

TAXATION, INFORMATION AND WITHHOLDING: EVIDENCE FROM COSTA RICA*

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100-Word Abstract

Withholding of taxes by employers or firms' trading partners is common around the world, but absent in public finance theory. We demonstrate the surprising power of withholding as a compliance instrument, studying a scheme in Costa Rica where credit-card companies withhold tax from retail firms. Doubling the withholding rate increases sales tax remittance among treated firms by 29% and aggregate revenue by 8%, although the statutory tax rate and third-party reporting requirements remain unchanged. We identify the mechanisms driving this effect, show that such withholding schemes are common in developing countries, and replicate our results in multiple contexts.

Long 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 lower-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 29% 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. We replicate our main findings using withholding-rate reforms in multiple contexts.

JEL codes: H25, H26, H32, O23.

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1 Introduction

Tax withholding schemes are widely used around the world, but absent in public finance theory.¹ Withholding of the personal income tax by employers is almost universal. Withholding is also commonly 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, sending the tax withheld to the tax authority as an advance tax remittance² by the payee.³ Large firms and financial institutions are common withholding agents. We identified over 60 countries which use such withholding schemes for firms. Figure 1 shows that the use of these schemes is particularly prevalent in lower-income countries, and that lower-income countries have a broader application of the withholding scheme across firm types, and higher withholding rates. This suggests that withholding may be a desirable policy tool in a context with low tax compliance. In standard public finance theory, however, tax compliance is modeled primarily as a function of enforcement (audits and penalties) and third-party reported information about the taxpayer's income.⁴ The fact that the third party may also withhold tax at source has been largely ignored.

This paper studies the surprising power of withholding and its mechanisms. In our main application in Costa Rica, credit- and debit-card companies⁵ 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 authority, and as the withheld tax is fully creditable against a taxpayer's final tax liability, standard models suggest that withholding should be irrelevant to tax compliance. However, our empirical evidence rejects these models. We exploit variation in firm-specific withholding rates in a difference-in-difference design to show that a doubling of the withholding rate increases sales tax remittance among treated firms by 29%, although third-party reporting requirements and statutory tax rates do not change. The mechanisms are

¹Slemrod (2008) and Slemrod and Boning (2018) discuss the importance of withholding qualitatively, without specifically modeling it.

²We 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 2008).

³In 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.

⁴Formal employment contracts (Kleven et al. 2011, Jensen 2019), modern accounting systems (Kleven et al. 2016), financial transactions (Gordon and Li 2009), electronic receipts (Naritomi 2019) and firm-to-firm transaction records (Pomeranz 2015) all generate third-party information, which allow the tax authority to verify a taxpayer's self-reported income and deter evasion.

⁵Henceforth referred to as credit-card companies for simplicity.

a default payment effect and a change in enforcement perceptions. This rationalizes the use of withholding as a compliance instrument.⁶

To examine the potential effect of withholding conceptually, 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, and if taxpayers correctly perceive the audit function, third-party reporting puts a lower bound on the reported tax liability. Withholding is then 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. When 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.⁷

To evaluate the effect of third-party reporting and withholding empirically, we use a ten-year panel of administrative tax records from Costa Rica. Our data contains the universe of income tax and sales tax declarations, registration and deregistration records, and over 20 million third-party information and withholding reports.

Our analysis is divided into three parts. As withholding is always accompanied by third-party reporting, we start by providing 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 40% after the first third-party report by another firm, by 23% after the first report by a credit-card company, and by 21% 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, 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 declara-

⁶Withholding 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.

⁷We also discuss how withholding would impact compliance if firms are liquidity constrained, but find no empirical evidence for this mechanism.

tions, 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 as an alternative compliance instrument, which we evaluate in the third part of the analysis. We exploit a reform to the withholding-rate schedule applied by credit-card companies. Firm-specific withholding rates are determined each semester based on each firm's sales tax declarations from two semesters prior, which means there is no scope for firms to manipulate withholding rates ex-post. Prior to the reform, withholding rates were increasing in reported value-added; after the reform they were increasing in the share of domestic sales. As a result, the reform triggered an increase in the withholding rate for firms with a low value-added rate and a high share of domestic sales. Firms in an intermediate range of value-added and intermediate share of domestic sales, and firms 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. Importantly, the reform allows us to isolate the impact of withholding from other determinants of compliance, as 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 29% 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 8%.⁸ 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 a change in enforcement parameters, or by the bunching of reported tax liabilities at the amount of tax withheld (which could arise in a model with liquidity constraints or rule-of-thumb reporting behavior). We argue instead that withholding changes enforcement *perceptions* and provide evidence consistent with this.

As with any study exploiting a specific reform, questions of external validity may arise. To allay such concerns, we replicate our results using event studies and difference-in-difference

⁸While the withholding rate change affected firms' tax compliance, we find little evidence for an effect on real firm growth, as proxied by the wage bill and number of employees.

estimations of withholding rate changes which apply to different taxes and different types of taxpayers in Costa Rica. In addition, we demonstrate that Costa Rica’s tax enforcement and audit capacity is in line with the capacity observed in other countries at a similar level of development.⁹ Withholding in Costa Rica applies to relatively larger firms, but among the firms subject to withholding, the tax remittance response to withholding is larger among smaller firms. Withholding might thus generate even larger effects in lower-income countries with smaller firms.

Our paper contributes to several strands of the literature. First, we contribute to a large body of work on tax compliance surveyed in [Slemrod \(2018\)](#) and [Slemrod and Yitzhaki \(2002\)](#).¹⁰ We present withholding as an empirically important compliance mechanism which has been missing in the literature.¹¹ 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). As withholding agents are usually firms, our work also connects to [Kopczuk and Slemrod \(2006\)](#), who have emphasized the important role of firms in tax enforcement, and [Slemrod \(2008\)](#), who emphasized firms’ role as withholding agents in particular. 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. Our study is the first to estimate the impact of withholding on compliance and identify the mechanisms through which it works.

Since withholding is always accompanied by third-party information reporting (but not vice-versa), our study also relates to the empirical literature on third-party reporting ([Pomeranz 2015](#), [Jensen 2019](#), [Naritomi 2019](#); the latter being methodology most closely related to our study). While these papers show that information trails increase compliance, it remains unclear whether there are remaining compliance gaps, and how large they are. There are also studies highlighting the limits of third-party reporting if firms can adjust less easily verifiable margins ([Carrillo et al. 2017](#), [Slemrod et al. 2017](#)). We can reconcile these findings with empirical

⁹We have also conducted a difference-in-difference estimation around a withholding-rate increase in another developing country, which yields similar results as the study in Costa Rica (results available upon request).

¹⁰Previous 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](#), [Kleven et al. 2016](#)), and (iii) social motives, such as the desire to conform to social norms ([Singhal and Luttmer 2014](#), [Slemrod et al. 2019](#)).

¹¹A few policy reports ([Samanamud 2013](#), [OECD 2009](#)) and legal studies ([Soos 1990](#)) anecdotally describe the relationship between withholding and tax compliance among small firms, and an empirical study by [Carrillo et al. \(2018\)](#) examines bunching at a withholding-rate kink. Another literature has analyzed personal income tax withholding with a special focus on the United States, examining why individuals voluntarily over-withhold ([Barr and Dokko 2008](#), [Gandhi and Kuehlwein 2014](#), [White et al. 1993](#), [Highfill et al. 1998](#)).

evidence from a novel setting by examining firms' responses not to intensive-margin increases in information reporting or to the use of preexisting reports (as in previous studies), but to extensive-margin changes in being reported, which is arguably where the largest compliance response should be expected. We find large increases in reported tax liability in response to information reporting, despite some offsetting adjustments on the cost margin. We then 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: withholding.

Third, our study relates to the literature on state capacity and development, and the optimal mix of tax instruments in a low-capacity setting (Besley and Persson 2013, Gordon and Li 2009, Keen 2008). Similar to the minimum tax studied in Best et al. (2015), withholding on firms is a tax instrument that is predominantly used in lower-income countries and low-compliance settings. We provide evidence that rationalizes its use in these contexts. Lastly, 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 (Chetty et al. 2014, Thaler and Benartzi 2004, Madrian and Shea 2001). 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.

The remainder of the paper is organized as follows. We start by presenting our conceptual framework in Section 2. Section 3 describes the context and data. Sections 4, 5 and 6 evaluate the impact of information reporting, the anatomy of compliance and the impact of withholding. While the main innovative contribution of the paper is the effect of tax withholding examined in section 6, we consider it important to first study the effect of information reporting, as withholding is always associated with information reporting, and our objective is to separately estimate the effect of the former and the latter. Section 7 provides evidence for the external validity of our findings, and section 8 concludes.

2 Conceptual Framework

This section presents a simple framework for analyzing behavioral responses to third-party reporting and withholding. This is based on the canonical tax-evasion model by Allingham and Sandmo (1972), extended by Kleven et al. (2011) and Carrillo et al. (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 the mechanisms through which withholding can impact compliance.

2.1 A Tax-Evasion Model with Third-Party Reporting

The basic setup of our model follows Carrillo et al. (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 τ 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 θ , 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 .¹² To account for the tax authority's use of risk scores and third-party information to target audits, we assume that the audit probability is decreasing in the reported profit rate, $p = p((\hat{\pi} + \epsilon)/\hat{R})$ with $p' < 0$.¹³ Misreporting against third-party information is automatically flagged and triggers the maximum audit probability: $p = \bar{p} = \max(p)$ if $\hat{R} < R_T$.¹⁴

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 $\epsilon \rightarrow 0$, a firm with $R_T = 0$ sets $\hat{R}^* = \hat{\pi}^*$ to satisfy the first order condition, and set $\hat{C}^* = 0$. 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 and the audit function is not public knowledge. Third-party reporting mechanisms usually require third parties to report

¹²Modeling firms in a middle-income country 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.

