

Information, Asymmetric Incentives, or Withholding? Understanding the self-enforcement of Value-Added-Tax

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Information, Asymmetric Incentives, Or Withholding? Understanding the Self-Enforcement of Value-Added Tax*

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Abstract

The central attraction of value-added tax relative to its alternatives is that it facilitates tax enforcement. By allowing the adjustment of tax paid on inputs, VAT reduces a firm's incentive and ability to evade. The mechanism makes good sense in theory but remains largely untested empirically. This paper exploits the staggered adoption of VAT in Pakistan, whereby it was first implemented on manufacturers and was later extended one-by-one to the other production stages, to test the hypothesis empirically. Using the population of VAT returns, I find robust support for the self-enforcement hypothesis. Taxable sales of firms already in the tax net rise significantly as their trading partners enter the tax regime. The tax, however, has a far weaker effect on informality. Firms operating outside the formal regime remain almost insensitive to the deepening penetration of VAT around them. They ultimately enter the tax net once the government begins checking their records physically. Using the differences in response to the upstream and downstream extension of the tax, I uncover the mechanism driving the self-enforcement.

Keywords: VAT, Tax evasion, Informality

JEL Classification: H25, H26, O17

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I Introduction

Since 1975, the share of value added tax (VAT) in total government revenue has risen from 9% to 20% in the OECD countries. At the same time, the share of income tax has fallen from 30% to 24% (OECD, 2017). A similar shift towards VAT is taking place in emerging economies, where it is replacing falling revenues from international trade (Baunsgaard & Keen, 2010; Cage & Gadenne, 2017). VAT has now been adopted by every country in the world other than the United States and a few oil-rich countries, and its rates are increasing steadily over time (International Tax Dialogue, 2013).¹ The marked shift towards VAT has been one of the most significant public finance developments of recent years but has been understudied in the literature.

The principal force driving the expansion of VAT is that it is considered easier to enforce than its alternatives. It is a simple tax on transactions, wherein the tax paid on inputs of a firm is offset against its output tax liability. This peculiar collection mechanism means that every inter-firm transaction gets recorded at two places, creating paper trails on such transactions. The information trails linking unrelated, arm's length parties are argued to facilitate tax compliance (Kopczuk & Slemrod, 2006; Pomeranz, 2015). Firms lose their ability to conceal the transactions unilaterally and it becomes easier for the government to trace them from the source. Furthermore, VAT's base is broader than income tax's. Its assessment therefore requires fewer calculations and involves less human judgment than the computation of profits, making the tax more transparent and hence less manipulable (Best *et al.*, 2015).

The self-enforcement of VAT makes good sense in theory, but it remains largely untested empirically. The difficulties in testing it are partly mechanical. The microdata needed to estimate the enforcement spillovers of VAT had not been available to researchers until quite recently. But some of the difficulties are also methodological. The enforcement dividend of VAT, if it creates one, is intricately intertwined with macro shocks and secular trends in outcomes, and the variation needed to disentangle the confounding effects has rarely been available.

This paper combines unique variation created by the staggered introduction of VAT in Pakistan and the availability of administrative microdata to overcome these difficulties. Pakistan decided in principle to implement a broad-based VAT in its standard form in 1990. However, to make the new levy politically more palatable, it was not implemented

¹For example, the standard rate of VAT in OECD countries has gone up on average from 11.7% on its introduction to 18.7% now, increasing by more than 60% (see Table 1 in the International Tax Dialogue, 2013). For some of the discussion and numbers reported here, I also draw on John Kay's column in the Financial Times of September 1, 2017 (<https://goo.gl/NLexoe>)

in one go but was staggered into phases. In its initial phase lasting until 1995,² the tax was applied to a narrow base consisting of a few manufacturing industries only. The base was expanded aggressively after that, and the tax was extended to almost all manufacturers in 1996; to importers in 1997; to distributors, wholesalers, and retailers in 1998; to the energy sector in 1999; and to service providers in 2000. Because of these extensions, the penetration of VAT in the country grew sharply during the period 1996-2000, increasing by almost twenty-fold in terms of the number of firms in the tax net and almost ten-fold in terms of the volume of transactions subject to it. I use this variation to identify the causal impact of VAT on tax compliance, along both the intensive and extensive margins.

For this purpose, I focus on manufacturers—the firms who enter the tax net at the earliest—and see how their outcomes respond as the tax gets extended to their buyers and suppliers. To the extent that VAT is self-enforcing, the tax compliance of existing manufacturers will improve as their trading partners become subject to the tax (intensive-margin response). The increasing exposure to VAT will also push informal firms into the formal sector as the government begins receiving information on their transactions with registered firms and their returns from operating informally squeeze (extensive-margin response).

One useful feature of the Pakistani setting is that I can compare these enforcement spillovers with the effects of another experiment in which tax enforcement was tightened using more traditional measures. Pakistan launched a countrywide survey of households and enterprises from May 2000. Inspectors from the tax administration and other law enforcement agencies visited firms and households, gathering their financial data. These data were reconciled with information from other sources, and tax assessments were raised where necessary. The survey, which continued for more than twenty-four months, arose out of political compulsions of the country at the time and was in no way connected with the planned trajectory of VAT in the country. It however was a large enforcement shock in the sense that within a short span of time all firms in the country—both registered and unregistered—underwent a brief audit of their records. I estimate the effects of the survey on firm behavior and compare them to the VAT spillovers. The comparison allows me to put the enforcement gains from VAT into perspective to see how significant they are.

To estimate these effects, I follow a simple event-study research design, comparing the outcomes of manufacturers and importers over time. I focus on manufacturers because they are the first group to enter the tax net and hence experience the maximum tax varia-

²Pakistan's financial year begins from July. Any reference to year t in this paper refers to the financial year from July t to June $t + 1$.

tion. They are also the most important group in terms of tax revenue, contributing more than 90% of the domestic VAT collected in the country. I use importers as the control group because they operate in the same markets as manufacturers and thus experience similar macro shocks. But they are not affected by the enforcement shocks to the same degree as manufacturers are. Importers have limited ability to evade VAT. The government observes their purchases directly when they pass through customs stations. They, therefore, cannot reduce their reported sales below a given level. Nor can they operate in the informal sector as VAT registration is a mandatory prerequisite for the clearance of import consignments. Using importers as the control group rests on the assumption that for an unchanged enforcement environment their outcomes would trend similarly to manufacturers'. I show that this is indeed true for a large number of pre- and post-intervention periods and a variety of intensive and extensive margin outcomes.

Using administrative data comprising the universe of VAT returns, I document four key findings. First, I show that VAT is indeed self-enforcing. Taxable sales reported by manufacturers already in the tax net rise considerably relative to importers as their exposure to VAT deepens. The effect is strong (around 40 log points), precisely estimated, and remarkably robust to a variety of specification checks. Second, VAT has a far weaker effect on informality. The increasing penetration of VAT does accelerate the registration of informal manufacturers, but the new registrants do not begin filing returns or remitting the tax until the inspectors begin visiting them during the enforcement survey. Third, the upward extension of the tax bites much more than the downward extension. The outcomes of manufacturers begin to diverge from those of importers exactly from the time electricity and gas—a production stage upstream to manufacturers—become taxable. In contrast, the extension of VAT to distributors, dealers, wholesalers, and retailer—production stages downstream to manufacturers—does not produce any response at all. And finally, traditional enforcement measures are also effective against noncompliance, in particular in bringing informal firms into the formal sector. The enforcement survey causes unregistered firms to register and dormant firms to become active and begin paying the tax.

VAT encapsulates three distinct mechanisms that can give it its self-enforcing character. It, as explained above, generates third-party information on inter-firm transactions (Kopczuk & Slemrod, 2006). It creates asymmetric incentives between sellers and buyers to cheat (Pomeranz, 2015). Specifically, underreporting by a seller hurts the buyer who cannot claim tax credit to the full extent of inputs used by it. And lastly, VAT contains a built-in withholding element to it, as the tax to the extent of inputs acquired from the formal sector gets deducted at the upstream stage (Keen, 2008). These three mechanisms, though intricately linked to each other, have features that permit their separation in

the empirical application. Withholding works downwards, from an upstream to a downstream stage. Asymmetric incentives, on the other hand, act in the opposite direction, as buyers induce sellers to report truthfully or collude. Third-party information works in either directions. The empirical results show that the upstream extension elicits an extremely large response. In comparison, the downstream extension produces no response at all. One can also argue that the Pakistani upstream extension—bringing electricity and gas into the tax net—generates no new information trails. Electricity and gas in Pakistan are primarily supplied by four large public-sector companies. Information on transactions of these suppliers was always available to the inspectors, even in the pre-VAT periods. Collectively, the three empirical facts suggest that withholding—higher tax collection on inputs of a firm—drives the large self-enforcement response documented in this paper.

In the standard tax compliance models, withholding is considered neutral to a firm's reporting choice. The firm makes the choice trading off the benefits and costs of tax evasion, and withholding does not enter the calculus unless it affects the costs of evasion directly. I propose a simple model that explains why withholding may have a strong bite in the nonstandard setting of VAT, where tax liability of a firm can become negative. In the model, audit is the main instrument through which the government secures tax compliance. The government, however, does not observe real activity of a firm and is therefore constrained to make the selection of audit contingent on the limited information it gets through the VAT return. One of the most salient cells in the return is whether the tax liability of a firm exceeds zero. Negative liability, in particular for a manufacturer, signals suppressed sales, and the government oversamples firms who go into the red frequently. This audit rule feeds into the evasion costs faced by a firm, creating a large jump at the point tax liability becomes zero. Withholding in this setting does affect the evasion costs. The zero-tax-liability point shifts when more tax is withheld on the inputs of a firm, giving withholding a bite it lacks in the standard setting.

The discontinuity in evasion costs will induce firms to locate just to the right of the zero-liability point. Consistent with this prediction of the model, I find large and extremely sharp bunching of manufacturers just above the point where taxable sales equal taxable input costs and hence tax liability becomes zero. Note that the taxable input costs of a firm do not include labor costs and the costs of other inputs that may be exempt at the time. The bunching therefore cannot be explained by any *real* phenomenon such as market competition (zero profits), liquidity constraints, or any feature of the technology. Nor can it be explained by the transaction costs, as firms can carry forward the balance amount costlessly by ticking a cell on the tax return. Comparing the bunching across 1998 and 1999, the year before and after electricity and gas—two major inputs of manufactur-

ers—become taxable, I show that firms close to the zero-liability point absorb the increase in their input tax instead of passing it on one-for-one to the tax liability, thereby reducing the amount they evade. These firms report higher sales to avoid falling into the negative liability region. Higher reported sales mean that the government receives more revenue in aggregate than earlier—an enforcement dividend of VAT.

The results in this paper have three implications that go beyond VAT. First, third-party information is increasingly been seen in the public finance literature as the key to tax compliance (Kleven *et al.*, 2016; Kopczuk & Slemrod, 2006; Gordon & Li, 2009; Pomeranz, 2015). This paper, however, demonstrates that the third-party information in itself does not guarantee truthful reporting. Firms continue to cheat and operate in the informal sector even when their trading partners are in the VAT regime, and therefore transactions with them are recorded. Second, the paper documents that the traditional enforcement measures also work. In fact, they are a necessary complement of the self-enforcing mechanisms built into the modern broad-based taxes. Recent literature casts the tax compliance problem almost entirely as an incomplete information problem, taking quite a cynical view of these measures. This paper, however, shows that the tax survey induces numerous informal firms to formalize. It also shows that the vast majority of these firms should have been remitting VAT. Yet, they were operating informally and the self-enforcement mechanism of VAT did not have sufficient bite to bring them into the tax net on its own. They formalized only when the physical enforcement was tightened: the inspectors visited them to conduct their audit. Lastly, the large impact of withholding in this setup emphasizes the importance of nonstandard models in explaining behavior in developing economies. Despite the theoretical result that withholding makes VAT a welfare-improving tax relative to its alternatives in settings with large informality (Keen, 2008), the empirical results that withholding reduces noncompliance (Brockmeyer & Hernandez, 2017), and withholding’s widespread use in the developing world, it is still not a part of the discourse in the public finance literature, dismissed largely as an undesirable feature of the taxation structure of developing economies.

