Dodging the Taxman:
Firm Misreporting and Limits to Tax Enforcement[†]

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Reducing tax evasion is a priority for many governments. A growing literature argues that verifying taxpayer reports against third-party information is critical for tax collection. However, effectiveness can be limited when tax authorities face constraints to credible enforcement and taxpayers make offsetting adjustments on other margins. We exploit a policy intervention in which Ecuadorian firms were notified about detected revenue discrepancies. Most firms simply failed to respond. Firms that responded increased reported revenue, matching the discrepancy amount when provided. However, they also increased reported costs by 96 cents per dollar of revenue adjustment, resulting in minor increases in tax collection. (JEL D22, H25, H26, O23)

Tax evasion limits the development of fiscal capacity (Besley and Persson 2013), distorts the allocation of resources in the economy (Skinner and Slemrod 1985), and can result in a reliance on economically inefficient tax instruments (Gordon and Li 2009, Best et al. 2015). A recent literature has shifted emphasis from the traditional idea of tax enforcement through auditing (Allingham and Sandmo 1972) toward a focus on "third-party information:" the ability to verify taxpayer reports against other sources, such as employer reports of salary or reports by firms' trading partners (e.g., Kopczuk and Slemrod 2006, Kleven et al. 2011, and Pomeranz 2015). Third-party information is central to modern tax collection in developed countries (Kleven, Kreiner, and Saez 2016), and the global revolution in information technology has made its application easier than ever before.[1] Improvements in third-party

[1] Recent years have seen widespread adoption of electronic tax filing and computerization of tax records (Organisation for Economic Co-operation and Development 2011). Of the World Bank projects with a major tax or customs administration component in the 1990s, over 75 percent included computerization of taxes and customs (World Bank 2012).

information would appear to have the potential to transform tax collection, particularly in developing economies.

In practice, however, the effectiveness of third-party reporting in developing economies may be limited along two dimensions. First, verification of taxpayer information must be backed by credible enforcement. While we often assume that detection of evasion is sufficient for the government to collect owed tax payments, enforcement may in fact be difficult and costly, particularly in weak institutional environments. Second, taxpayers may respond to third-party information by making offsetting adjustments on less verifiable margins of the tax return, thereby reducing the effect of such information on tax revenue.

We analyze these issues in the context of corporate income tax reporting in Ecuador. In 2011 and 2012, the tax authority (Servicio de Rentas Internas, SRI) sent almost 8,000 notifications about discrepancies between self-reported and third-party reported revenue on previously filed corporate income tax returns and requested firms to file amended returns. These notifications represent the first time third-party information was used for tax enforcement in Ecuador in any systematic, large-scale way and are typical of the way in which third-party reporting is used by tax authorities in many countries.

We present three main sets of empirical results. First, there is widespread misreporting in the universe of incorporated firms (about 88,500). Self-reported revenue is lower than third-party reports in 24 percent of filings, suggesting substantial scope for revenue collection through enforcement based on third-party information. There is little bunching at the third-party amount, consistent with almost no use of third-party reporting prior to the notifications. We also find some suggestive evidence of cost underreporting: 26 percent of all firm filings and 5 percent of filings by firms with positive tax liability report costs below third-party reported costs. The finding that some firms may underreport costs is consistent with our model, in which firms have an incentive to underreport scale when audits are based on reported profit rates. These estimates of both revenue and cost underreporting should be taken as lower bounds since third-party reporting is incomplete.

Second, we examine the filing of amended returns in response to the notifications. Only 10–20 percent of notified firms filed an amended return. While in some cases the notification did not reach the intended recipient, it is clear that the majority of firms simply failed to file the requested amendment, indicating limits to credible enforcement. In the specific case of Ecuador, some legal constraints (discussed below) limited the ability of the tax authority to prosecute non-compliers. More generally, many developing countries suffer from limits to tax authority capacity, weak legal institutions and corruption, making prosecution of taxpayers challenging.

Finally, we examine how firms adjust reporting in response to the notifications. We focus on firms that file amended returns, but we observe similar and strongly significant responses (mechanically attenuated) in the sample of all notified firms. The notifications induced large increases in reported revenue. When firms were informed of the specific third-party revenue amount, 36 percent of amending firms matched this amount exactly. Firms that adjusted revenue did so by 93 cents per dollar of notified discrepancy. This holds throughout the distribution, including for discrepancies in the hundreds of thousands of dollars. When firms were not provided

with the specific discrepancy amount, adjustments were only 36 cents per dollar of discrepancy, suggesting that firms were misreporting both before and after the notifications.

However, the effects of these increases in reported revenue on tax payments were severely limited because firms increased reported costs by 96 cents for every dollar of revenue adjustment. This implies that third-party reporting had little effect on preexisting levels of evasion (profit underreporting). The results are difficult to reconcile with simple correction of lazy reporting or honest errors. Twenty-eight percent of notified firms reported *zero* revenue on their initial filings, and revenue discrepancies are large: over half of notifications involved revenue discrepancies greater than US$50,000. Revenue adjustments and cost offsets are similar regardless of the magnitude of notified discrepancy. In addition, there is no correlation between prenotification reported profit rates and implied profit rates on the amended portion of the return, as one might expect had firms simply neglected to account for a share of their transactions. Finally, firms tended to choose cost adjustments that are more difficult to verify: for example, the most frequent cost adjustment is to "Other Administrative Costs."

Our paper contributes to the literature on tax compliance and enforcement along several dimensions. Our unique data for periods in which third-party information was available but not used allows us to both quantify misreporting and also directly examine firm responses to introduction of enforcement based on third-party information. This form of enforcement is often considered the primary mechanism by which modern governments are able to collect taxes (Long and Swingden 1990, Slemrod 2008, Kleven et al. 2011, and Gillitzer and Skov 2013). Since the notifications refer to previously filed returns, all responses reflect changes in reporting rather than in real behavior. We show that tax enforcement through third-party reporting can be severely limited in developing economies.[2] First, we show that enforcement capacity of the tax authority is critical. To the best of our knowledge, this study is the first to model and provide direct evidence for limits to enforcement conditional on detecting misreporting. Second, our paper relates to the literature on multitasking (Holmstrom and Milgrom 1991) by showing at the individual taxpayer level that monitoring on one margin can increase misreporting on other margins. Similar behavior can be expected in the segments of developed countries that face similar informational constraints, consistent with findings in Slemrod et al. (2015) and Asatryan and Peichl (2016).[3] Finally, our findings contribute to a growing literature on public finance in developing economies (see Besley and Persson 2013, for a recent review) and are complementary with studies that demonstrate that optimal tax policy may differ across developed and developing countries as a result of differences in information and enforcement constraints (e.g., Gordon and Li 2009, Best et al. 2015).

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[2] See also Kumler, Verhoogen, and Frías (2013); Naritomi (2016); and Pomeranz (2015) for related work on third-party reporting in developing countries.

