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Ghosting the Tax Authority: Fake Firms and Tax Fraud*

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Abstract

An important but poorly understood form of firm tax evasion arises from the use of "ghost firms"—fake firms that issue fraudulent receipts so that their clients can claim false deductions. We provide a unique window into this global phenomenon using transaction-level tax data from Ecuador. Ghost transactions are widespread, prevalent among large firms and firms with high-income owners, and exhibit suspicious patterns in comparison to ordinary transactions: bunching at round numbers, at the end of the fiscal year, and just below financial system thresholds. We go on to study an innovative enforcement intervention that targeted ghost clients rather than ghosts themselves, which led to substantial tax recovery.

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1 Introduction

Developing countries rely disproportionately on tax revenues collected from firms as they strive to build state capacity, fund public goods, and enable redistributive programs in an efficient manner. A widespread scourge on these efforts throughout the world arises when fake firms—often known as "ghost firms," "invoice mills," or "missing traders"—issue fraudulent receipts that allow their supposed clients to claim additional tax deductions on value-added and corporate income taxes.[1] Enforcement against ghosts has proven to be a challenging game of whack-a-mole since these ephemeral entities can disappear just as quickly as new ones can open up.

Despite the global prominence of ghost-enabled tax evasion, the existing economics research on this phenomenon (discussed below) is extremely limited. Basic questions remain largely unanswered: How extensive and quantitatively important is ghost evasion? Which types of firms and firm owners transact with ghost firms? How do firms strategically use ghost transactions to engage in tax evasion? And how can tax authorities effectively combat this form of evasion?

This paper provides a unique window into the ghost economy and the scope for interventions to recoup tax revenues that have been lost due to ghost deductions. Our empirical context is Ecuador, where we can identify ghost clients and transactions by combining firm-to-firm transaction-level tax data with a sample of over 800 firms identified as ghosts by the tax authority. These transaction-level data allow us to investigate how ghost transactions—ones for which the seller is a detected ghost firm—facilitate evasion of both VAT and corporate income taxes. We then supplement our analysis by drawing on a unique dataset documenting the owners of Ecuadorian firms in order to quantify the extent to which evasion via ghost transactions, and the government's ability to recoup evaded revenue, are regressive or progressive in nature.

Our first contribution is to document new facts about the ghost economy. We begin with the aggregate nature of this form of tax fraud, demonstrating that: evasion through the use of ghost deductions is indeed widespread and quantitatively important; ghost clients are not limited to small, semi-formal firms; and ghost evasion benefits those at the top of the income

[1] See, e.g., OECD (2017) and Keen and Smith (2006). We use the term "ghost firms," which corresponds to the name used by the tax authority in Ecuador ("*empresa fantasma*"). Appendix B provides documentation of the importance of this concern around the world.

distribution. In 2015, over 7,000 firms (4.7% of potential clients) took deductions from an identified ghost firm (likely a subset of true ghosts). Among these ghost clients, average annual ghost deductions were 14.1% of the value of their purchase deductions. Larger firms are more likely to engage in ghost transactions and feature larger shares of such transactions in total input costs. Tax evasion via ghost firms has a regressive effect in the sense that ghost deductions are disproportionately used by firms owned by high-income individuals.

We next turn to opening the black box of ghost client behavior, exploiting disaggregated firm-to-firm-transaction data to compare transactions that ghost clients make with ghost firms to those they make with regular firms. The observed patterns indicate that ghost activity is a deliberate form of evasion on the part of many clients, with firms utilizing ghost transactions strategically and doing so in a way that avoids transacting through the formal financial sector. Ghost transactions are relatively concentrated at the end of the tax year, a time when firms can more easily determine the level of fake costs needed to offset annual revenues to reduce reported profits. They are more likely to bunch at round numbers, consistent with representing fake flows of non-existent goods. In addition, ghost transactions disproportionately bunch just below the $5,000 threshold at which firms are required to make payments via the formal financial system. Such behavior avoids the need for ghost firms to have a (traceable) bank account and makes it possible for ghost firms to issue receipts without the stated transaction amount actually changing hands.

From a policy perspective, utilizing information on the typical characteristics of ghost clients and transactions—such as those we describe here—could be used to help identify ghost firms. However, this leaves open the question of how to recoup lost tax revenue even when ghost firms are successfully identified.

Our second contribution is therefore to provide the first evaluation—to the best of our knowledge—of an enforcement policy against the use of ghost firms. Enforcement efforts targeted directly at ghost firms face unique obstacles. Ghosts are often part of criminal enterprises; "owners" may be shell companies, deceased individuals, or victims of identity theft; and ghosts are often transient, disappearing and re-emerging as new entities (see OECD, 2006; de La Feria, 2020). To deal with these challenges, the Ecuadorian Internal Revenue Service (SRI) began an innovative enforcement scheme in 2016 that targeted ghost *client* firms rather than chasing the ghosts themselves. Notifications were sent to over 1,500 unique firms, informing them that SRI had detected ghost transactions on previously filed

tax returns and requiring that they submit revised returns removing these deductions.

We use administrative records of firms' amendments to their corporate income tax filings to conduct an evaluation of this novel scheme for tackling ghost-enabled evasion. The policy was highly effective and resulted in a total increase in reported firm income tax of $20.6 million within three months, despite the fact that a large fraction of firms did not respond to the notifications (consistent with the findings in Carrillo et al., 2017). Among responding firms, the average tax increase was over $\$44,000$ (81% of their original filings) while the administrative cost of issuing notifications—conditional on having identified ghost firms—was close to zero. We find that the tax increases stem mostly from firms owned by high-income individuals. For example, the amount of additional tax reported as a share of owners' income is 170 times higher in the top 1% than in the bottom 80% of the income distribution. Despite the large additional tax filings—which will presumably underestimate the full impact because we do not see firms' VAT amendments—we do not find evidence of client firms going out of business or becoming informal. This is consistent with ghost clients being large, established firms.