The enforcement properties of VAT have been studied before. But owing mainly to the two difficulties mentioned above, the existing evidence is largely limited to cross-country studies (see for example Baunsgaard & Keen, 2010; Keen & Lockwood, 2010).³ There are two notable exceptions to this. Pomeranz (2015) randomizes enforcement shock among small firms in Chile to show that the third-party information created by VAT complements

³Another set of papers looks at the effects of the VAT exemption threshold on firm behavior in particular on their decisions to register voluntarily and grow beyond the given size (e.g. Liu *et al.*, 2017; Harju *et al.*, 2017; Asatryan & Peichl, 2017). This strand of literature, however, does not investigate the behavior of firms already in the tax net, the subject of the current paper.

enforcement. Tax evasion is far less extensive in firm-to-firm transactions that generate such information than it is in firms-to-consumer transactions that do not. Somewhat relatedly, [de Paula & Scheinkman \(2010\)](#) show that VAT induces formal firms in Brazil to trade more with formal firms, creating *good* compliance chains. The Pakistani setting offer three methodological advantages that let me extend the analysis in these papers. First, the variation created by the staggered introduction of the tax covers more than 90% of the VAT base of the country. This permits me to examine the VAT spillovers on a much larger scope and over a longer time horizon. Second, the setting allow me to estimate the effects along both the informality and conditional-on-participation compliance choices of firms. Third, the availability of both upstream and downstream extensions helps uncovering the mechanisms underlying the self-enforcement. For these reasons, the paper represents to my knowledge the first holistic examination of the self-enforcement hypothesis in literature. On a broader level, the paper contributes to the growing empirical literature that uses microdata to estimate how enforcement technologies, both traditional and nontraditional, impact reporting and participation choices of economic agents in a low taxation-capacity setting (see for example [Waseem, 2018](#); [Naritomi, 2016](#); [Carrillo et al., 2017](#); [Bachas & Soto, 2017](#); [Waseem, 2017](#)). Relative to the existing papers, I am able here to compare the impacts of the traditional and nontraditional technologies.

II Context

II.A Introduction and Growth of VAT in Pakistan

Like many other developing countries, Pakistan introduced VAT in the 1990s. The country, at the time, was facing a gradual decline in revenues from falling import tariffs, and a broad-based consumption tax was seen as the long-term solution to bridge the fiscal gap. The legislation to implement VAT was enacted in July 1990, but to reduce the political costs of introducing a major new levy, its roll out was staggered into phases. [Figure I](#) illustrates this. It plots the number of firms who file a VAT return at least once in a given quarter, highlighting three distinct phases in the development of the tax in the country: introduction (1990-1995), expansion (1996-2000), and steady state (2001 onward). In the introductory phase, the new tax was applied to a very narrow base consisting of a few manufacturing industries only. The tax was systematically expanded after that. It was first extended to the rest of manufacturers and later one-by-one to the other stages of the production chain. Specifically, it was extended to almost all manufacturers in 1996; to importers in 1997; to distributors, wholesalers, and retailers in 1998; to energy suppliers

in 1999; and to service providers in 2000. With these extensions, the number of firms in the tax net grew sharply from around 3,500 in 1995 to 80,000 in 2000.

Figure II plots the entry of new firms into the VAT regime, disaggregating the analysis by production stage. It shows that the sharp expansion of the tax during 1996-2000 was largely driven by the statutory changes. The majority of firms of a given production stage began remitting VAT immediately after their supplies became taxable. Relative to these spikes, the macro-driven changes in entry are small. This can be seen by looking at the post-2002 period during which the tax policy and enforcement environment remained stable. Throughout this fairly long period, the entry of new firms continued to be flat, exhibiting no secular trend, and the macro shocks to the process remained minimal.

The widening scope of the tax also meant that increasingly more firm transactions came under its coverage. Figure III shows this visually. Starting from a low base, sales and inputs covered by VAT rose steadily, with quarterly taxable sales increasing from PKR 80 billion at the start of 1996 to around 750 billion by the end of 2000.⁴ The increase was particularly sharp in 1999 when the tax was extended to the energy sector, which includes electricity, gas, and other forms of fuel.

Collectively, Figures I-III illustrate that in the short period between 1996 and 2000 the coverage of VAT in the country expanded by almost twenty-fold in terms of the number of firms and almost ten-fold in terms of the volume of transactions. I exploit this variation to estimate how the compliance of incumbent firms changes as their exposure to VAT deepens, meaning more of their input and sales transactions become subject to the self-enforcing forces created by the tax.

II.B Tax Design

During the period covered in this study, the design of VAT in the country remained quite similar to its standard form. Firms whose supplies were not exempt were required to register with the tax administration. Exemptions were of two types. A small-firm exemption was available to manufacturers and retailers if their annual turnover did not exceed PKR 1 million (2.5 million from 1999 and 5 million from 2004) and 5 million respectively.⁵ Other than this, a generic exemption applied to firms whose supplies fell in the negative list. The negative list, as noted above, largely operated at the production stage level. After the withdrawal of these exemptions in 1996-2000, the list contained only a few items such as unprocessed food. Firms not required to register could do so voluntarily.

⁴One US\$ was worth around fifty PKR in 1999.

⁵The manufacturers and retailers below the exemption threshold were required to pay turnover tax under a simplified scheme. The turnover tax was introduced in 1996 and was withdrawn in 2004.

While registered, whether voluntarily or otherwise, firms were obliged to remit VAT on their sales and were allowed to adjust the tax paid on their inputs. In case the adjustment exceeded the tax due, they could carry forward, or obtain the refund of, the balance amount. There were no transaction costs of claiming a carry forward as firms could do so on their own by ticking a cell on the return form. Obtaining refunds, on the other hand, was costly, as refunds were sanctioned only after a preaudit of the claim. A seller was required to issue a tax invoice for each sale transaction, and the buyer could claim the tax credit only if it possessed the invoice issued in its name. The tax was destination-based: imports into the country were taxed at the standard rate and exports were zero-rated. Any tax remitted on inputs used for exports was refunded. Throughout this paper, I focus solely on the domestic taxable sales of firms, abstracting from exports. Figure A.I plots the standard VAT rate in the country. It generally remained at 15% other than two brief episodes during which it was first decreased to 12.5% and then increased to 18%. The standard rate applied to domestic sales only as exports were zero-rated.

Firms were required to file a return and remit the tax due every month. The filing was based on the principle of self-assessment and there was no preaudit contact between taxpayers and tax collectors. The filed returns were considered final unless selected for audit. The tax administration at the time did not have the capacity to cross-match transactions electronically. Accordingly, the audit selection was largely based on the limited information received through the single-paged return form. One of the more salient cells on the return form was if the tax liability exceeded zero. Negative tax liability is a rare event for taxpayers other than exporters. Going into the red frequently, in particular by a manufacturer, was therefore one of the major triggers of audit.

II.C Enforcement Survey

I contrast the enforcement spillovers created by the expansion of VAT with the effects of another experiment that tightened tax enforcement in the country through more traditional measures. The experiment—a nationwide survey of enterprises—took place in 2000-02, soon after VAT had been extended to all production stages. The objective of the survey was to document the national economy, hoping it would bring in more taxpayers and revenue. In the original design of the survey, teams comprising officials of the tax administration and other law enforcement agencies were to visit both registered and unregistered firms, gathering information such as their sales, income, assets, liabilities, and inventories. The information was to be reconciled with data from other sources, and assessment orders were to be issued in case of discrepancies.

Unsurprisingly, the survey was unpopular and met determined resistance from small traders, who boycotted it immediately after its announcement on May 24, 2000. After a protracted period of strikes, closedowns, and negotiations, the government and traders reached an agreement on August 22, 2000. The agreement softened the survey considerably, removing its most unpopular provision requiring the physical verification of inventories. The revised survey was completed over the next two years.

Two facts about the survey need emphasizing. First, it arose out of political compulsions of the country at the time and was not connected in any way with the planned trajectory of VAT in the country. Pakistan had an unanticipated change in government in October 1999, and the survey was one of the measures the new government took to reduce corruption in the country. Second, although the survey consisted of traditional enforcement measures such as inspectors' visits and audits, it was different in the sense that the threat from these measures was credible. The government invested considerable political stock in the exercise and took measures to ensure that there was as little corruption in this process as possible.

III Conceptual Framework

III.A Self-Enforcement Under VAT

The central focus of this paper is to test if VAT is self-enforcing, and if so what drives this process. Self-enforcement refers to the idea that in VAT firms in the consecutive stages of a production chain are linked to each other through its invoice-credit mechanism, which reduces their ability and incentive to evade the tax. To develop intuition on how this process works, consider a firm that uses taxable inputs costing $c(s_j)$ to produce s_j units of revenue. The subscript j indexes the ordered set of production stages $j \in 1, 2, \dots, J$ through which a good passes before its ultimate consumption. For simplicity, I assume for the time being that each production stage contains only one firm. The firm reports taxable sales \hat{s}_j and taxable input costs \hat{c}_j to the government, paying the VAT of $T_j = \tau(\hat{s}_j - \hat{c}_j)$, where τ is the tax rate. The government does not observe real sales or costs so that the firm can underreport sales $\hat{s}_j < s_j$ and/or overreport costs $\hat{c}_j > c_j$ on paying a resource cost of $g(s_j - \hat{s}_j, \hat{c}_j - c_j)$.

Note that the notion of self-enforcement makes sense in this second-best world only. If the government can costlessly observe s_j and c_j , the enforcement problem disappears and there is no distinction between VAT and its alternative consumption taxes such as the retail sales tax. VAT is thus attractive only if the enforcement problem is nontrivial, meaning that

the evasion costs $g(s_j - \hat{s}_j, \hat{c}_j - c_j)$ are finite. Self-enforcement is in fact a statement on these costs, asserting that they are strictly greater under VAT than the alternatives. Theoretically, the higher evasion costs under VAT could result from one or more of the following three mechanisms.

Third-Party Information: In VAT, each inter-firm transaction is recorded at two places, creating a paper trail on such transactions. The trail makes one-sided evasion, where the two reports do not match, extremely risky and two-sided evasion, where the two reports do match, less profitable. In both cases, evasion decreases relative to the counterfactual where the transaction is recorded at one place only. This is the mechanism most discussed in literature in relation to the self-enforcement of VAT (see, for example, [Kopczuk & Slemrod, 2006](#); [Pomeranz, 2015](#)). In fact, the self-enforcement and third-party information have become synonymous. But recently evidence has started to emerge that casts doubt on the deterrence potential of third-party information in low-enforcement-capacity setting ([Carrillo *et al.*, 2017](#)). Though it must be emphasized that the evidence relates to income tax and no parallel result exists in the context of VAT.

Asymmetric Incentives: VAT makes a downstream firm a stakeholder in the tax paid at the upstream stage, creating asymmetric incentives between sellers and buyers to cheat. Specifically, in a firm-to-firm transaction the seller would like to under-report its sales but doing so would hurt the buyer who would not be able to adjust tax to the full extent of inputs used by it. In fact, if a seller under-reports $\hat{s}_j < s_j$ and the buyer cooperates so that $\hat{c}_{j+1} = \hat{s}_j$, the buyer would be left owing the underreported tax from the previous stage.⁶ This is a unique feature of VAT: truthful reporting at one stage recovers the unremitted tax from all previous stages of the production chain. Because of this, underreporting by an upstream firm is feasible only if it either takes the extreme risk of one-sided evasion or shares the proceeds of evasion with the downstream firm. Note that the mechanism does not work at the final stage, as end consumers cannot claim the tax back.

