informant and the taxpayer, the transaction amount, the tax withheld if applicable, and the income or transaction type. The relevant informative declarations are listed in Table III. All information reporting and withholding mechanisms apply in the same way to self-employed individuals and corporations. The tax authority uses informative declarations, as well as customs declarations on imports and exports, to automatically cross-check taxpayers’ self-reported tax declarations. Taxpayers with large discrepancies between third-party information and self-reported

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<sup>17</sup>Wage earners are taxed according to another tax schedule, which features three tax brackets with marginal rates of 0%, 10%, and 15%, respectively. The highest kink for wage earners is below the lowest kink for self-employed individuals.

<sup>18</sup>These include having annual purchases equal to less than 150 base salaries, owning fixed assets equal to less than 350 base salaries, and employing fewer than six workers. The base salary is a national accounting unit equivalent to CRC 424,000 (US\$764) in 2016.

information are selected for intensive margin controls or audits. The exact selection algorithm is not public and changes from year to year.

*Information Reporting.* A firm must report firm-to-firm purchases and sales if its cumulative annual transactions with a single partner reach 2.5 million Costa Rican colones (CRC), equivalent to US\$4,365.<sup>19</sup> The payment of rent, commissions, professional-service fees, or interests must be reported if annual transactions with a single transaction partner reach CRC 50,000 (US\$87). These reports are purely for information purposes and are not linked to tax withholding.<sup>20</sup>

*Withholding.* State institutions and credit-card companies act as both third-party informants and withholding agents. State institutions report all purchases from the private sector and withhold 2% of the transaction amount, which is remitted to the tax authority and creditable against the taxpayer's income tax liability.<sup>21</sup> credit-card companies report all sales processed through card machines and withhold taxes at a firm-specific rate, which varies from 0 to 6%. The withheld tax is creditable against the firm's sales tax liability. Withholding agents remit the withheld tax to the tax authority the day after the transaction takes place and thus receive almost no liquidity benefit. Compliance with withholding obligations is high, as discussed in section VI.A..

The sales tax withholding system generates the key variation used in this paper. Table II shows the withholding-rate schedule for the sales tax. Prior to August 2011, the withholding rate was determined by a notched schedule on the value-added rate. Valueadded is defined as tax-liable sales net of tax-liable purchases and imports, where tax-liable refers to the sales tax. The notches are located at 5%, 20%, 30%, 40%, 55%, and 75% of value added. All notches are associated with a one percentage-point increase in the withholding rate. Prior to August 2011, 40.3% of firms subject to credit-card transaction reporting faced a withholding rate of 0%, and only 21.8% faced the maximum rate of 6%. In August 2011, in an effort to better align withholding rates with sales tax liability, the authorities consolidated the withholding-rate schedule to three rates of 0%, 3%,

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<sup>19</sup>As of October 5, 2017, US\$1 was equal to CRC 573.

<sup>20</sup>Firms provide these reports only to the tax authority and not to each other, but each firm should be aware of whether it is being reported, as transactions above the reporting threshold must be reported by both the supplier and the client.

<sup>21</sup>A small number of companies also withhold taxes on the purchase of certain specified services (e.g., transportation, communications) from foreign firms. However, this type of withholding applies to just 2% of corporations and 0.8% of self-employed individuals and is thus not considered in our study.

and 6% and changed the rate-determination methodology. As exports are exempt from the sales tax, the rates are now based on the share of domestic sales in total sales, with notches at 0% and 50%. Since the reform, 68.7% of firms subject to credit-card reporting have faced a withholding rate of 6%.

Importantly, firms were not able to manipulate the withholding rates assigned to them at the time of the reform. This is because withholding rates for semester  $t$  are always based on or domestic sales reported in firms' tax declarations in semester  $t - 2$ .<sup>22</sup> Each semester, the tax authority calculates the firm-specific withholding rates and communicates them to the withholding agents. Only in special circumstances (e.g. consecutive annual losses) are firms able to request a reduction in their withholding rate before the end of the semester. In this case, the realized withholding rate may differ from the rate predicted by value added or share of domestic sales reported in semester  $t - 2$ .

Withholding agents are required to provide firms with a receipt confirming the amount of tax withheld. Appendix Figure AII shows the structure of a standardized credit-card machine statement, in which the card company informs its client of the volume of transactions processed, the commission charged, the tax withheld, and the total amount due to be transferred from the card company to the client firm. Because a specific column in this statement is dedicated to tax withholding, taxpayers should know whether or not they are subject to withholding, and a change in the withholding rate from 0% to any positive rate should be very salient.

Taxpayers can deduct (or “reclaim”) the amount of tax withheld from their gross income or sales tax liability on the relevant tax declaration, either during the same fiscal period or in future fiscal periods through the tax-return box marked “compensation request”. If the taxpayer has reported zero tax liability for three consecutive months, and therefore has no liability from which to deduct withheld taxes, the taxpayer can submit a “refund request” form. Such a request requires detailed information on the withholding agent, including the amount of tax withheld and the timing of withholding, as well as confirmation that the taxpayer has no outstanding tax liabilities of any other kind. Refund requests are evaluated on a case-by-case basis, often involving manual checks of the taxpayer's record, and the process can take several months.

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<sup>22</sup>The two semesters extend from January to June and from July to December.

### *III.D. Data*

Our analysis combines tax-return data and third-party information and withholding reports from the Government of Costa Rica. The tax-return data include the universe of income tax declarations for 2006-2015 and sales tax declarations for 2008-2015, as well as the corresponding remittance (payment) receipts. Since 2006, all tax returns have been digitized, and electronic filing has gradually been introduced for the different declarations, resulting in a highly accurate dataset. The EDDI-7 filing software automatically validates the internal consistency of filed returns. The data contain all tax-return line items, including firm type and sector, income sources, cost items, deductions, gross and net liability, and tax remittance. The final dataset contains 112,000 to 260,000 self-employed individuals per year, as well as 90,000 to 150,000 corporations and 58,000 to 70,000 sales tax filers per month.

We merge the tax records with all third-party reports for the period 2006-2015. These data have been filed electronically through the DECLAR@7 system, which conducts similar validation checks as EDDI-7. Table III provides an overview of the number of records and their coverage. Firm-to-firm transaction reports have both the largest number of observations and the widest coverage, as they are available for approximately half of all firms. This coverage rate is similar for both self-employed individuals and corporations. The filing of informative declarations is more concentrated than the coverage, meaning that a smaller share of firms act as informants.

The coverage of withholding by state institutions and credit-card companies is much lower than the coverage of firm-to-firm information reporting, especially for self-employed individuals. Withholding reports by state institutions and card companies are available for only 5.0% and 5.8% of self-employed tax filers and 8.4% and 11.5% of corporate filers, respectively.<sup>23</sup> A significant share of third-party reports cannot be matched to income tax records, suggesting that a large number of firms covered by reporting or withholding are non-filers.

In addition to tax returns and third-party reports, we use the registration and deregistration records for 2006-2014 to reconstruct the tax register for each fiscal period.

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<sup>23</sup>As indicated by the percentages in squared brackets in Table III, the coverage of credit-card reports among sales tax-liable firms is higher, since they constitute only a small subsample of income taxpayers.

## IV. THE IMPACT OF INFORMATION REPORTING

This section presents estimates of the impact of third-party information on self-reported taxable income. We begin by analyzing the heterogeneity of bunching—a proxy for misreporting—across subsamples of firms with different degrees of third-party information coverage. We then conduct an event study of firms’ responses to the first third-party report.

### IV.A. *Heterogeneity in Bunching*

Numerous studies have used bunching at kinks or notches in the tax schedule to estimate how reported taxable income responds to changes in the tax rate. Bunching is usually shown to be driven by tax evasion or avoidance rather than a real response (e.g. [Bachas and Soto 2016](#), [Almunia and Rodriguez 2015](#), [Seim 2017](#)). In Costa Rica, we observe large and sharp bunching at the first kink for self-employed individuals and at the first notch for corporations. Bunching moves every single year with the location of the kink, as shown in Figure [AI](#) for self-employed individuals.<sup>24</sup> This speedy adjustment supports the interpretation of bunching as a reporting response rather than a real production change.<sup>25</sup> We thus use bunching as a proxy for misreporting.

To examine the heterogeneity of bunching with the coverage of third-party information, we pool the data for 2006 to 2015 and display the distribution as a percentage difference from the year-specific threshold location in 1% bins. To estimate the size of bunching, we fit a flexible polynomial to the observed distribution, excluding a range around the thresholds, as is standard in the bunching literature ([Chetty et al. 2011](#), [Kleven and Waseem 2013](#)). Given the asymmetric nature of bunching, we estimate bunching to the left of the kink and the missing mass to the right of the kink. As the missing mass does not seem to be the same size as the excess mass, at least for self-employed filers, we apply the estimation strategy suggested by [Best and Kleven \(2017\)](#) rather

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<sup>24</sup>The first threshold in each schedule is the most salient one, and also the largest in terms of the tax rate change for the self-employed. We focus on this threshold, considering [Chetty et al. \(2011\)](#) who argue that larger kinks generate disproportionately larger bunching, as the size of the tax incentive allows some taxpayers to overcome optimization frictions that would otherwise prevent them from bunching.

<sup>25</sup>Strikingly, the excess mass is always concentrated to the left of the kink, and in some years the distribution exhibits a missing mass to the right of the kink. Such asymmetric bunching at kinks is at odds with the prediction of standard utility theory ([Kleven and Waseem 2013](#)) and might instead reflect reference-point dependence ([Kleven 2016](#)). While caution should be exercised when using bunching to estimate the elasticity of taxable income, this does not prevent us from interpreting bunching as a measure of misreporting that generates a revenue loss for the government.

than the convergence method.<sup>26</sup>

Figure II displays the observed distribution (dotted blue line), the estimated counterfactual (solid red line), and excess-mass and missing-mass estimates for different subsamples. The top row (A) shows the distribution of taxable income for self-employed individuals around the first kink; the bottom row (B) shows the distribution of revenue for corporations around the first notch. Among both firm types, the largest excess mass is found in the sample of firms not subject to third-party reporting (panel 1). The subsample of firms subject to third-party reporting (panel 2) still exhibits a large excess mass around both the kink and the notch, but in both cases the excess-mass estimate is significantly smaller than the estimate for firms not subject to third-party reporting. The excess mass drops from 4.5 to 2.08 for self-employed individuals and from 4.49 to 3.17 for corporations, and those changes are statistically significant at the 1% level.<sup>27</sup> The fact that bunching is smaller but still highly significant, among firms subject to third-party reporting is consistent with the fact that bunching can be partly driven by legal avoidance, and that the information trail is incomplete, covering only large and electronic transactions.

Third-party reporting by state institutions and credit-card companies, which also act as withholding agents, is associated with a further reduction in misreporting (panels 3 and 4). For self-employed filers, the excess mass among firms subject to state reporting is similar to the excess mass among firms subject only to third-party reporting by other firms, but the excess mass drops to 0.52 for firms subject to reporting by credit-card companies. For corporations, the excess mass drops to 1.44 and 1.35, respectively, for firms subject to reporting by state institutions and credit-card companies. Once again, these changes are highly statistically significant. While the heterogeneity of bunching across subsamples captures a correlation rather than a causal relationship, it is consistent with a compliance impact of third-party information reporting and an even stronger impact of withholding.<sup>28</sup>

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<sup>26</sup>We choose the lower bound of the excluded range as the point where bunching starts and the upper bound as the point where the derivative of the observed distribution shifts from positive to negative. The convergence method would require the missing mass and the excess mass to be of the same size and assumes that there are no extensive-margin responses, which is unlikely in our context due to the large share of non-filers.

<sup>27</sup>Note that the change in the missing-mass estimate is driven by a change in the counterfactual density that scales the excess mass, rather than by a change in the absolute size of the excess mass. The missing mass drops for corporations, but increases for self-employed individuals. In fact, the missing mass for the latter is clearly visible only in panels 2 and 3. This suggests that some self-employed individuals in subsample may erroneously perceive the threshold to be a kink not covered by third-party reporting.

<sup>28</sup>Our results are also consistent with audit-based estimates from the United States, where the Internal Revenue

## IV.B. *Event Study*

To move towards estimating a causal effect of information reporting, we exploit within-firm variation across time in the coverage of information reporting. Each year, over a thousand Costa Rican firms become subject to third-party reporting for the first time. Our conceptual framework predicts that, among firms which correctly perceive the enforcement parameters, third-party reporting of sales  $R_T$  imposes a lower bound on reported taxable sales  $\hat{R}$ , and an increase in  $R_T$  weakly increases reported sales and profits.

We thus conduct an event study of firm behavior around the time of its first third-party report. We distinguish reports by the different informing agents, which may be other firms, state institutions, or credit-card companies.<sup>29</sup> We are mindful of two identification challenges. First, whether or not a firm becomes subject to third-party reporting is partly under the firm's control. A firm is almost certain to be reported to the tax authority if it provides goods or services to a state institution or executes transactions via a credit-card machine. Conducting transactions with another firm above the relevant annual threshold should also trigger a report to the tax authority; however, other firms may be less likely to comply with their reporting obligations than state institutions or credit-card companies, and transacting partners could collude to avoid reporting.<sup>30</sup> Second, a new transaction that triggers third-party reporting may increase not only the share of true taxable income that is reported to the tax authority, but also the amount of true taxable income itself, which would raise reported taxable income even if the share of income that is reported remained unchanged. For instance, securing a government contract has been shown to accelerate firm growth (Ferraz, Finan and Szerman 2016), and offering consumers the opportunity to pay by credit card may enable firms to attract additional customers. While there are no credible estimates

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Service reports tax evasion rates of 63%, 7% and 1%, respectively, on income covered by little third-party reporting, income covered by substantial third-party reporting, and income subject to withholding (IRS 2016).

<sup>29</sup>The Costa Rican tax authority does not notify taxpayers about the third-party reports it receives. However, given the structure of reporting requirements, each firm should be aware of the informative declarations made to the tax authority regarding its business activities. Each inter-firm transaction above the relevant threshold needs to be reported by both the seller and the buyer. State institutions and credit-card companies acting as withholding agents are required to provide taxpayers with a receipt stating the amount of tax withheld, and they are considered to be highly compliant with this requirement, according to the author's discussion with the tax authority and with firms.

<sup>30</sup>Incomplete compliance with third-party reporting obligations is not a concern for our analysis, which seeks to identify the impact of actual (observed) third-party reports rather than that of reporting obligations, as the former is the policy-relevant effect.

of the potential size of these demand effects, they are unlikely to drive our estimates, as we discuss below.