¹³The inclusion of ϵ , 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 $\hat{\pi} = 0$.

¹⁴As 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 $p'' \geq 0$.

transactions to the tax authority, but not directly to the taxpayer, so taxpayers may be unaware of the exact value of R_T . In this context, we predict that firms with $\tilde{R}_T < R_T$ underreport sales compared to third-party reports: $\hat{R}^* \leq \tilde{R}_T < R_T$. We test this prediction in our anatomy of compliance, comparing firms' self-reports to third-party reports of sales and costs.

2.2 Modeling Withholding

We introduce withholding into the model by assuming that tax is withheld at a rate μ 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 is $P = T - \mu R_T$, where the tax withheld is deducted from the gross tax liability. We further assume that firms always pay their tax in full, meaning that the actual tax payment $\hat{P} = P$. 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 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 assumptions which we relax in the next section.

2.3 Withholding Impact Mechanisms

This section examines firm behavior when relaxing some of the assumptions in the naive model to bring it closer to reality. In this case, withholding can impact compliance.

Default Mechanism. The naive model assumes that taxpayers subject to withholding can fully and costlessly reclaim the tax withheld. In reality, firms may incur administrative or monetary costs to credit the tax withheld against their liability. A simple way to model this is to consider that firms incur a firm-specific fixed cost f_i , distributed according to a cumulative distribution function $H(f)$, to deduct the tax withheld μR_T from the gross tax liability T . This 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. The presence of the fixed cost generates a cutoff $\bar{f} = \mu R_T$ 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 μ) are more likely to reclaim, $\partial H(\bar{f})/\partial R_T > 0$ and $\partial H(\bar{f})/\partial \mu > 0$.¹⁵

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.¹⁶ Such a statement can prompt taxpayers to update their enforcement perceptions either because it provides new information or because it makes known information more salient (Chetty et al. 2009, Finkelstein 2009). Specifically, the statement conveys that an amount μR_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 the true 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 $\tilde{p}' \neq 0$. As another example, 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. When confronted with tax withholding, these taxpayers may revise \tilde{p} upwards and hence increase $\hat{\pi}$.

Updating of \tilde{R}_T and \tilde{p} is more likely among the following groups of firms: firms that have previously misreported their taxable 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.

Alternative Mechanisms. In our empirical analysis, we consider and refute two potential alternative mechanisms. In a dynamic model with liquidity constraints, withholding could influence tax compliance behavior if taxpayers suffer unexpected shocks between the time of

¹⁵A cap on reclaims or an increase in the audit probability for reclaimers would similarly generate incomplete reclaim, but these features are empirically not relevant, as we discuss below.

¹⁶See Figure A.11 and section 3.2 for more details on reporting requirements.

income receipt and the time of tax remittance, or if they myopically consume income before taxes are due. Such taxpayers earn taxable income, but find themselves without liquidity to remit tax at the end of the period. In this case, they would report $\hat{\pi} = 0 \leq \pi$.¹⁷ The introduction of withholding could then increase compliance. It would allow taxpayers to report a positive tax liability, even if they have no liquidity to remit the tax, as (part of) the tax has already been withheld. In this case, the reported tax liability would equal the amount of tax withheld: $\hat{\pi} \cdot \tau = \mu R_T$, still ensuring $P = 0$. This mechanism thus predicts bunching of reported tax liabilities at the amount of tax withheld.¹⁸ Another model of firm behavior which could generate such bunching is one in which firms interpret the amount of tax withheld as a signal about the appropriate tax liability to declare (e.g. rule-of-thumb reporting behavior). In either model, an increase in withholding would increase tax compliance, because it would mechanically move firms to report higher tax liabilities. We will thus examine the presence of bunching in reported tax liabilities, and any changes in bunching with the withholding rate. We also test whether firms with low profit margins, for whom liquidity constraints are more likely to bind, exhibit a larger response to the withholding rate.

3 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 these taxes, the compliance mechanisms used to enforce them, and the data we use.

3.1 Income Tax, Sales Tax and Simplified Regime

Firms are liable for income tax on taxable profits. Tax declarations are filed annually by December 15, with three quarterly advance remittances due in March, June, and September.¹⁹

¹⁷Note, however, that the nature of shocks or myopia that would generate this result needs to be very specific, affecting only disposable but not taxable income. An example could be an owner-manager using business income to pay for a family emergency. A shock to taxable income would affect also true tax liabilities, and would thus not necessarily generate non-compliance. Also note that, for taxpayers who find themselves without liquidity to remit tax, and whose sales are partially covered by third-party reporting, non-payment or non-filing would not be optimal in our model, unless the taxpayers mis-perceive the enforcement parameters $p()$ and R_T .

¹⁸In a more complicated model where only part of firms' taxable income is lost between the receipt of income and tax remittance, the distribution of (reported tax liability-tax withheld)/(reported tax liability) would exhibit excess mass just above 0, and an increase in the withholding rate would lead to an increase in bunching at 0.

¹⁹Fiscal 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 of the average liability over the last three years, whichever is higher.

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 1 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%, and 30% were unchanged during the 2006-2015 period.²⁰ 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.

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 thresholds²¹ 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.

3.2 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 3. All information reporting and withholding mechanisms apply in the same way to self-employed

²⁰Wage earners are taxed according to another tax schedule, which features three tax brackets with marginal rates of 0%, 10%, and 15%, respectively.

²¹These 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 446,200 (US\$764) in calendar year 2019.

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

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\$4,365.²² 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.²³

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.²⁴ 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 6.1.

The sales tax withholding system generates the key variation used in this paper. Table 2 shows the withholding-rate schedule for the sales tax. Prior to August 2011, the withholding rate was increasing in the reported value-added rate. Value added is defined as tax-liable sales net of tax-liable purchases and imports, where tax-liable refers to the sales tax. Under this schedule, 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%, and 6% and changed the rate-determination methodology. As exports are exempt from the sales tax, the rates are now increasing in the share of domestic sales in total sales, with notches at 0% and 50%. Since then, over 60% of firms subject to credit-card reporting have faced a withholding rate of 6%.

²²As of October 5, 2017, US\$1 was equal to CRC 573.

²³Firms 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.

²⁴A 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.

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 domestic sales reported in firms' tax declarations in semester $t - 2$.²⁵ 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, as illustrated in Appendix Figure A.11. This receipt lists the volume of transactions processed, the commission charged, and the tax withheld. 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 (henceforth "reclaim") the amount of tax withheld from their gross tax liability by simply filling in one additional box on their tax return. Taxpayers only need to keep track of the amount of tax withheld. 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, and may take several months to be processed. While taxpayers reclaiming the tax withheld are not subject to higher audit rates than other taxpayers, taxpayers requesting a refund are often subjected to a desk audit. Refund requests are, however, very rare, as the amount of tax withheld is smaller than the tax liability for most taxpayers in our context. We will show below that the difficulty of obtaining refunds is not the key driver of our results.

3.3 Sanctions for Non-Compliance

Non-compliant taxpayers face monetary sanctions, temporary firm closure or prison sentences. Relatively minor non-compliance such as non-filing, non-payment, non-filing of third-party reports, or non-emission of receipts is subject to monetary sanctions of up to three base salaries (one base salary was CRC 446,200, i.e. USD 764, in calendar year 2019). For repeated non-filing or non-payment, the tax authority can close a business for five days. Misreporting is sanctioned with a 25% or 75% penalty on the unreported tax liability, with the higher sanction applying

²⁵The two semesters extend from January to June and from July to December.

in cases where misreporting with the intention to evade taxes can be proven and unintentional errors ruled out. The sanction for misreporting also applies to incorrect reclaims of tax withheld and to refund requests. Taxpayers who evade tax of an amount higher than 200 base salaries (USD 152,800) can be imprisoned for up to ten years.²⁶

3.4 Data

Our analysis combines electronically-filed tax returns, 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. These data have 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. Table 3 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 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.²⁷ 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.

²⁶Prison sentences are applied in rare cases of extraordinary levels of fraud, and the judicial proceedings can take many years: <https://www.nacion.com/sucesos/judiciales/empresario-ira-15-anos-a-prision-por-fraude/4TVYNLZZ2BDMDKDDTZK57EQBU/story/>. As of September 2016, 24 judicial proceedings were ongoing. There are usually several hundred firm closures per year, as Brockmeyer et al. (2019) documents.

²⁷As indicated by the percentages in squared brackets in Table 3, the coverage of credit-card reports among sales tax-liable firms is higher, since they constitute only a small subsample of income taxpayers.

3.5 Summary Statistics for Samples of Analysis

Table A.1 presents summary statistics of the samples used in the analysis, for the years 2010 and 2013, before and after the withholding rate reform. Firms in the sample used in the event study of third-party reporting are bigger than the average income taxpayer, and firms in the bunching sample are on average smaller, largely due to differences in the tails of the distribution. Thus, if both samples yield evidence consistent with the idea that third-party information enhances compliance, the result might well generalize to the overall population of firms.

Sales tax filers, which are relevant for the withholding analysis, have higher turnover than income tax filers all along the distribution, and are also bigger than the event study sample and more likely to be corporations. This is consistent with the fact that the sales tax is levied mostly on the sale of manufactured goods. To the extent that we find large effects of withholding among sales tax filers, and larger effects among the relatively smaller firms, we might expect even larger effects if withholding was applied to the full population of firms.

Finally, the summary statistics show that regular filers, which we focus on in our main analysis, have higher turnover than irregular filers (defined as filing at least once during the three-year period around the withholding reform), but the latter still constitute a significant proportion of the tax liability. We therefore confirm the robustness of our results to using various types of unbalanced panels (Section 6.4), and show that there is no evidence for extensive margin responses to withholding (Figure A.9).