Tax Withholding: One important feature of VAT that often gets overlooked is that it also embeds a withholding mechanism into it. Consider for example a formal firm in stage j that sells intermediates valuing s_j to a downstream firm. The seller will remit VAT amounting to τs_j on the transaction, and the buyer can credit the tax if it is registered. The tax remitted at the upstream stage thus functions as a withholding tax if the down-

⁶In this particular example, the buyer—assuming that it reports truthfully—will pay $\tau(s_{j+1} - \hat{s}_j)$ in place of $\tau(s_{j+1} - s_j)$ if it goes along with the underreporting of seller, matching its input purchases with the sales reported by the seller i.e. $\hat{c}_{j+1} = \hat{s}_j$. Thus, it will pay $\tau(s_j - \hat{s}_j)$ over and above its true tax liability, which exactly equals the tax evaded by the seller at the upstream stage.

stream firm is formal and as an input tax if it is not (see Keen, 2008 for the theoretical implications of this mechanism). Note that in the first-best setting such withholding has no effect on behavior; it only means that the tax is collected at two rather than one stage. But in a setting where evasion is feasible, withholding can have a large effect, especially if the upstream stage is more formal. Withholding in this case creates a floor the reported sales of the downstream firm cannot cross without triggering a significant jump in the audit probability. As I noted in section II.B, when a firm's input tax adjustment exceeds the tax due on output, it opts for either the refund or carry forward of the balance amount. Both cases raise a flag with the tax administration if the firm is not an exporter, raising its likelihood of facing an audit discretely. The discontinuity in the audit probability at zero tax liability can compel firms to stay in the black, giving withholding a bite it lacks in the standard setting. I explain this mechanism in greater details in section V of the paper.

The above three mechanisms, though intricately linked to each other, have features that permit their separation in the empirical application. The withholding mechanism works downwards, from an upstream to a downstream stage. Asymmetric incentives, on the other hand, act in the opposite direction, as buyers induce sellers to remit tax or collude. Third-party information works in either direction. In the Pakistani setting, VAT was first introduced on manufacturers and was later extended to the other production stages, one after the other. If we focus on manufacturers only, the impacts of the three mechanisms can be disentangled using their differential responses to the upstream and downstream extensions of VAT.

How important is it to differentiate the three mechanisms? Note that while VAT has a few standard features, its design can always be tweaked to strengthen a given mechanism. For example, if withholding deters noncompliance the most, tax rate at the upstream stages can be raised to make the effect stronger. In fact, many countries impose a higher tax rate and/or deploy additional withholding on imported raw materials for this purpose (see Table 1 in Keen, 2008 for details). Similarly, the absence of the other two mechanisms in firm-to-consumer transactions makes the retail stage a particularly vulnerable point for VAT. The tax can potentially unravel from this point if the two mechanisms are the principal drivers of compliance. This has led a few countries, including Argentina, Bolivia, China, Chile, Colombia, Indonesia, Italy, Portugal, Puerto Rico, South Korea and Slovakia, to introduce schemes that create incentives among consumers to obtain receipts of their purchases and report them to the authorities (Naritomi, 2016).

The above framework applies regardless of whether noncompliance occurs along the intensive or extensive margin. The double-recording of transactions, tax withholding by sellers, and push from buyers for correct payments make evasion by a registered firm

harder (intensive margin). These forces make operating without registration difficult, too (extensive margin). Information concerning sales to, and purchases from, an unregistered firm exposes the firm to a greater risk of getting caught. Withholding reduces tax savings from operating informally. And an informal firm can lose customers if it cannot issue tax invoices. To the extent that these mechanisms work, the expansion of VAT over time will push informal firms into formality in the same way it will push registered firms to greater tax compliance.

III.B Empirical Strategy

The principal econometric challenge in estimating the enforcement effects of VAT is to distinguish them from contemporaneous macro shocks. To see this formally, let i index firms and t units of time. Reported taxable sales of a firm \hat{s}_{it} are potentially a nonlinear function of tax rate τ_t , firm characteristics \mathbf{X}_{it} , demand and supply shocks λ_t , and government policy θ

$$(1) \quad \hat{s}_{it} = f(\tau_t, \mathbf{X}_{it}, \lambda_t; \theta).$$

The dependence of the outcome on the policy regime θ captures the intuition developed above that the cost of misreporting varies with the enforcement regime chosen by the government, which includes inter alia the design and coverage of VAT at time t . Suppose that in period t' the regime changes from θ to θ' . In the Pakistani context, it could mean either extending VAT to a hitherto untaxed production stage—making more inter-firm transactions subject to the tax—or tightening the enforcement directly through the tax survey. Using the terminology of the Neyman-Rubin-Holland potential outcomes framework, the effect of the policy change can be expressed as $\Delta_{it'} = \hat{s}_{it'}(\tau_{t'}, \mathbf{X}_{it'}, \lambda_{t'}; \theta') - \hat{s}_{it'}(\tau_{t'}, \mathbf{X}_{it'}, \lambda_{t'}; \theta)$. Because the second term in this expression—counterfactual sales—is not observed, the effect cannot be estimated without making some assumptions. The first assumption I make is the following

Assumption 1: *The functional form of reported sales is log-linear, and the effect of the policy is additive in percentage terms.*

Under this assumption, equation (1) can be written in its estimating form as

$$(2) \quad \log \hat{s}_{it} = \alpha_i + \beta \cdot \mathbf{1}(t > t') + \tilde{\mathbf{X}}_{it}' \boldsymbol{\gamma} + \tilde{\lambda}_t + \varepsilon_{it},$$

where $\tilde{\mathbf{X}}_{it}$ now contains the time-varying covariates only and $\tilde{\lambda}_t$ absorbs the tax rate. The

parameter of interest in this equation β is not identified, being indistinguishable from the shocks $\tilde{\lambda}_t$. To get around this problem, I follow the standard difference-in-differences methodology, comparing the outcome across manufacturers and importers.

I focus on manufacturers for two reasons. First, they are the first group to enter the tax net and therefore experience the maximum tax variation. Over time, a production stage immediately upstream to them—the energy sector—and production stages downstream to them—distributors, dealers, wholesalers, and retailers—switch from being exempt to taxable. Focusing on them therefore allows me to utilize all the post-1996 variation. It also lets me see if the effects of down and upstream extensions differ from each other. I use this evidence to understand the mechanisms underlying the self-enforcement. Second, manufacturers are also the most important group in terms of tax revenue, contributing roughly 90% of the domestic VAT collected in the country each year. Their responses are therefore the most consequential in term of both revenue and welfare.

I use importers as the control group. They operate in the same markets as manufacturers and therefore are exposed to similar demand shocks. Importantly, however, they are not affected by the enforcement shocks to the same degree manufacturers are. Importers have limited ability to evade VAT. Their purchases are directly observed by the government when they pass through the customs station.⁷ Their reported sales therefore cannot fall below a minimum level without inviting attention of the tax authority. Nor can they operate in the informal sector, as registration with VAT is a necessary prerequisite for imports. Their tax compliance is therefore almost perfect along the extensive margin and must be high along the intensive margin. Importers are also the uppermost production stage. For this reason, they are largely insulated from VAT shocks, as the shocks can propagate from the downstream side only. Note that the empirical strategy does not assume that importers are immune from the enforcement shocks, but rather that their exposure to the shocks is much less intense relative to manufacturers. In this sense, any relative difference in the two groups' reactions to the deepening penetration of VAT or enforcement survey will represent a lower bound on the response of manufacturers.

Thus, to the extent that the following assumption

⁷Of course, importers can misreport their purchases to customs authorities. Doing so, however, is much more difficult relative to a domestic transaction. Importers pay their foreign suppliers through a letter of credit, which gets two banks—one each in the domestic and foreign country—involved in each transaction. The value of imported goods is also reported to the shipping and insurance companies. If an importer decides to underinvoice imports, it has to make the balance payment to the supplier in foreign exchange through a nonbanking channel. It also has to forge the invoice and shipping/insurance documents. Finally, it has to convince customs authorities of the genuineness of the reported value. It is particularly costly in Pakistan where all import consignments are preaudited—verifying both the quantity and value of goods. None of such issues occurs in a domestic transaction.

Assumption 2: *Conditional on controls, the reported taxable sales of manufacturers $i \in M$ and importers $i \in I$ on average follow the same time path as long as the enforcement regime chosen by the government remains unchanged*

$$(3) \quad \mathbb{E} \left[\hat{s}_{it}(\theta \mid \alpha_i, \tilde{\mathbf{X}}_{it}; i \in M) \right] = \mathbb{E} \left[\hat{s}_{it}(\theta \mid \alpha_i, \tilde{\mathbf{X}}_{it}; i \in I) \right],$$

is satisfied, β_3 in the following regression captures the causal effects of the policy change on manufacturers

$$(4) \quad \log \hat{s}_{it} = \alpha_i + \beta_1 \cdot \mathbb{1}(i \in M) + \beta_2 \cdot \mathbb{1}(t > t') + \beta_3 \cdot \mathbb{1}(i \in M) \cdot \mathbb{1}(t > t') + \tilde{\mathbf{X}}'_{it} \boldsymbol{\gamma} + \tilde{\lambda}_t + \varepsilon_{it}.$$

I offer two pieces of evidence to support the assumption. First, I estimate placebo specifications corresponding to Equation (4), establishing that the difference in outcomes between the two groups remains statistically insignificant for a large number of pre- and post-intervention periods during which the policy environment remains stable. Second, I always complement the regression-based analysis with nonparametric event studies. A typical event study takes the following form

$$(5) \quad \log \hat{s}_{it} = \alpha'_i + \sum_{r=1}^{r=T} \lambda'_r + \varepsilon'_{it}.$$

The key objects of interest in this equation are the λ'_r 's. These coefficients denote the log-change in outcome in period r relative to the first period ($r = 0$) once the firm fixed effects have been partialled out. I run these regressions separately for the two groups and plot the coefficients over a long time horizon, indicating the times from which the policy changes take effect. These event study charts permit transparent, visual assessment of the identification assumptions underlying equation (4) and the impacts produced by the policy changes. All specifications I estimate, whether the nonparametric event study or the difference-in-differences model, allow unrestricted variance-covariance structure over time at the firm level.⁸

III.C Data

The data for this project comprise the universe of VAT returns filed in Pakistan. I focus principally on the period 1997-2003 but extend the analysis to other periods for robustness

⁸Bertrand *et al.* (2004) show that this technique works well when the number of entities in the panel are large, which is the case in my empirical application.

checks. The VAT return consists of three main sections. In the first section, firms report the aggregate value of their sales, breaking it down into three—domestic taxable, domestic exempt, and exports—components. In the second section, the aggregate value of inputs purchased are reported, divided likewise into the three components. In the final section, firms calculate their tax liability, indicating the tax charged on sales, the tax credited on inputs, and the final tax payable. They select one of the two options—carry forward or refund—in case the tax payable is negative. Each firm is assigned a unique VAT registration number and is expected to file every tax period (month). The data, therefore, have a panel structure. In addition to the return data, I use information on firm characteristics from the tax register. This information includes the 4-digit industry, date of registration, production stage, and geographic location of the firm.

The production stage and 4-digit industry together form the 2-tier system the tax administration uses to classify firms. The broader tier classifies firms into eight categories: manufacturers, importers, exporters, wholesaler, dealers, distributors, retailers, and service providers. Firms may undertake more than one of these activities, in which case the data indicate both the principal and secondary activities. Manufacturers sell goods distinct from their inputs. The other categories sell same-state goods or provide services. The broader classification of a firm corresponds to its position in the supply chain. Importers are the first stage in the chain, followed by manufacturers, distributors, dealers, wholesaler, and retailers. The scheme pins down whether a given firm is upstream or downstream to another. The tax variation exploited in this paper is largely at this broader level, as VAT was extended by one production stage at a time. There is one notable exception to this. Utility and energy companies are classified as manufacturer but remained exempt until 1999. The second tier classifies firms on the basis of goods or services they supply, using the 4-digit Harmonized Commodity Description and Coding System (HS Code).⁹ This system characterizes the industry within a given production stage a firm operates in. For example, I observe whether a given manufacturer is a supplier of energy.

III.D Key Outcomes

My two primary outcomes of interest are the number of firms in the VAT net and taxable sales reported by them. Under the assumption of no one-sided evasion, an increase in taxable sales caused by a policy change is a sufficient condition that the government receives more revenue after the change. To see this formally, consider a production stage j (manu-

⁹ This system is commonly used by customs administrations around the world to classify traded goods and services.

facturing in my empirical application). VAT revenue remitted by all production stages up to and including j is given by

$$(6) \quad T = \tau \hat{s}_1 + \dots + \tau(\hat{s}_{j-1} - \hat{c}_{j-1}) + \tau(\hat{s}_j - \hat{c}_j),$$

which equals $T = \tau \hat{s}_j$ if we can rule out one-sided evasion meaning that $\hat{c}_j = \hat{s}_{j-1}$ and so on. I will show later that one-sided evasion can safely be ruled out in my setting so that higher sales reported at the j th stage implies that more VAT is collected from stages j and upwards.