Our findings contribute to several strands of literature. First, we add to the extremely sparse literature on tax evasion via ghost firms. Waseem (2020) exploits a policy in which VAT rates were reduced to zero in Pakistan and demonstrates that this resulted in a reduction of ghost firms identified by the tax authority. He further shows that most ghost deductions are claimed by exporters and that these deductions comprise a large share of over-claimed refunds for these firms. Mittal et al. (2018) focus on the problem of identifying ghost firms, developing a machine learning algorithm to detect them. As argued in Slemrod and Velayudhan (2022), more evidence is needed on the topic of ghost firms to answer key tax policy questions such as the overall effectiveness of the VAT. We advance this literature in two ways. First, we provide the first detailed analysis of the characteristics of ghost client firms, their owners, and their patterns of reported transactions with ghost firms. Second, we provide the first analysis of an enforcement intervention aimed to close the tax gap arising from ghost firms.

More broadly, we contribute to economists' understanding of the underlying mechanics of firm tax evasion. While much recent work on tax compliance has focused on misreporting of firm revenues (see e.g., Slemrod, 2019; Pomeranz and Vila-Belda, 2019, for overviews),

little research has focused on policies to combat firms' cost misreporting.[2] Cost misreporting can undermine self-enforcement in VAT systems and may force governments to rely on inefficient tax instruments (Best et al., 2015). While several recent studies have found that enforcement policies targeting revenue under-reporting led to firms increasing reported costs, we find almost no offsetting behavior in the form of a reduction in reported revenue in our intervention. This is consistent with third-party information providing a floor on reported revenues.[3]

Our finding that ghost clients' purchases tend to bunch at the $5,000 threshold speaks to the role of the formal financial sector in hindering tax evasion. Forcing transactions to occur through the financial sector disincentivizes ghost transactions, consistent with existing evidence about ghost workers in public transfer programs (Niehaus and Sukhtankar, 2013; Banerjee et al., 2020). These results speak more generally to models in which transacting through the formal financial system limits evasion (Gordon and Li, 2009) and to the question of whether outlawing cash can foster tax compliance (Rogoff, 2016; Gadenne et al., 2022). To the best of our knowledge, this study provides the first direct evidence that firms avoid the formal financial system specifically when engaging in illegal activity.[4]

Finally, we provide novel insights into distributional links between corporate tax evasion, individuals and anti-evasion efforts. While recent work has examined distributional implications of individual-level income and wealth tax evasion (e.g., Alstadsæter et al., 2018, 2019; Brounstein, 2021; Guyton et al., 2021; Londoño-Vélez and Ávila-Mahecha, 2021), we are not aware of prior studies that have linked individual owners to their firms to examine individual-level consequences of corporate income tax evasion and enforcement efforts against such activities.

[2]For personal income taxes, policies to address over-reporting of charitable deductions or child allowances have been studied by LaLumia and Sallee (2013); Fack and Landais (2016); Tazhitdinova (2018).

[3]Interventions targeting revenue under-reporting are studied e.g. in Ali et al. (2015); Asatryan and Peichl (2017); Carrillo et al. (2017); Mittal and Mahajan (2017); Slemrod et al. (2017); Almunia and Lopez-Rodriguez (2018); Mascagni et al. (2018); Brockmeyer et al. (2019); Naritomi (2019); Fjeldstad et al. (2020); Li and Wang (2020); Okunogbe and Pouliquen (2022).

[4]Other studies have found bunching at tax cutoffs such as for VAT reporting thresholds (e.g., Onji, 2009; Asatryan and Peichl, 2017; Luksic and Mittal, 2019; Liu et al., 2021) or for being subject to different tax regimes and regulations (e.g., Hasegawa et al., 2013; Best et al., 2015; Almunia and Lopez-Rodriguez, 2018; Lopez-Luzuriaga, 2019; Chen et al., 2021; Clifford and Mavrokonstantis, 2021); see Kleven (2016) for an overview.

2 Institutional Background and Data

The fabrication and use of falsified invoices is commonly considered an intentional tax offence and regarded as a criminal activity. It is therefore more severe than other types of evasion such as simple revenue under-reporting (de La Feria, 2020; OECD, 2021).

Our data on these activities in Ecuador draws on SRI's 2016 anti-ghost initiative.[5] While the details of these efforts are deliberately secret, they are known to involve four steps. First, candidate ghost firms were identified based on information from audits, whistle-blowers, and tax records. This included, in particular, firms that filed no returns or reported very little income, yet were listed as suppliers for large amounts of purchases by other firms. Second, SRI made attempts to contact candidate ghost firms. Firms that were neither found at their registered address nor responsive to emails were taken forward as potential ghosts. Third, the list of potential ghosts was posted on SRI's website. Finally, firms that were wrongly on this list were given an opportunity to contact SRI, prove their real existence and be removed. After these steps, a list of 811 identified ghost firms remained. This list forms the basis for the policy intervention that we study in Section 4. Given the secretive nature of ghost firms, it is of course likely to be incomplete.[6]

We combine this list with rich administrative data from the universe of annual corporate and individual income tax filings in Ecuador (for 2010–2017) as well as monthly purchase annexes (for 2010–2015) detailing the amount and supplier identities of input costs that firms deduct.[7] Our sample focuses on firms that are economically active in a given year in that they file positive revenues or costs, appear as a seller or buyer in a purchase annex, or report payments to an employee. We restrict attention to active firms that are required to file purchase annexes: incorporated firms and large sole proprietorships (i.e., those with annual sales above $100,000, annual costs above $80,000, or capital above $60,000).[8] This

[5] Appendix C provides further details on data construction.