4 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.

4.1 Heterogeneity in Bunching

Numerous studies have used bunching at kinks or notches in the tax schedule to estimate tax base responses to 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 2019](#), [Almunia and Lopez-Rodriguez 2018](#), [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 A.1 for self-employed individuals.²⁸ This speedy adjustment supports the interpretation of bunching as a reporting response rather than a real production change.²⁹ 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 (2018) rather than the convergence method.³⁰

Figure A.2 displays the observed distribution (dotted blue line), the estimated counterfactual (solid red line), and excess-mass estimates for different sub-samples of the self-employed individuals (row A) and corporations (row B). Among both firm types, the largest excess mass is found in the sample of firms not subject to third-party reporting (panels A1 and B1). The subsample of firms subject to third-party reporting (panels A2 and B2) 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.³¹ The fact that bunching is smaller but still highly significant, among firms subject to third-party reporting is consistent with the fact that the information trail is incomplete, and that firms could still bunch through legal tax avoidance.

²⁸We focus on the first threshold as it is the most salient one, and also the largest in terms of the tax rate change for the self-employed.

²⁹Strikingly, 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 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.

³⁰We 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.

³¹Note 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 A2 to B3. This suggests that some self-employed individuals in subsample may erroneously perceive the threshold to be a kink not covered by third-party reporting.

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 A3 to B4). 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.³²

4.2 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, distinguishing reports by the different informing agents, which may be other firms, state institutions, or credit-card companies. As we seek to identify a reporting rather than a real response to the information reports, we are mindful of two identification challenges. First, the receipt of a first information report may coincide with a real growth acceleration the firm is experiencing. Second, the event leading to the first information report may itself cause a growth acceleration. This is most relevant for the receipt of a first information report by a state institution and card company, which are generated by the award of a public procurement contract and the adoption of a credit card machine respectively.³³ We argue below that our estimates capture a reporting rather than a real response, because of the sharpness and large size of the response, the fact that almost the entire response is realized immediately in the event period after otherwise parallel trends between event-group firms and control-group firms,

³²Our results are also consistent with estimates from the United States, where the Internal Revenue 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).

³³Incomplete compliance by firms 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.

and the absence of a trend-break in the wage bill, a real outcome unlikely to be misreported

Our main specification considers 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 estimates, we follow [Hilger \(2016\)](#) and [Naritomi \(2019\)](#) in re-weighting the control group to match the treatment group. We estimate each firms' propensity score of being reported by a third party for the first time in $k = 0$, and then re-weight the control group by quintile bins of the propensity score to match the propensity-score distribution of the event group, following [DiNardo et al. \(1996\)](#).³⁴ We consider a balanced sample of firms we can observe for at least four periods before and three periods after the event. This means that we use events in event periods $p = \{2010, 2011, 2012, 2013\}$ (for the income tax) and between February 2009 and August 2014 (for the sales tax).

Table [A.2](#) illustrates why estimates from a balanced panel are most meaningful. The definition of the event requires that a firm is economically active, which is correlated with filing a tax declaration. A substantial fraction of firms only start filing at or after the event, and a few firms file prior to the event but not afterwards. Moving from a balanced to an unbalanced panel thus increases the sample size but adds little useful variation. Moving from a panel in which a firm appears at least once before and after the event to a fully balanced panel around the event has little effect on the number of observations. We thus focus on the balanced panel in our main results. The appendix shows robustness of our results to numerous other specifications.³⁵

Our main results are shown in [Figure 2](#). Each panel 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

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

The unit of observation in this estimation is a firm i in event period p at event time k . We

³⁴The weight is thus constant within a firm over time. The propensity score is estimated separately for each of the four different third-party reports, 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.

³⁵First, we show that the results hardly change when dropping the propensity score reweighting ([Figure A.3](#)), when considering shorter pre- and post-event periods which means considering a larger number of events over more event periods ([Figure A.4](#)), and when considering a semi-balanced panel (in which case there is also no propensity score reweighting, [Figure A.5](#)). To further explore the robustness of the results to unbalanced or semi-balanced samples, [Table A.3](#) reports the difference-in-difference estimates from all event studies, for five different samples, adopting the preferred specification presented in this section, but without propensity score reweighting. [Table A.4](#) does the same for the specifications with shorter pre- and post-periods (as in [Figure A.4](#)). These tables show that the effects are robust to all sample definitions, and that our preferred estimates from the balanced sample are in fact on the lower end.

estimate the firm’s reported taxable income as a function of event-time dummies γ_k , firm-event-period fixed effects α_{i_p} , and the post-event and treatment group dummy $I\{k \geq 0, i \in E\}$.³⁶ A challenge for all estimations in this paper is that our preferred outcome variables (tax base, tax liability or tax remittance) take the value zero for a large fraction of observations, which means that estimates from a log or inverse hyperbolic sine transformation are difficult to interpret. To obtain an estimate that is equivalent to a percentage effect, we use the Poisson Pseudo Maximum Likelihood (PPML) estimator pioneered by Santos Silva and Tenreyro (2006) throughout the paper. Appendix A discusses this choice and the properties of this estimator.³⁷

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 in Figure 2 show, this first third-party report is associated with a 20% increase in reported taxable income for self-employed individuals and a 40% increase for corporations. This large effect emerges precisely at event time, after otherwise similar trends in the event and control groups. Almost the entire treatment effect materializes in the event period, after which the event and control group 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 on average one year after the first supplier report, is considered in panels A2 and B2. The first client report is still associated with an increase in reported taxable income but the deviation is now less sharp. This is likely because firms receiving the first client report have already become more compliant when receiving the first supplier report, so that the new report does not provide much additional information. A sharp deviation at event time emerges again when firms receive the first report by a state institutions, or by a card company, which raises reported taxable income by 20%-23% (panels A3-B4). 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 reporting to transactions that were previously not reported, and

³⁶A firm could, for example, be in the control group for events happening in 2010 and 2011, but in the treatment group for events 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 firm level account for the potentially repeated appearance of firm-year/firm-month observations.

³⁷Our estimates are qualitatively robust to running an OLS estimation on log or IHS-transformed data, and are quantitatively very similar when running an OLS estimation on untransformed data, and scaling the coefficient by the pre-event mean to obtain a proportional effect (see Figure A.6).

should therefore have an additional effect on the self-reported tax base.³⁸

In all figures, the event and control group follow almost identical trends in the pre-event period, and then diverge precisely at event time $k = 0$ ³⁹, until the difference between the two groups stabilizes at approximately $k = 1$. It is particularly striking that the sharp deviation at event time can be observed even in the sales tax data with monthly frequency (panels A4 and B4). In further robustness tests (available upon request), we find that the of pattern results – a sharp deviation at event time and a large increase in the reported tax base/liability in the event group – is still present after controlling for the wage bill or the number of employees. Neither of these two proxies of firm size changes discontinuously at event time. We thus conclude that the size and timing of the effect is hard to reconcile with a pure growth effect, and must be largely driven by a compliance response to information reporting.

5 The Anatomy of Compliance

Having shown that third-party reporting substantially increases reported tax liability, we now study whether it moves taxpayers close to full compliance. 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.

5.1 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

³⁸Figure [A.6](#) shows that, 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. The increase in reported taxable income is also associated with an increase in the reported profit rate. For reporting by credit-card companies (last two panels), we use the reported tax liability (rather than reported taxable income) as the main outcome, and use sales tax collected and input tax credits deducted (rather than sales and costs) for the decomposition, as sales and costs are not available on monthly sales tax declarations.

³⁹The only exception to this pattern are corporations receiving a first client report from other firms (fourth panel), whose trend diverges from the control group at $k = -1$ rather than $k = 0$.

described in detail in the appendix.⁴⁰ Table 4 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-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).⁴¹ 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 4-5). 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 4 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

⁴⁰Note 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 A.5 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 oficio* if it has not filed a tax declaration for three years.

⁴¹Note 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.

is difficult and costly (de Mel et al. 2013, Bruhn and McKenzie 2014), Brockmeyer et al. (2019) 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.

5.2 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-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 5 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.⁴²

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 et al. (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.

⁴²Estimating 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.

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 9).⁴³ The especially large increase among self-employed individuals is driven by their 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 A.7 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%.⁴⁴

5.3 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

⁴³We 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 supported by evidence from Carrillo et al. (2017) and Slemrod et al. (2017), and it is consistent with firms' response to desk audits discussed below.

⁴⁴Whether 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).

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 and to test the previously implicit assumption that declared tax liabilities automatically translate into tax remittances.⁴⁵ 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.⁴⁶ 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 A.8, 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 patterns 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 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,

⁴⁵The 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.

⁴⁶Note 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.

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 information, 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 outstanding liabilities after a several-month delay. Perfect enforcement could increase income tax revenue by over 30%. Yet, 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.

6 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 describing the policy change and the empirical strategy. We then present the main results on the tax-remittance response to the withholding-rate increase. Lastly, we decompose this response into its mechanisms.

6.1 Policy Change

As discussed in section 3.2, the government revised the withholding-rate schedule for the sales tax in August 2011. Panel A in Figure 3 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 the new rates are 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 relationship 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 (Table 2). As panel B in Figure 3 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.⁴⁷

Panels C and D investigate whether the reform reduced firms' propensity to file their sales tax declarations or to use their credit-card machines. The effect of withholding on filing propensity is theoretically ambiguous. Panel C shows that the number of sales tax filers increases steadily and smoothly around the reform. This is true both in the full sample, and in the retail sector, which has the highest share of treated firms (over a third). Figure A.9 confirms this zero-effect on tax filing, using a difference-in-difference analysis on an unbalanced sample.