To address these two identification concerns, we consider the event group  $E$  of firms that become subject to third-party reporting for the first time at event time  $k = 0$  and a control group  $C$  of firms that have not become subject to third-party reporting by  $k = 0$ . As a precaution, but without substantively modifying the core results, we follow [Hilger \(2016\)](#) and [Naritomi \(2016\)](#) in re-weighting the control group to resemble the treatment group’s pre-event trend. For each event period, we estimate the firms’ propensity score of being reported by a third party for the first time.<sup>31</sup> Following [DiNardo, Fortin and Lemieux \(1996\)](#), we re-weight the control group by quintile bins of the propensity score to match the distribution of the event group. We consider the event’s impact on both income tax declarations and sales tax declarations. For the income tax, we consider a balanced panel of firms that we can observe for at least four years before and three years after the event, allowing us to evaluate events happening in event periods  $p = \{2010, 2011, 2012\}$ . For the sales tax, we consider a balanced panel of firms that we can observe for at least five months before and after the event, allowing us to evaluate events happening in event periods between February 2009 and August 2014.<sup>32</sup>

Each panel in [Figure III](#) displays the trend in reported taxable income for the event group (orange dots) and the control group (blue crosses), scaled by the pre-event average, along with the difference-in-difference coefficient obtained from estimating

$$y_{ipk} = \gamma_k + \alpha_{ip} + \beta \cdot I\{k \geq 0, g = E\} + u_{ipk}. \quad (1)$$

The unit of observation in this estimation is a firm  $i$  in event period  $p$  at event time  $k$ . We estimate the firm’s reported taxable income as a function of event-time dummies  $\gamma_k$ , firm-event-period fixed effects  $\alpha_{ip}$ , and the post-event and treatment group dummy  $I\{k \geq 0, i \in E\}$ .<sup>33</sup>

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<sup>31</sup>This propensity score is estimated separately for each declaration type and event year/month using firm-type and tax-administration dummies and the two lags of a third-order polynomial of total income and taxable income. See [Yagan \(2015\)](#) for a detailed description of the re-weighting procedure.

<sup>32</sup>The results are robust to the inclusion of fewer or more event periods and remain robust when propensity scores are not re-weighted.

<sup>33</sup>A firm could, for example, be in the control group for events happening in 2010 and 2011, but in the treatment group for events happening in 2012. Each firm-year observation for this firm would appear in the event dataset three times, for event years 2010, 2011, and 2012. Firm-event-period fixed effects and clustering of standard errors at the

For most firms, the first transaction partner that reports to the tax authority is a supplier providing a report about the firm's purchase. As panels A1 and B1 of Figure III show, this first third-party report is associated with a 26% increase in reported taxable income for self-employed individuals and a 49% increase for corporations.<sup>34</sup> This large effect emerges precisely at event time, after otherwise identical trends in the event and control groups. The entire treatment effect materializes in the event period, after which the event and control group immediately return to parallel trends. This is perfectly consistent with a reporting response but difficult to reconcile with a real growth effect, which would emerge less suddenly and prove more persistent.

Over time, firms gradually become subject to more third-party reports, including reports from their clients. This event, which happens an average of one year after the first supplier report, is considered in panels A2 and B2. The first client report is associated with a much smaller increase in taxable income than the first supplier report, likely because part of the relevant transactions have already been reported to the tax authority in response to the first supplier report. Once again, the effect size is larger for corporations than it is for self-employed individuals (25% vs 9%).

Reporting by state institutions or credit-card companies (panels A3-B4) has a relatively homogeneous effect on self-employed individuals and corporations<sup>35</sup>, leading to a 21-26% increase in reported taxable income for both sample groups.<sup>36</sup> Although most firms that become subject to reporting by a state institution or a credit-card company are already subject to reporting by other firms, these new reports expand the coverage of third-party-reported transactions and should therefore have an additional effect on self-reporting. In all figures, the event and control group follow

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firm level account for the potentially repeated appearance of firm-year/firm-month observations. Outcomes are in levels rather than logs to include the large number of firms with zero values and are winsorized at the 95th percentile to limit the influence of outliers. The results are qualitatively similar in a simple event study without a control group, in which we estimate coefficients for each event time.

<sup>34</sup>The smaller effect for self-employed individuals might be due to the lower tax rates applied to these firms, as well as the presence of an exemption allowing firms whose true income is below the exemption threshold to file without remitting any tax.

<sup>35</sup>The effect is likely similar for both firm types because although these events are especially relevant for firms with higher profit levels, self-employed individuals and corporations face similar marginal tax rates.

<sup>36</sup>Consistent with the fact that firms under-report both sales and costs, the taxable-income response to all events is driven by a similarly sized percent increase in reported sales and reported costs, as the numbers in squared brackets demonstrate. Note also that the increase in reported taxable income (reported tax liability for the sales tax) is associated with an increase in the reported profit rate (reported value-added rate for the sales tax). For reporting by credit-card companies (last two panels), we use the reported tax liability (rather than reported taxable income) as the outcome variable; sales tax collected and input tax credits deducted (rather than sales and costs) are used for the decomposition, as these variables are available on monthly sales tax declarations.

almost identical trends until the event, and then diverge precisely at event time  $k = 0$ <sup>37</sup>, until the difference between the two groups stabilizes at approximately  $k = 1$ . In the monthly sales tax data, the event group has a slightly higher pre-event growth rate than the control group, but the sudden divergence in the event month still supports a causal interpretation of the effect.

## V. THE ANATOMY OF COMPLIANCE

Having shown that third-party reporting substantially increases reported tax liability, we now study whether taxpayers subject to third-party reporting fully comply with their tax obligations. Our conceptual framework suggests that this should be the case if taxpayers correctly perceive the enforcement parameters  $R_T$  and  $p()$ , but not if taxpayers misperceive those parameters. Following [Fisman and Wei \(2004\)](#), we examine compliance by comparing two data reports on the same tax base. We consider successively the extensive, intensive and remittance margin of compliance.

### V.A. *The Extensive Margin*

To examine compliance on the extensive margin, we construct the set of tax-liable firms based on all tax declarations, third-party reports, and registration reports, and compare it to self-reported income tax and sales tax declarations. The algorithm to identify tax-liable firms is described in detail in the appendix.<sup>38</sup> Table IV reports the share of non-filers for different taxes and subsamples. The overall share of non-filers for the income tax is substantial in all years and rose from 38% of tax-liable firms in 2010 to 55% in 2013 (panel A, column 1). Non-filing for the sales tax seems less prevalent at about 20% of tax-liable firms, which is consistent with the self-enforcing nature of Costa Rica’s VAT-like sales tax. However, identifying non-filers is more difficult for sales tax than for income tax, as third-party reports provide no information on which firms are liable for sales tax. The majority of the sales tax non-filers that we identify are registered firms that file only intermittently. By contrast, the majority of income tax non-filers are identified through third-

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<sup>37</sup>The only exception to this pattern are corporations receiving a first sales report from other firms (fourth panel), whose trend diverges from the control group at  $k = -1$  rather than  $k = 0$ .

<sup>38</sup>Note that our algorithm is more conservative than the tax authority’s own algorithm, which considers firms to be tax-liable if they have filed in the past three years and have not deregistered since. Appendix Table AI reports estimates using a more lenient algorithm, which goes back three years for income tax and 12 months for sales tax. The estimates are marginally higher for the income tax and about one-third higher for the sales tax. The three-year window reflects the tax authority’s practice of deregistering a firm *de officio* if it has not filed a tax declaration for three years.

party reports (column 2). This suggests that although third-party information helps identify taxable activities, it does not necessarily induce reported firms to comply with their tax-filing obligations.

An analysis of filing behavior across firm types shows that non-filing rates are generally lower for registered firms (panel B, column 1). Among registered firms, non-filing rates are lower for corporations than for self-employed individuals (columns 2 and 4).<sup>39</sup> The coverage of third-party reporting is also correlated with tax filing among registered firms, as theory would predict (columns 3 and 5), and this correlation is stronger for corporations. Non-filing rates are significantly lower among firms reported by state institutions or credit-card companies than among firms reported only by their suppliers or clients (panel C). This suggests that reporting mechanisms have a stronger compliance impact when accompanied by withholding.

To proxy the loss of tax revenue due to non-filing, we estimate that the share of undeclared sales represents 16-23% of declared sales and that the estimated share of unreported income tax liabilities represents 7-10% of reported liabilities (panel A, columns 4 and 5). The estimates rely on non-filers' third-party-reported sales or their most recent available tax return. It is assumed that the distribution of profit rates by firm size is similar for non-filers and filers and that the tax schedule is applied according to Costa Rican law (see the notes to Table IV for details).

As our data does not capture firms that are fully informal and do not transact with any third-party reporting agents, our estimates provide a weak lower bound for extensive-margin compliance gaps. However, they should still capture the policy-relevant subsample of extensive-margin non-compliers. Indeed, while several studies find that formalizing fully informal firms is difficult and costly (de Mel, McKenzie and Woodruff 2013, Bruhn and McKenzie 2014), Brockmeyer et al. (2017) show that low-cost deterrence messages can significantly increase filing rates among firms known to the tax authority, especially those covered by third-party reporting.

### *V.B. The Intensive Margin*

To examine compliance on the intensive margin, we compare taxpayers' self-reports and third-party reports, for sales and costs respectively. We construct a taxpayer's third-party reported sales as the sum of sales reported by other firms (the taxpayer's clients), state institutions, and credit-

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<sup>39</sup>Note that column 1 in panel B is not the average of columns 2 and 4, as column 1 also includes firms for which the firm-type indicator, which identifies self-employed individuals and corporations, is missing.

card companies, as well as sales recorded in export data from the customs service. A taxpayer's third-party-reported costs (purchases) are the sum of sales reported by the taxpayer's suppliers as well as purchases recorded in import data. Firms reporting an amount at least 0.25% smaller than the relevant comparison amount are defined as "under-reporters," while firms reporting an amount at least 0.25% larger than the relevant comparison amount are defined as "over-reporters."

Table V shows estimated under-reporting for tax year 2012, distinguishing sales reports and cost reports and self-employed individuals from corporations. Panel A focuses on income tax under-reporting, panel B on estimating under-reported income tax liability, and panel C on the internal consistency between the income tax and sales tax.<sup>40</sup>

While 16% of self-employed individuals and 13% of corporations under-report sales compared to third-party reports, the share of firms under-reporting their costs is even higher, at 51% for self-employed individuals and 35% for corporations (row 1). This indicates that firms not only under-report sales, they also under-report the scale, which is consistent with the findings of Carrillo, Pomeranz and Singhal (2017). The presence of an exempt tax bracket in the self-employed tax schedule explains the larger share of cost under-reporters among self-employed individuals. While under-reporters leave 41-46% of their third-party-reported sales and 36-40% of their third-party-reported costs unreported (row 5), these amounts represent about 20% of total third-party reports (row 6). The share of unreported sales in total third-party-reported sales is slightly larger than the share of sales under-reporters, at least among corporations, suggesting that under-reporters are not disproportionately likely to be small firms (rows 1 vs 6, column 2). The share of under-reported costs in total third-party-reported costs is significantly smaller than the share of cost under-reporters (rows 1 vs 6, columns 3 and 4). This suggests that although cost under-utilization is widespread, it is modest in scale.

With a few assumptions, we estimate that if all third-party-reported sales were declared, reported tax liability would increase by 19% for corporations and by 48% for self-employed individuals (row 11).<sup>41</sup> The especially large increase among self-employed individuals is driven by their

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<sup>40</sup>Estimating under-reporting for sales tax is more challenging, due to its narrow base and the fact that third-party reports do not distinguish between sales that are liable for sales tax and those that are not.

<sup>41</sup>We assume that under-reporters declare all third-party-reported sales, apply the initially reported profit rate to their initially unreported sales, and then apply the tax schedule. This means we allow under-reporters to offset additional reported sales with additional reported costs in proportion to their initial declared profit rate. This assumption is

high initial reported profit rates, given the exempt tax bracket. However, self-employed individuals report tax liabilities that are, on average, much smaller than those reported by corporations. If all third-party reported sales were declared and taxed, overall income tax revenue from firms would increase by about 22%.

Combining estimates from the extensive and intensive margin indicates that fully enforcing compliance with third-party reports could boost income tax revenue by up to 30%. However, enforcement is costly, and the limited impact of desk audits (phone calls to misreporting taxpayers requesting that they file an amended tax declaration) suggests that it is unlikely to substantially increase compliance rates. Figure IV displays the results of desk audits for the income tax (panel A) and the sales tax (panel B). Comparing a firm's initial tax return to the post-audit amended return, the figure plots the change in reported costs against the change in reported revenue (the change in reported input tax credit against the change in sales tax collected in panel B). The figures focus on the small share of desk-audited firms that actually amend their declarations in response to the desk audit: 19% of firms for income tax and 16% for sales tax. Firms that amend their declarations clearly offset increases in reported revenue by increasing reported costs. Such changes offset each other by almost 100% for income tax and by about two-thirds for sales tax. On average, firms that file an amended declaration more than double their reported tax liability, as their initial reported liability is extremely low, but the number of such firms and their aggregate liability are so small that amended declarations increase total revenue by less than 0.5%.<sup>42</sup>

### *V.C. The Tax Remittance Margin*

Finally, to examine taxpayers' compliance with the obligation to remit their net tax liability, we match income and sales tax returns with remittance records (payment receipts). Importantly, Costa Rican remittance records display the remittance date, the tax period, and the taxpayer to which each remittance corresponds, allowing us to exactly match remittances with liabilities. To our knowledge, this is the first attempt to estimate remittance compliance for the income and sales tax

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supported by evidence from Carrillo, Pomeranz and Singhal (2017) and Slemrod et al. (2017), and it is consistent with firms' response to desk audits discussed below.

<sup>42</sup>Whether it is optimal for the tax authority to invest in desk audits rather than full audits or follow-up communications with non-filers or late payers depends on the relative revenue elasticities of these different enforcement methods. See, e.g., Keen and Slemrod (2017).

and to test the previously implicit assumption that declared tax liabilities automatically translate into tax remittances.<sup>43</sup> The relevant liability is the taxpayer's final tax liability and is to be remitted per the final (amended) tax declaration, after deductions, advance remittances, and withheld taxes have been subtracted. We compare this liability to each taxpayer's final tax remittance, excluding remittances made by withholding agents and advance remittances made by the taxpayer.<sup>44</sup> We then take the share of remittance over liability for each taxpayer, and average this share across all taxpayers in each fiscal period.

The results are displayed in Figure V, where panel A corresponds to the income tax and panel B correspond to the sales tax, and the thick blue and thin red lines correspond to corporations and self-employed individuals, respectively. In both panels, the average remittance share is below 100% in all fiscal periods and decreases in more recent periods, dropping to 85% for the sales tax and 70% for the income tax in the most recent period considered (solid lines). This pattern is clear despite the fact that we consider remittances made until April 2015, the remittance deadline for fiscal year 2014. There are two potential explanations for this downward sloping profile of the average remittance rate: delayed remittance and diminished compliance. If taxpayers remit tax only after a substantial delay, then more recent periods will mechanically display lower remittance rates than earlier periods, for which a longer data series is available. It is also possible that a rising number of firms is failing to remit tax entirely, and these two explanations are not mutually exclusive.

To distinguish these two explanations, we add two more remittance profiles, considering only remittances made until April 2013 and April 2011, respectively (dashed and dotted lines). These remittance profiles are similarly downward sloping and shifted to the left, suggesting that remittance delays do indeed play a role in the observed decline in average remittance rate. For instance, while the income tax remittance share for 2010 is about 88% when measured in April 2011, it is above 95% when measured in April 2015—indicating that a small share of taxpayers remit their tax after a substantial delay. This finding is consistent with anecdotal evidence that cash-constrained

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<sup>43</sup>The estimates of property tax compliance in Peru by Del Carpio (2014) are conceptually different from our estimates, as property taxes are assessed by the government and thus have no misreporting margin.