[3] See also Klepper and Daniel (1989) on misreporting across types of line items in the United States and Yang (2008), who shows that enforcement on one method of customs duty avoidance in the Philippines prompts a shift to another avoidance method.

I. Conceptual Framework

We start by considering the firm problem in the standard Allingham-Sandmo model of tax evasion. Firms have revenue and costs and pay a flat tax on reported profit (reported revenue minus reported costs). Both revenue (R) and costs (C) can be comprised of third-party and self-reported components: $R = R_T + R_S$ and $C = C_T + C_S$. Reported revenue and costs are $\hat{R}$ and $\hat{C}$. Firms choose the level of reported profit, $\hat{\pi} = \hat{R} - \hat{C}$, taking true profit, $\pi = R - C$, as given and pay tax on $\hat{\pi}$ at rate τ.[4] Evasion is detected and punished with probability p. Firms then pay owed tax and a penalty (at rate θ) on evaded tax (Yitzhaki 1974).[5]

We depart from the (unrealistic) assumption of random detection (scalar p) by assuming that the tax authority has some information about the true distribution of profit rates: reporting \$100 in profit on \$1,000 in revenue is more plausible than reporting \$100 in profit on \$1,000,000 in revenue. Correspondingly, we assume that the detection probability is $p((\hat{\pi}+\varepsilon)/\hat{R})$, where $p' < 0$ and ε is a small number greater than zero.[6] This specification of the detection probability is appropriate for our empirical context: in field interviews, tax authority staff indicated that the reported profit rate is a key characteristic in determining audits, and many firm owners and accountants stated that they pay close attention to the choice of this variable.

The firm optimization problem is as follows:

$$EU = \left(1 - p\left(\frac{\hat{\pi} + \varepsilon}{\hat{R}}\right)\right) U(\pi - \tau\hat{\pi}) + p\left(\frac{\hat{\pi} + \varepsilon}{\hat{R}}\right) U(\pi - \tau\pi - \theta\tau(\pi - \hat{\pi})).$$

Since $p' < 0$, firms will choose the lowest level of reported revenue consistent with their reported profit. Specifically, as $\varepsilon \to 0$, $\hat{R}^* = \hat{\pi}^*$. This then implies that $\hat{C}^* = 0$. Intuitively, the firm will maximize its reported profit rate $\hat{\pi}/\hat{R}$ in order to minimize its detection probability and chooses the optimal *level* of reported profit $\hat{\pi}$ given this minimized detection probability. Firms can achieve their desired level of profit by adjusting either reported revenue or reported costs, but underreporting revenue gives the added benefit of reducing the detection probability. In the absence of any third-party information, they will not even report their legitimate costs. This is because the detection probability function creates incentives for firms to appear smaller on paper than they are in reality by potentially underreporting *both* revenue and costs.

We now introduce third-party reporting (R_T). Following Kleven et al. (2011), we assume that p jumps discontinuously to its maximum possible value, $\bar{p}$, if $\hat{R} < R_T$. However, even for firms that initially reported revenue below the third-party amount, the introduction of R_T will not translate directly into an increase in reported profit

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[4] We assume that $\pi \geq 0$ and $\hat{\pi} \geq 0$. We take R_T and C_T as given for the firm. This assumption holds in our empirical context since firms cannot take actions to change existing third-party reports at the time notifications are sent.

[5] We model firms as risk averse to allow ease of comparison to the standard framework. This is realistic for many developing countries, where many firms are sole proprietorships or owned by a single family.

[6] The addition of ε differentiates among cases where $\hat{\pi} = 0$.

and tax revenue. First, there may be limits to enforcement. Second, firms may offset increases in $\hat{R}$ with adjustments to $\hat{C}$. We now discuss these two reasons in turn.

Recall that p is the probability that the firm is caught *and* punished. If the tax authority faces limits on enforcement even conditional on detecting misreporting, $\bar{p}$ will be bounded below 1. When deciding whether to amend their reports, firms will compare the expected utility from not amending and the expected utility from their optimal choice conditional on amending. If there are fixed costs to filing a new return, some firms will rationally choose not to amend in response to a discrepancy notification.[7]

Firms that do file an amendment will revise their reported revenue to bunch at the point of the discontinuity, R_T. This allows firms to minimize their detection probability for any choice of reported profit. The first-order condition with respect to $\hat{\pi}$ is then:

$$p\left(\frac{\hat{\pi}+\varepsilon}{R_T}\right)U'(Y_A)\theta\tau - \left(1-p\left(\frac{\hat{\pi}+\varepsilon}{R_T}\right)\right)U'(Y_N)\tau - \frac{1}{R_T}\,p'\left(\frac{\hat{\pi}+\varepsilon}{R_T}\right)(U(Y_N)-U(Y_A)) = 0,$$

where $Y_N \equiv \pi - \tau\hat{\pi}$ (after tax profits in the non-detected state) and $Y_A \equiv \pi - \tau\pi - \theta\tau(\pi - \hat{\pi})$ (after tax profits in the detected state). The first and second terms capture the standard Allingham-Sandmo trade-off: higher evasion results in higher utility in the non-detected state but lower utility in the detected state. The third term captures the fact that reports by the firm change the detection probability.

Note that choosing the new optimal level of reported profit is equivalent to choosing the new optimal level of reported costs, since $\hat{R} = R_T$. This brings us to the second reason for limited impact of third-party reporting on tax payments: offsets through increases in cost reporting. There is a tradeoff for firms reporting higher costs: doing so lowers tax liability but increases the probability of detection, since it lowers the reported profit rate. The extent of cost offset will depend on the functional forms of the p and U functions. In theory, it is even possible for an increase in R_T to result in a reduction in reported profit (greater than one-for-one cost offset) depending on the curvature of the p function.

Note that the new level of reported costs may be larger or smaller than true costs. Third-party reporting of costs creates a *floor* on reported costs. Unless third-party reporting covers 100 percent of costs, which is almost never the case, the tax authority cannot determine whether additional reported costs are legitimate costs which were not third-party reported or false costs without performing expensive audits. This fundamental feature of partial third-party cost reporting provides a micro-foundation for why costs (and profit) may be easier to misreport than revenue (Best et al. 2015) and implies that the effectiveness of third-party reporting will ultimately depend on the ability to perform traditional audits on non-third-party reported margins.

Our framework yields the following empirical predictions. In the universe of firms, we would expect revenue underreporting and potentially cost underreporting and little bunching at R_T. Observing firms with reported revenue greater than R_T does *not* imply that firms are necessarily overreporting revenue, since third-party

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[7] If fixed costs are large enough, some firms could theoretically choose not to amend even if $\bar{p} = 1$. However, the lower the bound on $\bar{p}$, the smaller the fixed costs need to be to generate failures to amend.

reporting is incomplete. The discrepancy notifications effectively introduce R_T. If there are limits to enforcement, some firms may choose not to file an amendment. Among firms that do file an amendment, we should see bunching of reported revenue at R_T (when it is disclosed). For firms that increase reported revenue, we expect to see increases in reported costs.