Note that I cannot use VAT revenue or input costs to measure the causal effects of VAT expansion. As VAT coverage expands, these outcomes change due to both mechanical and behavioral reasons. For example, after an upstream extension downstream firms remit less revenue for the pure mechanical reason that their input tax credit goes up. Looking at the input costs is even more problematic. As I mention above, firms in my data report input costs in four cells: (i) domestic taxable inputs, (ii) domestic exempt inputs, (iii) imports, and (iv) total inputs. When a production stage switches from being exempt to taxable, firms in the next stage begin reporting inputs acquired from the hitherto exempt stage in the first rather than the second cell. The evolution of the two cells will therefore be contaminated by these mechanical effects. Even more crucially, when an input becomes taxable the incentive to record and report it accurately increases discretely. It means that the evolution of total input costs, although free from any mechanical effect, will conflate behavioral responses arising from VAT expansion and lazy reporting. The evolution of reported sales, on the other hand, provides a clean measure of the effect of interest. I focus solely on firms whose sales remain taxable throughout the sample period so that any change in the outcome can only reflect a behavioral response to a policy change. The causal effects of a policy change in this paper are accordingly measured along the intensive margin as the increase in reported sales it induces and along the extensive margin as the number of informal firms it pushes into the formal sector.

Table I presents the descriptive statistics of these two outcome variables at three points in time, stratifying the sample by production stage.¹⁰ Between 1997 and 2003, the number of firm-month observations grows by 70% for manufacturers and 271% for importer (columns 1-3). The growth largely results from the entry of new firms, although some of it may reflect that filing becomes more regular with time. To address any selection issues arising from this, I create two other samples that shut down entry and exit. The first of these (Balanced Panel 1) consists of firms who file a return at least once in every quarter

¹⁰For space considerations, I collapse sectors other than manufacturing and imports into the “other” category.

included in the sample (columns 4-6). These firms remain active throughout the sample period, although they may not file in every tax period. The second restricted sample (Balance Panel 2) has a more stringent criterion. It consists of firms who file the return in every tax period included in the sample (columns 7-9). Note that the later two samples mitigate the selection issues arising from the changing composition of the sample, but may create external validity concerns as they contain regular taxpayers only. Empirically, I always obtain similar results from the three samples, alleviating both the internal and external validity concerns.

One other important feature of the data is that the distribution of reported sales is quite skewed: the mean is generally larger than the 75th percentile. To ensure that the results are not driven by few large firms, I also estimate specifications where I drop firms larger than a given size threshold.

III.E VAT Expansion and the Real Economy

I have abstracted so far from any effects the staggered implementation of VAT may have on output produced by firms. Note that VAT does not distort input prices faced by registered firms. Its partial implementation, therefore, does not create production inefficiency in the registered sector. It, however, could distort production in the unregistered sector. It could also distort consumption. I discuss below how these distortions can influence the two outcomes of interest, conflating the real and compliance effects produced by the policy changes.

Demand-side effects.—Imposition of VAT on a commodity increases its consumer price relative to the others, creating the following three effects: (i) own-price substitution effect; (ii) cross-price effects; and (iii) income effect. Of these, the first is entirely absent in my setting as I focus solely on commodities that remain taxable throughout the sample period. The Pakistani VAT extensions, as noted above, operate at the broadly-defined commodity-group level: they bring all substitutes into the tax net together.¹¹ For this reason, we can also rule out the cross-price effects on substitutes. We, however, cannot rule out the other demand-side effects. For example, the VAT extension to the energy sector may depress the demand of all goods in general (income effect) and complements of energy in particular (cross-price effect). These two effects work in opposite direction to the enforcement spillovers and will make finding the spillovers harder.

Supply-side effects.—Expansion of VAT can boost formal sector production through the in-

¹¹For example, the 1999 extension brought all energy inputs—including electricity, gas, and petroleum products—into the tax net at the same time.

put prices channel in three ways. First, informal firms cannot claim credit of the tax remitted on their inputs. VAT, thus, induces such firms to substitute toward untaxed inputs. Inefficient production in the informal sector can spur the registered sector if the goods produced by the two are close substitutes. Second, if the supply chain of an intermediate used by the formal sector is incomplete, the VAT remitted at the upstream stages gets loaded into the price of the intermediate. The expansion of VAT, to the extent that it completes the broken chains, can reduce the price of such intermediates, making formal manufacturing more efficient. Third, a downward extension of VAT to a hitherto untaxed stage improves production efficiency in the stage, stimulating the demand of good supplied by the upstream stage.

I take two measures to establish that my results represent compliance and not real responses. First, I conduct subgroup analysis at the industry level. To the extent that the demand and supply elasticities, and other factors such as the degree of competition from the informal sector, vary across industries, uniform industry-level response will rule out large real-side effects. Second, I also estimate the impact of VAT extensions on the entry of firms in the already-taxed industries. If supply-side factors stimulate production in these industries, the impact would also show up in the entry series.

IV Is VAT Self-Enforcing?

In this section, I first estimate the impacts of the two enforcement shocks—widening exposure to VAT and tax survey—on firm outcomes. I then compare the two sets of responses to examine if VAT creates positive enforcement spillovers and, if so, how large they are.

IV.A Taxable Sales Response

Nonparametric Event Study.—Figure IV plots the results from equation (5). I estimate the equation on the period July-1997 to June-2003, dropping the dummy for July 1997. The regression is run separately for manufacturers and importers, and the coefficients λ_r' 's are plotted in Panel A. Each coefficient in the plot shows the average log change in domestic taxable sales from July 1997 to the period, once the firm fixed effects have been partialled out. The bottom panel displays a difference-in-differences version of the plot, assessing the statistical significance of the relative difference between the two groups in the period.

I begin the analysis from July 1997. Before that, importers were not required to remit VAT on their sales. Between 1997 and 2003 four events occur that might impact the re-

ported sales of manufacturers: VAT gets extended to dealers, distributors, wholesalers, and retailers in July 1998; to energy suppliers in July 1999; and to service providers in July 2000; and the tax survey begins from May 2000. I demarcate these events in the diagram by broken vertical lines. I terminate the analysis on June 2003, although in one of the robustness checks I extend it to further periods.

It is important to emphasize that the supplies of firms depicted in this figure remained taxable throughout the period 1997-2003. Any change in the reported sales would therefore reflect a behavioral response to the four events mentioned above and not a mechanical change arising, for example, from the extension or withdrawal of VAT to an industry.

Four facts stand out from these plots. First, the outcome trends similarly in the two groups during the periods of no policy change. The DD coefficient remains statistically insignificant in all the twelve periods between July 1997 and June 1998, the time during which no change to the enforcement environment takes place. Second, the extension of VAT to the downstream stages elicits almost no response. The relative difference between the two groups continues on the preexisting trend in 1998-99, hovering around zero and remaining indistinguishable from it in nine out of the twelve periods. Third, the outcomes of manufacturers and importers begin to diverge immediately after the energy sector enters the VAT net. Not only does the DD coefficient become positive and statistically significant, it starts growing in magnitude with time, reaching 32 log points by May 2000. And finally, the two trends continue to drift apart as the final two events occur, stabilizing only after the survey gets closer to its conclusion in 2002-03.

The nonparametric evidence thus suggests that the entry of the energy sector creates significant enforcement spillovers on the downstream side. That the impact manifests itself as a trend rather than a one-time increase in level suggests that withholding is the dominant mechanism driving the response.¹² I explore the mechanisms underlying the response in detail in section V of the paper. The final two events of interest are too close to each other, and one important challenge in the subsequent empirical analysis is to separate the causal contribution of each in the post-2000 response.

Difference-in-Differences Results.—Table II reports the results from estimating equation (4). The outcome variable here is the log of domestic taxable sales, and I collapse, for the time being, the last three events into one, denoting the period after June 1999 by the *Post* dummy. I show results for the complete and two balanced panel samples separately (see

¹²With withholding, the response will occur in a series of reinforcing steps. There will be an initial impact: as more inputs of manufacturers become taxable they will report higher sales to avoid falling in the negative tax liability region. This increase in sales will cause a further increase in taxable inputs as manufacturers also trade between themselves, triggering a second wave of response. This reinforcing loop will continue until we reach the new steady state.

section III.C). Panel B conducts a placebo analysis. The placebo specification is an exact replica of the baseline specification. I estimate equation (4) on the next seven years 2004-2010, defining the period after June 2006 as the *Post* period.

Unsurprisingly, the results are in line with the nonparametric event study. The coefficient on the interaction term $manuf \times 1998$ is weak and insignificant, demonstrating that bringing distributors and other downstream stages into the VAT net does not generate an enforcement dividend up the production chain. In contrast, the coefficient on $manuf \times post$ is both strong and significant, capturing on average a larger than 40 log point growth in the sales of manufacturers relative to importers after June 1999. The placebo exercise validates the empirical strategy. In combination with the graphical evidence above, it confirms that absent any policy changes the outcome indeed evolves similarly in the two groups in a large number of pre- and post-intervention periods. Lastly, the results from the three alternative samples are almost identical, putting to rest any concerns from selective entry into or exit from the complete panel sample.

Table III explores the dynamics of the response. I now focus solely on the complete panel sample and partition the $manuf \times post$ dummy into two. The new term $manuf \times year$ captures the additional sales response in the given year. The sales of manufacturers continue to outgrow those of importers at an almost steady pace until the end of 2003. After that, the two growth rates become indistinguishable as they were initially in the period 1997-1999. The dynamic analysis reinforces the conclusion that the changes in enforcement environment cause a substantial expansion of the tax base during 1999-2003. But it does not fully reveal the forces driving the expansion. Nor does it help disentangling the influence of the last two events. I postpone the discussion of these questions until after I have reported the extension margin results.

Robustness.—The principal concern with the above results is that they might be driven by demand and supply shocks coincident with the events of interest that affect manufacturers differently than importers. While similar evolution of the treatment and control outcomes during the times of no policy change mitigates this concern, I alleviate it further by rerunning the above regressions separately for each industry. To the extent that macro shocks affect different industries differently, disaggregating the response by industry can rule out the concern. It can also help us decide the real vs. compliance nature of the response, as discussed in section III.E.

Figure V performs this exercise. I estimate equation (4) restricting the sample to firms of one industry only. Panel A plots the $Manuf \times Post$ coefficient and 95% confidence interval around it from these regressions, comparing it against the baseline coefficient of 0.48 (see column (1) of Table II). Panel B and C replicates the exercise, showing the $Manuf \times 1998$

and placebo coefficients respectively. The industry classifications used here comes from the 2-digit aggregation scheme of the HS Code. The scheme along with the description of the industries is shown in Table A.I.

The response is quite homogeneous across industries. The coefficient of interest is positive and significant in all but two instances, and the 95% confidence interval around it contains the baseline coefficient for all but four industries. In contrast, the $Manuf \times 1998$ and placebo coefficients are almost always trivial and insignificant. The sub-group analysis, thus, effectively rules out the alternative, macro-based explanation of the observed response. It also suggests that the response predominantly reflects compliance rather than real effects. But perhaps more importantly, it shows that the weaker-than-average response occurs in largely labor-intensive industries that were not exposed to the expanding VAT around them to the same degree as others were. Table A.II illustrates this. It investigates the characteristics of firms in the four industries—wood products; footwear; arms and ammunition; and furniture, where the response is significantly weaker than the average. Firms in these industries are on average smaller, employ less capital, have lower input to output ratios, and are much less likely to register voluntarily. They are thus the least likely to be affected by the expansion of VAT, in particular to its extension to inputs such as electricity and gas.