<sup>44</sup>Note that we use the net liability derived from the firm's tax return, and take into account only the amount of advance tax remittances and withheld taxes that the taxpayer chose to reclaim on the tax declaration. Including remittances that are enforced retroactively by the tax authority through administrative or judicial procedures does not significantly affect the results.

firms remit tax when they have adequate liquidity rather than when the remittance is due, as fines and interest fees for late remittance are small. Meanwhile, remittance compliance is relatively high, especially in the aggregate. As firms that do not remit tax or remit after a significant delay are disproportionately small, the aggregate remittance rate (i.e., the sum of remittances divided by the sum of final liabilities) approaches 100% shortly after the remittance deadline and remains stable over time.

To summarize, despite the tax authority's systematic use of third-party reporting, compliance gaps remain widespread. About 50% of firms fail to file their taxes, another 13-16% under-report their sales, 35-50% under-utilize their deductible costs, and 15-25% remit their outstanding liabilities after a several-month delay. Perfect enforcement would increase income tax revenue by over 30%. However, the observed effect of desk audits is orders of magnitude smaller than would be necessary to achieve full compliance. The persistence of large compliance gaps despite third-party reporting is consistent with taxpayers misperceiving tax enforcement parameters  $R_T$  and  $p()$ . This suggests that there is scope for withholding to improve tax compliance.

## VI. THE IMPACT OF WITHHOLDING

In this section, we use the August 2011 reform of the sales tax withholding-rate schedule to estimate the compliance impact of withholding, keeping the tax authority's information set constant. We start by analyzing the first-stage impact of the reform on realized withholding rates and on the use of credit cards. We then conduct a difference-in-difference estimation of the tax-remittance response to the withholding-rate increase. Finally, we decompose the main treatment effect into its mechanisms.

### VI.A. *First Stage and Impact on Card Use*

As discussed in section III.C., the government revised the withholding-rate schedule for the sales tax in August 2011. Panel A in Figure VI shows that the reform roughly doubled the average withholding rate applied to sales taxpayers. The graph also displays small jumps every semester, when the withholding rates are revised by the tax authority and communicated to the withholding agents. This suggests that withholding agents (card companies) tend to comply with

the government-assigned withholding rates. To better understand the extent of the disparity between the assigned and realized withholding rates, we predict each firm's withholding rate based on its past tax returns and the withholding-rate schedule in Table II. As panel B in Figure VI shows, the predicted rate tracks the realized rate very closely among firms for which we can observe both rates. The realized withholding rate is slightly higher, though only prior to the reform. This is consistent with the fact that firms can request a lower withholding rate from the tax authority if, for instance, they experience losses for several consecutive months.<sup>45</sup>

Panels C and D investigate whether the reform reduced firms' propensity to file their sales tax declarations or to use their credit-card machines, which would limit third-party reporting and withholding by card companies. Both the number of sales tax declarations and credit-card reports (i.e., the informative declaration by card companies) filed with the tax authority steadily and smoothly increase around the time of the reform. Similarly, the share of sales tax declarations that can be matched with at least one credit-card report, and vice versa, displays no discontinuity at the time of the reform. In the period prior to the reform, the share of firms subject to credit-card reporting that file sales tax falls as the total number of credit card reports rises. The share stagnates for over a year after the reform, then decreases again. The possibility of reclaiming withheld tax may have increased firms' propensity to file sales tax declarations.<sup>46</sup> Overall, we conclude that the reform did not reduce tax filing or the use of credit-card machines on the extensive margin.

One remaining possibility is that the reform may have decreased the intensity of card machine use. However, as panels E and F show, among firms whose transactions are reported by at least one credit-card company, neither the share of card sales in total sales nor the average of the firm-specific share of card sales changes discontinuously with the reform. While both series display a small drop at the time of the reform, this drop is statistically significant only for the average share of card sales, suggesting it is driven by firms with a relatively small volume of total sales. Moreover, the size of the drop is economically insignificant even in this sample, accounting for

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<sup>45</sup>There is only a weak behavioral response to the withholding-rate notches in reported value added and the share of domestic sales, suggesting that few firms manipulate the withholding rate by misreporting the relevant line items on their sales tax declaration.

<sup>46</sup>Estimating this extensive-margin effect is complicated by the fact that non-filers can be observed only if they are subject to credit-card reporting, which significantly reduces the sample size for both the treatment and control groups. The difference-in-difference estimate from a balanced panel of credit-card reported non-filers suggest that the reform increased the filing rate among treated firms by one percentage point, but the control group does not fulfill the parallel-trends assumption.

one percentage point of an average share of 50%.

The analysis suggests that firms lack the market power to refuse card transactions in an effort to avoid the withholding-rate increase or reduce its impact, possibly because consumers highly value the ability to make card payments once they have started using credit/debit cards. We can therefore regard the third-party reporting environment as unaffected by the reform, and we can use the reform to isolate the effect of withholding.<sup>47</sup>

## VI.B. *Difference-in-Difference Estimation*

To estimate the impact of the withholding-rate increase on total tax remittances and other intermediate outcomes, we conduct a difference-in-difference estimation on the balanced panel of firms that consistently submitted sales tax declarations during a 40-month period around the reform. Firms that are subject to withholding and experienced an increase in the predicted withholding rate between July and August 2011 are considered treated. The control group consists of firms that experienced no change in their withholding rate or were not subject to withholding at the time of the reform.<sup>48</sup> The treatment assignment is based on the predicted rather than the realized increase in the withholding rate, as the latter may be affected by a firm-specific request or a connection to the tax authority that allowed the firm to obtain a lower withholding rate.<sup>49</sup> The predicted rate change depends on a firm's value added and share of domestic sales in total sales in the second semester of 2010, well before in July 2011, when the reform decree was drafted. Consequently, firms could not have gamed the system to avoid an increase in the predicted withholding rate. We estimate the effect of the rate increase using the specification

$$y_{it} = \alpha_i + \gamma_t + \mu_i \cdot t + \beta \cdot Treat_i \cdot Post_t + \varepsilon_{it}, \quad (2)$$

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<sup>47</sup>Any reduction in credit-card usage would cause a downward bias in the difference-in-difference estimates presented below. It would not challenge our identification assumption, but merely affect the interpretation of the results. If the small number of firms that reduced their card usage after the withholding-rate reform were the firms with the largest potential evasion rents, our estimates would constitute a lower bound on the true compliance impact of withholding.

<sup>48</sup>The results are similar, but much more noisy, when the control group consists solely of firms that were subject to withholding but experienced no withholding-rate change. We always exclude firms that experienced a reduction in their withholding rate, as the small size of this sample does not allow us to separately estimate the impact of a rate reduction, which is not necessarily symmetric to the impact of a rate increase.

<sup>49</sup>We consider collusion between the withholding agent and the firm unlikely, given the small number of withholding agents and the intense monitoring to which they are subject.

where  $y_{it}$  is the outcome reported by firm  $i$  in month  $t$ ;  $\alpha_i$  and  $\gamma_t$  are firm and month fixed effects;  $\mu_i$  is a firm-specific linear time trend;  $Treat_i$  and  $Post_t$  are dummies indicating the treatment group and the post-reform period; and  $\varepsilon_{it}$  is the error term.<sup>50</sup> As several outcome variables take a value of zero for a large share of observations, we use levels rather than logs and report both point estimates and proportional effects, i.e. point estimates scaled by the treatment group's pre-reform average.

To visualize the identifying assumption and treatment effect on total tax remittance, panel A in Figure VII plots the month-on-month change in total tax remittance for the treatment and control groups, together with the DiD coefficient estimates from Equation 2. Total tax remittance is the sum of the tax withheld and the taxpayer's remittance. The treatment and control groups exhibit parallel pre-reform trends, including the same seasonal fluctuations, with peaks during the December shopping season. At the time of the reform, tax remittances in the treatment group increase sharply by 39% and remain at this elevated level for the next 15 months.<sup>51</sup>

In addition to this revenue effect from tax filers, the withholding-rate reform mechanically increased tax remittance by non-filers. Prior to the reform, non-filers represent about 15% of all firms for which taxes are withheld and account for 5-7% of all withheld taxes. Though identification concerns prevent us from estimating a precise treatment effect<sup>52</sup>, descriptive evidence suggests that the tax withheld among non-filers doubled at the time of the reform. The reform also advanced part of the tax remittance among delayed remitters, but this has little impact on the total treatment effect, even under the assumption of large discount rates. Delayed remitters comprise only 5% of taxpayers, they have very small liabilities on average, and most remit within a few months of the deadline.

In aggregate, the withholding-rate reform increased sales tax revenue by 8.4%. Panel B in Figure VII illustrates this result by using a simple regression discontinuity in time on demeaned semester-wise revenue data. Importantly, these revenue figures are from official government statistics and are net of any tax refunds granted to taxpayers.<sup>53</sup> We also show in Panel C that revenue

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<sup>50</sup>The results are almost identical when using treatment-group specific Christmas fixed effects to account for the larger share of retailers among treated firms.

<sup>51</sup>There is an additional increase during the post-reform period, but this parallels a qualitatively similar development in the control group. The results are robust to considering a shorter or longer post-reform period and hence a larger or smaller balanced panel.

<sup>52</sup>See footnote 46.

<sup>53</sup>The number and total amount of the refund requests increased slightly at the time of the reform, but there are

from the simplified tax regime, which is paid quarterly and not subject to withholding, evolves completely smoothly at the time of the withholding-rate reform, allaying concerns that the increase in sales tax revenue may be driven by fluctuations in the business cycle.

### *VI.C. Decomposition*

The detailed tax-return data allow us to precisely decompose the treatment effect into changes in the underlying components of final tax liability. Table VI examines all of the main line items in the sales tax return, reporting the pre-reform mean in the treatment group (columns 1-3) and the DiD coefficient  $\beta$  (columns 4-6) for different specifications, trimming the data at the 99.9th, 99th, and 95th percentile, respectively, of the distribution of total sales. Our preferred specification is the one with data trimmed at the 99th percentile, as it achieves the highest internal consistency between variables. A tax return is considered internally consistent if we can reconstruct within a 10% error margin all line items that should be either the sum or the difference of other line items.<sup>54</sup>

The decomposition yields three main conclusions. First, the withholding-rate increase had a positive impact on total sales reported and sales tax collection, with no impact on average input tax credits. This translated into a significant increase in the reported gross tax liability, which rose by 19% in our preferred specification (columns 5 and 8). Second, firms reclaim an average of just 73% of the tax withheld prior to the reform, and this gap widened with the reform, as the amount of tax withheld rose by over 200%, while the amount of tax reclaimed increased by only 140%.<sup>55</sup> Third, the increases in reported gross liability and in the reclaiming of withheld taxes broadly offset each other, so that the final tax to be remitted by the taxpayer and the taxpayer remittance barely change. Accordingly, the main treatment effect of a 39% increase in total sales tax remittance corresponds to the increase in the amount of tax withheld at source.

The last three rows in Table VI conduct robustness tests to show that the treatment effect is not overturned by refund requests, increases in compensation requests on the income tax declaration (possibly due to net credits from sales tax withholding), or a reduction in income tax remittance.

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usually less than 300 refund requests per month, compared to about 6000 treated firms in our balanced panel, and less than half of the refund requests are filed by sales taxpayers. The delay in receiving a refund is reportedly several months, and the request procedure is cumbersome and thus undertaken primarily by large and sophisticated firms.

<sup>54</sup>We trim rather than winsorize the data in all specifications to maximize internal consistency.

<sup>55</sup>Requests for compensation, i.e. the deduction of net credits from other taxes or past fiscal periods, also increased slightly. However, the reclaiming of withheld taxes far exceeds requests for compensation.

The main treatment effect is statistically indistinguishable when the outcome is defined as total sales tax remittances net of any refund requests and income tax compensation. When the dependent variable is the sum of total income and sales tax remittances minus refunds (dividing annual income tax remittances equally across months of the relevant fiscal year for estimation purposes), we estimate that the reform increased tax remittances by 29%. Given that annual sales tax remittances among these firms are on average twice as high as income tax remittances, this is consistent with the demonstrated increase in sales tax remittances by 39% and even with a slight increase in income tax remittances. Indeed, to the extent that taxpayers are internally consistent (i.e., that they report the same tax base on their income and sales tax declarations), an increase in reported sales tax liability should spill over to the income tax.

#### *VI.D. Mechanisms*

The decomposition suggests that the treatment effect occurs through two main mechanisms, each of which explains about half of the total effect. The first is the incomplete reclaiming of withheld taxes due to the default mechanism, and the second is the increase in reported liabilities due to a change in firms' perceptions of enforcement. Figure VIII and Table VII shed more light on these mechanisms.

*Default Mechanism.* Our conceptual framework predicts that withholding can increase tax remittances if some taxpayers do not reclaim the withheld tax, and it shows how a fixed cost of reclaiming would shape reclaiming behavior. Panels A and B of Figure VIII show that reclaiming behavior is indeed consistent with this framework. First, reclaiming is incomplete: fewer than 50% of all firms with withheld taxes and fewer than 60% of those with a non-zero gross liability reclaim any amount of withheld tax. Second, the withholding-rate increase in 2011 also increases taxpayers' propensity to reclaim. At the time of the reform, the reclaiming rate temporarily falls because the reform increases the number of taxpayers subject to withholding, many of whom are initially unfamiliar with the reclaiming procedure. As these firms gradually begin reclaiming withheld taxes, the share of reclaiming firms rises, eventually surpassing the pre-reform level by approximately 10 percentage points. Third, firms with larger amounts of withheld tax are more likely to reclaim. Indeed, the share of withheld tax reclaimed reaches almost 80% prior to the reform

and continues to exceed 60% after the reform, significantly higher than the share of reclaiming firms.<sup>56</sup> These three empirical facts support our argument that a fixed cost prevents some firms from reclaiming their withheld taxes, thereby establishing a compliance default.

*Enforcement-Perceptions Mechanism.* For firms that reclaim the withheld taxes, the treatment effect is driven by an increase in reported tax liability, which occurs sharply at reform time, as illustrated in Panel C of Figure VIII. Before discussing evidence that this is due to a change in firms' perception of the enforcement environment, we rule out two alternative explanations. First, there is no real change in enforcement probabilities. Panel D shows that audit rates are constant over time. Moreover, the announcement of the withholding-rate reform was not accompanied by any public statement on enforcement activities. Second, while the amount of tax withheld may signal the appropriate tax liability to report, Panel D shows that only a small fraction of firms bunch their declared liability at the amount of tax withheld, so this can also be ruled out as the main driver of our results.<sup>57</sup>

Instead, our conceptual framework predicts that withholding leads firms to increase their reported tax liability in response to a change in enforcement perceptions, which is more likely to occur among certain subsamples of firms. Table VII displays treatment-effect point estimates (panel A) and proportional effects (panel B) for ten different subsamples. Columns 1-2 shows that firms with below-median turnover experience a larger proportional treatment effect on total tax remittances than firms with above-median turnover; this difference is driven by differential reclaiming rates, and the effect on reported liability is similar in the two samples.

Columns 3-8 show that firms which misreported their tax liability in the past, firms that are subject to withholding for the first time,<sup>58</sup> and firms that frequently reclaim withheld taxes all experience a larger proportional increase in their reported gross tax liability compared to the rest of the sample. Firms that infrequently reclaim withheld taxes display a smaller proportional increase

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<sup>56</sup>This figure also suggests that while the reform pushes more small firms to reclaim the tax withheld, it also pushes some firms to the point where their amount of withheld tax exceeds their declared gross liability, constraining their ability to reclaim. As a result, the overall share of withheld taxes reclaimed decreases.