[6] However, even if SRI misses some of the smaller ghost firms, the detected sample is likely to capture a large share of total ghost transactions, since our data show that the production of fake receipts is highly concentrated and it seems plausible that SRI's targeting would detect relatively large ghosts. For example, we find that just 10% of ghost firms account for over half of all ghost receipts in the sample (both in terms of number and amounts) and 10 ghost firms alone issue 25% of ghost receipts (or 14% of total value).

[7] Purchase annexes are required to enable cross-checking of cost deductions from VAT and firm income tax filings.

[8] Corporations file corporate income tax (form F101), whereas sole proprietorships file a combined business and individual income tax return (long form F102). Our sample also includes smaller sole proprietorships that file purchase annexes because they wish to deduct itemized costs. These make up less than 0.2% of total firm revenue in our sample.

sample comprises the universe of potential ghost clients, since these firms are required to file purchase annexes to support the claiming of non-labor cost deductions from the VAT and from business income taxes.[9] Corporations make up 88% of total firm revenue in our sample, and sole proprietorships 12%. In robustness checks we find that our results are qualitatively similar in both groups.

We define a firm as a ghost client for a given year if it reports at least one purchase from an identified ghost firm in that year. Our analysis focuses on the behavior of these client firms—their characteristics, the transactions they make with both ghost and non-ghost firms, and their amendments to past income tax filings in response to SRI's anti-ghost intervention.

Lastly, we link firms to administrative ownership records, which allows us to determine individual owners of each firm and their ownership shares. We also observe labor income components from tax and social security data for individuals employed at these firms. This allows us to construct individuals' income from the sum of their salaries (from social security filings), self-employment income, and capital income from firm ownership (computed from the annual profit of each firm in which they have a stake, multiplied by their ownership share).

3 New Facts About Ghost Clients and Transactions

Ecuador's transaction-level data allow us to shed new light on the nature of the ghost economy. Since these records form the tax authority's basis for cross-checking cost deductions from both VAT and firm income tax filings, our findings expose evasion of both forms of taxation.

We establish six novel descriptive facts, the first three of which describe overall magnitudes of ghost transactions as well as the types of firms (and owners) involved as clients. All statistics in this Section refer to pooled 2010–2015 data unless stated otherwise.

Fact 1: Tax deductions based on fake receipts from ghost firms are widespread and large. 10.4% of unique firms file deductions based on receipts from at least one identified ghost firm. Table 1 shows that, on average, 3.6% of all purchases registered by these ghost clients are from ghosts, amounting to 10.4% of the value of their purchase deductions. At 4.6% and 14.1%, respectively, these shares are higher for 2015, the last year before the list

[9]It is theoretically possible that some other taxpayers engage in unreported ghost transactions, retaining receipts to justify claiming of non-itemized deductions in case of an audit.

of ghost firms was established. This may reflect the potential for earlier ghosts to have disappeared by the time the list was established. In total, ghost clients reported ghost transactions amounting to $2.1 billion in value. This represents a substantial amount of tax evaded: 1.7% for corporations and 11.5% for sole proprietorships.

Fact 2: Evasion through ghost firms is more prevalent among relatively large firms. Table 1 shows that ghost clients are much bigger than other firms, with higher revenues, costs, and tax liabilities.[10] Looking at the full size distribution, Figure 1, Panel A shows that the probability of engaging in ghost transactions increases monotonically in firm revenue. While this may simply reflect the fact that larger firms have more transactions, Panel B shows that the share of ghost deductions out of total deductions also increases throughout much of the size distribution, except at the very top. The sharp drop at the top may be due to the possibility that very large corporations have stronger incentives to avoid illegal behavior or that they can use more sophisticated avenues of tax avoidance that do not require evasion using fake receipts (as in e.g., Bustos et al., 2022).

Fact 3: Ghost deductions are most prevalent in firms owned by high-income individuals. Involvement with ghost firms is increasing towards the top of the individual income distribution (Figure 1, Panels C–F). Not only does the probability of having ownership of a ghost client increase with individuals' income, but so does the amount of ghost purchases attributed to individuals relative to their income.[11] The ratio of ghost transactions over individuals' income is about 17 times higher in the top 5% of the income distribution than in the bottom 80%, and almost 36 times higher in the top 1%. Further, zooming in on only those individuals who have some capital income from firm ownership, we also see an increase throughout the income distribution.[12] These findings imply that the type of evasion that ghost firms enable tends to reduce the effective taxation of firms owned disproportionately by rich individuals.

Our next three facts draw on transaction-level data of ghost clients and show that trans-

[10] Consistent with Waseem (2020), their exporter share is higher (7%) than among regular firms (2%).

[11] We attribute ghost purchases to individuals by multiplying individuals' ownership shares by the corresponding firms' ghost purchases.

[12] These findings likely represent a lower bound on the true extent to which the use of ghost deductions increases with income. Since individuals' income includes reported profits of firms they own, their income mechanically looks smaller when firms take more fake deductions. As Figure A1 shows, when we calculate individuals' incomes without counting the deductions made with ghost receipts, the use of ghost deductions increases more monotonically and substantially more steeply with income.

actions with ghost firms differ in striking ways from those that these same ghost clients make with regular firms.

Fact 4: The number and value of ghost transactions are clustered towards the end of the tax year. Figure 2, Panels A and B show that both the number and value of transactions with ghost firms increase strongly towards the end of Ecuador's tax year (which is also the calendar year), while those from other firms do not. In December, there are over twice as many monthly ghost transactions as in the first six months of the year, while the number of non-ghost transactions (by the same client firms) is only about 6% higher in December. This is consistent with firms assessing their annual revenues at the end of the year and then utilizing ghost transactions to achieve a target reported profit level or rate for tax purposes.[13]

Fact 5: Round number bunching is more prevalent among transactions with ghosts than with non-ghost firms. Figure 2, Panels C and D illustrate the distribution of ghost clients' purchase transaction values (net-of-VAT) from ghosts and non-ghost firms. 6.5% of net-of-VAT transaction values for purchases from ghost firms are multiples of $500, far more than for purchases from regular firms (0.7%).[14] This type of bunching is also observed in Kleven and Waseem (2013) for self-employed individuals' reported taxable income and is consistent with ghost transactions representing false activity (e.g., Klimek et al., 2018; Nigrini, 2018).