II. Background and Policy Intervention

Our empirical setting is the corporate income tax in Ecuador. All incorporated firms are required to file an annual tax return. Firms must distribute 15 percent of pretax profits to employees and pay a flat rate of 25 percent on the remainder.[8] The fiscal year corresponds to the calendar year and firms file the following April.

All firms are also required to file a monthly VAT return. To deduct input costs, they must include a purchase annex listing the amount purchased from each supplier along with the supplier's tax ID. A similar annex for sales to client firms must be submitted by firms with annual sales above US$200,000, Large Taxpaying Units, public sector firms, financial institutions, credit card companies, and firms requesting tax refunds.[9]

The SRI can cross-check firm reports against several sources. Information about a firm's sales is calculated by summing across purchase annexes from all firms that made purchases from that firm. This is supplemented with credit card sales data, customs data, and records from financial institutions. Since third-party reporting is incomplete, the resulting estimates will provide a lower bound on true revenue.[10] The ability of the SRI to utilize this information is relatively recent. Digitized VAT annex data have been collected since 2007, but discrepancies were initially computed only in special cases, such as when auditing a large company. The SRI began conducting large-scale cross-checks of taxpayers in 2011, computing revenue discrepancies for previously filed corporate income tax returns and sending notifications to selected firms. While the specific firm selection methodology is confidential to the SRI, key factors included the size of discrepancies and potential tax adjustments. We discuss selection in the context of our empirical strategy in Section III.

The SRI sent three rounds of notifications. They correspond to tax returns that were filed previously in 2008, 2009, and 2010, respectively. Notifications corresponding to the 2008 filings (3,136 firms) were sent in August–September 2011; those corresponding to the 2009 and 2010 filings (2,221 and 2,636 firms, respectively) were sent in March–April 2012. Since notifications were sent after all real transactions for the relevant tax period were completed, any changes we observe are pure reporting responses.

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[8] This rate was constant for over 20 years up to and including the years of this study. Special provisions apply to oil and public sector companies, which are included in the full sample but were not subject to the notifications. Losses up to 25 percent of profits can be carried forward, with some limitations, for five years.

[9] Ecuador dollarized its economy in 2000. All financial figures in this paper are expressed in US dollars.

[10] It is possible that there are errors or misreports on the annexes of firms' transacting partners, but given the incompleteness of third-party information, the resulting estimates of R_T will still underestimate true revenue in most cases.

The relevant portion of the 2008 notification is translated below:[11]

"Dear Mr/Mrs [XXX], General Manager of Firm [XXX],
After reviewing the databases which it possesses, the Tax Administration has identified revenue amounts that are attributable to the firm that you represent, which are larger than the amount reported on its 2008 *corporate income tax return.* […] *The Tax Administration requests that you submit an amended return for the year* 2008 *via internet within* 10 *business days."*

In the 2009 and 2010 rounds, the notifications also included the SRI's calculation of firm revenue based on third-party sources (online Appendix D).[12]

The relevant portion of the message is translated below:

"… which are larger than the amount reported on its 20XX *corporate income tax return, as shown in the following table:"*

Fiscal year	Line item of the corporate income tax	Value calculated by the tax administration	Value declared by the taxpayer
20XX	699—Total revenue	$255,300	$190,500

Notifications were sent by e-mail to the address on record, typically the firm's general manager or accountant. We observe initial filings and any subsequent amended filings. Firms can amend without filing additional documentation or revised annexes.

III. Data and Empirical Strategy

We combine several sources of administrative data: self-reported revenue and costs from corporate income tax forms; third-party reported revenue—the sum of exports, bank interest, and the maximum of the sum of purchases reported by client firms and the sum of sales by credit card; and third-party reported costs—the sum of imports and sales reported by suppliers.[13]

Table 1 shows summary statistics for economically active firms in 2008–2010.[14] The sample includes 88,505 firms and almost 200,000 firm-year observations. Mean declared annual revenue is $1.53 million with a median of $40,728 and mean declared cost is $1.43 million with a median of $41,105. Correspondingly, tax liability has a large range. The mean is $22,757, the median is zero, and the standard

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[11] For the full original notification (in Spanish), see online Appendix C.

[12] The text of the 2009 and 2010 rounds did not include the reference to a ten-day window to file an amendment. In practice, this window was not binding.

[13] The third-party revenue measure was checked by SRI staff for notified firms, resulting in some adjustments. We use the adjusted measure to evaluate responses to the notifications and the unadjusted one for cross-sectional results. The two measures are highly correlated, and results are robust to excluding firms for which adjustments were made.

[14] We define economically active firms in a given year as those that filed a corporate tax return within six months of the filing deadline and had nonzero revenue or costs, based on self-reported or third-party reported information, or were notified by the SRI. For 2008, we have third-party cost information only for notified firms.

TABLE 1—DESCRIPTIVE STATISTICS, ALL FIRMS, 2008–2010

Revenue ($000)	1,528
	(41,512)
	[41]
Cost ($000)	1,430
	(40,913)
	[41]
Tax liability ($000)	23
	(617)
	[0]
For 2009–2010 only	
Reported revenue minus third-party revenue ($000)	535
	(13,490)
	[5]
Reported costs minus third-party costs ($000)	677
	(26,830)
	[24]
Percent of firms with positive third-party revenue	74
Percent of firms with positive third-party costs	90
Observations	199,043
Number of firms	88,505

Notes: Sample includes all economically active firms. Means are reported along with standard deviations in parentheses and medians in brackets. All monetary figures in thousands of US dollars. Information on third-party reports are for 2009–2010 only, the years for which we have complete information on third-party reporting.

Source: Authors' calculations

deviation is over $600,000.[15] Self-reported revenue and cost are on average higher than third-party reports. This does not mean that firms are overreporting since third-party information is incomplete. For example, cash sales to final consumers are generally not third-party reported.

Table 2, panel A, shows summary statistics for firms that were selected for notification. All numbers reflect the last prenotification filing for the corresponding tax year. In this sample, self-reported revenue is always lower than third-party reports, since the SRI only notified such firms. Mean discrepancies are $307,000, $176,000, and $197,000 in 2008, 2009, and 2010, respectively.[16] The median discrepancy as a share of baseline self-reported revenue $((R_T - \hat{R})/(\hat{R} + 1))$ is 0.63. Not all notifications arrived: approximately 7 percent of e-mails bounced due to invalid addresses, and it is likely that additional notifications were not received. E-mail addresses may have been out-of-date or belonged to individuals who no longer worked for the firm. The notification sample is therefore an intent-to-treat sample.

We estimate the causal effects of the notifications without an explicit control group by comparing firms' prenotification and post-notification returns. The identifying

[15] The fact that the median is zero is not unique to Ecuador. In the United States, an average of 65 percent of corporations reported no tax liability between 1998 and 2005 (US Government Accountability Office 2008).