<sup>57</sup>Columns 9 and 10 of Table VII also show that the treatment effect on gross tax liability is large and statistically significant among both bunchers and non-bunchers.

<sup>58</sup>We exclude from this group all firms that experience the maximum withholding-rate increase of six percentage points to ensure that the average rate increase in this group is not larger than the average rate increase among other treated firms.

in their gross tax liability, and firms that never reclaim withheld taxes exhibit no significant change in their reported liability. This heterogeneity in the treatment effect, and the fact that a rise in reported tax liability is always driven by a rise in reported sales, is consistent with an increase in the perceived probability of enforcement.

To further support our argument, we examine the reporting response to the introduction of tax withholding at other points in time, unrelated to the 2011 withholding-rate reform. Figure IX shows that firms which become subject to sales tax withholding at different points in time, independently of the withholding-rate reform, also exhibit a sudden increase in their reported tax liability.<sup>59</sup> To show this, we conduct an event study of firms that are already subject to third-party reporting by a credit-card company, but not subject to withholding, and that experience a change in their withholding rate due to the biannual withholding-rate updates.<sup>60</sup> Finally, Figure X shows firms exhibit an increase in their reported tax liability also in 2015, after the introduction of tax withholding by credit-card companies for the purpose of income tax compliance. Similar to the 2011 reform, this reform again required withholding agents to supply monthly statements to firms with withheld taxes. It did not affect the government's information set, and statutory tax rates remained unchanged. The response is driven by treated firms that had previously misreported their tax liability, and no effect appears among other firms that are subject to withholding for the first time.

We conclude that two mechanisms drive the impact of withholding on compliance: a default mechanism, whereby some firms fail to reclaim withheld taxes, which mechanically translates into higher tax remittances, and an enforcement-perceptions mechanism, whereby the withholding-rate increase alters firms' perceptions of the enforcement environment, increasing reported tax liability.

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<sup>59</sup>Decomposing the sample into misreporters and compliers as for the income tax is complicated by the small sample size.

<sup>60</sup>As the update of the withholding rate between June and July in year  $t$  depends on a firm's reported valued added and share of domestic sales in the second semester of year  $t - 1$ , any change in the reported tax liability in  $t$  is likely driven by the withholding-rate change itself, rather than by the underlying fundamentals driving the withholding rate. Accordingly, the reported tax liability in the event and control groups evolve in parallel between March and June. Upon treatment in July, the event group diverges and continues reporting a 5-6% higher tax liability for the following six months.

## VII. CONCLUSION

This paper has studied the compliance impact of tax withholding, exploiting variation generated by withholding on firms' sales. We show that third-party reporting increases tax compliance among firms, but that large compliance gaps remain, which tax withholding can partially close. Doubling the withholding rate applied by credit-card companies increases sales tax remittances by 39% among treated firms and by 8% overall, although the government's information set and the statutory tax rates both remain constant. The treatment effect is driven in equal measure by the incomplete reclaiming of withheld taxes and by an increase in reported tax liability. We interpret our results on the impact channels of withholding as evidence that withholding is a distinct compliance mechanism, which, unlike traditional enforcement and third-party reporting mechanisms, does not attempt to elicit taxpayers' true income, but instead establishes a default tax remittance at source.

This explains why withholding schemes for firms are a key feature of tax systems in lower-income countries and in low-compliance sectors. Out of 118 countries for which the relevant data are available, 66 countries use some form of tax withholding. The average per capita GDP of these countries is 40% lower than the average for countries that do not use withholding. This correlation holds for both corporate income tax and VAT/sales tax (Figure I, panel A). Among countries that use withholding, the breadth of the withholding base and withholding rates are both negatively correlated with GDP. Lower-income countries are significantly more likely to use broad withholding schemes that apply to all firms in all sectors, whereas higher-income countries tend to use targeted withholding schemes that apply specifically to firms in low-compliance sectors, such as self-employed individuals in several OECD countries and the construction sector in the United Kingdom. Lower-income countries also apply higher withholding rates to comparable bases. For example, panel B shows withholding rates for technical service fees and contractor fees, which are commonly subject to withholding.

However, even if withholding increases tax compliance, its welfare impact remains ambiguous. Withholding shifts administrative costs from the tax authority to the withholding agent and the taxpayer. It also transfers liquidity from the taxpayer to the government and increases effective tax rates, particularly for small and liquidity-constrained firms, and we find some evidence that these

firms reduce output. Studying the optimal level of withholding rates and examining the distributional and real effects of withholding could yield important insights into the welfare implications of this policy. Analyzing the spillover effects of withholding on firms along the supply chain (as withholding changes treated firms' reporting behavior) and on competitor firms in the same sector or location (as withholding changes firms' effective tax rates) is also worthwhile. Analyzing these spillovers would allow decomposing the aggregate revenue impact of withholding into the direct effect on treated firms and the potential indirect effects on non-treated firms.

Finally, investigating the optimal scope for withholding and identifying the ideal withholding agents, would be a fruitful area for future research. In addition to state institutions and credit-card companies, governments may consider using other financial institutions and large firms as withholding agents. In doing so, policymakers would face a tradeoff between improving compliance and increasing administrative costs for both the government and the withholding agents. These costs are likely to be smallest for firms that are already large taxpayers and thus subject to increased government monitoring, as well as firms that have sophisticated accounting departments. In this context, it would also be interesting to study under which conditions governments should provide monetary or non-monetary incentives to withholding agents.

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# Appendix

## *Algorithm to Estimate Non-Filing: Income Tax*

This section describes the procedure by which the pool of income tax-liable taxpayers is constructed for each year between 2010 and 2013. This pool forms the sample for Tables **IV** and **AI**.

The following algorithm is used to identify tax-liable firms:

- **Income tax filing:** Firms that declare income tax in current fiscal year  $t$  and are not found to have deregistered or switched to a simplified (non-tax-liable) regime by year  $t$  are included in the pool of income tax-liable taxpayers. Additionally, firms that filed in the previous year  $t - 1$  and did not deregister or switch regimes in the interim are included to capture taxpayers who were previously identified as income tax-liable and then do not file in subsequent years. This condition is applied to generate the sample used in Table **IV**; for the sample used in Table **AI**, the rule is extended to include firms that declared income tax in any year between  $t - 1$  and  $t - 3$  for years 2011 and later and between  $t - 1$  and  $t - 4$  for years prior to 2011, which are the historical rules officially applied by the tax authority for determining income tax liability, though in practice this condition may not have been systematically applied.
- **Registration:** Firms that are found to have registered with the tax authority in any of the previous three years prior to the current fiscal year  $t$  but did not file income tax returns in the current fiscal year are included. This step identifies firms that are officially registered as tax-liable but which did not file for the years during which these firms were registered, which step 1 does not capture as it relies only on the records of filings.
- **Subsequent deregistration:** In addition to identifying firms that are registered but do not file for income tax in prior years in step 2, firms that deregister in years following the current fiscal year  $t$  but are not found to have registered in year  $t$  or the previous three years are classified as having been income tax-liable despite not appearing on the official registration roster.

- **Declaring sales tax in current fiscal year:** Firms that declare sales tax in any of the months of the current fiscal year  $t$  - which spans from October of year  $t - 1$  to September of year  $t$  - are included in the pool of income tax-liable taxpayers. This rule corresponds to the tax authority's official regulation that firms liable for sales tax are also deemed liable for remitting income tax (though the reverse is not true).
- **Informative declarations:** Records of transactions between firms or between firm and the government provide information on the sales and costs of individual firms that can be used to identify income tax-liable taxpayers. Firms that report or are reported as having tax-liable sales in the current fiscal through the third-party reporting mechanisms described above are included in the pool of income tax-liable firms.

### *Algorithm to Estimate Non-Filing: Sales Tax*

This section describes the procedure by which the pool of sales tax-liable taxpayers are constructed for each month of fiscal years 2011 to 2013. This pool forms the sample for Tables **IV** and **AI**, which reports the average of the monthly values for each measure in corresponding fiscal year. The following algorithm, which is similar to the method used to identify income tax-liable firms, is used to identify sales tax-liable firms:

- **Income tax filing:** Firms that declare sales tax in month  $m$  of the current fiscal year  $t$  and are not found to have deregistered or switched to a simplified (non-tax-liable) regime by month  $m$  in year  $t$  are included in the pool of sales tax-liable taxpayers. Additionally, firms that filed in the previous four months -  $m - 4$  to  $m - 1$  - and did not deregister or switch regimes in the interim are included to capture taxpayers who were previously identified as sales tax-liable and then do not file in subsequent months. This could include firms that either declare sales tax in previous months within the same fiscal year or in months falling within the previous fiscal year  $t - 1$ , depending on the month. This condition is applied to generate the sample used in Table **IV**; for the sample used in Table **AI**, the rule is extended to include firms that

declared sales tax in months between  $m - 12$  and  $m - 1$ .

- **Registration:** Firms that are found to have registered with the tax authority in any of the previous thirty six months (three years) prior to the current month  $m$  of fiscal year  $t$  but did not declare sales tax in month  $m$  are included. This step identifies firms that are officially registered as tax-liable but which did not file for the years during which these firms were registered, which step 1 does not capture as it relies only on the records of filings.
- **Subsequent deregistration:** In addition to identifying firms that are registered but do not file for income tax in prior years in step 2, firms that deregister in months following the current month  $m$  but are not found to have registered within the previous thirty six months are classified as having been income tax-liable despite not appearing on the official registration roster.
- **Informative declarations:** Firms that are reported as having been subject to withholding by credit-card companies are considered tax-liable for the sales tax.

**TABLE AI**  
**NON-FILING, ROBUSTNESS**

<b>Panel A: Non-filing among all tax-liable firms</b>					
	(1)	(2)	(3)	(4)	(5)
	% Non-filers	Of which registered non-filers	Non-filers' TPI sales as % of declared TPI sales	Undeclared sales as % of declared sales	Unreported liability as % of declared liability
Income Tax 2010	0.420	0.335	0.154	0.225	0.081
Income Tax 2011	0.509	0.239	0.195	0.246	0.077
Income Tax 2012	0.547	0.218	0.114	0.189	0.076
Income Tax 2013	0.586	0.266	0.112	0.203	0.104
Sales Tax 2011	0.335	0.960	.	.	.
Sales Tax 2012	0.325	0.955	.	.	.
Sales Tax 2013	0.372	0.962	.	.	.

<b>Panel B: Non-filing among registered firms</b>					
	All	Self-Employed	Self-Employed with TPI	Corporations	Corporations with TPI
Income Tax 2010	0.195	0.158	0.131	0.155	0.073
Income Tax 2011	0.198	0.161	0.134	0.143	0.071
Income Tax 2012	0.209	0.153	0.126	0.128	0.051
Income Tax 2013	0.273	0.215	0.158	0.216	0.067
Sales Tax 2011	0.326	0.439	0.155	0.192	0.073
Sales Tax 2012	0.315	0.423	0.126	0.185	0.054
Sales Tax 2013	0.363	0.478	0.101	0.185	0.040

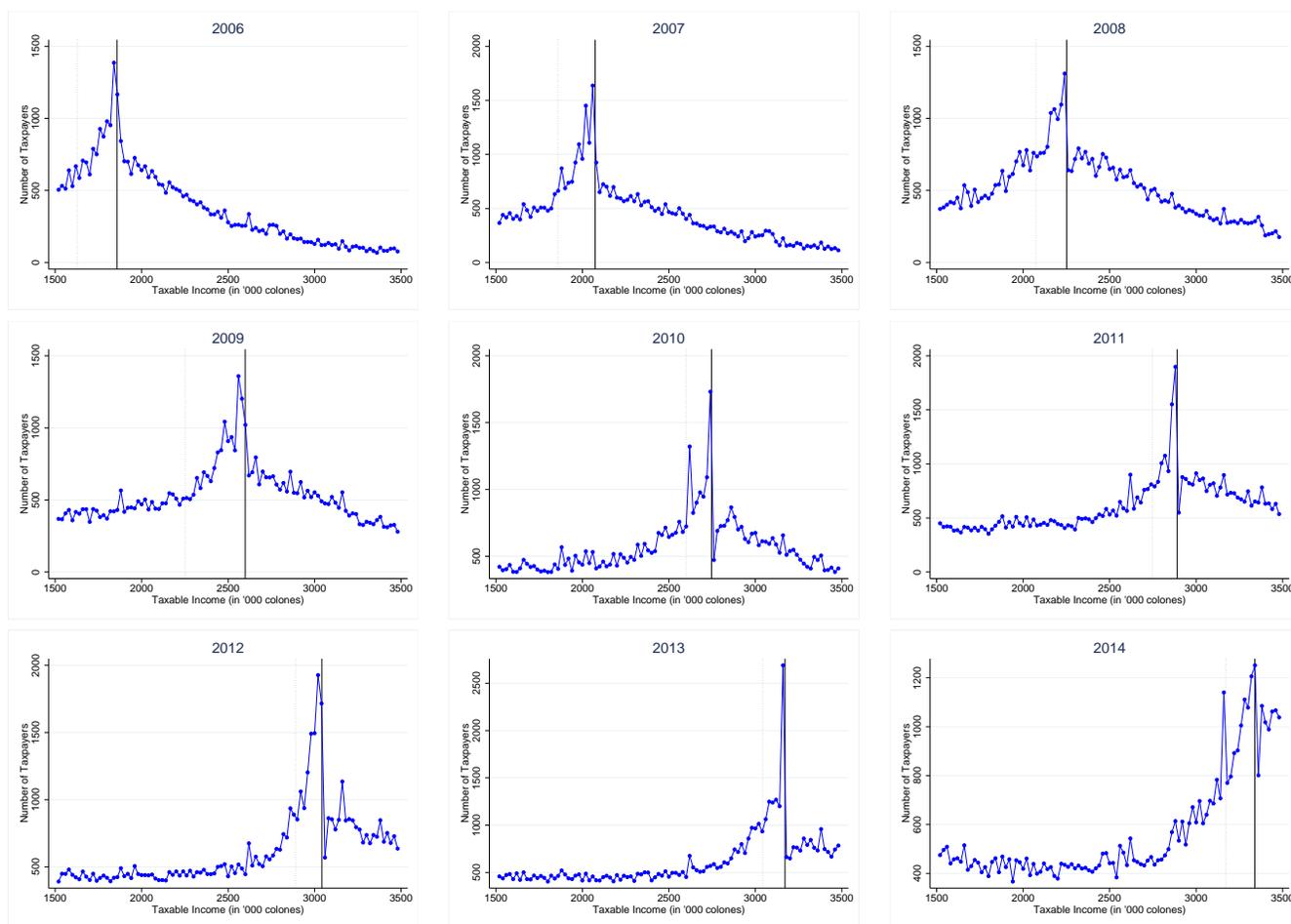
  

<b>Panel C: Non-filing among firms covered by information reporting</b>					
	All	Reported by firms	Reported by state	Reported by card companies	
Income Tax 2010	0.573	0.578	0.235	0.293	.
Income Tax 2011	0.652	0.658	0.202	0.297	.
Income Tax 2012	0.672	0.678	0.186	0.308	.
Income Tax 2013	0.676	0.681	0.177	0.320	.