Panel D in Figure 3 shows that also the number of credit card reports and the share of sales tax filers with a credit-card machine displays no discontinuity at the time of the reform. Similarly, there is little change in card machine usage. 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 drastically 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 very small even in this sample, accounting for one percentage point of an average share of 50%.⁴⁸

This suggests that most firms lack the market power to refuse card transactions to avoid the withholding-rate increase or reduce its impact. We can thus regard the third-party reporting environment as unaffected by the reform and use the reform to isolate the effect of withholding.⁴⁹

6.2 Empirical Strategy

To estimate the impact of the withholding-rate increase on total tax remittances, and on intermediate outcomes such as reporting behavior, we conduct a difference-in-difference estimation on a panel of firms observed during a three-year window around the reform (January 2010 to December 2012). Treatment is defined at the firm-level and requires that firms are in the sample at least once per semester for two semesters prior to the reform, as withholding rates

⁴⁷There 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.

⁴⁸This is consistent with the regression results presented below. While the PPML and OLS estimations do not detect a significant effect on the volume of card transactions, the estimation with an inverse hyperbolic sine transformation, which put more weight on small observations, finds a small negative effect.

⁴⁹Any reduction in credit-card usage would cause a downward bias in the difference-in-difference estimates presented below. 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.

for semester t are determined based on firms' sales tax declarations from semester $t - 2$. The least balanced panel we can use is thus a semesterly-balanced panel, in which firms file at least once per semester during the period we study. In practice, most filers file regularly, so that the semesterly-balanced panel is similar to a fully balanced panel, our preferred choice.⁵⁰

Firms that used a credit-card machine at least once during January to July 2011, and for which we calculate an increase in the predicted withholding rate between July and August 2011 are considered treated. The control group consists of firms for which we predict no change in their withholding rate or that were not subject to withholding at the time of the reform.⁵¹ 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.⁵² 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 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

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

where y_{it} is the outcome reported by firm i in month t ; α_i and γ_t are firm and month fixed effects; μ_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 ϵ_{it} is the error term. As several outcome variables take a value of zero for a large share of observations, we use the PPML estimator as our preferred specification, a choice we explain in Appendix A. We discuss below the robustness of our results to numerous alternative specifications.

6.3 Tax Remittance Response to Withholding

To visualize the identifying assumption and treatment effect on total tax remittance, Figure 4, panel A, plots total tax remittance for the treatment and control groups over time, scaled by

⁵⁰As filing rates are not affected by the reform (cf previous section) using a semesterly-balanced panel is not a strong restriction. The results are robust to using a longer or shorter semesterly-balanced panel, or balancing the panel only pre-reform and allowing firms to exit at any time after the reform (Table A.9).

⁵¹The results are similar but 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. We instead estimate the effect of a rate reduction in an event study, shown in Figure A.10.

⁵²Collusion between the withholding agent and the firm is unlikely, given the small number of withholding agents and the intense monitoring to which they are subject.

the pre-reform mean, together with the DiD estimate 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 almost 30% and remain at this elevated level for the next 16 months.

In addition to this revenue effect from tax filers, the withholding-rate increase mechanically increased tax remittance by non-filers. Prior to the reform, non-filers represent about 15% of firms for which taxes are withheld and account for 5-7% of the amount of withheld taxes. The amount of tax withheld from non-filers doubled at the time of the reform, while the filing propensity did not change, as discussed above.⁵³

In aggregate, the withholding-rate reform increased sales tax revenue by 8.1%. Panel B in Figure 4 illustrates this result by using a simple regression discontinuity in time on demeaned semester-wise revenue data. Importantly, the revenue data is from official government statistics and net of any tax refunds granted to taxpayers. We also show in panel C that revenue 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.⁵⁴

6.4 Robustness

Table 6 reports the treatment effect on total tax remittance and other tax return line items for various specifications. We report the treatment effect (semi-elasticity) for the fully balanced and the semesterly-balanced panel.⁵⁵ For each panel, we report three different specifications, trimming the data at the 99.9th, 99th, and 95th percentile, respectively, of the distribution of total sales. We trim rather than winsorize the data to preserve internal consistency of a firm’s tax return, for the decomposition of the treatment effect. Our preferred specification is to trim at the 99th percentile, as it achieves the highest internal consistency between variables.

The treatment effect on total sales tax remittance is highly significant and large in all specifications. The point estimate is larger in the more trimmed samples, showing that withholding has a larger effect on smaller firms. The effect is also slightly larger in the semesterly

⁵³The 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 5% of taxpayers, they have small liabilities on average, and most remit within a few months of the deadline.

⁵⁴To investigate potential real effects of withholding, we use data on the wage bill and number of employees, and a similar difference-in-difference estimation as in our main analysis of sales tax withholding. We do not find a significant effect of withholding on these proxies of real firm size (results available upon request).

⁵⁵In the appendix tables, we also report results for a quarterly balanced panel.

balanced sample, suggesting that irregular filers (though few in number) are relatively more responsive than regular filers. Appendix Tables A.6 to A.8 show that the estimates from our main specification are quantitatively very similar to OLS estimates, and also similar to estimates from data transformed with the inverse hyperbolic sine transformation or from collapsed data (Bertrand et al. 2004), though the latter two specifications suggest much larger point estimates (due to how these specifications process the presence of zeros). The estimates are also robust to adding treatment-group-specific Christmas fixed effects to account for the larger share of retailers among the treated firms, sector-month fixed effects, clustering of errors at the sector level, and longer or shorter pre- and post-reform periods (Table A.9).

The effect on total tax remittance is driven by the combination of a 16% increase in the share of firms that remitted any sales tax (either by direct remittance or via withholding), and a 0.7 log-point increase in the remittance amount among firms that already remitted regularly before the reform. A similar combination of intensive and extensive margin reporting changes holds for other tax return items. This is evidenced in an OLS estimation with a binary dependent variable (Tables A.10 and A.11) and an IHS estimation on the sample of firms with mostly non-zero outcomes pre-reform (Tables A.12 and A.13).

Table A.14 shows 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. 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.⁵⁶ When the outcome is the sum of total income and sales tax remittances minus refunds, we estimate that the reform increased tax remittances by 22% in our preferred specification (column 2). 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 29% and even with a slight increase in income tax remittances. Indeed, to the extent that taxpayers are internally consistent (reporting 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.

⁵⁶The number of the refund requests increased slightly at the time of the reform, but we observe less than 150 refund requests by sales tax filers per month, for 6000 treated firms in our balanced panel. This is because the amount of tax withheld is smaller than the gross tax liability for most firms, so a refund is rarely necessary.

6.5 Decomposition

The detailed tax-return data allow us to precisely decompose the treatment effect into changes in the underlying components of final tax liability, as shown in Table 6. The order of variables in this table follows the logical order on the tax return. The decomposition suggests that two main mechanisms drive the compliance effect of withholding.

First, the withholding rate increase led to a substantial increase in the amount of tax withheld, but only part of this tax withheld was reclaimed by taxpayers and credited against their liability. The amount of tax withheld reclaimed increased by less, and from a lower base, than the total amount of tax withheld. Figure 5, panel A1, shows that less than 60% of firms subject to withholding make any reclaim in a given month prior to the reform. Panel A2, shows that firms reclaim an average of just 73% of the tax withheld prior to the reform, and this share fell after the reform, as the amount of tax withheld rose more than the amount of reclaimed.

Second, the withholding rate change was followed by an approximately 20% increase in the reported gross tax liability. Figure 5, panel C, shows that this increase, just as the tax remittance response, occurs sharply at reform time after otherwise parallel trends in the treatment and control groups. The tax liability increase is driven by both an increase in reported output VAT and a reduction in input tax credits. Table A.6 (linear OLS specification) suggest that the increase in reported output was predominant among large firms, while Tables A.7 and A.8 (log-linear models on IHS-transformed and collapsed data) suggest that the input credit reduction was predominant among small firms.

The increases in reported gross liability and in the reclaiming of withheld taxes almost offset each other, so that the final tax to be remitted by the taxpayer and the taxpayer remittance decreased only little (and primarily among large firms). Accordingly, the main treatment effect of a 29% increase in total sales tax remittance corresponds roughly to the increase in the amount of tax withheld at source. The decomposition is illustrated in the Table A.15.

6.6 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, which we call the default mechanism, and the second is the increase in reported liabilities, driven by a change in firms' perceptions of enforcement.

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 A1 and A2 of Figure 5 show that reclaiming behavior is indeed consistent with this framework. First, panel A1 shows that 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 in a given month prior to the reform. Second, panel A1 also shows that the withholding-rate increase lead to an increase in taxpayers' likelihood of making any reclaim, with the share of reclaimers eventually surpassing the pre-reform level by approximately 10 percentage points (but never approaching full reclaim).⁵⁷ Third, the comparison of panels A1 and A2 shows that firms with larger amounts of withheld tax are more likely to reclaim. Indeed, the share of withheld tax reclaimed reaches almost 73% prior to the reform and continues to exceed 60% after the reform (panel A2), significantly higher than the share of reclaiming firms.⁵⁸ 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 a large (approximately 20%) increase in reported tax liability. Table 7 studies the heterogeneity of this effect, to substantiate our claim that it is driven by a change in enforcement perceptions. As discussed in section 2, firms which had previously misreported their tax liability, firms which are subject to withholding for the first time, and those that reclaim their reported tax liability are more likely to update their perceived enforcement probability with the withholding reform, and should thus exhibit larger increases in their reported tax liability. This is indeed the pattern we observe. The interactions between the treatment indicator and the stated characteristics are all highly statistically significant, and remain so when we use them all at once and additionally control for an interaction with firm size. Firms which are neither misreporters, nor first-time withholders nor reclaimers do not exhibit any increase in their reported tax liability.⁵⁹ This heterogeneity in the treatment effect is consistent with an increase in the perceived probability of enforcement.