[16] The 2008 sample differs from later rounds because the selection was changed somewhat; summary statistics for the full sample are similar across years.

TABLE 2—DESCRIPTIVE STATISTICS BY YEAR, NOTIFIED AND AMENDING FIRMS

	Fiscal year		
	2008	2009	2010
Panel A. Notified firms			
Revenue ($000)	1,541	624	592
	(6,118)	(1,260)	(1,237)
	[136]	[121]	[103]
Cost ($000)	1,439	583	552
	(5,398)	(1,170)	(1,153)
	[129]	[113]	[96]
Tax liability ($000)	26	10	10
	(171)	(31)	(28)
	[1]	[1]	[1]
Reported revenue minus third-party revenue ($000)	−307	−176	−197
	(1,741)	(312)	(388)
	[−42]	[−64]	[−66]
Observations	3,136	2,221	2,636
Number of firms with invalid e-mail addresses	–	159	163
Panel B. Amending firms			
Revenue ($000)	1,402	371	418
	(4,367)	(944)	(960)
	[179]	[59]	[34]
Costs ($000)	1,331	352	398
	(4,172)	(887)	(924)
	[163]	[62]	[33]
Tax liability ($000)	18	5	5
	(70)	(17)	(13)
	[1]	[0]	[0]
Reported revenue minus third-party revenue ($000)	−217	−150	−173
	(806)	(299)	(333)
	[−40]	[−54]	[−63]
Observations	596	249	420
Start of notification period	August 11, 2011	March 26, 2012	March 26, 2012
End of notification period	–	April 20, 2012	April 20, 2012

Notes: Means are reported along with standard deviations in parentheses and medians in brackets. Notified firms are those to whom the SRI sent an e-mail notification (including those for whom the e-mail bounced back). Amending firms are those that filed an amendment in the post-notification window. All monetary figures in thousands of US dollars.

Source: Authors' calculations

assumption is that firms would not have filed amendments absent notification. In this case, firms' prenotification filings provide a valid counterfactual for post-notification reports. Indeed, the probability that non-notified firms revised their returns from previous years is low. Figure 1 plots amendment rates for notified and non-notified firms. Amendment rates are close to zero for both samples prior to the notification. There is a stark increase after the start date for the notified sample but not for the non-notified sample.[17] Moreover, as we show in Section IVB, the types of adjustments made

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[17] Patterns are very similar in a hazard rate analysis using first amendments (online Appendix Figure A1).
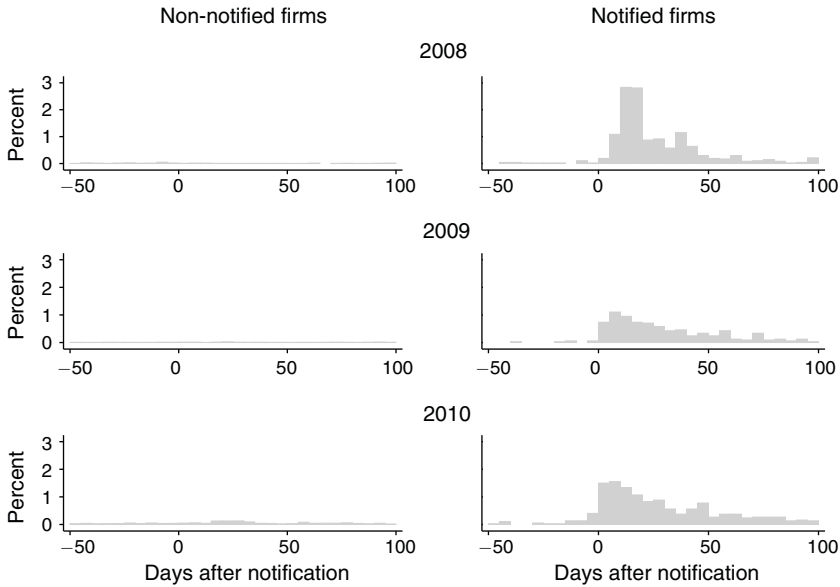
FIGURE 1. AMENDMENT RATES

Notes: The left column plots amendment rates for the universe of non-notified firms before and after the start of the intervention. The right column does the same for notified firms. Zero indicates the notification start date. For 2008, the start date is imputed (see footnote 19 for details).

by non-notified firms that happened to revise their returns are very different from those of notified firms. Correspondingly, the comparison between prenotification and post-notification returns provides a causal estimate of the effect of notification.

The sample of firms selected for notifications is of course not representative of all firms in Ecuador. However, it is of particular interest for tax enforcement, since firms with large discrepancies have the greatest potential for improved tax collection through third-party based enforcement. Therefore, such enforcement strategies typically target this type of firm.

IV. Results

A. *Evidence from the Full Sample of Firms*

We first examine revenue and cost discrepancies in the full sample in 2009 and 2010, the two years for which we have third-party information for all firms. Figure 2, panel A, plots a histogram of the difference between logs of self-reported and third-party reported revenue for firms with nonzero third-party reported revenue. Twenty-four percent of filings report revenue below third-party amounts. There is a small degree of bunching around R_T, but it is not sharp: only 3.8 percent of revenue reports exactly match the third-party amount. These are cases where R_T is relatively small on average. We see a similar lack of bunching for costs (panel B of Figure 2).[18]

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[18] We see more bunching when we include filings for which we have no third-party information, reflecting cases in which both the self-report and third-party report are zero (online Appendix Figure A2).