Tables IV and A.III-A.IV address two further sets of concerns. The first two of these demonstrate that the results are not driven by large firms. I restrict focus to Balanced Panel 1 and replicate the analysis in Table II, after dropping firms greater than a given cutoff. I use predetermined firm size, dropping firms on the basis of turnover in 1997-1998 in Table IV and 1997 only in Table A.III. The results from these restricted samples are similar to the baseline results. Some firms in the treatment and control groups operate in more than one stages. For instance, some of the manufacturers may combine their principal activity with a secondary activity such as distribution or retail. Forces created by the expansion of VAT may not act on these multistage firms in the same way they do on single-stage firms. Table A.IV alleviates this concern. I replicate Table II after reducing the sample to firms who operate in only one sector—manufacture or import—throughout the period 1997-2003. Reassuringly, there is no meaningful difference between the two set of results.

Finally, Tables A.VII and A.VIII show results from equation (4) after including a full set of industry, tax office, period, industry \times period, and tax office \times period fixed effects. These specifications allow firms in each industry and tax office to have a separate time trend. Again, results are very similar to ones from the baseline specification.

IV.B Participation Response

Does the tightening of enforcement—caused indirectly by the increasing penetration of VAT and directly by the tax survey—push informal firms into the formal sector? I now turn to this question, comparing the entry of new manufacturers and importers into the tax net over time. The entry of importers, as I explained above, is driven entirely by macro forces and cannot respond to the enforcement shocks.¹³ To the extent that the two groups of firms experience similar macro forces, the difference in entry isolates the impact of enforcement.

Graphical Evidence.—Figure VI presents this analysis. The entry of a firm can be defined to occur at three different points in time: (i) when the firm registers, (ii) when it files its first return, and (iii) when it files its first positive-activity return.¹⁴ The LHS panels plot the raw data of these three outcomes, while the RHS panels show the corresponding plot in the difference-in-differences format. The domestic supplies of importers become taxable from July 1997. Due to this, their entry remains noisier than usual in the next few periods, stabilizing only around the end of the tax year (see Figure II-C). I, accordingly, begin the analysis from July 1998.

Importers, clearly, provide a good counterfactual for manufacturers. For a long period during which the enforcement environment remains stable 2002-05, the three outcomes of manufacturers and importers evolve indistinguishably from each other. The other striking feature of the plots is that the entry of new manufacturers spikes dramatically in June 2000, jumping roughly eight-fold from an average of around 250 to more than 2,000 (see Panel C). This large jump is caused either by the tax survey, which begins from May 2000, or by the extension of VAT to service-providers, which takes effect from July 2000, and I disentangle the two effects below. In distinction to the large influx of new manufacturers after June 2000, bringing the energy sector under VAT in 1999 produces only a modest effect. It clearly pushes more manufacturers to register (Panel A) but has little or no effect on their decision to file a VAT return, positive-activity or otherwise (Panels B and C). In fact, comparing the three outcomes between 1999 and 2002 reveals a peculiar sequence of the response: firms who register in 1999 do not begin filing until June 2000, and they become active even later.

To see what triggers the sudden and sharp entry of manufacturers into the formal regime, I zoom in on the period around July 2000. Figure VII shows the weekly registration of new firms between April and December of 2000, comparing manufacturers to

¹³An importer cannot operate without VAT registration, as it needs to produce the registration certificate before getting the delivery of its import consignment from the customs station.

¹⁴I define positive-activity return as a return in which at least one of the cells showing sales or purchases made by the firm during the tax period is nonzero.

both importers and service providers. Vertical lines in the plots denote four important events during this period: the government announces the tax survey on May 24 and the extension of VAT to services on June 17; the extension takes effect on July 1; and the traders end their resistance to the survey on August 21. The registration of new manufacturers accelerates at the time the survey is announced, gaining momentum from early July as the survey gets underway. It loses steam as resistance to the survey strengthens, but regains pace again when the resistance ends. These movements are largely mirrored in the time series of services. But, importantly, the entry of service-providers lags that of manufacturers and therefore cannot have caused it. In fact, very few service-providers register when their supplies become taxable. The subsequent surge in their arrival, especially the peak after August 21, demonstrates that their own entry in large part results from the survey and is not voluntary.

Regression Results.—Table V formalizes the above analysis. Using importers as counterfactual, I estimate how many manufacturers move from informality into the VAT regime in response to the enforcement shocks. Columns (4), (7), and (10) of the table report this number for the three definitions of entry. I obtain the standard error on the number using a nonparametric bootstrap procedure explained in greater detail below the table. The results show that eliminating the exemption on electricity, gas, and other energy inputs causes more manufacturers to register (columns 2-4). The registration is around 58% higher in 1999 than it would have been in the counterfactual world. However, the majority of new registrants do not begin filing their returns in 1999 (columns 3-10). The enforcement survey, on the other hand, leads to both more registration and filing. Registration grows by 83%, filing by 144%, and positive-activity filing by 270% in 2000. Registration and filing continue to be significantly higher than the counterfactual as the survey progresses.

The above results, although unequivocal in highlighting a large shift towards the formal sector in 1999-2003, need further probe along two dimensions. The post-99 entrants potentially include firms who were not legally obliged to register at the time of their entry and did so only out of fear of the survey. Their entry is an undesirable byproduct of the survey and needs to be separated. Figures VIII and IX do this. Figure VIII compares the first-year turnover of firms by their entry period.¹⁵ While doing this exercise, I drop the firms whose first-year turnover exceeds PKR 1 billion. These are excessively large firms,

¹⁵The first year here is defined as the tax year immediately succeeding the one in which the firm files its first VAT return. For example, if a firm files its first return in August 2000, its first-year turnover is the aggregate value of its sales in the tax year 2001-02.

whose exclusion reduces noise in the plots without altering the message.¹⁶ Panel B of the figure looks at the same question using another metric. It illustrates the proportion of firms whose first-year turnover is above the exemption cutoff.¹⁷ Clearly, the 2000-2001 entrants are on average smaller than the 1999-2000 entrants. The proportion of firm above the exemption cutoff also drops at the time the survey kicks in, but the drop is less pronounced, and recovers quicker, than the decline in the average turnover.

If the firms who enter after 2000 do so solely out of the fear of physical enforcement, they are expected to drop out once the threat ceases. To test this, Figure IX plots the long-term survival probability of firms by their entry period. The post-2000 entrants are less likely to last the next eight to ten years in the tax net, but this effect is noticeable for the initial few periods only. Survival likelihood then becomes indistinguishable from the trend. Figures A.II-A.III replicate this analysis, defining entry as the period in which a firm registers. The results are comparable. Overall, the evidence thus suggests that the survey indeed pushes few not-liable-to-register firms into the tax net. But this effect is generally small, and accordingly the extensive margin response to the survey in large part represents the firms who should have been in the tax net but would not have done so without the government intervention.

One other result in Table V needs mentioning. The filing response to the survey is significantly larger than the registration response in its first year (compare column 4, 7 and 10 in the second row). The difference suggests a buildup of registered firms inside the VAT net as its coverage deepens. These firms register but do not begin remitting the tax until the government takes more intrusive and direct enforcement measures. The behavior suggests a model wherein firms (a) derive benefit from VAT registration independent of filing and (b) face fixed adjustment costs or other frictions in moving from registration to filing that they cannot overcome without an extraneous force. On a broader level, the results therefore demonstrate that physical- and self-enforcement are complements, and that self-enforcement on its own is insufficient to compel informal firms into full compliance.

V Mechanism Underlying Self-enforcement

I have documented above that the extension of VAT to the downstream stages causes no significant change in the reported sales of manufacturers. Note that the downstream ex-

¹⁶Their inclusion creates large spikes in the outcome variable for the periods during which one or more of such large firms enter. These spikes do not affect the trend, which is the matter of interest here.

¹⁷Note that the exemption cutoff applies only to manufacturers. I use the same cutoff for importers.

tension brings the first two self-enforcing mechanisms of VAT into play: the third-party information available to the government increases and the buyers become stake holders in the tax paid at the upstream stage after the extension. The reform however has no withholding element to it, as the tax extends to a downstream stage.

I have also documented that bringing the energy sector into the tax net causes a large increase in the reported sales of manufacturers. In distinction to the above, this reform has a large withholding element to it. Energy is a major input to the manufacturing process, and once it becomes taxable a significant proportion of VAT payable by manufacturers gets withheld at the upstream stage. It can also be argued that the reform creates no new information trails. Energy in Pakistan is predominantly supplied by a few large suppliers, the majority of whom are in public ownership.¹⁸ The information on sales transactions of these companies were always accessible to the government and it is hard to argue that the information flows increased significantly after the reform.¹⁹ The evidence thus suggests that withholding is the likely mechanism driving the self-enforcing impact of VAT documented above.

In the standard tax compliance model, a firm makes its reporting decision trading off the costs of evasion with its benefits, and it is not clear *a priori* how withholding would affect this calculus. In this section, I first propose a simple model that shows how withholding may have a large bite in settings similar to Pakistan's. I then provide additional evidence that (a) confirms the predictions of the model and (b) shows that withholding could indeed be the mechanism driving the observed responses.

V.A Setup

A continuum of manufacturing firms of measure one is indexed by $i \in I$. Each firm is characterized by a two-dimensional vector $\phi = \{\phi^r, \phi^e\}$ determining its ability to produce real output and evade taxes. A firm i combines taxable inputs costing $c(s_i; \phi)$ and non-taxable inputs costing $\psi(s_i; \phi)$ to produce s_i units of output that can be sold at a fixed price, normalized to one. The government implements the standard VAT, whereby the firm is required to charge the tax at a rate τ of its output and is allowed to deduct the tax paid on inputs. The government's ability to observe output is limited and the firm can underreport its sales $\hat{s}_i < s_i$ on paying a resource cost of $g(s_i - \hat{s}_i; \phi)$. VAT can be evaded

¹⁸For example, electricity and gas, which constitute the major component of the energy sector, are almost entirely supplied by four public sector companies.

¹⁹In fact, the legislation requires taxpayers to maintain their electricity and gas bills and make them available during the time of audit. Thus, even before the extension of VAT to the energy sector, the information on input transactions with the sector was available to the government.

by underreporting sales and/or overreporting costs. Here I abstract from costs overreporting to keep the exposition simple, assuming that taxable inputs are acquired from the organized sector and their misreporting is therefore not feasible. The firm's profit in this setting (compressing some notation) are given by

$$(7) \quad \pi(s_i, \hat{s}_i; \phi) = s_i - c_i - \psi_i + \underbrace{\tau s_i}_{\text{output tax}} - \underbrace{\tau c_i}_{\text{input tax}} - \underbrace{\tau(\hat{s}_i - c)}_{\text{tax remitted}} - \underbrace{g(s_i - \hat{s}_i; \phi)}_{\text{evasion costs}}.$$

The above expression implicitly assumes that the firm recovers VAT from its buyers on all its sales s_i but remits only $\tau(\hat{s}_i - c_i)$ to the government. The evaded sales ($s_i - \hat{s}_i$) thus should be seen as sales made to the unregistered sector, where buyers have no incentive to obtain the VAT invoice so that the firm can appropriate all the surplus from tax evasion to itself.²⁰ Equation (7) can be written more compactly as

$$(8) \quad \pi(s_i, \hat{s}_i; \phi) = s_i - c_i - \psi_i + \underbrace{\tau(s_i - \hat{s}_i)}_{\text{tax evasion}} - \underbrace{g(s_i - \hat{s}_i; \phi)}_{\text{evasion costs}}.$$

I assume here that the evasion costs $g(s_i - \hat{s}_i; \phi)$ are a function of the evaded amount only and do not depend on the real output produced by the firm (the two elements of productivity ϕ^r and ϕ^e are independent of each other). The separability between evasion and production costs along with the fact that VAT does not distort input prices allows me to focus solely on the tax compliance decision of the firm, abstracting from real decisions such as substitution between taxable and nontaxable inputs. One distinguishing feature of VAT is that in it a firm's tax liability can become negative if the input tax τc_i exceeds the reported output tax $\tau \hat{s}_i$. I assume that the costs of evasion faced by the firm are of the following form

$$(9) \quad g(s_i - \hat{s}_i; \phi) = \begin{cases} \gamma(s_i - \hat{s}_i; \phi) & \text{if } \hat{s}_i > c_i \\ \alpha \gamma(s_i - \hat{s}_i; \phi) & \text{if } \hat{s}_i \leq c_i, \end{cases}$$

where $\gamma(\cdot)$ is an increasing and convex function of the evaded amount ($s_i - \hat{s}_i$) and $\alpha > 1$, which means that the costs jump at the point tax liability becomes negative. The jump reflects the intuition that the likelihood of a firm facing an audit rises discretely as its reported sales fall below the taxable inputs costs. It is because the firm opts for either the

²⁰Note that this assumption is for notational economy only and can be relaxed easily. In a general model where the seller and buyer bargain over the evasion surplus, everything here goes through other than that the benefit of evasion to the seller is $\sigma \tau(s_i - \hat{s}_i)$ rather than $\tau(s_i - \hat{s}_i)$, where σ is the seller's bargaining weight. We are effectively assuming here that $\sigma = 1$, so that the buyer receives no surplus from evasion.

refund or carry forward of the balance amount $\tau(\hat{s}_i - c_i)$ when this happens, and both cases raise a flag with the tax administration, as negative liability is not a common occurrence for firms other than exporters. The jump could potentially be large, particularly because the government has limited pre-audit information available to it to select cases for audit and negative tax liability is one very salient piece of such information.