Alternative Mechanisms. We now refute potential alternative mechanisms. First, the withholding reform does not seem to coincide with or lead to an increase in enforcement probabilities.

⁵⁷Graphs with a longer post-reform window show that the reclaiming rate eventually approaches a steady level at below 60%. At the time of the reform, the reclaiming rate temporarily fell because the reform increased the number of taxpayers subject to withholding, many of whom were initially unfamiliar with the reclaiming procedure. As these firms gradually begin reclaiming withheld taxes, the share of reclaiming firms rose.

⁵⁸Panel A2 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.

⁵⁹Table A.16 shows the response is larger for larger withholding rate changes (4-5 percentage points, as opposed to 1-3 percentage points), particularly among previous withholders. Among first-time withholders, even small changes in the withholding rate seem salient enough to generate a large change in reported liabilities.

Panel C1 in Figure 5 shows that audit rates are constant over time.⁶⁰ Second, the reader may be concerned that taxpayers bunch their reported tax liabilities at or around the amount of tax withheld, in which case an increase in withholding would mechanically generate an increase in reported tax liabilities. As discussed in section 2, bunching behavior could arise if taxpayers are liquidity constrained and declare a liability equal to the amount of tax withheld to avoid having to remit any tax, or if taxpayers consider the tax withheld as a signal for an “appropriate” tax liability to declare. Panel C2 in Figure 5 plots the distribution of the difference between the reported tax liability and the amount of tax withheld. It shows that only a small fraction of firms exhibit bunching of reported liabilities, and the vast majority of firms report liabilities much larger than the amount of tax withheld.⁶¹ Importantly, though the withholding reform shifts the distribution left-wards, the degree of bunching does not increase disproportionately.

Columns 6, 7 and 9 of Table 7 show that firms with below-median profitability, which are more likely to be liquidity constrained, or bunchers do not exhibit a stronger response to the withholding rate increase than other firms.⁶² This evidence runs counter the idea that liquidity constraints mediate the effect of withholding, or that withholding increases tax compliance mechanically. Instead, the evidence is consistent with our interpretation of the reported tax liability change as a conscious behavioral response by firms.

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 a reporting mechanism, whereby the withholding-rate increase alters firms’ perceptions of the enforcement environment, increasing reported tax liability.

7 External Validity

As with any policy evaluation that relies on a specific source of variation in a specific context, concerns about the external validity of our study may arise. In addition to recalling that withholding for firms is widely used around the world (Figure 1) which is *prima facie* evidence for its attractive properties, this section provides causally identified evidence on the impact of

⁶⁰There is no evidence that the withholding reform was accompanied by a public statement on enforcement activities, or that enforcement activities other than audits changed discontinuously with the reform (such a change would also have to be targeted only at firms subject to withholding to generate our results).

⁶¹The fact that tax filing and remittance is monthly for the sales tax, and at a minimum quarterly (for the income tax) also limits the potential impact of shocks and myopia among liquidity-constrained firms. It also means that the damage which withholding can do to firms’ liquidity is limited, as withholding advances the timing of tax remittance only marginally.

⁶²We do not use seasonality or variability of income as a marker of liquidity constraints, as the frequency at which we observe outcomes (monthly) is the same at which firms have to remit tax.

withholding from multiple reforms.

First, for readers concerned that the withholding reform in August 2011 increased compliance only due to fortunate timing or a particular targeting, we can show that other reforms in Costa Rica which generated an increase in the withholding rate have a similar impact on compliance. Panel A1 in Figure 6 shows that firms which become subject to sales tax withholding at different points in time, independently of the withholding-rate reform, exhibit a sudden increase in their reported tax liability. The figure presents 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.⁶³ Panel A2 shows that 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 did not affect the government’s information set (as all card transactions were already reported) nor the statutory tax rates. Consistent with the enforcement perceptions mechanism, the response to the introduction of withholding is larger among treated firms that had previously misreported their tax liability.⁶⁴

In addition to concerns about the particular reform we study, one may be concerned that the Costa Rican context exhibits features which would lend withholding an outsized impact. For instance, in a context where audit rates are low, third-party information reporting may have little bite, as taxpayers would assume that audits based on cross-checks between third-party reports and self-reports are unlikely. A similar result may hold true if audits are not based on risk assessment or cross-checks, regardless of the audit rate. However, as Figure 6, panel B shows, audit rates in Costa Rica are in line with the average for countries at a similar level of per capita income. Section II.C. in Brockmeyer et al. 2019 shows that the Costa Rican tax authority conducts a variety of enforcement interventions, from phone calls to taxpayers with discrepancies between self-reports and third-party reports to comprehensive audits, most of which are targeted using cross-checks and risk criteria.⁶⁵

⁶³As 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.

⁶⁴Figure A.10 displays event studies for a reduction in the withholding rate, showing that a (larger) reduction in the rate leads to a (larger) reduction in reported tax liability.

⁶⁵To provide direct evidence that withholding also increases compliance in other countries, we have conducted a difference-in-difference estimation around a withholding-rate increase in another developing country, and confirmed that this reform also lead to an increase in the reported tax liability (results available upon request).

These results support the external validity of our study, not only in terms of its main finding – that withholding increases tax compliance – but also in terms of a key mechanism to which we ascribe the positive impact of tax withholding – the fact that withholding leads to an increase in reported tax liabilities.

8 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 29% among treated firms and by 8% overall, although the government's information set and the statutory tax rates remain constant. The treatment effect is driven 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.

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. Studying the optimal level of withholding rates and examining the distributional 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 and on competitor firms in the same sector or location is also worthwhile. This would allow decomposing the aggregate revenue impact of withholding into the direct effect on treated firms and the potential indirect effects.

Finally, investigating the choice of withholding agents would also be relevant. 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, they face a trade-off 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 subject to increased government monitoring and have sophisticated accounting departments. It would

also be interesting to study under which conditions governments should provide monetary or non-monetary incentives to withholding agents.

Tables

TABLE 1: INCOME TAX SCHEDULE

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Panel A: Self-Employed										
Kink 1	1,858	2,074	2,252	2,599	2,747	2,890	3,042	3,171	3,339	3,522
Kink 2	2,775	3,097	3,362	3,880	4,102	4,316	4,543	4,735	4,986	5,259
Kink 3	4,629	5,167	5,609	6,473	6,843	7,199	7,577	7,898	8,317	8,773
Kink 4	9,276	10,354	11,241	12,972	13,713	14,427	15,185	15,827	16,667	17,581
Panel B: Corporations										
Notch 1	27,811	31,043	33,701	38,891	41,112	43,253	45,525	47,451	49,969	52,710
Notch 2	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 2: WITHHOLDING-RATE SCHEDULE FOR SALES TAX

	Withholding Rate						
	0	1	2	3	4	5	6
Before 08/2011: Value-Added Rate \leq	5	20	30	40	55	75	∞
Since 08/2011: Share of Domestic Sales \leq	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 3: INFORMATIVE DECLARATIONS TO THE TAX AUTHORITY

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

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 2. For more information on the filing of informative declarations, see <http://www.hacienda.go.cr/contenido/12997-declaraciones-informativas>

TABLE 4: NON-FILING

Panel A: Non-filing among all tax-liable firms					
	(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	.	.	.

Panel B: Non-filing among registered firms					
	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

Panel C: Non-filing among firms covered by information reporting					
	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 5: MISREPORTING

	(1)	(2)	(3)	(4)
	Sales Reports		Cost Reports	
	Self-Employed	Corporations	Self-Employed	Corporations
Panel A: Underreporting for Income Tax				
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
Panel B: Underreported Liability				
7) Unreported Tax	17.2	61.4		
8) Reported Tax	35.7	318.8		
9) Unreported Tax (% Reported Tax)	48.4	19.3		
Panel C: Internal Consistency, Income Tax vs Sales Tax				
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 1. 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 6: IMPACT OF WITHHOLDING-RATE INCREASE

	Fully-Balanced Panel			Semesterly-Balanced Panel		
	(1)	(2)	(3)	(4)	(5)	(6)
	Trimmed 99.9th pctile	Trimmed 99th pctile	Trimmed 95th pctile	Trimmed 99.9th pctile	Trimmed 99th pctile	Trimmed 95th pctile
Total Sales Reported	0.0314* (0.0162)	0.0130 (0.00912)	0.0252*** (0.00765)	0.0372** (0.0147)	0.0171* (0.00885)	0.0290*** (0.00714)
Sales Tax Collected	0.0493 (0.0304)	0.0758** (0.0371)	0.124* (0.0681)	0.0599** (0.0266)	0.0771** (0.0355)	0.0639** (0.0295)
Input Tax Credits	-0.0225 (0.0315)	-0.0512** (0.0223)	-0.0717* (0.0422)	-0.0129 (0.0278)	-0.0500** (0.0217)	-0.0692* (0.0413)
- Import Credits	-0.0462 (0.0526)	-0.0292 (0.0273)	0.0113 (0.0326)	-0.0124 (0.0355)	-0.0310 (0.0264)	-0.00871 (0.0331)
- Local Purchase Credits	-0.00910 (0.0343)	-0.0402 (0.0360)	-0.0585 (0.0599)	-0.0106 (0.0324)	-0.0370 (0.0350)	-0.0529 (0.0586)
Gross Tax Liability	0.215** (0.0865)	0.199*** (0.0259)	0.262*** (0.0248)	0.236*** (0.0845)	0.221*** (0.0237)	0.277*** (0.0229)
Withholding Base	-0.0142 (0.0259)	-0.0160 (0.0187)	0.0238 (0.0160)	-0.00775 (0.0238)	-0.00662 (0.0175)	0.0303** (0.0142)
Withheld Tax	0.793*** (0.0666)	0.867*** (0.0423)	0.938*** (0.0340)	0.806*** (0.0605)	0.881*** (0.0345)	0.912*** (0.0285)
Withheld Tax Reclaims	0.691*** (0.0712)	0.773*** (0.0425)	0.861*** (0.0377)	0.709*** (0.0659)	0.803*** (0.0359)	0.847*** (0.0326)
Compensation Requests	0.244* (0.138)	0.304** (0.134)	0.0823 (0.105)	0.265** (0.130)	0.355*** (0.118)	0.199** (0.0995)
Final Tax To Remit	-0.00999 (0.0990)	-0.0758*** (0.0258)	0.00807 (0.0214)	0.00802 (0.0977)	-0.0540** (0.0240)	0.0170 (0.0201)
Taxpayer Sales Tax Remittance	-0.0843** (0.0352)	-0.0419* (0.0238)	0.0194 (0.0213)	-0.0728** (0.0332)	-0.0256 (0.0221)	0.0189 (0.0201)
Total Sales Tax Remittance	0.255*** (0.0303)	0.293*** (0.0216)	0.395*** (0.0191)	0.277*** (0.0285)	0.318*** (0.0193)	0.407*** (0.0172)
Month FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Time Trend	Yes	Yes	Yes	Yes	Yes	Yes
Observations	962,424	944,352	871,308	1,046,304	1,026,540	946,368