Panel A. Revenue discrepancy
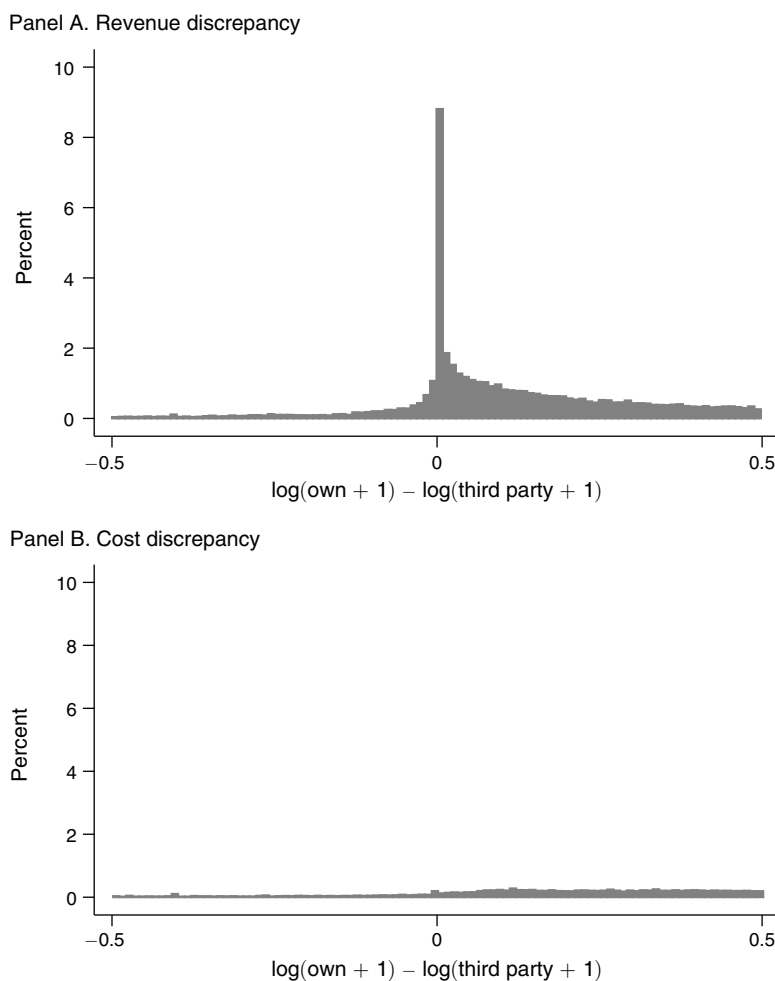

Panel B. Cost discrepancy

FIGURE 2. REVENUE AND COST DISCREPANCIES, ALL FIRMS WITH POSITIVE THIRD-PARTY INFORMATION

Notes: Both panels include data for 2009–2010, the years for which complete third-party information is available. Of the reports, 3.8 percent match revenue exactly and 0.1 percent match costs exactly. The sample in panel A includes the 60,067 active firms for which there are positive third-party revenues and the sample in panel B includes the 74,614 active firms for which there are positive third-party costs. We restrict the range to −0.5 and 0.5 to focus on the amount of bunching at zero. Results are similar if histograms are separated by year. Bins are of size 0.01, and the top and bottom 1 percent of the sample are omitted when calculating bin heights for computational purposes.

We also find that 26 percent of returns report costs below third-party amounts. Firms that declare zero tax liability may have limited incentives to declare all costs, even though some loss carryover is allowed. However, 5 percent of returns with positive tax liability also exhibit cost underreporting. While potential noisiness or mistakes in reporting could explain some of these cases, overall these estimates likely understate cost underreporting since third-party reporting of costs is highly incomplete. To the best of our knowledge, these results represent the first direct evidence that firms may underreport costs.

B. *Response to Discrepancy Notifications*

Patterns of Amendment.—Panel B of Table 2 presents summary statistics for firms that submitted an amendment within three months after the notification.[19] The share of amending firms in the notification sample was 19 percent for the 2008 round, 11 percent for 2009, and 16 percent for 2010. As explained above, not all e-mails were received, so these figures understate response rates. Nevertheless, it is clear that a substantial share of firms chose not to amend in response to the notifications.

The low response rate is striking and consistent with a low perception of SRI's enforcement capacity, even conditional on the detection of discrepancies. In addition, firms could only have been prosecuted according to Ecuadorian law for failure to submit an amendment if a written notification had been delivered in person by the SRI. Since such hand-delivery is expensive, notification via e-mail option was chosen due to resource constraints. These types of enforcement constraints are emblematic of challenges faced by tax authorities in developing countries.

Amending firms are somewhat smaller in terms of self-reported economic activity than the full notification sample, but median revenue discrepancies are quite similar. Somewhat surprisingly, the amendment probability is essentially flat with respect to the size of the detected discrepancy (online Appendix Table A1). In 2009–2010, an increase in the detected discrepancy of $1,000 was associated with only a 0.0025 percentage point decrease in the probability of amending. The correlation is even lower for the 2008 round. We also look at the probability of amending as a function of observable firm characteristics such as industry, region, size, and age (online Appendix Table A2). Overall, these characteristics appear to have little power in explaining variation in amendment rates. Firms with smaller reported revenue, firms that underreport costs relative to third-party costs, and young firms are somewhat more likely to respond.[20]

Revenue Adjustments.—Next, we look at the pattern of adjustment among amending firms. The first two graphs of Figure 3 show a histogram of the difference between the log of post-amendment self-reported revenue and the log of third-party reported revenue when firms are provided with a specific value for third-party reported revenue, R_T (2009 and 2010 rounds). There is very large bunching around zero, indicating that firms adjusted revenue to match the provided amount. Thirty-nine percent of firms in the 2009 round and 35 percent in the 2010 round match exactly.

Figure 4 shows these responses in more detail, plotting the change in reported revenue against the pretreatment revenue discrepancy. Panel A displays results for amending firms. About 16 percent filed an amendment but did not change revenue or any other major variable. These firms are essentially analogous to non-amending firms. We therefore define the sample of adjusting firms as firms which made any

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[19] In 2008, we do not observe firm-specific notification dates and therefore impute the notification start as August 11, 2011 based on the discontinuity in amendment rates. We assume that the 2008 notifications were made over one month, as in 2009 and 2010, and therefore consider amendments filed within four months of the start date in 2008. Results are robust to the choice of post-notification window.

[20] The latter is consistent with the notion that younger firms may still fear the tax authority more and also with findings in Pomeranz, Marshall, and Castellon (2014).
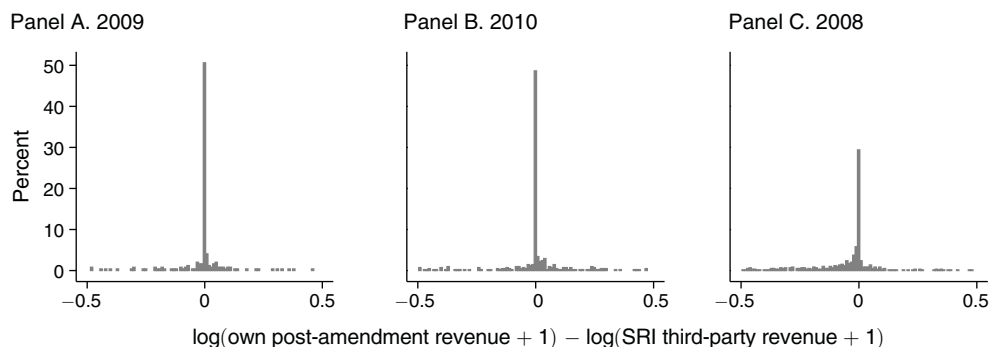
Panel A. 2009   Panel B. 2010   Panel C. 2008

log(own post-amendment revenue + 1) − log(SRI third-party revenue + 1)