Fact 6: Ghost transactions exhibit bunching below the financial system payments threshold. A common policy in many countries requires that firm-to-firm transactions greater than a cutoff value ($5,000 gross-of-VAT in Ecuador) be made through the formal financial sector (i.e., via electronic transfer, check, or credit card). Exceeding this threshold makes ghost transactions more costly, both because payments must be made to a valid—and traceable—bank account, and because real payments must actually take place, even if no goods or services are exchanged. While payments could be reimbursed by the ghost firm, doing so would require coordination and trust. Figure 2, Panel D shows strong bunching

[13]This is similar to how US firms have been found to spend more on capital investments towards the end of the fiscal year to reduce tax obligations (Xu and Zwick, 2022) and how public entities spend more at the end of the year to target spending to their budget (Liebman and Mahoney, 2017).

[14]This finding that bunching is at values net-of-VAT is consistent with the fact that in Ecuador's tax forms costs are recorded net-of-VAT. The above bunching statistics are calculated for the full range of transaction amounts. When we exclude transactions below $400 (which make up a sizeable number of transactions but by construction cannot bunch at multiples of $500) round-number shares are somewhat higher for both ghost and non-ghost transactions: 8.1% and 2.9%, respectively.

in ghost transactions just below the transaction value corresponding to $5,000 gross-of-VAT, and very little density above.[15] By contrast, the distribution of transactions with non-ghost firms (Panel C) is relatively smooth through the $5,000 gross-of-VAT threshold, suggesting the requirement does not create large economic distortions.

Supplementary analysis in Appendix A shows how Facts 1-6 are robust across two key subgroups of firms. First, our findings are qualitatively similar for incorporated firms and sole proprietorships (Figures A2, A3, A4, A5; Tables A1, A2). Second, we analyze results by firms' filing behavior. Even though firms are required to file purchase annexes to claim deductions, some of this filing is incomplete. However, Figures A6, A7 and Table A3 show that results look very similar among firms that file purchase annexes every month.[16]

Taken together, the previous six facts shed light on basic, unanswered questions about ghost-enabled tax evasion. One might have thought that ghost evasion would be utilized by small or semi-formal firms, with larger firms exploiting more sophisticated mechanisms of tax avoidance and evasion. Our findings reject this view—in fact, ghost deductions comprise an increasing share of purchases for larger firms, except at the very top of the firm size distribution. Over the entire income distribution, richer individuals benefit more from ghost evasion, not only because they are more likely to own firms or stakes in firms but also because, even within the set of firm owners, ghost deductions are disproportionately larger relative to income for richer individuals. While the sample of ghost firms detected by SRI may be incomplete, it is the relevant sample for determining the distributional implications of enforcement, since tax authorities can only target detected tax fraud. The within-client transaction-level patterns are strongly indicative of deliberate evasion by clients: Ghost transactions are highly concentrated at the end of the year, exhibit strong round number bunching, and avoid use of the formal financial sector. We would not expect to see these patterns if apparent ghost transactions simply reflected misclassification of real firms as ghosts by SRI or genuine transactions between ghost clients and informal firms who in turn

[15] In contrast to the round number bunching in Fact 5, which happens at net-of-VAT amounts (as this is the amount firms use for tax deductions), the $5,000 requirement is based on gross-of-VAT amounts. For this reason, this value does not correspond to one at which round number bunching occurs. For a small number of ghost clients (4%), we observe bunching of ghost transactions at $1,000 gross-of-VAT starting in May 2013. We are not aware of any relevant regulatory changes at that time that could explain bunching at this threshold.

[16] Purchase annex filing behavior is very similar for corporations and sole proprietorships (Table A4).

purchase fake receipts with supplier identification numbers from ghost firms.

4 Enforcement Against Ghost Clients

What can a tax authority do about the sort of widespread tax evasion via ghost firms we have documented above? Substantial obstacles arise when agencies pursue ghost firms via direct enforcement since, by their nature, these firms and their true owners are difficult to locate, and any success may only be fleeting because new ghost entities can easily reappear. To address these challenges, in 2016 SRI began an innovative enforcement alternative based on targeting *clients* of ghost firms rather than ghosts themselves. A potential advantage of targeting clients is that, unlike ghost firms, client firms have a genuine economic presence that makes them less able to disappear and re-emerge, potentially allowing for recovery of evaded taxes. In this section, we evaluate the effectiveness of this approach.

In their enforcement program, SRI sent notification emails to ghost clients, retroactively challenging their deductions from ghost firms on tax returns filed for fiscal years 2010–2015. The relevant portion of these notifications (with financial details provided as an example) translates as follows:[17]

> Dear taxpayer,
>
> Upon reviewing the information available in its registries, the Tax Authority detected that you registered transactions with firms that have been classified, for tax purposes, as non-existent, ghosts, or individuals and firms that undertake fictitious activities or transactions. [. . .]
>
> Therefore, you are given a deadline of 10 business days to submit your amended corporate income tax and VAT tax forms, in which you must modify the corresponding differences and pay resulting taxes as well as interests and fines:"

Fiscal year	Line item	Costs reported by taxpayer	Costs calculated by tax administration	Difference
20XX	799 - Total costs and expenditures	$ 1,023,686	$ 947,166	$ 76,520

We focus on notifications sent to incorporated firms in regards to their corporate income tax filings because this is the sample for which we have data on firms' amendments (discussed below). 2,382 such notifications were sent to 1,589 such ghost clients—10.8% of all

[17] Appendix D shows the full notification (Spanish and translated).

incorporated firms that made a detected ghost deduction in 2010–2015.[18] Notified clients were selected by SRI primarily on the basis of having made large deductions based on ghost receipts in 2010–2015. While SRI's specific methodology is deliberately confidential, the notified clients sample presumably represents the type of firms a tax authority desires to target.