Notes: This table displays DiD estimates of the impact of the (predicted) withholding-rate increase, as per equation 2. Each cell represents the point estimate (semi-elasticity) on the treatment dummy, indicating firms with a predicted rate increase at reform time. The rows reflect different outcome variables corresponding to the main line items on the sales tax return. 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. The estimates are based on the Poisson Pseudo Maximum Likelihood Estimator (PPML, see Appendix A). All estimations allow for sector-specific time-trends, firm and month fixed effects, and standard errors are clustered at the firm level. Columns 1-3 and 4-6 correspond to estimations on a fully balanced panel (firms filing every month during 2010-2012), and on a semesterly balanced panel (firms filing at least once per semester during 2010-2012), respectively. To reduce the effect of outliers while maintaining the internal consistency of the tax declaration, we trim rather than topcode outliers, at the 99.9th, 99th or 95th percentile in the distribution of reported sales (as indicated in the column headings).

TABLE 7: HETEROGENEITY OF WITHHOLDING IMPACT

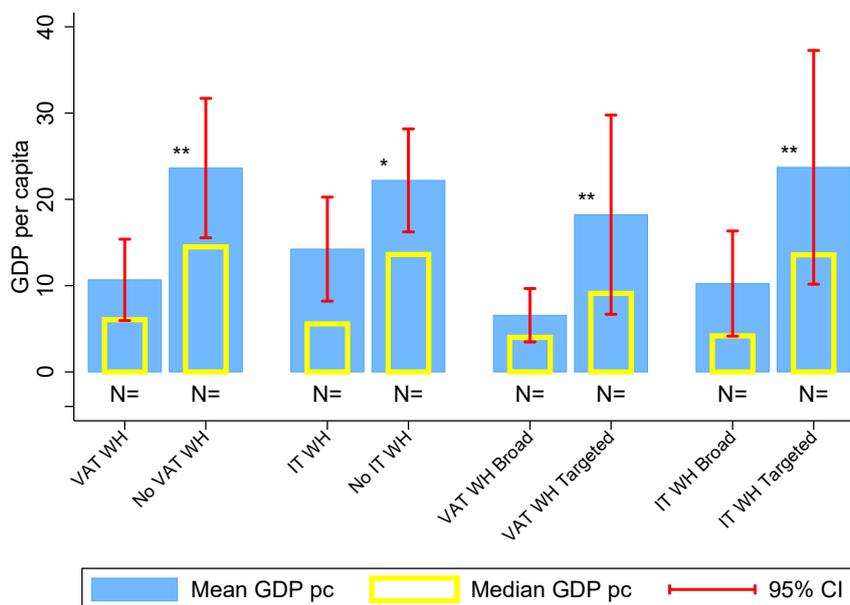
	Outcome: Reported Gross Tax Liability								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Treated (Withholding Rate Increase)	0.199*** (0.0259)	0.178*** (0.0271)	0.157*** (0.0269)	0.163*** (0.0246)	0.0971* (0.0574)	0.178*** (0.0310)	0.186*** (0.0271)	-0.0382 (0.0584)	-0.0541 (0.0657)
Treated X Below Median Turnover		0.251*** (0.0368)						0.217*** (0.0424)	0.218*** (0.0443)
Treated X Misreporter			0.172*** (0.0501)					0.155*** (0.0537)	0.164*** (0.0512)
Treated X First-Time Withholdee				0.573*** (0.191)				0.566*** (0.200)	0.512** (0.206)
Treated X Reclaimer					0.112* (0.0582)			0.159*** (0.0544)	0.161*** (0.0554)
Treated X Below Median Profitability						0.0362 (0.0366)			0.0436 (0.0346)
Treated X Buncher							0.0532 (0.0484)		-0.0381 (0.0496)
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	773,532	773,532	773,532	773,532	773,532	765,910	773,532	773,532	765,910

Notes: This table displays PPML DiD estimates of the impact of the withholding-rate increase on firms' reported gross tax liability, as per equation 2. The specification is identical to the one used in Table 6, column 2. In addition to the treatment dummy, columns 2-9 control for interactions between the treatment dummy and various firm characteristics. Misreporters are firms that declared sales less than third-party reports at least once prior to 2011. First-time withholdees are firms for whom the treatment (withholding-rate increase) was an increase from zero to a non-zero rate. We drop firms that experience the maximum withholding-rate increase of six percentage points, to ensure that the average rate increase among first-time withholdees is not larger than the average rate increase among other treated firms. Reclaimers are firms that reclaim (part of) the tax withheld on their tax return. Bunchers are firms that report a gross tax liability within a 5% margin of the amount of tax withheld.