FIGURE 3. REVENUE ADJUSTMENT AMONG AMENDING FIRMS

Notes: Thirty-nine percent of firms match exactly for the 2009 round, 35 percent for the 2010 round, and 6 percent for the 2008 round. We add 1 in all log specifications to deal with zero self-reports. Bins are of size 0.01, and the top and bottom 1 percent of the sample are omitted when calculating bin heights for computational purposes.
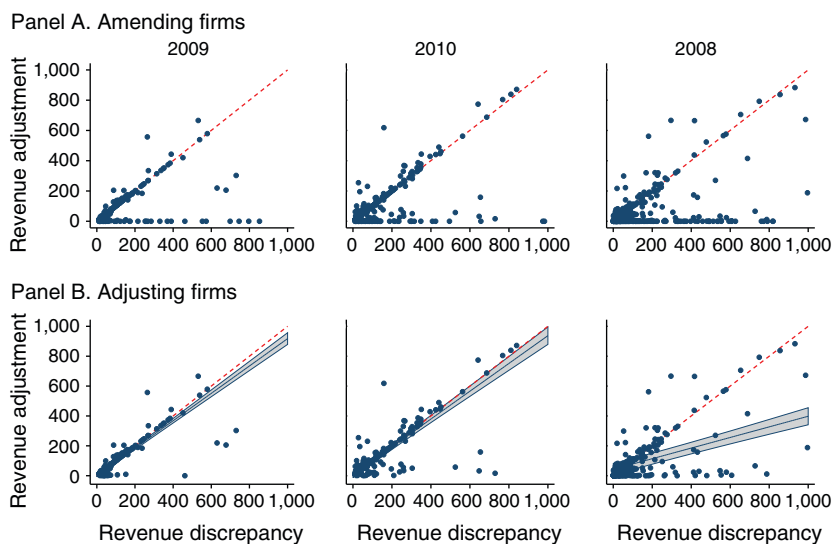
Panel A. Amending firms

Panel B. Adjusting firms

FIGURE 4. REVENUE MATCHING

Notes: The dashed line indicates a 45-degree line. In panel B, we also show a fitted line and a 95 percent confidence interval for the fitted line. Slopes are as follows: 0.916 for the 2009 round, 0.929 for the 2010 round, and 0.355 for the 2008 round. Axes are restricted to show zero to one million, but the fitted line and confidence interval reflect the unrestricted sample. Axes are in thousands of US dollars.

positive adjustment to revenue following the notifications. The first two graphs of Figure 4, panel B, shows results for adjusting firms in the 2009 and 2010 rounds. Firms tend to locate closely along the 45-degree line, matching the third-party amount, even when discrepancies are very large. To the extent that there is incompleteness or noise in the SRI's measure of R_T, these results indicate that firms match the number provided to them.

We next compare this to the response to the 2008 round, in which firms were not told the value of R_T. Figure 3 shows much less bunching, and only 6 percent of firms match R_T exactly. This exact matching could reflect some firms seeking out information about their revenue discrepancies from the SRI. Figure 4 shows that firms with larger discrepancies make larger adjustments on average, but there is much higher variance than in the 2009 and 2010 rounds. In addition, the fitted line in panel B lies below the 45-degree line: on average, firms in the 2008 round adjust revenue by only 36 cents per dollar of discrepancy.[21]

Comparing 2008 with the 2009 and 2010 rounds yields several insights. First, firms adjust revenue specifically in response to the information provided in the notifications rather than just the receipt of a notification from the tax authority itself. Second, the results provide evidence of misreporting both before and after the notification. The 2008 adjustments indicate that firms have substantial additional scope for upward revision in reported revenue. Since R_T is a lower bound on revenue, this indicates that firms in all rounds are likely to be underreporting revenue even in amended filings. Finally, the fact that firms make smaller adjustments when not provided the amount of R_T is consistent with the idea that they try to minimize reported revenue and suggests that they underestimate the ability of the SRI to collect third-party information.

Table 3 presents the results in regression form along with robustness tests. Panel A shows responses in reported revenue in the pooled 2009 and 2010 rounds. Standard errors are clustered by firm, and all results are statistically significant at the 1 percent level. The baseline regression coefficient corresponds to the fitted line in Figure 4, panel B. This coefficient is 0.927, indicating that adjusting firms increase reported revenue by 92.7 cents per dollar of indicated third-party revenue. This estimate is robust to restricting the sample to firms notified in only one round, restricting the sample by size of revenue discrepancy, excluding a very small number of firms which made negative revenue adjustments, using the measure of baseline reported revenue provided by SRI on the letters rather than the last firm F101 filing, and excluding cases in which SRI staff made adjustments to the third-party revenue measure.

Cost Adjustments.—Firms make substantial offsets to these increases in reported revenue by increasing reported costs. Figure 5 plots the change in reported costs against the change in reported revenue for adjusting firms. Firms locate almost exactly along the 45-degree line, even when revenue adjustments are in the hundreds of thousands of dollars. This is also the case for the 2008 round, indicating that firms match increases in reported costs to the increases in reported revenue.

Table 3, panel B, presents corresponding regressions for the pooled 2008–2010 rounds. The baseline coefficient corresponds to the fitted line in Figure 5. Adjusting firms increase their reported costs by 96 cents on average per dollar of revenue adjustment. This result is stable across the same robustness checks as in panel A and robust to scaling adjustments by baseline reported revenue (online Appendix Figure A3). The

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[21] Online Appendix Figure A3 adjusts for firm size by scaling both axes by baseline reported revenue. If anything, observed matching is stronger.

TABLE 3—TREATMENT EFFECTS AND ROBUSTNESS TESTS FOR ADJUSTING FIRMS:
REVENUE AND COST MATCHING

Specification	Coefficient	SE	Observations	R^2
Panel A. Regressing revenue adjustment on revenue discrepancy (2009–2010)				
Baseline (corresponds to Figure 4, panel B)	0.927	(0.105)	569	0.728
Robustness tests				
(1) Only firms notified in no more than one round	1.016	(0.093)	410	0.798
(2) Censoring to revenue discrepancies < $1,000,000	0.900	(0.112)	555	0.623
(3) Censoring to revenue discrepancies < $250,000	0.917	(0.052)	494	0.657
(4) Including negative revenue adjustments	0.926	(0.105)	579	0.285
(5) SRI letter measure of baseline $\hat{R}$	0.932	(0.098)	570	0.744
(6) Using only unadjusted variation in R_T	1.111	(0.151)	249	0.811
Panel B. Regressing cost adjustment on revenue adjustment (2008–2010)				
Baseline (corresponds to Figure 5)	0.962	(0.016)	978	0.982
Robustness tests				
(1) Only firms notified in no more than one round	0.960	(0.017)	737	0.983
(2) Censoring to revenue adjustments < $1,000,000	0.975	(0.029)	959	0.882
(3) Censoring to revenue adjustments < $250,000	0.897	(0.042)	885	0.677
(4) Including negative revenue adjustments	0.974	(0.015)	1,015	0.988
(5) SRI letter measure of baseline $\hat{R}$	0.942	(0.022)	1,053	0.962

Notes: Panel A shows linear regressions of revenue adjustment on revenue discrepancy for adjusting firms in 2009 and 2010. Panel B shows linear regressions of cost adjustment on revenue adjustment for adjusting firms in 2008–2010. A very small number of firms make negative revenue adjustments. The fourth robustness check shows what happens when they are included. We use the last filing prior to the notifications as the baseline measure of reported revenue. In some cases, the measure of baseline revenue provided to firms on the letters from the SRI differed slightly. The fifth robustness check uses the letter measure to calculate revenue adjustment. The measure of R_T provided to firms was hand-checked by SRI staff and adjusted in some cases. The sixth robustness check excludes such cases. All monetary figures are in US dollars. Standard errors clustered by firm are in parentheses, except for robustness check 1, which is a cross-section and therefore just uses robust standard errors.