Notes: The construction of this table is identical to Table IV, except that it uses a less conservative algorithm to calculate the share of non-filers as explained in this appendix.

# FIGURE AI

## BUNCHING AT THE FIRST INCOME TAX KINK FOR SELF-EMPLOYED INDIVIDUALS



Notes: This figures show the frequency distribution of taxable income of the self-employed (personas físicas con actividad lucrativa) around the first kink in the income tax schedule, for the years 2006-2014. The data is aggregated in bins of CRC 20,000. The black solid line marks the kink in year  $t$  (as per the figure title), the black dashed line marks the kink in year  $t - 1$ .

# FIGURE AII

## CARD-MACHINE STATEMENT

Pag: 1 Banco Nacional de Costa Rica Fecha: 08/06/2016

**Resumen de Depositos para Comercios Afiliados**  
 De: 01/05/2016 Hasta: 31/05/2016

Numero de Cuenta: [REDACTED]  
 Nombre de Cuenta: [REDACTED]

		Reporte Emitido por Cuenta				
COLONES		Valor Total	Ret. Venta	Ret. Renta	Comision	Neto a Pagar
01/05/2016	AUTOMATICO POR POS	1,356,380.00	0.00	23,872.29	53,945.20	1,278,562.51
02/05/2016	AUTOMATICO POR POS	483,100.00	0.00	8,502.56	19,135.55	455,461.89
03/05/2016	AUTOMATICO POR POS	1,465,575.00	0.00	25,794.12	58,448.16	1,381,332.72
04/05/2016	AUTOMATICO POR POS	1,026,590.00	0.00	18,067.98	40,844.40	967,677.62
05/05/2016	AUTOMATICO POR POS	687,650.00	0.00	12,102.64	27,452.58	648,094.78
05/05/2016	MANUAL/CARGO AUTOMATIC	944,500.00	0.00	16,623.20	37,543.50	890,333.30
06/05/2016	AUTOMATICO POR POS	818,500.00	0.00	14,405.60	32,657.50	771,436.90
07/05/2016	AUTOMATICO POR POS	676,900.00	0.00	11,913.44	26,774.45	638,212.11

Notes: This figure shows an example of the credit-card machine statement, that card processing companies provide to their affiliated businesses (clients) on a daily or monthly basis. The statement lists transaction amounts, withholding for the income tax and the sales tax remitted to the tax authority and commissions to the card processing company.

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**TABLE I**  
**INCOME TAX SCHEDULE**

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
<b>Panel A: Self-Employed</b>										
<b>Kink 1</b>	1,858	2,074	2,252	2,599	2,747	2,890	3,042	3,171	3,339	3,522
<b>Kink 2</b>	2,775	3,097	3,362	3,880	4,102	4,316	4,543	4,735	4,986	5,259
<b>Kink 3</b>	4,629	5,167	5,609	6,473	6,843	7,199	7,577	7,898	8,317	8,773
<b>Kink 4</b>	9,276	10,354	11,241	12,972	13,713	14,427	15,185	15,827	16,667	17,581
<b>Panel B: Corporations</b>										
<b>Notch 1</b>	27,811	31,043	33,701	38,891	41,112	43,253	45,525	47,451	49,969	52,710
<b>Notch 2</b>	55,943	62,444	67,791	78,231	82,698	87,004	91,573	95,447	100,513	106,026

Notes: This table shows the income tax schedule for the years 2006 to 2015. Amounts are in thousands of CRC (1USD=573CRC). Panel A shows the location of the kinks on taxable income that separate the five tax brackets for the self-employed. The tax is applied to taxable income at marginal rates of 0, 10, 15, 20 and 25% respectively for the first to fifth tax bracket. Panel B shows the location of the notches on revenue that separate the three tax brackets for corporations. The tax is applied to taxable income at average rates of 10, 20 and 30% respectively for the first to third tax bracket. For more information on the tax base, tax schedule and the filing procedure, see <http://www.hacienda.go.cr/contenido/12994-regimen-tradicional>.

**TABLE II**  
**WITHHOLDING-RATE SCHEDULE FOR SALES TAX**

	Withholding Rate						
	0	1	2	3	4	5	6
<b>Before 08/2011: Value-Added Rate <math>\leq</math></b>	5	20	30	40	55	75	$\infty$
<b>Since 08/2011: Share of Domestic Sales <math>\leq</math></b>	0	-	-	50	-	-	100

Notes: This table shows the withholding rate which credit-card companies apply to the card sales of firms using a credit/debt card machine. Prior to August 2011, the average withholding rate was determined by a notched schedule on the withholder's value-added rate, with notches at value-added rates of 5, 20, 30, 40, 55 and 75%, and resulting withholding rates of 0, 1, 2, 3, 4, 5 and 6%. Since August 2011, the schedule has been consolidated to three withholding rates of 0, 3 and 6%. The rates are determined by a notched schedule on the share of domestic (i.e. non-export) sales, with a notch at 50%. A firm's value-added rate and share of domestic sales are calculated based on its sales tax declarations in semester  $t - 2$ , as an average across months in the semester.

**TABLE III**  
**INFORMATIVE DECLARATIONS TO THE TAX AUTHORITY**

(1) Form	(2) Purpose	(3) Record Type	(4) Coverage of Corporations	(5) Coverage of Self-Employed	(6) % Matched With Income Tax Records
<b>D151</b>	Reporting of firm-firm transactions N=17,251,681 (53.4% sales)	Sales	46.4	38.9	36.8
		Purchases	49.2	53.9	65.1
<b>D150</b>	Reporting of and withholding on sales to specific clients for purpose of income tax compliance N=864,695 (98.7% state purchase)	Sales to state institutions	8.4	5.0	78.2
		Sales to specific firms	0.22	0.08	40.2
<b>D153</b>	Reporting of and withholding on credit/debit-card sales for sales tax for purpose of sales tax compliance N=3,928,545	Sales	11.5 [29.4]	5.8 [20.7]	67.8 [48.7]

Notes: This table provides information about the nature and coverage of third-party informative declarations used by the tax authority in Costa Rica, for 2006-2015. Columns 4 and 5 display the share of income tax filers covered by the different third-party declarations, distinguishing corporations and the self-employed. Column 6 displays the share of informative declarations which are matched with an income tax declaration. In the last row, the shares in brackets refer to the match rate with the monthly sales tax declarations for 2008-2014. The shares are calculated on the pooled data for all years/months. All declarations identify the reporter and taxpayer by their administration-internal anonymous tax ID, and provide information on the transaction amount, and (where applicable) the amount of the tax withheld. Amounts are accrued. Since January 2012, all declarations must be prepared using the DECLAR@7 software. All declarations are annual, except D153, which is monthly. D151 requires reporting of transactions >2.5 million CRC annually with a transaction partner, and transactions of >50,000 CRC annually for rent, commissions, professional services or interests. For D150, the withholding rate is 2% and 3% respectively for state and private purchases. For D153, the withholding rate is firm specific, following the schedule in Table II. For more information on the filing of informative declarations, see <http://www.hacienda.go.cr/contenido/12997-declaraciones-informativas>.

**TABLE IV**  
**NON-FILING**

<b>Panel A: Non-filing among all tax-liable firms</b>					
	(1)	(2)	(3)	(4)	(5)
	% Non-filers	Of which registered non-filers	Non-filers' TPR sales as % of declared TPR sales	Undeclared sales as % of declared sales	Unreported liability as % of declared liability
Income Tax 2010	0.384	0.185	0.155	0.211	0.071
Income Tax 2011	0.485	0.125	0.195	0.230	0.069
Income Tax 2012	0.528	0.116	0.115	0.168	0.071
Income Tax 2013	0.556	0.121	0.114	0.181	0.099
Sales Tax 2011	0.196	0.894	.	.	.
Sales Tax 2012	0.185	0.884	.	.	.
Sales Tax 2013	0.198	0.891	.	.	.

<b>Panel B: Non-filing among registered firms</b>					
	All	Self-Employed	Self-Employed with TPR	Corporations	Corporations with TPR
Income Tax 2010	0.104	0.095	0.082	0.081	0.045
Income Tax 2011	0.105	0.090	0.078	0.061	0.033
Income Tax 2012	0.115	0.080	0.070	0.065	0.028
Income Tax 2013	0.131	0.128	0.094	0.137	0.043
Sales Tax 2011	0.180	0.263	0.122	0.094	0.060
Sales Tax 2012	0.168	0.247	0.103	0.085	0.045
Sales Tax 2013	0.181	0.269	0.079	0.085	0.034

<b>Panel C: Non-filing among firms covered by information reporting</b>					
	All	Reported by firms	Reported by state	Reported by card companies	
Income Tax 2010	0.574	0.579	0.235	0.293	.
Income Tax 2011	0.653	0.659	0.202	0.297	.
Income Tax 2012	0.673	0.679	0.186	0.308	.
Income Tax 2013	0.677	0.682	0.177	0.319	.

Notes: These panels show the share of non-filers (tax liable firms that do not file) for the income tax (rows 1-4) and the sales tax (rows 5-7). The algorithm used to construct the share of non-filers is explained in the appendix. Panel A shows the share of non-filers among all tax liable firms (column 1), the share of non-filers that are registered (2), non-filers' third-party reported sales as share of filers' reported sales (3), non-filers' estimated sales as share of declared sales (4), and non-filers' estimated tax liability as share of declared liability (5). TPR stands for third-party reports, and TPR sales is the sum of all third-party reports except cost reports. A non-filing firm's estimated sales in period  $t$  is  $\max(\text{third-party reported sales in } t; \text{self-reported sales in the most recent prior reporting period})$ . A non-filer's tax liability is estimated using its estimated sales, applying the average profit rate of filers in the corresponding decile of the sales distribution of filers, and then applying the tax schedule. Panel B reports the share of non-filers among all registered firms (1), and among subsamples of registered firms as indicated by the column headings (2-5). Panel C reports the share of non-filers among all firms covered by information reporting (1), and among subsamples of firms reported by different informing agents, as indicated by the column headings (2-4).

**TABLE V**  
**MISREPORTING**

	(1)	(2)	(3)	(4)
	Sales Reports		Cost Reports	
	Self-Employed	Corporations	Self-Employed	Corporations
<b>Panel A: Underreporting for Income Tax</b>				
1) % Underreporters	16.1	13.2	51.4	35.6
2) Unreported Amount (bio CRC)	283	4540.9	448.6	3572.7
3) Underreporters' TPR	680.2	9679.7	1244.4	8865.6
4) Total TPR	2088.8	19489.9	1902.7	16140.3
5) Unreported Amount(% UR TPR)	41.6	46.9	36.1	40.3
6) Unreported Amount(% TPR)	13.6	23.3	23.6	22.1
<b>Panel B: Underreported Liability</b>				
7) Unreported Tax	17.2	61.4		
8) Reported Tax	35.7	318.8		
9) Unreported Tax (% Reported Tax)	48.4	19.3		
<b>Panel C: Internal Consistency, Income Tax vs Sales Tax</b>				
10) % Underreporters IT vs ST	7.8	8.4	12.5	6
11) % Overreporters IT vs ST	56.9	60.3	84.8	93.5

Notes: This table displays estimates of compliance gaps between third-party reports and self-reports. Third-party reported sales for the income tax is the sum of sales reported by clients, state institutions and credit-card companies, and exports. Third-party reported costs for the income tax is the sum of costs reported by suppliers, and imports. Third-party reported sales for the sales tax is the sum of sales reported by credit-card companies. All figures in this table are either in percent (as indicated), or in billions of constant 2015 CRC. Under-reporters (over-reporters) are firms reporting an amount at least 0.25% smaller (larger) than the relevant comparison amount. Rows 1-6 examine under-reporting of third-party reported sales/costs. They show the share of under-reporters among firms subject to third-party reporting for the income tax (1), the amount unreported (as compared to third-party reports) (2), the total third-party reports for under-reporters (3), the total third-party reports for the full sample (4), and the unreported amount as a share of the underreporters third-party reports (5), and as a share of total third-party reports (6). Rows 7-9 convert unreported sales into tax liabilities. They show an estimate of the unreported tax liability (7), the reported tax liability (8), and the unreported tax as a share of the reported tax (9). The estimation of the unreported (gross) tax liability assumes that the profit rate on unreported sales is the same as the profit rate on reported sales, and applies the tax schedule as displayed in Table I. Rows 10 and 11 analyze internal consistency in filing, comparing income tax reports to sales tax reports. All calculations are based on 2012 data, and we drop 2,200 firms that file following a non-standard fiscal year. Results are similar in the full sample and in other years.

**TABLE VI**  
**IMPACT OF WITHHOLDING-RATE INCREASE**

	Pre-Reform Mean Among Treated			Treatment Effect			Proportional Effect		
	(1) Trimmed 99.9th pctile	(2) Trimmed 99th pctile	(3) Trimmed 95th pctile	(4) Trimmed 99.9th pctile	(5) Trimmed 99th pctile	(6) Trimmed 95th pctile	(7) Trimmed 99.9th pctile	(8) Trimmed 99th pctile	(9) Trimmed 95th pctile
Total Sales Reported	55017.1 (541.9)	34699.3 (164.6)	19212.1 (52.71)	1667.9* (883.7)	1619.2*** (247.2)	1047.5*** (109.0)	0.0303	0.0467	0.0545
Sales Tax Collected	4241.9 (55.91)	2723.1 (41.66)	1641.5 (36.21)	239.6** (114.9)	224.0*** (84.52)	146.6* (84.11)	0.0565	0.0823	0.0893
Input Tax Credits	3557.1 (37.35)	2303.1 (10.78)	1387.5 (4.553)	-11.68 (83.53)	27.67 (32.11)	7.644 (26.24)	-0.00328	0.0120	0.00551
- Import Credits	1226.7 (24.47)	564.2 (9.226)	188.4 (7.379)	-41.02 (59.79)	4.082 (21.33)	-10.95 (14.87)	-0.0334	0.00723	-0.0581
- Local Purchase Credits	2329.1 (21.35)	1737.2 (13.21)	1197.1 (12.01)	33.92 (55.79)	21.50 (26.75)	12.57 (23.35)	0.0146	0.0124	0.0105
Gross Tax Liability	736.4 (46.08)	449.1 (6.248)	260.8 (2.347)	97.09** (49.53)	87.32*** (12.11)	62.92*** (6.095)	0.132	0.194	0.241
Withholding Base	9127.5 (118.6)	6122.9 (41.87)	3814.9 (15.31)	604.4*** (210.0)	499.2*** (59.92)	294.3*** (34.54)	0.0662	0.0815	0.0772
Withheld Tax	132.3 (4.196)	80.04 (1.557)	54.44 (0.580)	242.9*** (17.03)	178.7*** (7.629)	128.2*** (3.781)	1.836	2.233	2.354
Withheld Tax Reclaims	102.6 (4.123)	58.39 (1.534)	36.43 (0.553)	124.6*** (12.22)	82.25*** (4.647)	57.44*** (2.649)	1.214	1.409	1.577
Compensation Requests	16.40 (2.345)	15.16 (0.698)	9.849 (0.292)	16.76*** (5.617)	15.00*** (5.388)	4.689*** (1.730)	1.022	0.990	0.476
Final Tax To Pay	602.9 (48.15)	361.8 (11.82)	206.6 (1.949)	-1.872 (72.54)	-30.22* (16.83)	2.081 (4.516)	-0.00310	-0.0835	0.0101
Taxpayer Sales Tax Remittance	568.0 (15.95)	353.5 (4.887)	202.3 (1.735)	-9.083 (27.77)	-10.91 (9.519)	3.879 (4.421)	-0.0160	-0.0309	0.0192
Total Sales Tax Remittance	700.3 (18.04)	433.6 (5.665)	256.7 (2.008)	233.9*** (30.75)	167.8*** (10.96)	132.0*** (5.554)	0.334	0.387	0.514
Total Remittance - Refund	695.7 (18.08)	430.2 (5.703)	255.0 (2.030)	232.9*** (30.85)	167.5*** (11.01)	131.4*** (5.646)	0.335	0.389	0.515
Total Remittance - Refund - IT Compensation	671.5 (18.14)	410.2 (5.927)	243.2 (2.032)	234.0*** (31.06)	167.1*** (11.13)	129.9*** (5.673)	0.349	0.407	0.534
Sales Tax + Income Tax - Refund	1009.2 (28.26)	579.2 (8.588)	312.7 (4.246)	233.5*** (31.83)	165.1*** (11.25)	130.4*** (5.779)	0.231	0.285	0.417
Month FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time Trend	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	994,200	974,720	898,120	994,200	974,720	898,120	994,200	974,720	898,120