Notified firms were larger than typical incorporated ghost clients, with a 2.4 times higher median tax liability (Table A5, Panel A). This is consistent with SRI targeting firms with higher potential tax recovery. The median amount of ghost deductions indicated in the notifications was around $\$181,000$ (mean $\$338,000$) and the median share of ghost deductions out of total purchases was 26% (mean 38%) among notified firms.

To estimate the causal effect of these notifications, we compare each firm's own post-notification filings—after potential amendments—with its original corporate income tax filings for that same tax year. This identification strategy is similar to that used in Carrillo et al. (2017) and is feasible because we observe the original returns as well as amended returns. We focus on firms that file an amendment within 90 days of receiving a notification which involves a reduction in at least one cost category that could potentially stem from a ghost transaction (i.e. any non-labor costs). We call this the "adjusting firms" sample. The identifying assumption is that, absent the notification, firms would not spontaneously file amendments at the time of the notification to lower their cost deductions on filings from previous years. In this sense, firms' own pre-notification filings serve as the counterfactual.

Figure 3 provides supporting evidence for the identifying assumption in terms of *timing* and *content* of the amendments. There is a stark increase in amendments involving a reduction in cost deductions after notification (Panel A).[19] Panel B shows amendments in calendar time, zero indicating the start of the campaign in July 2016.[20] Before the campaign, such amendments were rare. After the first notifications were sent, amendments began to increase. This accelerated each time after a large batch was sent out—indicated by blue dotted lines. There is no similar increase in amendment rates by non-ghost client firms (Figure A8).

The pattern of amendment content—Panel C of Figure 3—provides additional support for the identifying assumption. This figure compares the amount of ghost deductions mentioned

[18] SRI also sent 1,288 notifications to sole proprietorships and 329 to incorporated firms about the VAT.

[19] The slight increase prior to notification stems from amendments made after the intervention started, but before the notification was sent to the specific firm. So these amendments appear to result from anticipatory spillover effects, as some firms learned that one of their suppliers was detected as a ghost.

[20] See Table A6 for notifications sent by month.

in a firm's notification (on the x-axis) to the reduction in reported cost in the amended filing within 90 days of notification (on the y-axis). The line of best fit shows that, on average, adjusting firms made reductions to their claimed non-labor costs of 98 cents per dollar in the notification. These patterns seem unlikely to have occurred without the intervention. While firms reduced their cost deductions overall, some firms also increased claimed deductions in some cost categories. Such increases appear designed to leave firms with less of an increase in their resulting tax liability. Consistent with this notion, the cost categories that were increased are labor, inventory, and financial costs while the cost categories that were reduced most strongly are domestic purchases, other production costs, and imports. Overall, total costs still decreased on average by 72 cents for every dollar contested in the notification (Panel D).

Unsurprisingly, many firms did not respond to the notifications. Within 90 days, 25.4% of notifications resulted in the filing of an amendment with a reduction in non-labor costs. Some firms may not have responded because of a failure of the email to reach the firm or the right person within the firm. In addition, as discussed in Carrillo et al. (2017), firms may choose not to amend, knowing that the tax authority has limited capacity for follow-up enforcement. Adjusting firms tend to be somewhat smaller than all notified firms (Table A5, Panel B).

The policy intervention had large effects on reported corporate income taxes of adjusting firms. Their tax liabilities increased by about $\$40,000$ per notification for filings from 2015 and around $\$34,000$ for the pooled sample across all years (Table 2).[21] Since some firms received notifications for multiple years, the tax increase per firm was over $\$44,000$. The total amount of additional taxes filed was \$20.6 million. This represents an 81% increase on the \$25.4 million filed by adjusting firms in their pre-amendment returns. It also represents 13.7% of the total reported tax (\$189 million) among all notified firms. We expect even these large effects to understate the total impact of SRI's program because we do not observe any potential amendments that firms make to their VAT filings and our definition of adjusting firms is conservative.[22]

These increases in tax liabilities are the result of large reductions in reported costs, as

[21] Table A7 presents results for each year separately and Table A8 for the full notification sample.

[22] 52 additional amendments (filed within 90 days of the notification) reported a change in taxes without updating underlying line items, so these are not included in our adjusting sample. Doing so would raise the total impact of the intervention by \$2.2 million.

seen in Figure 3. On average, reported costs were reduced by $\$229,000$ for 2015 and $\$182,000$ in the pooled sample (2010-2015) (Table 2). These findings complement the results from a number of recent studies that have found that enforcement strategies aimed at pushing firms to more truthfully report their *revenues* lead many firms to make large offsetting adjustments by increasing reported costs (Asatryan and Peichl, 2017; Carrillo et al., 2017; Slemrod et al., 2017; Almunia and Lopez-Rodriguez, 2018; Mascagni et al., 2018; Naritomi, 2019; Li and Wang, 2020). In contrast, we find that this intervention, which pushes firms to reduce their reported costs, did not lead to systematic offsetting reductions in reported revenues (Table 2 and Figure A9). This points to an important advantage of enforcement focused on cost over-reporting. The third-party reporting system means that, in principle, a firm's sales to other firms can be cross-checked with their clients' purchase records. It is plausible that the fear of such actions constrains notified firms' willingness to reduce reported revenues as a way of offsetting cost reductions.