Optimizing behavior in this setup implies that the firm would evade up to the point that the marginal cost of evasion equals the tax rate $g'(s_i - \hat{s}_i; \phi) = \tau$. Given the discontinuity in evasion costs, the firm may end up at the zero-liability point if

$$(10) \quad \begin{cases} \gamma'(s_i - \hat{s}_i; \phi) < \tau & \text{for } \hat{s}_i = c_i + \epsilon; \text{ and} \\ \alpha\gamma'(s_i - \hat{s}_i; \phi) > \tau & \text{for } \hat{s}_i = c_i - \epsilon, \end{cases}$$

with $\epsilon > 0$.

Heterogeneity: Firms draw their productivities from the joint distribution $f(\phi^r, \phi^e)$ on the domain $(\underline{\phi}^r, \overline{\phi}^r) \times (\underline{\phi}^e, \overline{\phi}^e)$. Under regularity conditions similar to Spence-Mirrlees, the smooth distribution of productivities translates into smooth distributions of real and reported sales as long as $\alpha = 0$. The jump in evasion costs ($\alpha > 1$), however, will cause bunching of firms at the zero-liability point.²¹ The bunching firms draw ϕ in the set $\phi \in \Phi_z$ where condition (10) binds: their optimal reported sales equal their deductible inputs costs. The first testable prediction of the model with $\alpha > 1$ therefore is

PREDICTION 1: *The discontinuity in evasion costs will cause bunching of firms at, and to the right of, the point zero in the reported tax liability distribution.*

Now consider that the government extends the coverage of VAT from time t' , making a nontaxable intermediate used by all firms taxable. The experiment is akin to the Pakistani policy change of 1999, whereby energy—an input used by all manufacturers—was brought into the tax net. Given that the tax paid on inputs is deductible, the change will not distort the input mix used by firms. For pure mechanical reasons, however, c_i will go up and ψ_i will go down by the same amount. Figures X and XI trace the impact of the change on two representative firms. The change will not affect the high-evasion-cost (low ϕ^e) firm other than that its tax liability $\tau(\hat{s}_i - c_i)$ will go down because of the mechanical increase in c_i (see Figure X). In contrast, the low-evasion-cost (high ϕ^e) firm will continue to bunch at the zero-liability point if condition (10) still binds at the new level of c_i . The

²¹The model presumes frictionless behavior. But with real-world considerations such as some discreteness in reported sales the bunching will not be concentrated exactly at the zero-liability point but will be spread toward the right of it.

firm will increase its reported sales \hat{s}_i by the same amount as the increase in c_i (see Figure XI).

PREDICTION 2: *Making a hitherto untaxed input used by all firms taxable will cause the distribution of reported tax liability to shift leftwards. To the extent that evasion costs are of the form (9), bunching at the zero-tax-liability point will persist even after the reform.*

The leftward shift of the distribution results from the mechanical decrease in tax liability of firms after the reform. The persistence of bunching, on the other hand, results from the behavioral response, whereby firms report higher sales to avoid falling into the high evasion cost region.

V.B Bunching at Zero Tax Liability

Figure XII tests the two prediction of the model. I plot $(\hat{s}_i - c_i)$ reported by manufacturing firms in their monthly returns in bins of 5,000 rupees, zooming in on the region around zero. I drop observations where reported sales exactly equal taxable input costs i.e. $\hat{s}_i = c_i$, as almost all of them relate to inactive firms who report zero in all cells. Panel A of the figure plots the distribution for the financial year 1998, showing sharp bunching of firms just above the zero-liability point: the bin just above zero contains 14 times as many firms as the one just below zero. Note that c_i being taxable inputs costs does not include important inputs, most notably electricity and gas (which are still not taxable in 1998) and labor (which is always nontaxable). The variable plotted in the figure $(\hat{s}_i - c_i)$ hence bears no relevance to the real production side of the firm. Its value always lies somewhere in between the turnover and profits of the firm. Bunching in its distribution at the point zero therefore cannot be explained by any real phenomenon such as market competition (zero profits), liquidity constraints, or any feature of the production technology. Nor can it be explained by transaction costs, as firms can costlessly carry forward the excess amount to the next period. The taxable inputs acquired by a firm in a given month do not need to match exactly with the taxable sales made by it in the period. The only plausible explanation of the bunching therefore is that firms tend to remain in the positive-tax-liability region to avoid attracting the attention of the tax authorities.

Panels B-D of the figure test the second prediction of the model. In 1999, electricity, gas, and other energy inputs become taxable. Because of the mechanical increase in c_i , the distribution of $(\hat{s}_i - c_i)$ should shift leftwards, pushing many of the firms just above zero into the negative liability region. And the distribution does shift leftwards: the 1999 distribution is stochastically (first-order) dominated by the 1998 distribution at all points. Yet, extremely few firms fall into the negative-liability region, and the bunching persists—in

fact it becomes even sharper. Figure A.IV tests the robustness of these findings. It replicates Figure XII, reducing the bin width to just PKR 1000 (US\$ 20 in 1998-99). The results are very comparable. The evidence thus confirms that withholding affects the reporting choices of firms substantively and could indeed be driving the self-enforcing impact documented in Table II.

V.C Taxable Inputs Response

The causal story linking the 1999 policy change to the rise in the reported sales of manufacturers goes like this. The deductible VAT of manufacturers goes up in 1999 as two of their major inputs electricity and gas become taxable. The peculiar structure of evasion costs (9) means that the manufacturers absorb some of the increased deduction instead of passing it on one-for-one in the tax liability, thereby increasing their reported sales. Since in this story it is the increase in VAT paid on inputs that drives the rise in sales, another way to test it is by looking at how taxable inputs reported by manufacturers behave around this time. I have already mentioned in section III.D that changes in taxable inputs conflate both the mechanical and behavioral effects. But if the increase in taxable inputs (sum of mechanical and behavioral effect) nearly equals the increase in taxable sales (pure behavioral effect), it will be another evidence that the withholding mechanism drives the self-enforcement response documented in this paper.

Table A.V conducts this analysis. I replicate Table II but use taxable inputs as the outcome variable in place of taxable sales. One difficulty with looking at this response is that firms do not apportion their taxable inputs by how much of them are utilized in making taxable sales (some manufacturers in the sample export part of their output). To get around this problem, I drop firms who report any exports or nontaxable sales in any of the periods included in the sample.²² The taxable sales response of firms in this restricted sample is shown in Table A.VI. The results are indistinguishable from those in Table II, confirming that the sample restriction does not create any selection concern. The results are also strictly consistent with the causal story laid out above. The taxable inputs of manufacturers rise substantially relative to importers after 1999. The increase is almost as large as that in taxable sales (see the corresponding Table A.VI). Together, the two facts show that the increased withholding of tax at the upstream stage does not reduce, one-for-one,

²²Some of the firms classified as manufacturers export the goods produced by them. Throughout this paper, I have focused on domestic taxable sales reported by firms as this variable captures the self-enforcing impact of VAT more cleanly. To be consistent with my earlier analysis, I restrict focus here to taxable inputs utilized in making domestic taxable sales only, dropping manufacturers who report any exports in any of the periods included in the estimation.

the tax liability of downstream firms. In fact, firms absorb some of the increase by reporting higher sales. Tax evasion reduces and aggregate tax payment increases as a result—the self-enforcement dividend of VAT.

VI Discussion and Conclusion

VI.A Effect on Government Revenue

How much additional revenue did the government receive from the self-enforcing action of VAT? Table II documents that the expansion of VAT caused a large increase in the reported sales of manufacturers. Section III.D shows theoretically that under the no-one-sided evasion assumption an increase in sales reported at the manufacturing stage results in a one-for-one increase in VAT collected from up to and including that stage. We can safely rule out one-sided evasion in this context as the upstream extension involves a completely formal sector.²³ The increase in revenue caused by the self-enforcement would therefore be of a similar magnitude as the increase in taxable sales documented in Table II. As I mention in section III.D, I cannot look directly at the firm-level revenue as an outcome variable because it conflates the mechanical and behavioral effects. In this section, I look at the *aggregate* VAT collected in Pakistan to get some sense of the additional revenue generated by the self-enforcement. Since manufacturers comprise a large (around 90%) part of the tax base and the self-enforcement causes a large increase in their reported sales, the effect must be visible in the aggregate revenue.

Table A.IX conducts this analysis. The FBR report commodity-wise VAT collected in the country in their annual reports. These reports are publicly available, and I access the 2001-02 to 2004-05 reports to construct this table. The first two columns of the table show that the VAT revenue grew sharply between 1999 and 2002, in particular in 1999.²⁴ Some of this growth results from the mechanical expansion of the base, the rest from the behavioral responses (self-enforcement). To provide a clean lower-bound on the behavioral component of the growth, columns (3)-(4) exclude the revenue from the energy sector. The commodities included in these columns remain taxable throughout the sample period, meaning that any growth in revenue would necessarily reflect the behavioral effect.

²³Engaging in one-sided evasion in this context means that manufacturers forge their electricity and gas bills to overclaim VAT paid on these inputs. This is extremely unlikely as these bills can easily be verified (the electricity and gas suppliers are publicly-owned firms). For this reason, the purchases of energy reported by manufacturers are likely to match exactly with the sales reported by the energy suppliers.

²⁴The standard VAT rate changed during this period for two brief episodes (see Figure A.I). To make the revenue comparable across years, I normalize it to a rate of 15% throughout the sample period.

The numbers provide a lower bound because they do not take into account the VAT deducted by manufacturers on their energy inputs. Columns (5) and (6) take into account these deductions. Using data from the Pakistan Economic Survey, I compute the proportion of energy used as an intermediate good by manufacturing firms.²⁵ I then add that proportion of revenue remitted by the energy sector to compute the aggregate revenue.

It is important to emphasize that these time-series aggregates are not directly comparable to the results in Table II: they do not control for macro factors and may be more sensitive to the performance of large firms (the results in Table II include firm fixed effects). Despite these caveats, the aggregate revenue growth is generally in line with the firm-level sales growth documented in Table II. VAT revenues were almost stagnant but grew sharply from 1999 as the energy sector came into the tax net. The results thus reinforce the conclusion that the government received a large enforcement dividend from the expansion of VAT: the already-taxed sector remitted more revenue as their exposure to VAT deepened (see columns 5-6 of the table, which are conceptually the closest to the estimates in Table II).