Notes: This table displays OLS estimates of the impact of the withholding-rate increase on firms in the treatment group (firms with a predicted rate increase at reform time), as per equation 2. We report pre-reform means in the treatment group (columns 1-3) and difference-in-difference point estimates (columns 4-6), and the proportional effect, i.e. the point-estimate scaled by the pre-reform mean (columns 7-8). Standard errors, clustered at the taxpayer level, are in parentheses. The columns reflect different specifications, in which the sample is trimmed at the 99.9th, 99th or 95th percentile in the distribution of total sales. All amounts are in '000 CRC. The rows reflect different outcome variables corresponding to the main line items on the sales tax return form (or on the income tax form, for the last two rows). Taxpayer remittance is the remittance made by the taxpayer at the end of each month. Total remittance is the sum of taxpayer remittance and any tax withheld. Total remittance - refund is net of any refund that taxpayers may have claimed on a separate form. Total remittance - refund - IT compensation is net of any compensation requests that the taxpayer made on her income tax declaration. Sales Tax + Income Tax - Refund is the sum of total sales tax and total income tax remittance (including tax withheld) minus any refund requested.

**TABLE VII**  
**HETEROGENEITY OF WITHHOLDING IMPACT**

	A: Point Estimates									
	(1) Below Median Turnover	(2) Above Median Turnover	(3) Income Tax Misreporters	(4) Continuing Withholdees	(5) First Time Withholdees	(6) Never Reclaimers	(7) Infrequent Reclaimers	(8) Frequent Reclaimers	(9) Bunchers	(10) Non Bunchers
Total Sales Reported	-406.8*** (105.1)	3645.2*** (461.9)	1981.8*** (513.0)	1998.7*** (324.1)	959.5* (582.5)	419.3 (326.7)	1716.8*** (486.0)	2608.2*** (361.0)	2086.2*** (353.5)	1399.1*** (310.6)
Gross Tax Liability	12.09** (6.141)	162.6*** (21.97)	133.6*** (23.01)	110.9*** (15.24)	33.30** (15.73)	-6.213 (9.567)	50.80** (19.92)	212.3*** (23.97)	89.79*** (19.95)	86.17*** (14.14)
Withheld Tax	41.93*** (1.992)	315.5*** (14.55)	321.0*** (21.38)	206.7*** (10.51)	129.0*** (12.20)	65.01*** (7.091)	151.4*** (8.982)	312.1*** (18.95)	248.0*** (15.19)	146.0*** (8.501)
Withheld Tax Reclaims	11.57*** (1.525)	152.9*** (8.836)	145.8*** (12.51)	109.4*** (6.305)	32.64*** (7.989)	-9.348*** (1.198)	32.32*** (4.582)	219.9*** (12.04)	143.8*** (11.25)	53.25*** (4.106)
Total Sales Tax Remittance	41.33***	294.3***	291.8***	180.1***	131.5***	69.98***	139.9***	287.3***	203.1***	151.1***

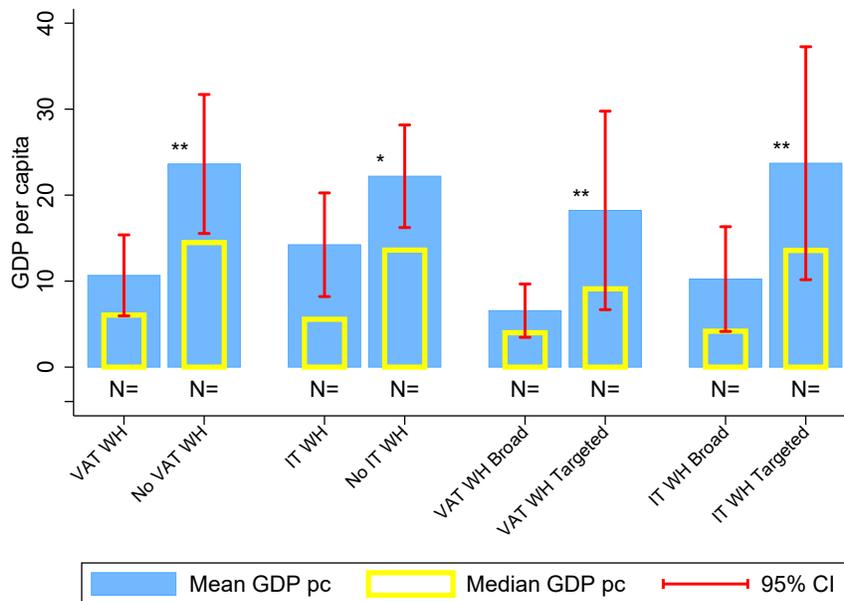
	B: Proportional Effects (Point Estimate Scaled by Pre-Reform Mean in Treatment Group)									
	(1) Below Median Turnover	(2) Above Median Turnover	(3) Income Tax Misreporters	(4) Continuing Withholdees	(5) First Time Withholdees	(6) Never Reclaimers	(7) Infrequent Reclaimers	(8) Frequent Reclaimers	(9) Bunchers	(10) Non Bunchers
Total Sales Reported	-0.0896	0.0562	0.0546	0.0506	0.0284	0.0179	0.0476	0.0599	0.0670	0.0385
Gross Tax Liability	0.188	0.195	0.338	0.175	0.280	-0.0458	0.143	0.253	0.227	0.182
Withheld Tax	1.939	2.279	2.051	1.820	6.446	5.058	3.148	1.773	2.183	2.274
Withheld Tax Reclaims	1.031	1.449	1.276	1.261	3.267	-4.962	1.378	1.488	1.668	1.176
Total Sales Tax Remittance	0.612	0.368	0.735	0.290	1.180	0.523	0.411	0.355	0.530	0.331
Month FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time Trend	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	882,440	882,440	832,200	911,360	808,480	839,400	852,000	845,840	842,880	922,000

Notes: This table displays OLS estimates of the impact of the withholding-rate increase on firms in the treatment group (firms with a predicted rate increase at reform time), as per equation 2, for different subsamples of the treatment group, as indicated in the column titles. The rows display the treatment effect on different outcomes, as indicated by the row titles. The estimations correspond to the specification in column 5 of Table VI. “Never reclaimers” never (or only once) deduct tax withheld on their sales tax declaration or request a refund. These firms are also in the bottom tercile of the distribution of reclaiming frequency post reform. “Infrequent reclaimers” are in the middle tercile of this distribution, and frequent reclaims are in the top tercile. Bunchers are firms that declare gross liability within 5% of the amount of tax withheld.

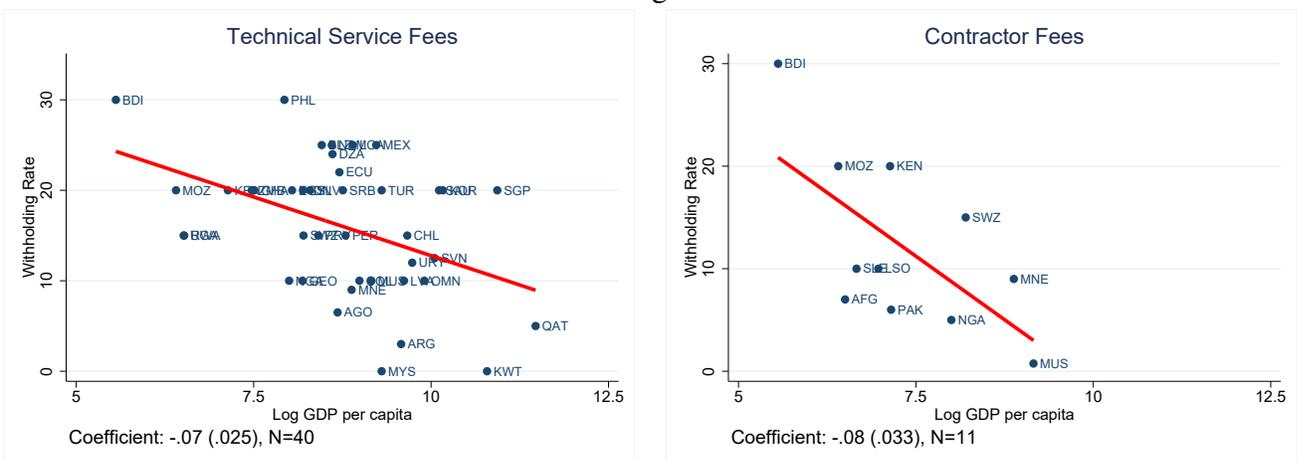
# FIGURE I

## WITHHOLDING SYSTEMS AND DEVELOPMENT

A: Withholding Bases



B: Withholding Rates



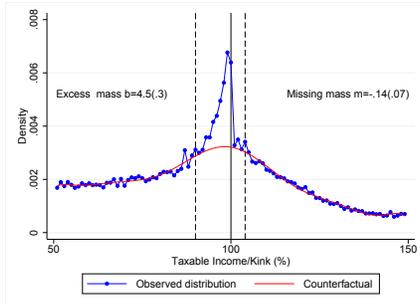
Notes: This figure shows that tax withholding on firms is widespread, and that the use of withholding, the breadth of withholding bases and the level of withholding rates are all negatively correlated with GDP per capita. Panel A displays the mean/median GDP per capita (in thousands of 2013 USD, WDI) for different subsamples of countries. The number below each bar displays the sample size. The stars reflect the significance levels of the mean difference between two adjacent bars: countries that use and do not use withholding on the VAT/sales tax; countries that use and do not use withholding on income taxes for firms; countries that use a broad withholding regime (that applies across sectors), and those that use a targeted withholding regime, applicable only to certain sectors (e.g. construction, fishing). The analysis is based on a sample of 118 countries for which data was available from the [PKF International Worldwide Tax Guide 2015](#), recent [EY International Tax Alerts](#), [PWC Tax Summaries](#), or the secondary sources referenced in the introduction. Panel B displays the correlation between log GDP per capita and the withholding rate, for withholding on technical services fees and on contractor fees, collected from the [PKF International Worldwide Tax Guide 2015](#).