Source: Authors' calculations
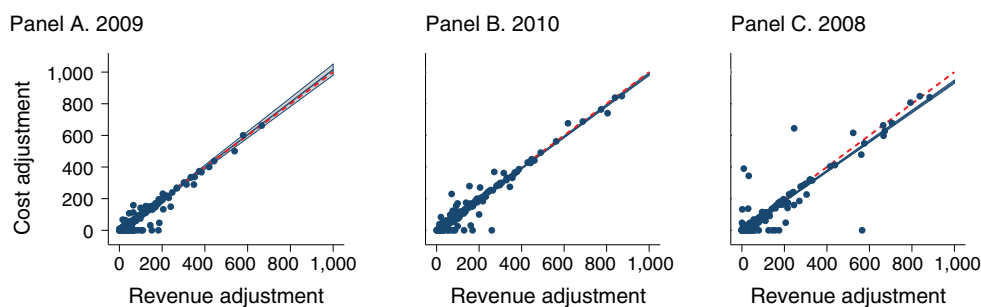
Panel A. 2009   Panel B. 2010   Panel C. 2008

FIGURE 5. COST MATCHING

Notes: The dashed line indicates a 45-degree line. Also shown are a fitted line and a 95 percent confidence interval for the fitted line. Slopes are as follows: 1.028 for the 2009 round, 0.993 for the 2010 round and 0.942 for the 2008 round. Axes are in thousands of US dollars and are restricted to show zero to one million, but the fitted line and confidence interval reflect the unrestricted sample.

revenue and cost adjustment estimates together imply that taxable profit increases by $(1 - 0.96) \times (0.93) = 3.7$ cents on average per dollar of notified discrepancy among adjusting firms.

These cost offsets imply that the notifications had little effect on preexisting tax evasion (profit underreporting). A natural question is why the tax authority would

not immediately pursue these firms. Conversations with SRI staff indicate that they are indeed in the process of follow-up control efforts. However, such efforts suffer from the exact problem third-party cross-checks are meant to mitigate. They require in-person audits, which are time consuming and costly. The main advantage of third-party reporting is that, *unlike* audits, it is meant to provide a simple, low-cost mechanism to enforce tax collection. However, when third-party reporting of costs is partial, the tax authority cannot definitively distinguish between legitimate and false cost offsets without a full audit.

One alternative explanation for our findings is that the notifications simply prompt firms to review their returns and correct lazy reporting or honest mistakes. Several empirical findings provide evidence against this as the main underlying mechanism. First, 28 percent of firms in the notification sample and 38 percent of the adjusting sample reported zero revenue on their initial returns. In Ecuador, as in other countries, registered firms have to file annual returns even if they have no economic activity.[22] Therefore, filing a return with zero reports does not raise a red flag in and of itself. It is unlikely for firms to "forget" that they had any economic activity, particularly given the magnitude of revenue discrepancies for this sample. Second, if mistakes were due to firms forgetting to report entire portions of economic activity (with their associated revenue and costs), we would expect a positive correlation between prenotification profit rates and implied profit rates on the amended portion of the return. However, this correlation among adjusting firms is -0.01.[23] Third, the very close matching of cost to revenue adjustments for many firms makes the correction of honest mistakes unlikely. It would imply that firms are accurately reporting the *level* of reported profits both before and after the notifications, but forgot to report revenue and costs that are often in the hundreds of thousands of dollars. Honest mistakes are also somewhat difficult to reconcile with constant treatment effects over the distribution of discrepancies. Finally, firms systematically choose cost adjustments that are more difficult for the tax authority to verify. Within line item, adjustments to harder to verify administrative costs, such as legal and consulting services, are more frequent than adjustments to production costs, and the most frequently adjusted line item is "Other Administrative Costs." The overall distribution of reported costs also shifts toward administrative versus production costs. While we cannot fully rule out other explanations, the results taken together strongly suggest that firms deliberately target cost adjustments to revenue adjustments, and at least some of the increase in reported costs likely reflects fake costs.

Effects on Tax Revenue.—Given the results above, it is not surprising that effects on tax collection are modest. Figure 6 shows a histogram of changes in the log of tax liability for adjusting firms, with a large spike around zero. Table 4 presents revenue and cost adjustments and resulting changes in tax liability. Panel A shows

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[22] Inactive firms face fines if they fail to submit tax returns until the firm is legally closed, a process which is costly and can take several years.
[23] This also indicates that the main form of misreporting detected by revenue discrepancies is not to keep entire parts of production off the books, as in Kopczuk (2012).
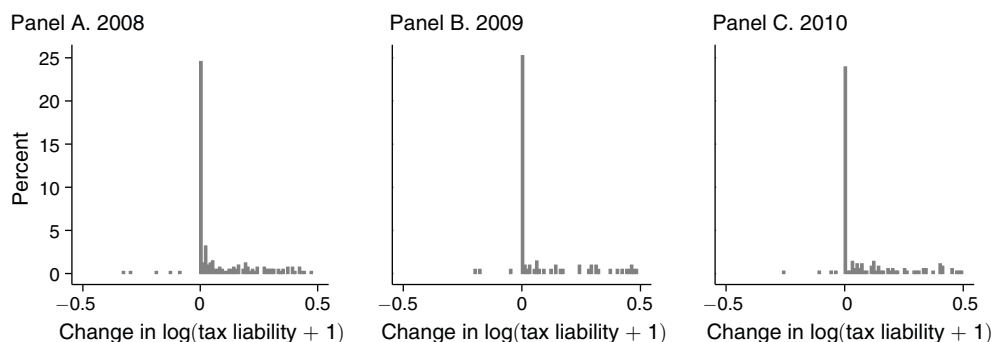
Panel A. 2008   Panel B. 2009   Panel C. 2010

FIGURE 6. CHANGES IN TAXES AMONG ADJUSTING FIRMS

Notes: Histograms of the change in log(tax liability +1) between prenotification and post-notification. We add 1 in all log specifications to deal with zero self-reports. Bins are of size 0.01, and the bottom 1 percent of the sample is omitted when calculating bin heights for computational purposes.