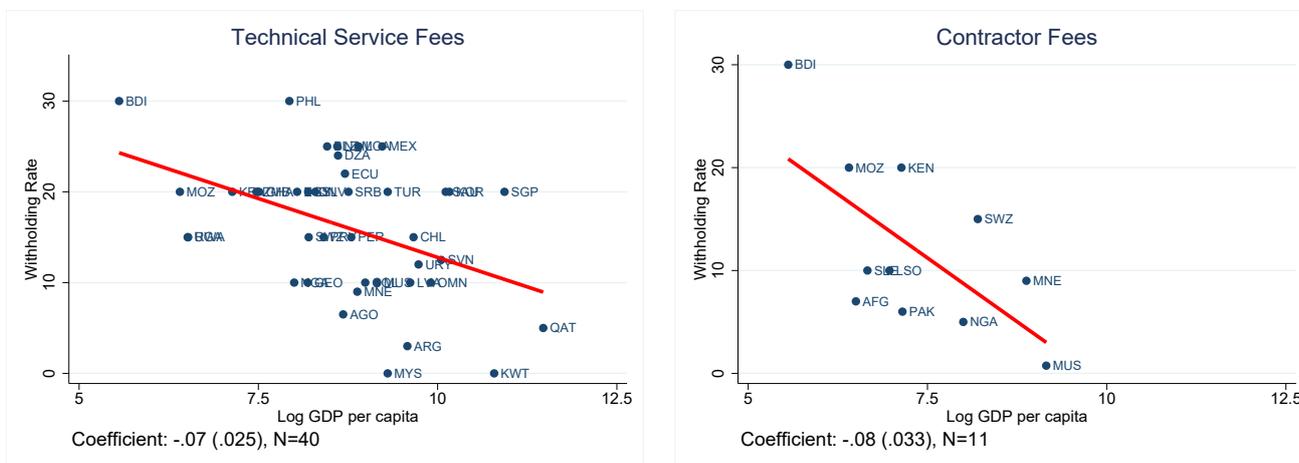
Figures

FIGURE 1: WITHHOLDING SYSTEMS AND DEVELOPMENT

A: Withholding Bases



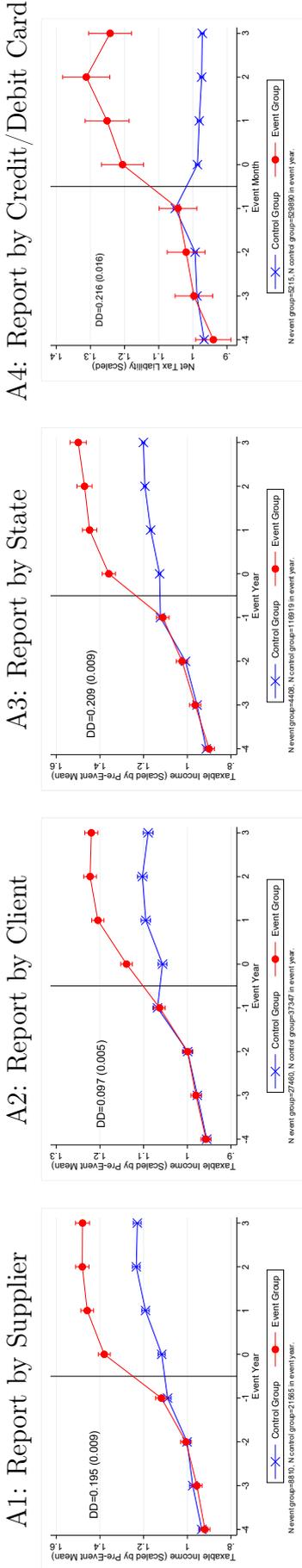
B: Withholding Rates



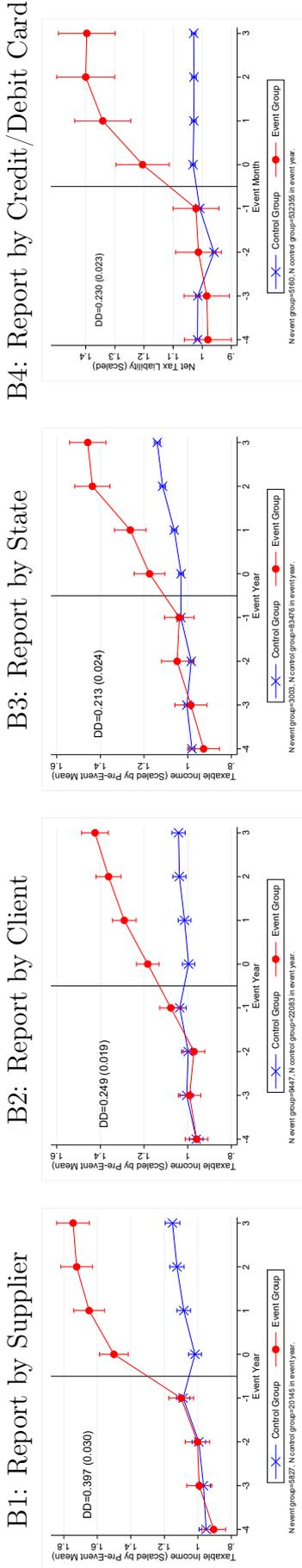
Notes: This figure shows that tax withholding on firms is widespread, and that the use of withholding, the breadth of withholding bases and the level of withholding rates are all negatively correlated with GDP per capita. Panel A displays the mean/median GDP per capita (in thousands of 2013 USD, WDI) 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 rates on technical services fees and on contractor fees, collected from the [PKF International Worldwide Tax Guide 2015](#).

FIGURE 2: EVENT STUDY OF FIRST INFORMATION REPORT

A: Self-Employed



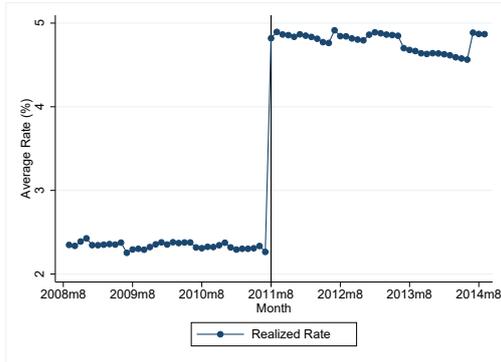
B: Corporations



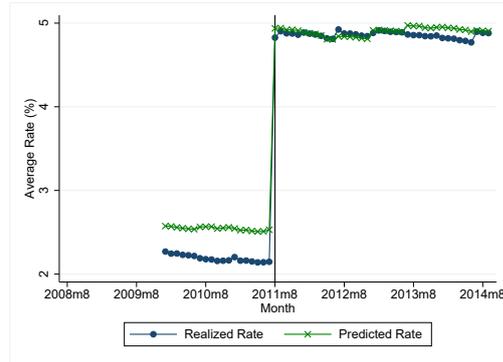
Notes: This figure displays event studies of firms' behavior after being reported for the first time by different reporting agents. Each panel displays the reported taxable income (tax liability, in panels A4 and B4) around the year (month) of the event, scaled by the pre-event mean, for an event group (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 data is top-coded at the 98th percentile by event-group-month. The control group is re-weighted by its propensity score of experiencing the event (cf. section 4.2 and footnote 34 for details). Each group consists of a balanced panel of firms that can be observed for the period displayed (four years/months before and three years/months after the event). Panels A1-A3 and B1-B3 consider events happening in 2010-2013. Panels A4 and B4 consider events happening in 02/2009-08/2014. The text displays the difference-in-difference coefficient from estimating equation 1. Standard errors are clustered at the firm-level. Figures A.3, A.4, A.5 and A.6, and Tables A.4 and A.3 show robustness of the results to alternative specifications.

FIGURE 3: WITHHOLDING-RATE REFORM

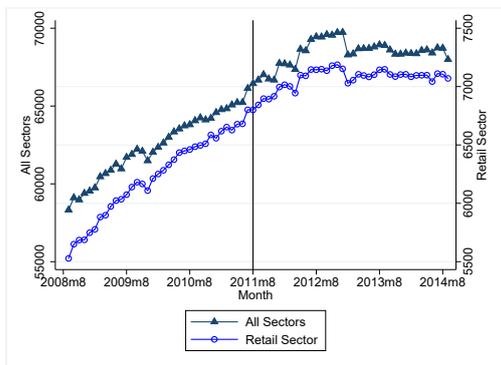
A: Withholding Rate (Full Sample)



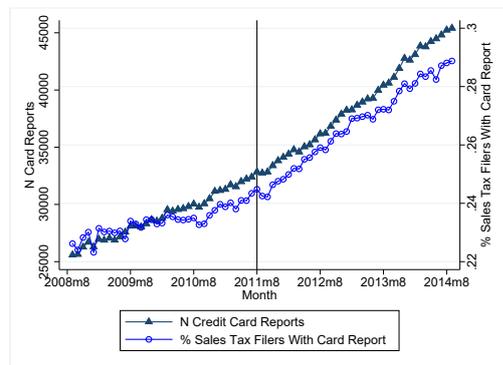
B: Withholding Rate (Prediction Sample)



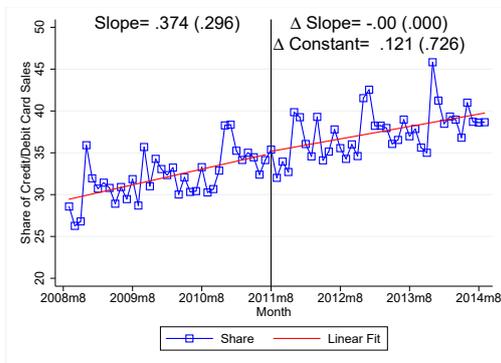
C: Number of Tax Filers



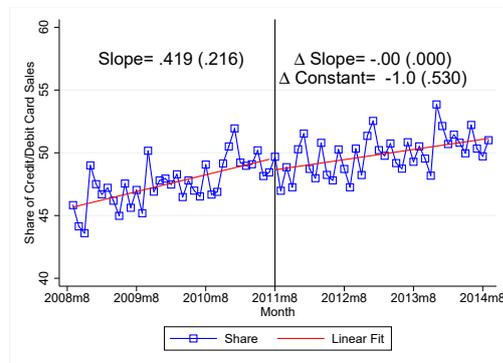
D: Number of Credit Card Reports



E: Total Share of Card Sales



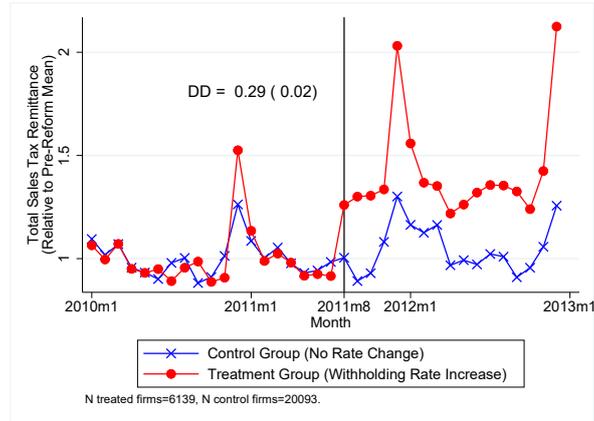
F: Average Share of Card Sales



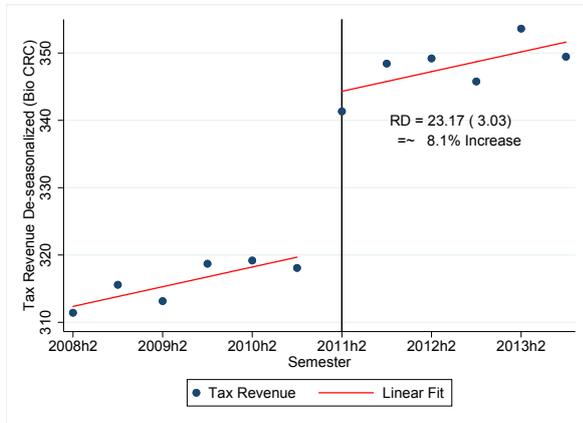
Notes: This figure displays the first stage of the withholding-rate reform and analyzes the reform's effect on sales tax filing and credit/debit card use. Panel A shows the average realized withholding rate among all firms subject to withholding. Panel B shows the average realized and predicted withholding 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 2. Panel C shows the number of sales tax declarations for all firms, and for the retail sector which has the highest rate of card machine usage and is thus most susceptible to be treated by the reform. The number of sales tax declarations corrects for revisions and duplicates. Panel D shows the number of firms using a credit/debit card machine (as per the third-party reports received by the government), and the share of sales tax filers that use a credit/debit card machine. Panel E shows the share of card sales in total sales among firms with a credit/debit-card machine, and panel F 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 4: IMPACT OF WITHHOLDING-RATE INCREASE

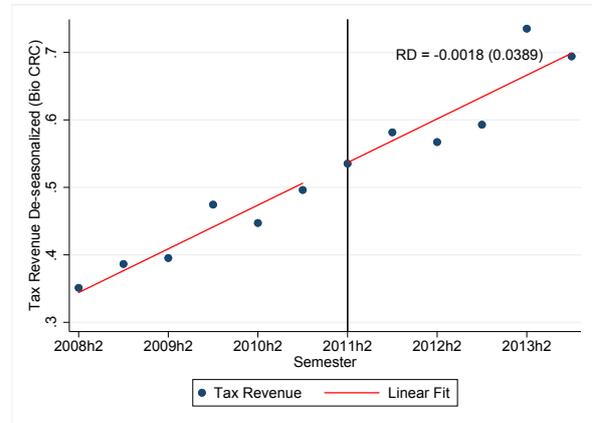
A: Impact on Sales Tax Remittance by Treated Firms