Looking at distributional considerations, the tax increases resulting from this intervention are even more strongly concentrated among firms owned by high-income individuals than is the overall use of ghost deductions (Figure A10). The amount of additional tax as a share of owners' income is over 56 times higher in the top 5% than in the bottom 80% of the income distribution, and almost 170 times higher in the top 1%.[23]

We find no evidence that the intervention was followed by firms going out of business or de-formalizing. Figure A11 shows these results. There is a natural decay rate over time, as some firms go out of business every period. However, at 13.1% between 2015 and 2017, this rate was extremely similar for both notified and non-notified ghost clients.[24] These findings are consistent with client firms being large and established.

5 Conclusion

The phenomenon of tax evasion through ghost firms highlights several broader challenges with building state capacity in the developing world. Third-party reporting is considered central to the ability of modern governments to raise revenue. Ghost firms exploit logistical

[23]Similarly to the distributional results in the overall cross-section shown above, the response to the notification is even more concentrated at the top of the income distribution when computing individuals' capital incomes without deducting their firms' ghost deductions (Figure A10, Panels E and F).

[24]Given the different pre-treatment evolution, this is of course merely suggestive and not a causally identified treatment effect.

limits in the ability to cross check information completely and in real time, thereby undermining self-enforcement mechanisms in the VAT and the legitimacy of apparently third-party reported firm deductions. While retroactively using information cross-checks can reveal discrepancies, allowing tax authorities to identify potential ghost firms, recovering revenue from these firms is often difficult, if not impossible.

Our results highlight the promise of retroactively targeting clients of ghost firms. The intervention was highly successful, and likely represents a lower bound on true revenue gains for two reasons. First, firms may also have filed amended VAT returns with reductions in ghost deductions that we do not observe. Second, the intervention may have disincentivized both targeted and non-targeted firms from using ghost firms in the future.

A trade-off governments often face when increasing tax enforcement against firms is that anti-evasion efforts may drive firms into the informal sector or out of business. We see no evidence of such responses in our context, consistent with our finding that the firms most aggressively using ghost deductions are large firms. An interesting future research avenue would be to investigate post-treatment impacts over a longer duration and for additional outcomes, such as for investments, employment, and the potential renewed use of fraudulent deductions from new ghost firms.

A final important consideration in tax enforcement is its distributional implications. Ghost clients—specifically those likely to be detected and targeted by the tax authority—have ownership that is concentrated at the top of the income distribution. To the extent that the economic incidence of reduced corporate profits falls on firm owners, tax enforcement against ghost clients is therefore likely to be quite progressive.

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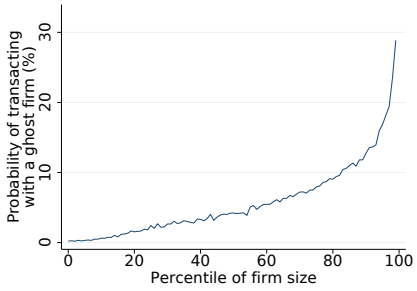
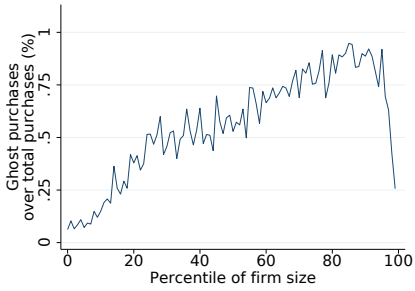
FIGURES

Figure 1: Distributional Results

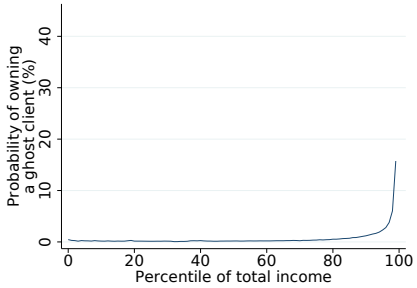
A) Probability of Being a Ghost Client, by Firm Size



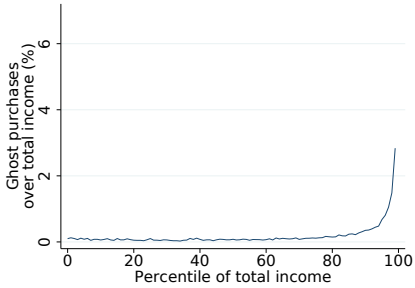
B) Value of Reported Ghost Purchases Over Firm Total Purchases, by Firm Size



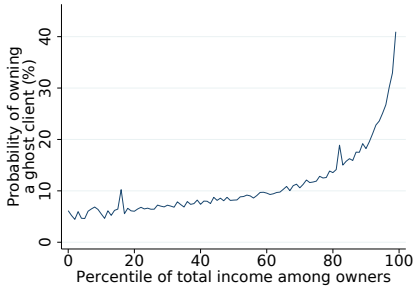
C) Probability of Owning a Ghost Client, by Individual Total Income



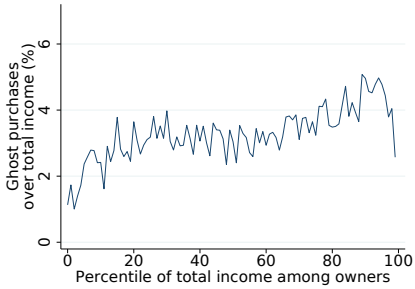
D) Value of Reported Ghost Purchases Over Total Individual Income, by Individual Total Income



E) Probability of Owning a Ghost Client, by Owner Total Income – Owners Only



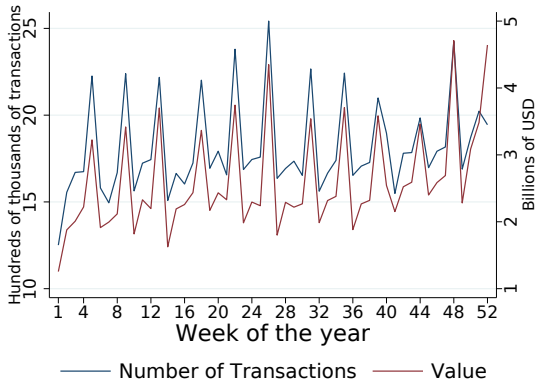
F) Value of Reported Ghost Purchases Over Total Owner Income, by Owner Total Income – Owners Only