# FIGURE II

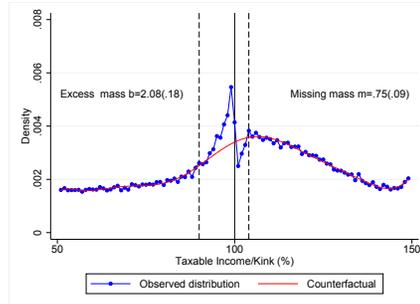
## BUNCHING, INFORMATION REPORTING AND WITHHOLDING

### A: Self-Employed

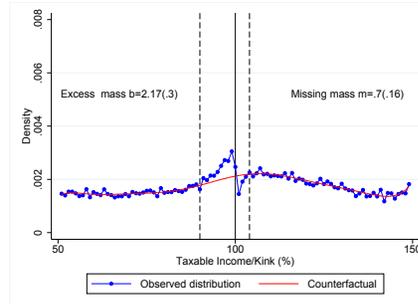
A1: No Information Reporting



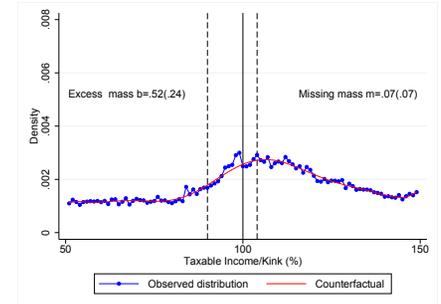
A2: Reporting by Firms



A3: Reporting by State

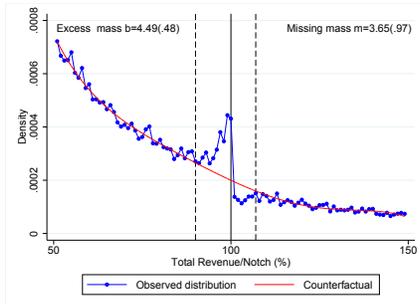


A4: Reporting by Credit/Debit Card

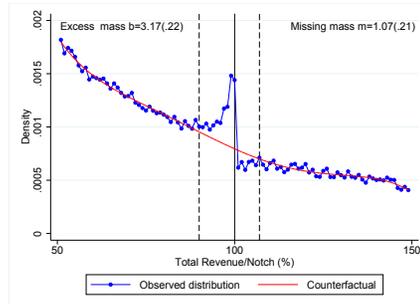


### B: Corporations

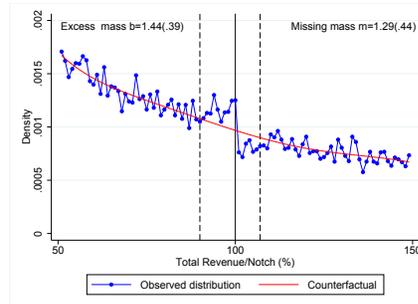
B1: No Information Reporting



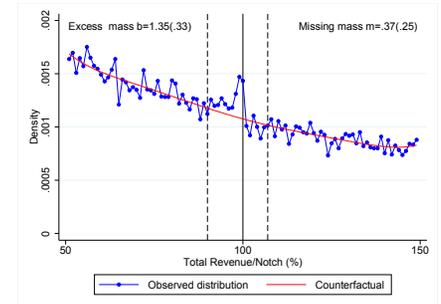
B2: Reporting by Firms



B3: Reporting by State



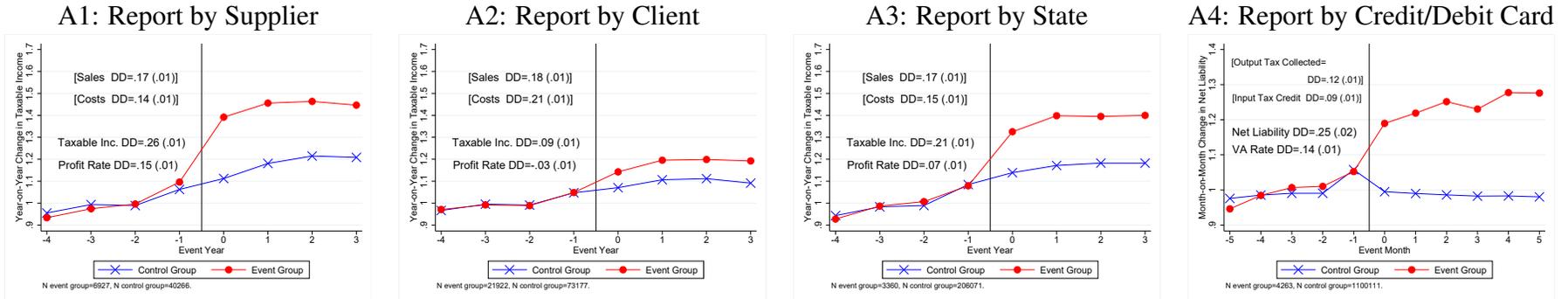
B4: Reporting by Credit/Debit Card



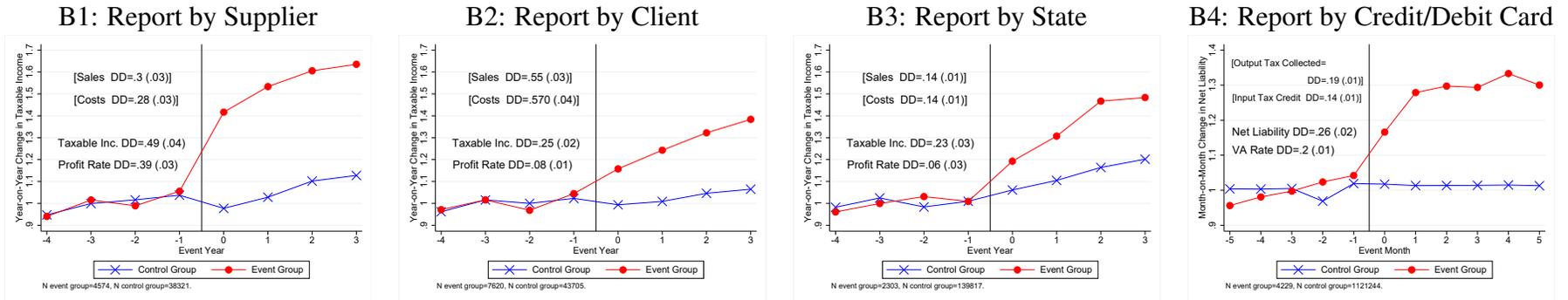
Notes: This figure shows the density distribution of taxable income for the self-employed around the first kink in the income tax schedule (top row, A), and the density distribution of total revenue for corporations around the first notch in the corporation tax schedule (bottom row, B). The data is pooled for years 2006-2015, represented as percentage distance from the kink, and aggregated in taxable income bins of 1%. The panels show the distribution for different subsamples, as per the panel titles that indicate whether and by what type of information reporting firms in the subsample are covered. The blue dotted line marks the empirical distribution, the red solid line marks the counterfactual, fitted as a flexible polynomial to the observed distribution outside the excluded range. We use a tenth-degree polynomial for self-employed and a sixth-degree polynomial for corporations. The excluded range above the threshold covers four and seven bins respectively in the two groups of firms. The excess mass  $b$  and missing mass  $m$  are estimated as the difference between the observed and estimated density, weighted by the height of the counterfactual density. The standard errors are bootstrapped.

# FIGURE III EVENT STUDY OF COMPLIANCE AFTER FIRST INFORMATION REPORT

## A: Self-Employed

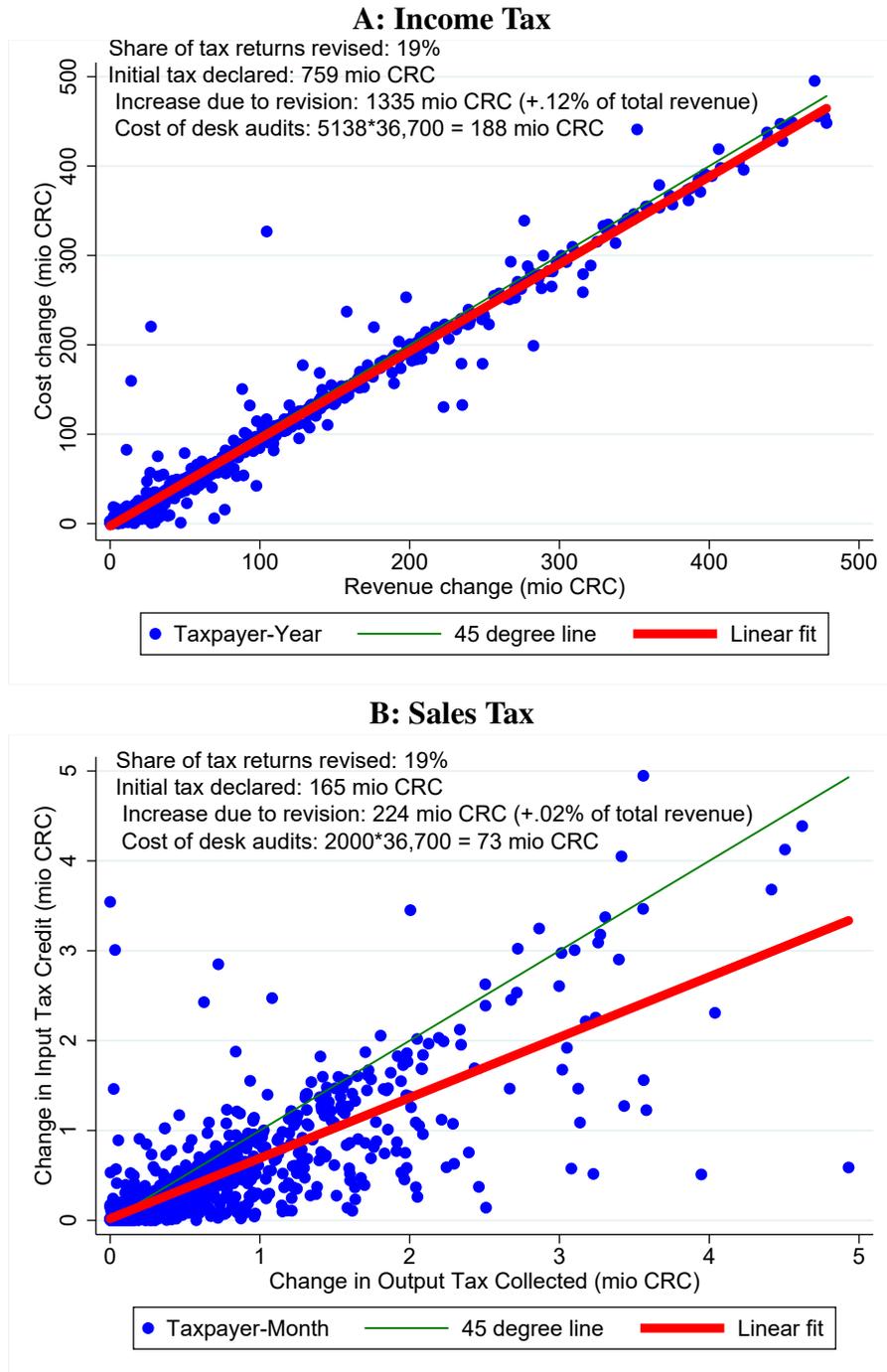


## B: Corporations



Notes: This figure displays event studies of firms behavior after being reported for the first time by different reporting agents, as indicated by the panel titles. The top row (A) is for the self-employed and the bottom row (B) for corporations. Each panel displays the year-on-year change (month-on-month change for credit/debit-card reporting) in reported taxable income (tax liability) for an event group (orange dotted line) and an event control group (blue crossed line). The black solid line marks event time 0, when firms in the event group are reported to the tax authority for the first time by the reporting agent indicated in the panel title. The control group is re-weighted by its propensity score of experiencing the event (cf. section IV.B. and footnote 31, for details). Each group consists of a balanced panel of firms that can be observed for the entire period displayed. Panels A1-A3 and B1-B3 consider events happening in 2010-2012. Panels A4 and B4 consider events happening in 02/2009-08/2014. The text displays the difference-in-difference coefficient from estimating equation 1, for different outcome variables as noted. A stands for value-added rate.

# FIGURE IV IMPACT OF DESK AUDITS



Notes: This figure shows the revenue and cost adjustments made by firms after they are informed that a desk audit uncovered a discrepancy between self-reported and third-party reported sales. The desk audits are for income tax returns for 2013 and 2014, and for sales tax returns for 2013. The figures focus on firms submitting a revised tax return, and display the change in revenue and costs (output tax collected and input tax credit deducted in panel B), comparing the initial return with the revised return. The text displays the share of audited firms that submit a revised return, the initial tax declared by revisers, the increase in declared tax due to the revision, and the cost of the desk audit intervention. The cost is calculated by multiplying the number of cases by the daily wage of a tax officer, as tax officers are asked to handle one case per day.

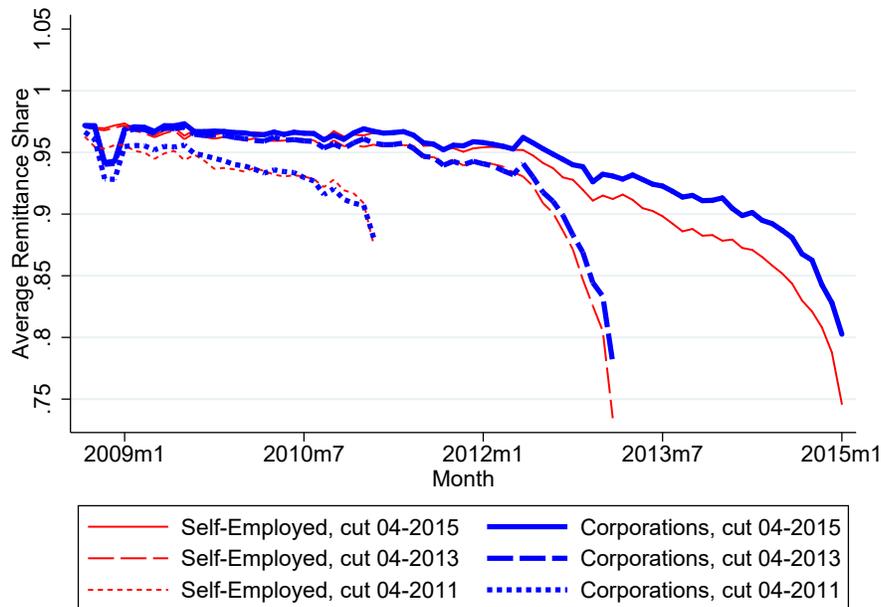
# FIGURE V

## REMITTANCE OF TAX LIABILITIES

**A: Income Tax, Average Share of Net Liability Remitted**

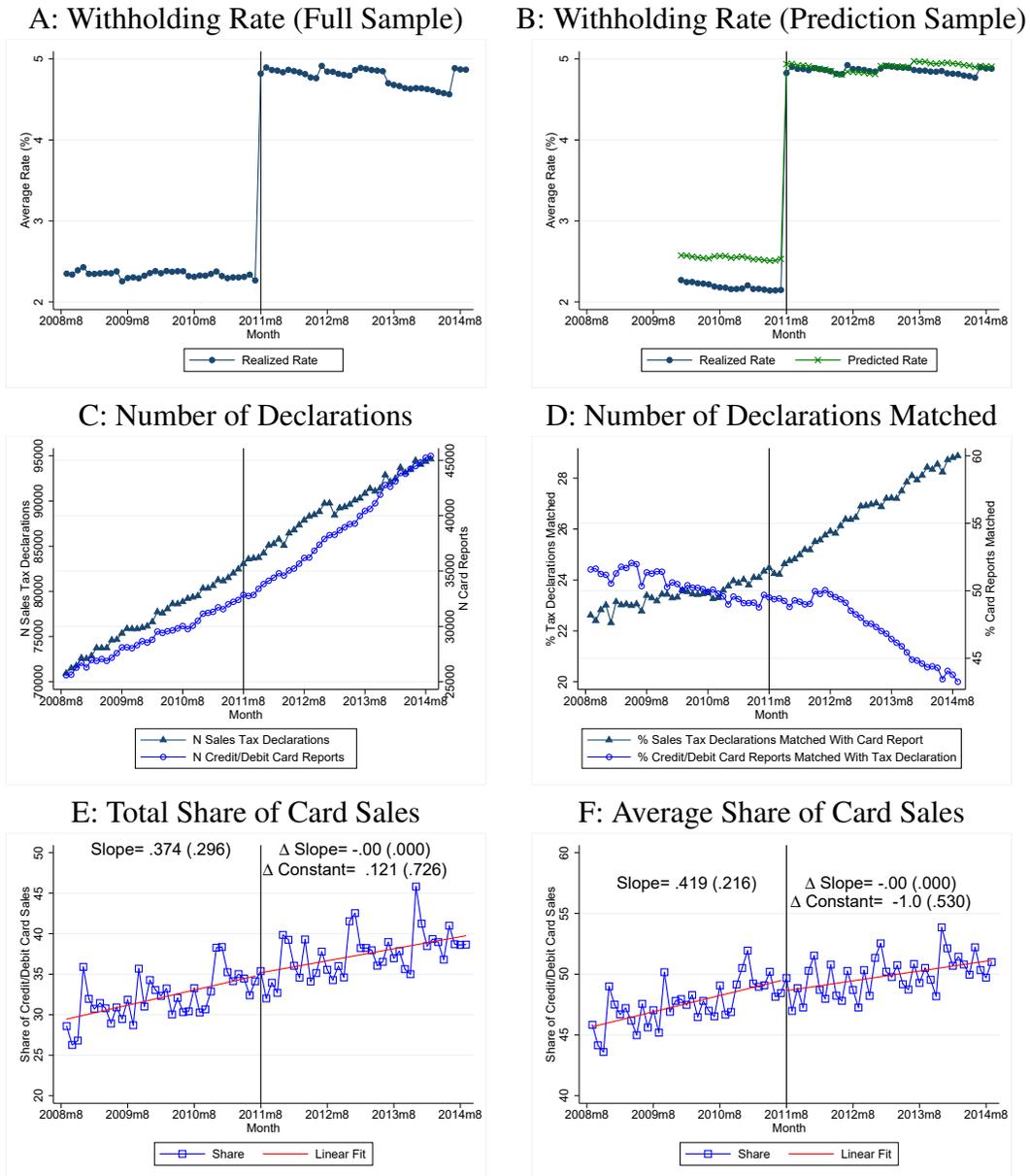


**B: Sales Tax, Average Share of Net Liability Remitted**



Notes: This figure shows the average tax remittance share, defined as the remittance made by the taxpayer for a specific tax period, divided by the tax liability to be remitted for that period. The average is an unweighted average across all taxpayers with a positive final liability. The tax liability is net of any deduction made for tax withheld, and the remittance data does not include tax withheld. The income tax data includes all declarations filed and remittances made by June 2015. The sales tax data includes all declarations filed and remittances made by October 2015. The thin red lines correspond to the self-employed and the thick blue lines corresponds to corporations. We show the series for three different cuts in the remittance data, taking into account all remittances made before the cut date.