B: Impact on Aggregate Sales Tax Revenue



C: Counterfactual, Simplified Regime Tax Revenue

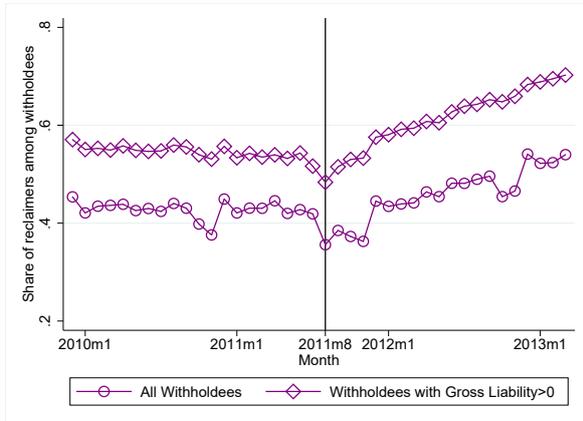


Notes: Panel A displays the results of the difference-in-difference estimation of Equation 2, with total tax remittance as outcome variable. The black solid line marks 08/2011, when the increase in withholding rates entered into effect. The data is trimmed at the 99th percentile of total sales, and scaled 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).

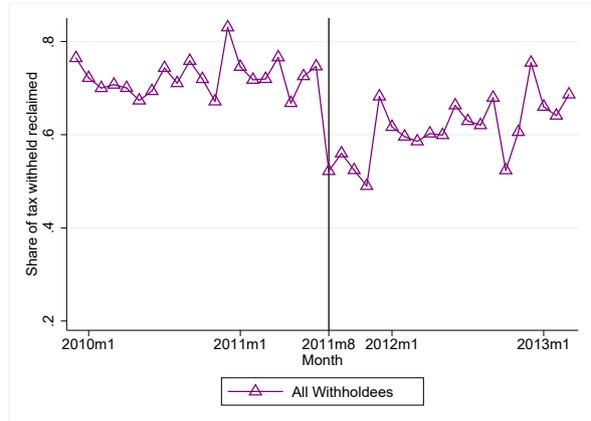
FIGURE 5: MECHANISMS OF WITHHOLDING IMPACT

A: Default Mechanism - Incomplete Reclaim of Withheld Tax

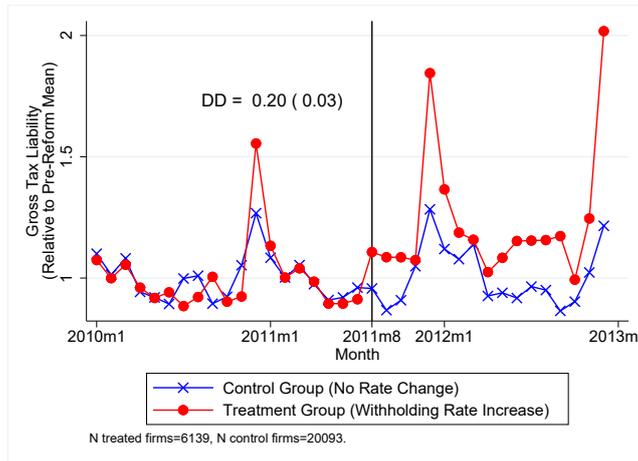
A1: Share of Reclaimers



A2: Share of Withheld Tax Reclaimed

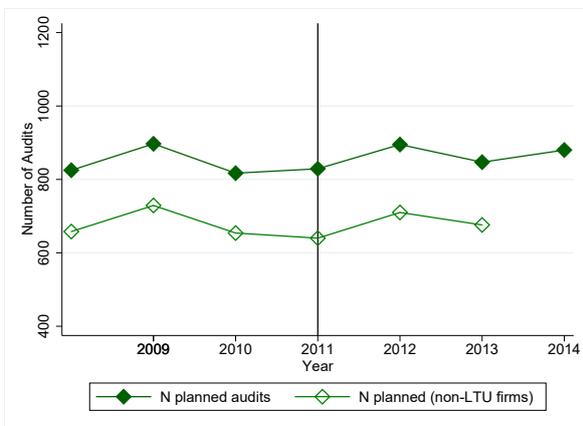


B: Enforcement-Perceptions Mechanism: Increase in Reported Tax Liability

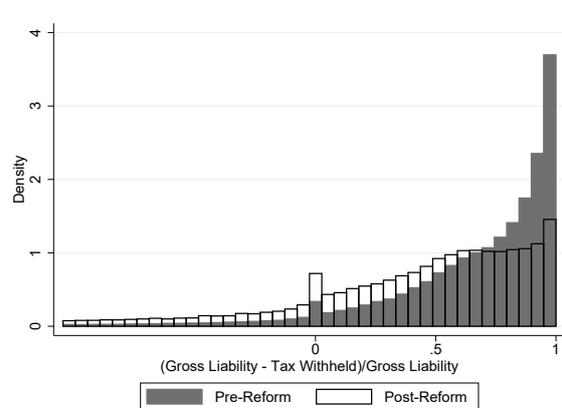


C: Ruling out Alternative Explanations

C1: No Change in Audit Rates



C2: Little Bunching in Gross Tax Liability

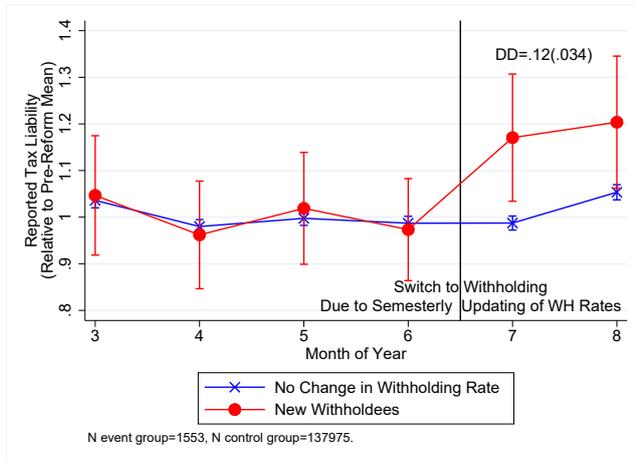


Notes: This figure illustrates the mechanisms for the withholding-rate impact. In all panels, the black solid line marks 08/2011, when the increase in withholding rates entered into effect. Panels A and B display, for all firms subject to withholding in a given month, the share of firms making a reclaim, and the average share of withheld tax reclaimed respectively. Panel B shows results of the difference-in-difference estimation of Equation 2, on gross liability. The Panel is constructed as Panel A in Figure 4. Panel C1 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 C2 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.

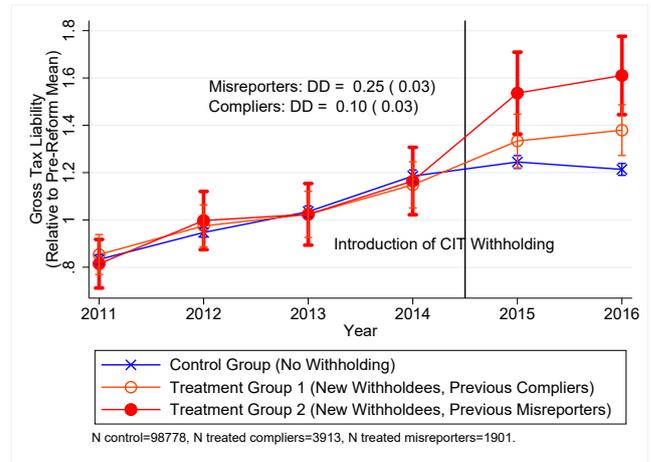
FIGURE 6: EXTERNAL VALIDITY

A: Impact of Other Withholding Schemes in Costa Rica

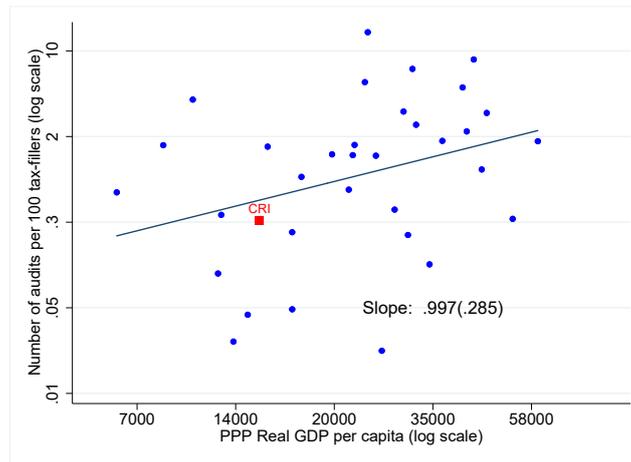
A1: Event Study of Sales Tax Withholding



A2: Introduction of Income Tax Withholding



B: Audit Rates Across Countries



Notes: Panel A1 displays an event study of the application of sales tax withholding to the self-employed, where the event group experiences an increase in the withholding rate from zero to positive in July, due to the biannual updating of withholding rates. Both groups are subject to credit card reporting prior to the reform. The outcome is the reported tax liability. Panel A2 displays a difference-in-difference study of the introduction of credit-card withholding for the income tax, where the treated group are firms which had a credit-card machine prior to 2015. Mis-reporters are firms which reported sales lower than third-party reported sales prior to 2015. The outcome variable is the reported tax liability. Panel B plots the number of comprehensive audits completed per 100 expected CIT filers, using data.rafit.org. The construction of all graphs is described in more detail in Appendix C.

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