VI.B Alternative Explanations

Given the event study research design, the principal alternative explanation of the self-enforcement result documented above is a macro event that occurs in 1999 and increases the profitability of manufacturing relative to imports. In the standard competitive setting, a positive demand or supply shock of such a nature would cause an increase in the output of manufacturers, hence explaining the observed response. Note, however, that such a shock would also cause an increase in the entry of manufacturers relative to importers. But we have seen in Figure VI that no relative change to the entry of manufacturers occurred during the entire financial year of 1999, while their sales were going up consistently. The simultaneous increase in sales and stagnant entry cannot be explained by a coherent real-side story, especially because the sales increased almost homogeneously across all industries, ruling out nonstandard markets (see Figure V). The only consistent explanation of the five pieces of evidence presented in this paper—(1) a large sales response (Figure IV); (2) no entry response (Figure VI); (3) parallel trends over large no-policy-change periods; (Figure IV and Table II) (4) homogeneity of the response across industries; (Figure V); and (5) strong bunching at the zero-liability point and the subsequent shifting of the distri-

²⁵Specifically, I use Table 14 of the Pakistan Economic Survey 2005-06 to compute this proportion for the years 1997 to 2004. The survey shows that on average around 33% of electricity, 66% of gas, and 70% of other petroleum products (including furnace oil) are used as input by manufacturing firms. The survey can be accessed [here](#).

bution (Figure XII)—therefore is the self-enforcement response driven by the withholding mechanism built into VAT.

VI.C Conclusion

Value-added tax has seen unparalleled growth in the past few decades. In large part, the growth has been driven by the belief—held by both public finance academics and policy practitioners—that VAT facilitates enforcement. This paper uses the staggered introduction of VAT in Pakistan to test if the tax creates significant enforcement spillovers and, if yes, what underpins this process.

I present three primary findings. First, taxable sales reported by firms already in the tax net go up as their exposure to VAT expands. This effect is strong, precisely estimated, and robust. Second, the tax has a much weaker effect on informality. Firms operating outside the tax net remain insensitive to the deepening penetration of VAT around them. The vast majority of them continue to operate informally even when increasingly more of their inputs become taxable and their transactions with formal firms begin leaving paper trails. Third, the large increase in taxable sales of VAT-paying firms is driven by the withholding mechanism built into VAT, whereby the tax on inputs of a firm is collected at the upstream stage. When more inputs of these firms become taxable, they report higher sales, absorbing thereby the additional input tax rather than passing it one-for-one into the tax liability. Because of the higher downstream sales, the government receives more revenue in aggregate.

I compare the indirect enforcement effects of VAT with those of a large-scale tax survey which tightens enforcement in the country directly using traditional measures. I find that the survey has a very strong effect on informality. Firms who were insensitive to expanding VAT around them entered the tax net almost immediately after the announcement of the survey. The effect is so large that it can be read directly from charts showing the entry of new firms over time. Once in, these firms were not more likely to quit the formal sector, illustrating large, persistent, and long-term gains from a one-time enforcement effort.

One overarching theme in the recent public finance literature is that third-party information is the key to tax compliance. The information enables the government to cross-match tax reports on a large scale, raising the costs of evasion to such an extent that it is no longer feasible. One issue with this line of research is that key empirical results establishing the efficacy of third-party information have been derived from contexts where it is intricately intertwined with withholding. For example, wage payment by an employer creates third-party reporting but tax is also withheld at the time of payment. This paper

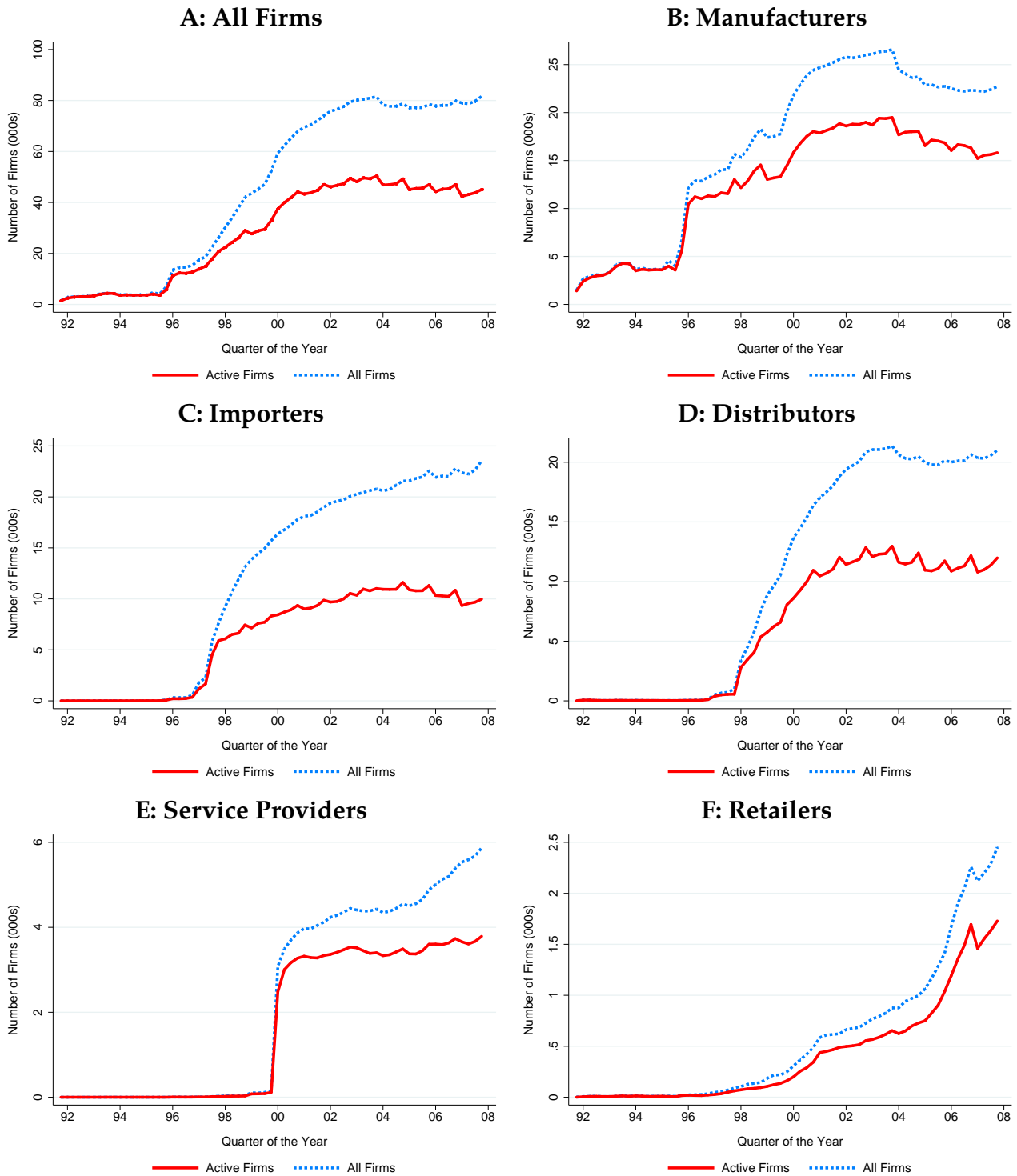
disentangles the two effects, showing that third-party information in itself is insufficient to secure tax compliance, at least in developing economies. It in fact requires credible enforcement threat from the government through traditional measures to be effective (see Carrillo *et al.*, 2017 for similar result in another context). In this sense, traditional enforcement and self-enforcement mechanisms built into modern broad-based taxes are necessary complements and need to be deployed together in optimal policy.

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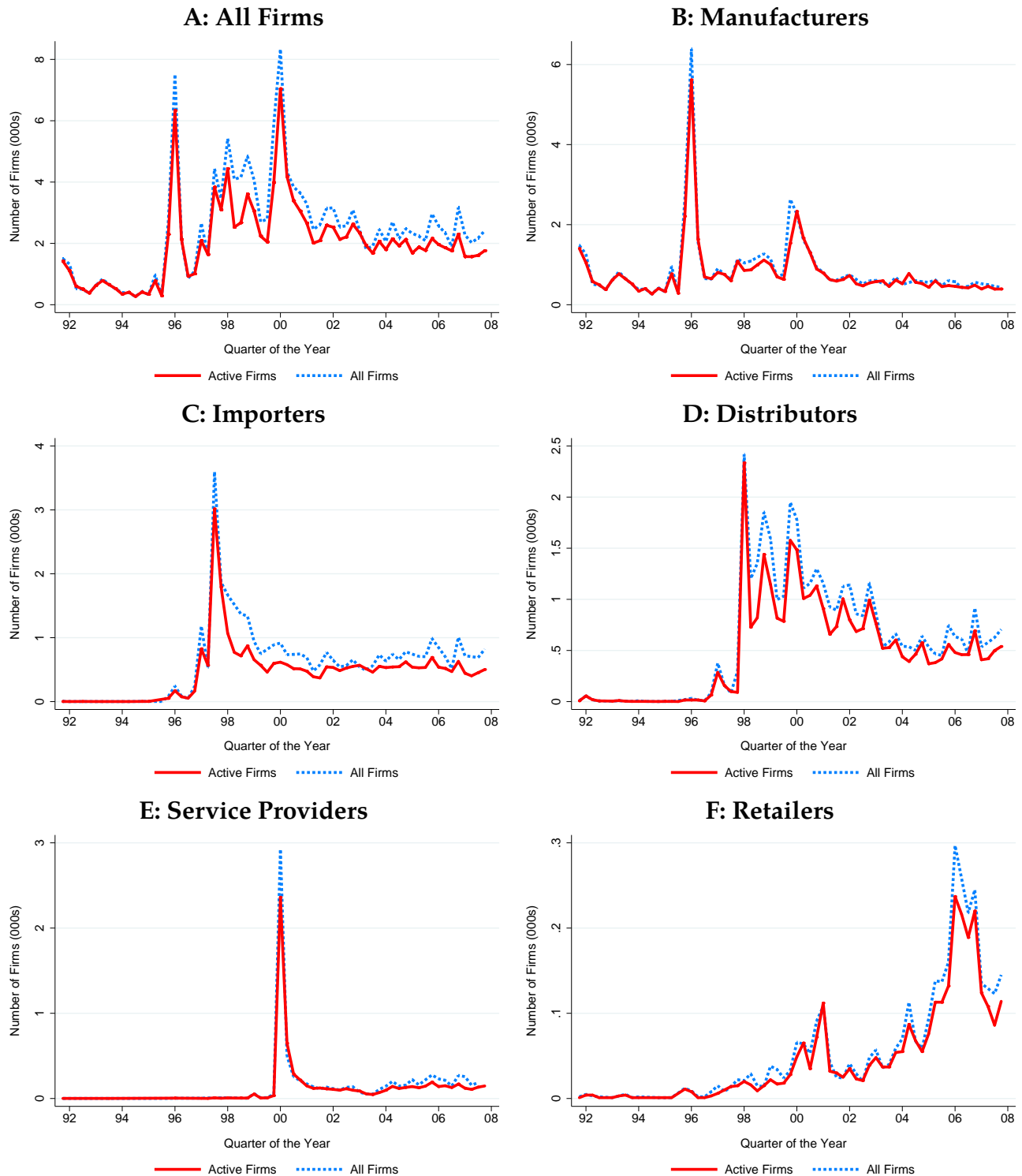
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FIGURE I: DEVELOPMENT OF VAT IN PAKISTAN – NUMBER OF FIRMS