# FIGURE VI WITHHOLDING-RATE REFORM

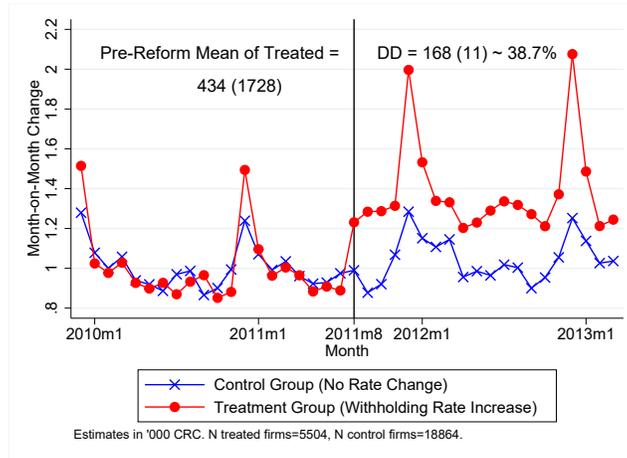


Notes: This figure displays the first stage of the withholding-rate reform and analyzes the reform’s effect on credit/credit card use. Panel A shows the average realized withholding rate among all firms subject to withholding. Panel B shows the average realized and predicted withholding rate among firms for whom we can predict the withholding rate based on previous semester’s tax returns and the withholding-rate schedule in Table II. Panel C shows the number of sales tax declarations and credit/debit-card withholding declarations presented to the tax authority, correcting for revisions and duplicates. Panel D shows the share of sales tax declarations matched with at least one withholding declaration and vice-versa. Panel E shows the share of card sales in total sales among firms with a credit/debit-card machine, and panel E shows the average over the firm-specific shares of card sales among firms with a credit/debit-card machine. The black solid line in all panels marks 08/2011, when the increase in the withholding rate for the sales tax entered into effect. Panel E and F show a linear fit that allows for a different trend and constant after the reform. The text displays the pre-reform slope of the linear fit, and the change in slope and constant after the reform, along with standard errors in parentheses.

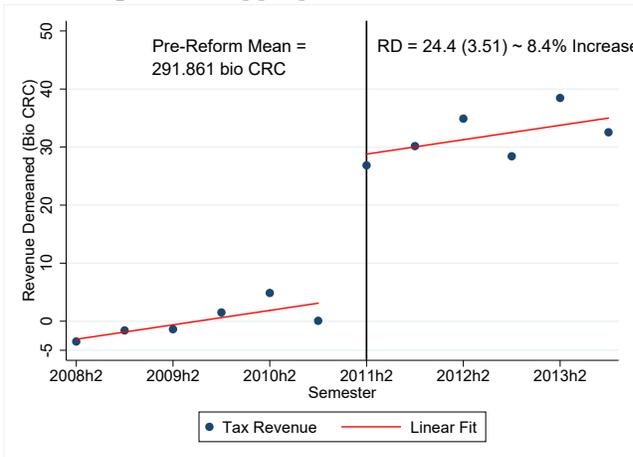
# FIGURE VII

## IMPACT OF WITHHOLDING-RATE INCREASE

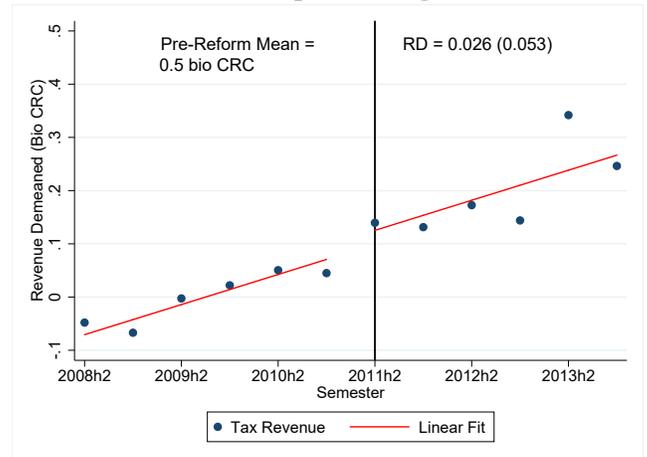
A: Impact on Sales Tax Remittance by Treated Firms



B: Impact on Aggregate Sales Tax Revenue



C: Counterfactual, Simplified Regime Tax Revenue

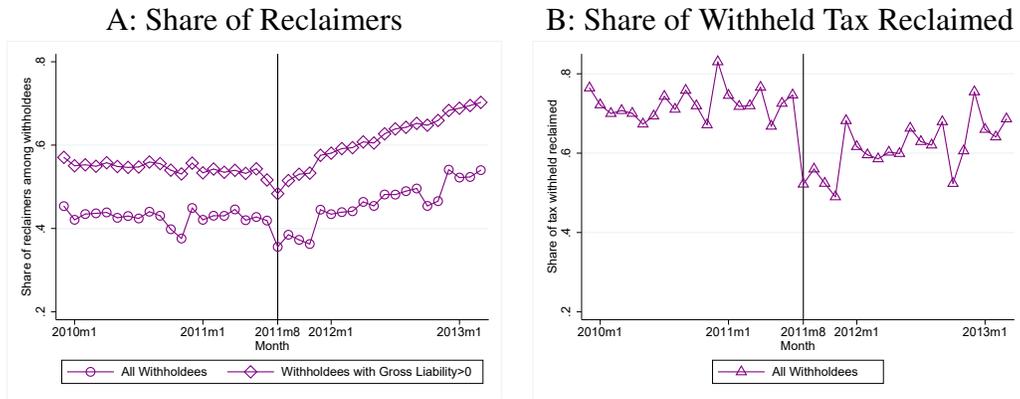


Notes: Panel A displays the results of the difference-in-difference estimation of Equation 2, with total tax remittance as outcome variable. The black solid line marks 08/2011, when the increase in withholding rates entered into effect. The data is winsorized by the 99th percentile, and scaled by the pre-reform average. The bottom panels show the reform's impact on aggregate sales tax revenue (panel B), and on aggregate revenue from the quarterly simplified regime tax, as a counterfactual (panel C). The sales tax data is based on official revenue statistics from the Ministry of Finance, net of the sum of refunds made by the tax authority to taxpayers who were subject to withholding in excess of their liability, and the simplified regime data is based on firm-level tax declarations. For panel B, semesters are defined to fit exactly around the time of the reform, so the first semester of each year includes February to July, and the second semester includes August to December, and January of the following year. The results are robust to running the analysis on monthly or quarterly data, using shorter or longer time series, and adding controls for the months of December and January (in the monthly data).

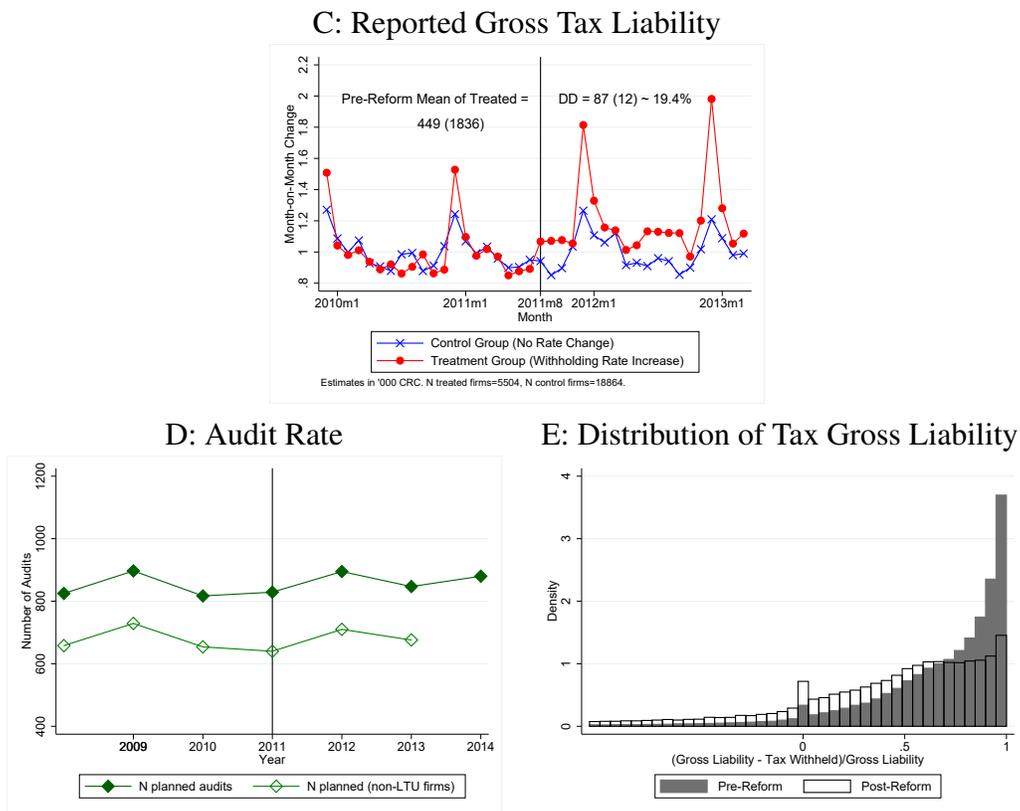
# FIGURE VIII

## MECHANISMS OF WITHHOLDING IMPACT

### Default Mechanism

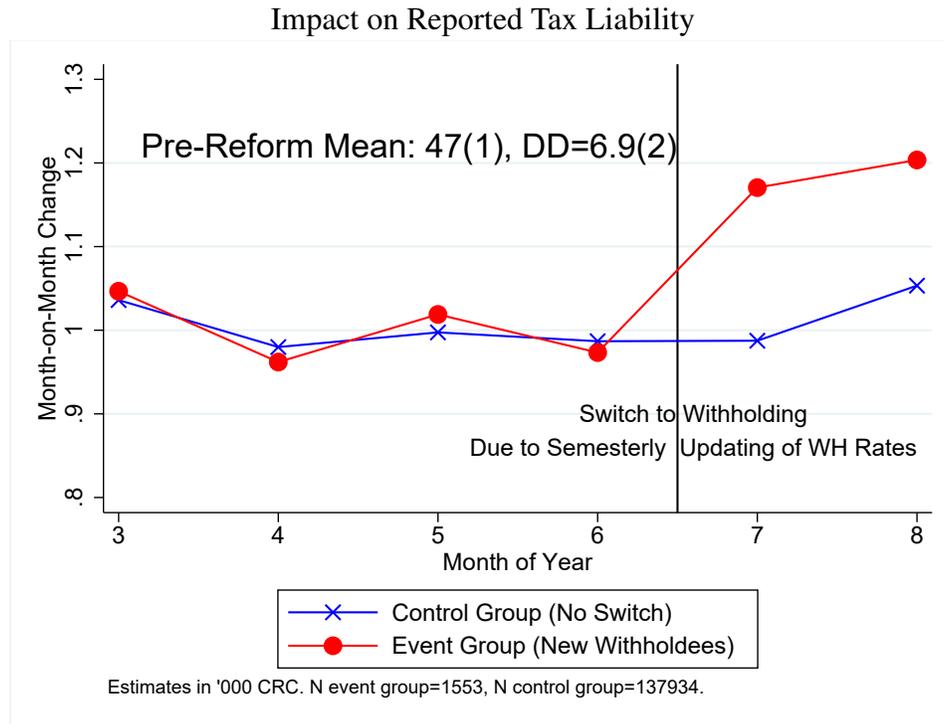


### Enforcement-Perceptions Mechanism



Notes: This figure illustrates the mechanisms for the withholding-rate impact. In all panels, the black solid line marks 08/2011, when the increase in withholding rates entered into effect. Panels A and B display, for all firms subject to withholding in a given month, the share of firms making a reclaim, and the average share of withheld tax reclaimed respectively. Panel C shows results of the difference-in-difference estimation of Equation 2, on gross liability. The Panel is constructed as Panel A in Figure VII. Panel D shows the evolution over time of the number of planned audits for all taxpayers and for taxpayers who are part of the large taxpayer unit, as per the annual work programs of the audit department. Panel E shows the distribution of the deviation of reported gross liability from the amount of tax withheld, before and after the reform, for the balanced panel underlying all difference-in-difference estimation.

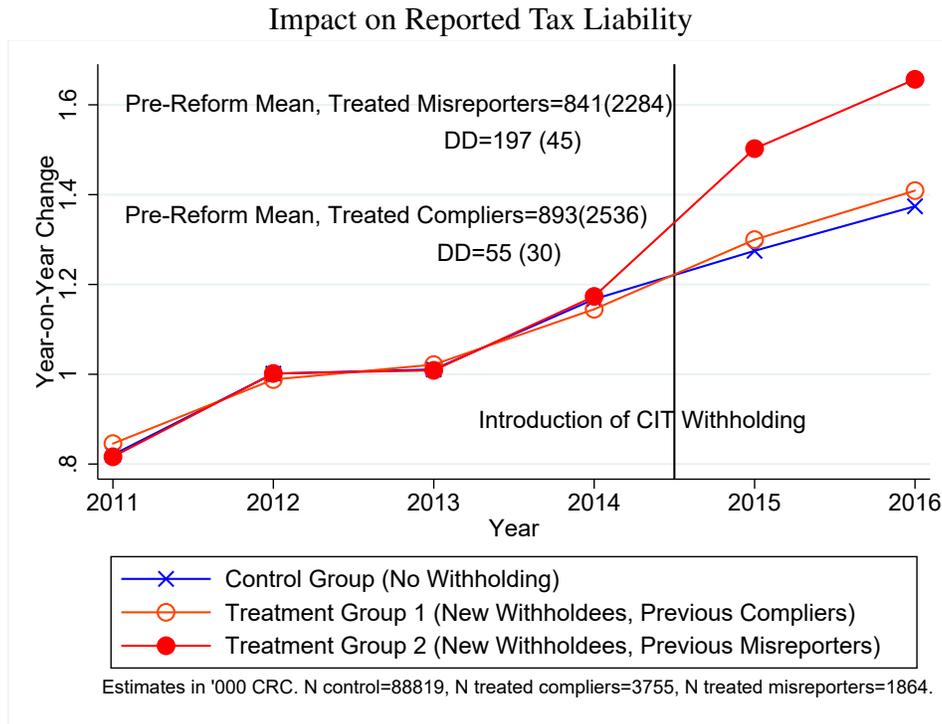
# FIGURE IX EVENT STUDY OF SALES TAX WITHHOLDING



Notes: This figure displays an event study of a switch in the firm's withholding rate from zero to a positive rate. Firms in the event group are self-employed who were subject to third-party reporting by their card company but not subject to withholding prior to July, and who became subject to withholding at a non-zero rate in July. This happens due to the biannual updating of withholding rates, based on firms' reported value-added or share of domestic sales two semesters prior, as per Table II. Firms in the control group experienced no change in the withholding regime nor in the third-party reporting regime between June and July. The graphs are constructed and labeled as in Figure III. The estimation follows equation 1, except that the control group is not propensity-score-reweighted, and events in the year 2011 are excluded.

# FIGURE X

## IMPACT OF INCOME TAX WITHHOLDING



Notes: This figure examines the impact of withholding for the purpose of compliance with the corporate income tax, which was introduced in 2015. Similar to sales tax withholding, this type of withholding is implemented by credit-card companies, applies to card sales at a rate of 2%, and the tax withheld is creditable against firms' income tax remittance. We compare control firms that were not subject to income tax withholding in 2015 to treated firms that were subject to withholding for the first time in 2015, dividing the treatment group into firms that had misreported in the previous years (i.e. had reported sales lower than third-party reported sales), and firms that had not misreported (labeled "compliers"). The estimation follows equation 2 (with the  $t$  referring to years).