TABLE 4—TREATMENT EFFECTS ON OVERALL REVENUE, COST, AND TAX LIABILITY, 2008–2010

	Revenue (1)	Cost (2)	Tax liability (3)
Panel A. Amending firms			
Post	86,036	80,184	1,851
	(15,367)	(15,054)	(223)
Constant	872,195	828,644	11,254
	(7,684)	(7,527)	(111)
Firm fixed effects	Yes	Yes	Yes
R^2	0.996	0.995	0.996
Observations	2,530	2,530	2,530
Number of firms	1,175	1,175	1,175
Panel B. Notified firms			
Post	13,616	12,690	293
	(2,364)	(2,311)	(35)
Constant	973,408	908,571	16,226
	(1,182)	(1,155)	(18)
Firm fixed effects	Yes	Yes	Yes
R^2	0.998	0.998	0.998
Observations	15,986	15,986	15,986
Number of firms	6,532	6,532	6,532

Notes: The baseline is the last filing before the notification and represents the amount after potential amendments during the post-notification window are taken into account. Dependent variables are in levels of US dollars. Standard errors clustered by firm are in parentheses.

Source: Authors' calculations

that firms increased reported revenue by $86,036 and costs by $80,184, resulting in an average tax increase of $1,851. The full notification sample (panel B) shows similar patterns, mechanically attenuated since non-amenders had zero adjustments by definition, but still significant at the 1 percent level.

We next simulate these treatment effects for non-notified firms (Table 5). This placebo specification tests our initial identifying assumption that the pre-post

TABLE 5—PLACEBO TESTS: SIMULATED TREATMENT EFFECTS FOR NON-NOTIFIED FIRMS,
2008–2010

	Revenue (1)	Cost (2)	Tax liability (3)
Panel A. All non-notified firms			
Post	2,565	−1,975	745
	(2,200)	(3,292)	(820)
Constant	1,867,316	1,744,932	28,332
	(1,100)	(1,646)	(410)
Firm fixed effects	Yes	Yes	Yes
R^2	0.889	0.875	0.863
Observations	293,370	293,370	293,370
Number of firms	66,872	66,872	66,872
Panel B. Amending non-notified firms			
Post	363,503	−279,836	105,568
	(376,976)	(564,536)	(140,517)
Constant	11,996,503	11,771,793	49,020
	(188,488)	(282,268)	(70,259)
Firm fixed effects	Yes	Yes	Yes
R^2	1.000	0.999	0.513
Observations	2,070	2,070	2,070
Number of firms	977	977	977

Notes: Linear regressions for the universe of all non-notified firms, supposing that they had been notified on the first day of the notification period for each year. Panel A includes all non-notified firms with prenotification filings and positive third-party revenue reports in the corresponding year. Panel B includes the firms from the previous panel that happened to amend during the post-notification window. All monetary figures in US dollars. Standard errors clustered by firm are in parentheses.

Source: Authors' calculations

difference in firms reports can be taken as a causal effect of the notifications. Table 5, panel A shows all non-notified firms and panel B non-notified firms that happened to make an amendment during the relevant period. There are no significant changes in revenue, cost, or tax liability, and the point estimates for revenue and cost adjustments are of opposite sign.[24]

Given the magnitude of revenue discrepancies, notifications had the potential for large effects on tax collection. If all firms in the 2009 and 2010 rounds matched third-party reported revenue amounts, aggregate pretax revenue for the 2009 and 2010 fiscal years combined would have increased by $910 million. If other line items were held constant, this would imply an increase in tax collection of $193 million.[25] Among just the amending firms, implied increases in total tax collection

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[24] We can also use non-notified firms as a control group for notified firms in a differences-in-differences specification (online Appendix Table A3). The effects for revenue and cost adjustments are similar to the original treatment effects. The point estimate for the tax liability coefficient switches sign but is statistically insignificant. This is largely because the few non-notified firms that amend (less than 1 percent) make extremely large but imprecisely estimated tax adjustments.

[25] This is calculated as the 25 percent tax rate multiplied by 85 percent of the additional declared revenue, since 15 percent of profits should be distributed to workers.

would be around $23 million. Total tax collection attributable to the notifications was approximately $2 million.

The above analyses examine how firms respond to ex post notifications of detected discrepancies. As taxpayers update beliefs, they should adjust their ex ante behavior for subsequent tax years. Most individuals in the United States, for example, report W2 income accurately, knowing that discrepancies will be detected and prosecuted with near certainty. In our context, we might expect notified firms to report both higher revenue and costs on post-notification returns. Online Appendix B presents suggestive evidence in support of this hypothesis. In addition, we might expect firms to reduce real production activity and take other actions to reduce the amount of third-party information available to the tax authority. Understanding these dynamic real responses is critical for assessing the long-run welfare implications of third-party reporting.

V. Conclusion

This paper investigates the impact and potential limitations of tax enforcement based on third-party information in low capacity environments. Our results have a number of implications. First, the effectiveness of third-party reporting will depend critically on other aspects of the information and enforcement environment. Standard tax evasion models have not considered limits to enforcement *conditional on* detecting misreporting. Our results show that such limits can be of first-order importance in developing countries. In addition, the effect of third-party reporting can be limited when such reporting is incomplete and the tax authority has limited ability to audit the unreported margins. As in the O-ring theory of development (Kremer 1993), the weakest link may play a preponderant role for tax collection: third-party reporting is not likely to be a silver bullet in solving the problem of improving state fiscal capacity.

Second, our findings suggest ways in which governments should take limits to information into account when designing tax policy. In particular, the optimal tax base will depend on third-party information on the base as a whole. For example, if firms can offset reported revenue with reported costs, it may be optimal to limit allowable cost deductions to those that are easy to verify. Our findings are complementary with Best et al. (2015), who show that governments may prefer productively-inefficient turnover taxes to profit taxes when costs are easier to evade.

Third, a novel finding of our paper is that some firms appear to underreport costs. Our framework provides a micro-foundation for the idea that firms may understate overall economic activity to "fly under the radar" of tax or other regulatory authorities (Almunia and Lopez-Rodriguez 2015). To the extent that firms do not have incentives to fully declare costs, the self-enforcement mechanism in the VAT can be undermined (see, e.g., Keen and Smith 2006). Cost underreporting could also encourage firms to remain in the informal sector: formal firms may be willing to trade with informal suppliers even if these suppliers cannot provide valid receipts to deduct input costs, a limitation that would otherwise disincentivize informality (de Paula and Scheinkman 2010). We see this as an important avenue for further research.

Finally, a common argument in favor of third-party reporting is that it can allow developing country governments to circumvent many of the problems and constraints associated with "traditional" tax enforcement methods. Our results suggest that third-party reporting and traditional methods may in fact be complementary with each other (see also Pomeranz 2015). Despite the growth of computer-based monitoring using cross-checks of third-party information, strengthening the auditing and enforcement capacity of developing country governments still remains crucial for effective tax collection. Over time, third-party reporting can become more effective as tax authority capacity increases and the scope of transactions that are third-party reported grows. This allows governments to target audits to remaining non-third-party reported margins.

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