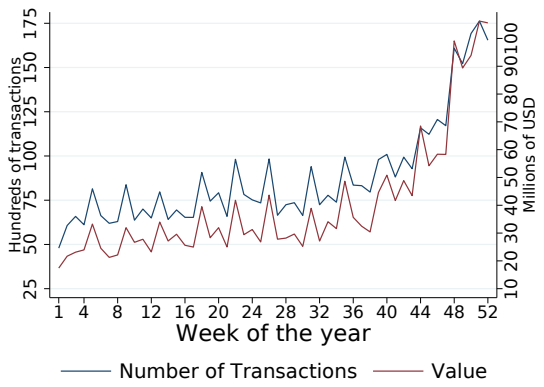
Note: This figure provides descriptive results on the use of receipts from ghost firms across the distribution of firm size and individuals' incomes (pooled 2010–2015). Panels A and B show the probability of being a ghost client and the share of firms' reported purchases that are based on receipts from ghost firms, by percentile of firm revenue (for firms that are required to file a purchase annex and have positive revenues). Panels C and D look at individuals and their ownership in ghost client firms, by percentile of individuals' income (for individuals who earn at least $1 a day and firms with up to 3,000 owners). Panel C shows the probability of having an ownership share in a ghost client. Panel D displays ghost purchases attributed to owners (i.e., individuals' ownership shares multiplied by the corresponding firms' ghost purchases) divided by individuals' total income. Panels E and F show the same as C and D, focusing only on firm owners (i.e., individuals with capital income from a firm in our sample). Outcome variables trimmed at the top 1% of positive values. This figure uses firms' reported profits to calculate their owners' incomes, which can make owners' income appear artificially lower the more ghost deductions a firm takes. Figure A1 shows results when using the profits firms would have without deducting the ghost transactions. Figures A4 and A5 show results separately for ghost purchases by incorporated firms and sole proprietorships, respectively. Figure A7 shows Panels A and B for firms that file a purchase annex every month.

Figure 2: Patterns of Reported Purchases by Ghost Clients from Regular Firms versus Reported Purchases from Ghost Firms

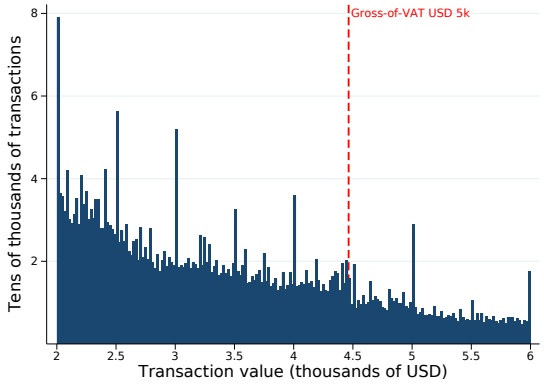
A) Number and Value of Reported Purchases from Non-Ghost Firms Over the Year



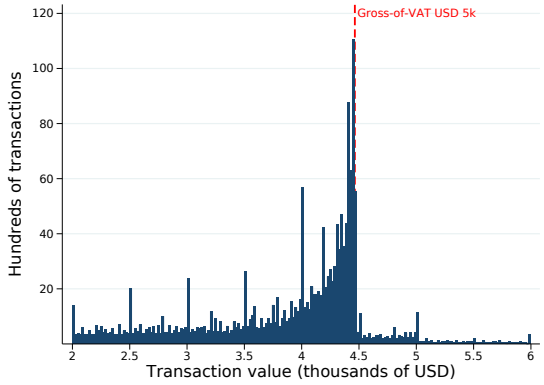
B) Number and Value of Reported Purchases from Ghost Firms Over the Year



C) Size Distribution of Reported Non-Ghost Purchases



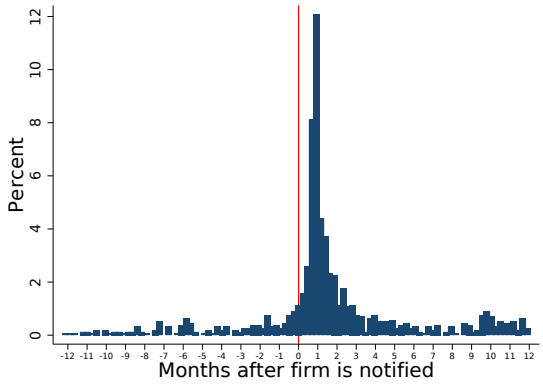
D) Size Distribution of Reported Ghost Purchases



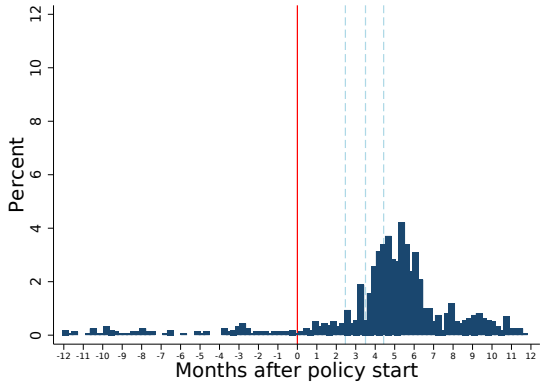
Note: Panels A and B show the weekly number and total value of reported purchases over the year, and Panels C and D the frequency of values, for reported purchases from non-ghost firms and ghost firms, respectively (for all years during 2010–2015) among economically active ghost clients that file a purchase annex. Transaction values are net-of-VAT. The red dashed lines in Panels C and D refer to the corresponding gross-of-VAT amount above which firms are required to make payments via the formal financial system. For ease of visibility, Panels C and D include only transactions that are fully subject to VAT. Figure A12 shows the same also including VAT-exempt transactions. Figures A2 and A3 show results separately for corporations and sole proprietorships. Figure A6 shows results for firm-year pairs that filed a purchase annex in all months of that year.

Figure 3: Amendment Patterns in Response to the Notifications

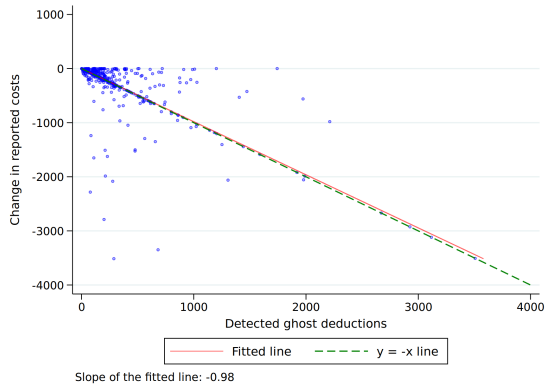
A) Amendment Rate of Notified Firms



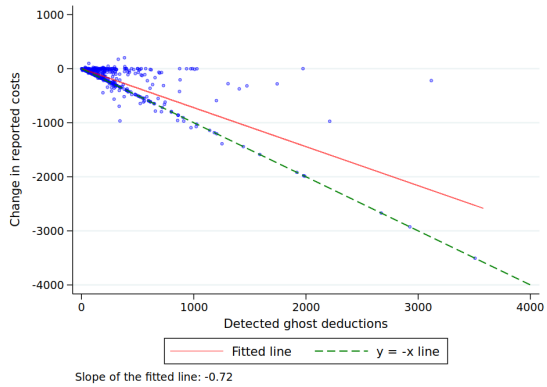
B) Amendment Rate of Notified Firms



C) Cost Reductions vs. Notified Amount (Adjusting Sample)



D) Total Cost Amendments vs. Notified Amount (Adjusting Sample)



Note: This figure shows amendment patterns following the notifications for tax filings from 2010–2015. Panels A and B show amendment rates for the universe of notified firms that include reductions to any non-labor costs. In Panel A zero indicates the date on which a given firm was sent its first notification, while in Panel B zero indicates the start of the notification intervention by SRI (July 18$^{\text{th}}$, 2016). The blue dashed lines in Panel B plot the dates on which SRI sent additional sizeable batches of notifications (see Table A6 for the number of notifications sent per month). Panels C and D show a firm's cost amendments compared to the amount of ghost deductions mentioned in the notification. Panel C only includes amendments of non-labor cost categories that involve a reduction in reported costs, while Panel D includes all amendments to any cost categories. The red solid line in Panels C and D plots the fitted line of a regression of the change in reported costs on the amount of detected ghost transactions mentioned in the notifications. The green dashed line plots the y = -x line. All monetary figures in thousands of USD.

TABLES

Table 1: Descriptive Statistics

	2015		2010-2015	
	(1) Ghost clients	(2) Non-Ghost clients	(3) Ghost clients	(4) Non-Ghost clients
Revenue ($000)	4,060	971	6,058	927
	(24,098)	(27,793)	(120,767)	(30,549)
	[568]	[97]	[568]	[101]
Cost ($000)	3,827	918	5,364	852
	(21,928)	(25,542)	(81,360)	(22,493)
	[538]	[94]	[536]	[96]
Tax liability ($000)	50.68	14.67	153	16.77
	(395)	(621)	(10,202)	(2,007)
	[3.68]	[0.00]	[3.91]	[0.01]
Number of unique ghost suppliers ($000)	2	0	2	0
	(2)	(0)	(2)	(0)
	[1]	[0]	[1]	[0]
Share exporting firms	0.07	0.02	0.07	0.02
Number of identified ghost purchases/ total number of purchases	0.05		0.04	
Value of identified ghost purchases/ value of total purchases	0.14		0.10	
Number of firms	7,118	143,486	22,630	215,197
Number of observations	7,118	143,486	39,982	756,127

Note: This table shows descriptive statistics by ghost-client status for the universe of economically active firms that are required to file a purchase annex for 2015 (Columns 1 and 2) and pooled for 2010–2015 (Columns 3 and 4). Ghost client status is defined at the firm-year level. All amounts are from filings prior to the start of the policy intervention. Means are reported along with standard deviations in parentheses and medians in brackets. All monetary figures in thousands of USD. Table A9 shows the statistics by year for 2010-2015. Tables A1 and A2 show robustness for incorporated firms and sole proprietorships only. Table A3 includes only firm-year pairs that filed purchase annexes in every month of that year.

Table 2: Impacts of Notifications on Reported Revenue, Cost, and Tax Liability of Adjusting Firms

	(1) 2015	(2) 2010-2015
Revenue	-17,733	-10,079
	(21,534)	(6,872)
Cost	-228,583	-181,626
	(51,238)	(28,680)
Tax liability	40,165	34,003
	(7,529)	(5,114)
Number of firms	172	460
Number of firm-year pairs	172	605

Note: This table shows changes to reported revenue, cost, and tax within 90 days after mailing of the notification from SRI, among the adjusting firms. Each coefficient stems from a separate regression showing the average difference in the reported outcome variable across notifications between the original filing from before the notification and the amendment filing after the notification. In Column (1) we regress the pre- and post-notification values for filings concerning the tax year 2015 on a post-notification dummy including firm fixed effects. In Column (2) we create a pooled sample of all filings (including amendments) for the 2010-2015 tax years. We then regress the reported values (separately for each outcome in question) on a firm-tax year fixed effect and a dummy variable indicating whether the filing was submitted in the 90 days following the firm was sent a notification about the filing from SRI. The coefficient reported here is that on the post-notification dummy variable. Each firm-tax year pair corresponds to a separate notification. Table A7 shows these results for each year separately. Table A8 shows results including all notified firms. Standard errors clustered at the firm level. All outcomes in USD.