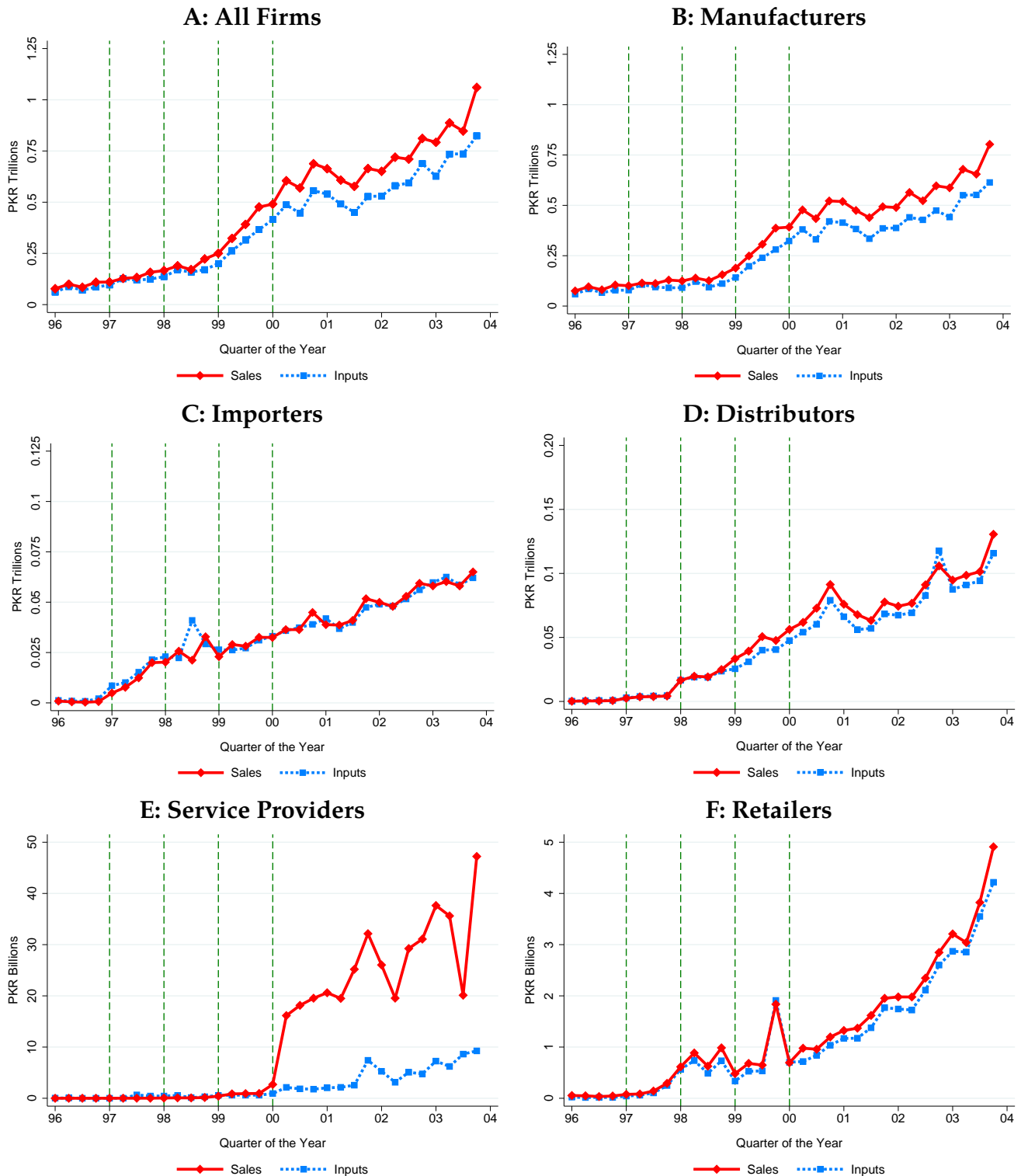
Notes: The figure illustrates the introduction and growth of VAT in Pakistan by tracking the stock of firms in the tax net between 1992 and 2008. It plots the number of firms who file their monthly VAT return at least once in the quarter indicated on the horizontal axis. Year t on the horizontal axis denotes the beginning of the financial year and therefore indicates the July-September quarter. Active firm is defined as a firm who reports nonzero activity in at least one of the cells in the return. Please see Appendix A for the classification of firms into manufacturers and other categories.

FIGURE II: DEVELOPMENT OF VAT IN PAKISTAN – ENTRY OF NEW FIRMS



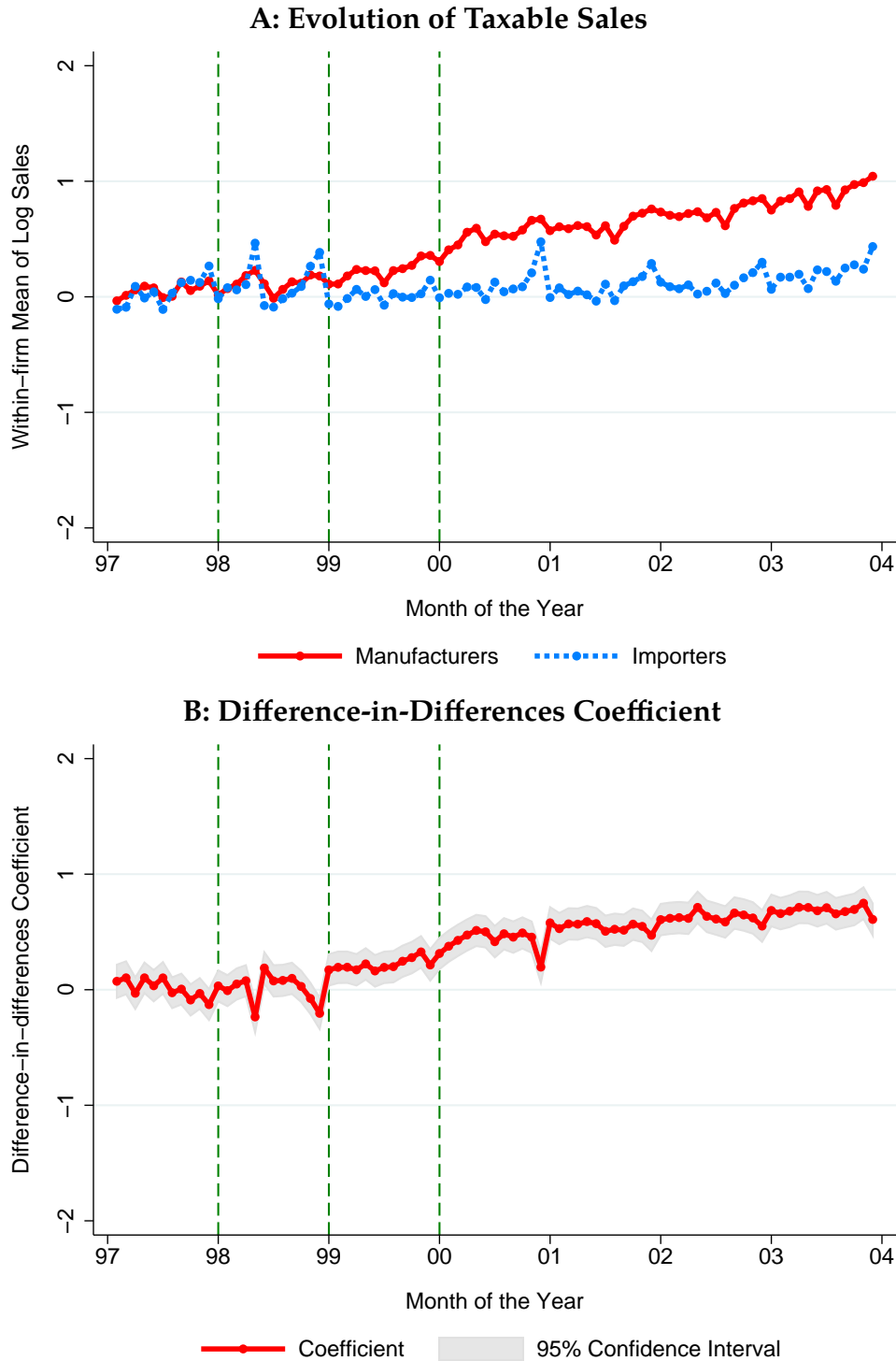
Notes: The figure illustrates the introduction and growth of VAT in Pakistan by tracking the entry of new firms into the tax net between 1992 and 2008. It plots the number of firms who file their first VAT return in the quarter indicated on the horizontal axis. Year t on the horizontal axis denotes the beginning of the financial year and therefore indicates the July-September quarter. Active firm is defined as a firm who reports nonzero activity in at least one of the cells in the return. The difference between All Firms and Active Firms represents “Nil Filers”—the inactive firms who report zero in all cells of the return. Please see Appendix A for the classification of firms into manufacturers and other categories.

FIGURE III: DEVELOPMENT OF VAT IN PAKISTAN – VOLUME OF TRANSACTIONS



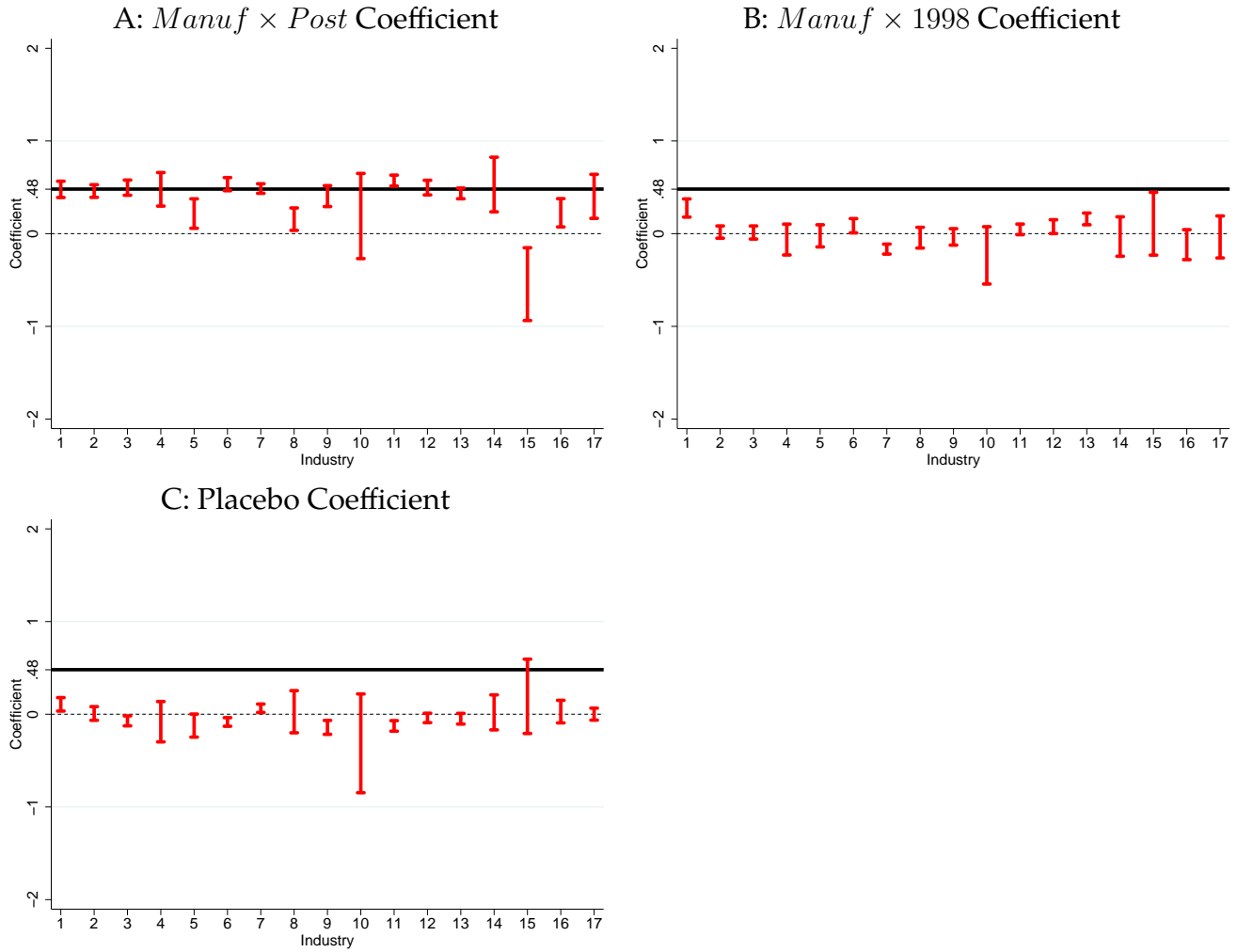
Notes: The figure illustrates the introduction and growth of VAT in Pakistan by tracking the volume of transactions covered by the tax between 1992 and 2008. It plots the aggregate value of taxable sales and taxable input costs reported by firms in the quarter indicated on the horizontal axis. Year t on the horizontal axis denotes the beginning of the financial year and therefore indicates the July-September quarter. Vertical dashed lines in the figure demarcate four important event during the period: the extension of VAT to importer (1999); distributor and retailers (1998); energy sector (1999); and services (2000). Please see Appendix A for the classification of firms into manufacturers and other categories.

FIGURE IV: TAXABLE SALES RESPONSE



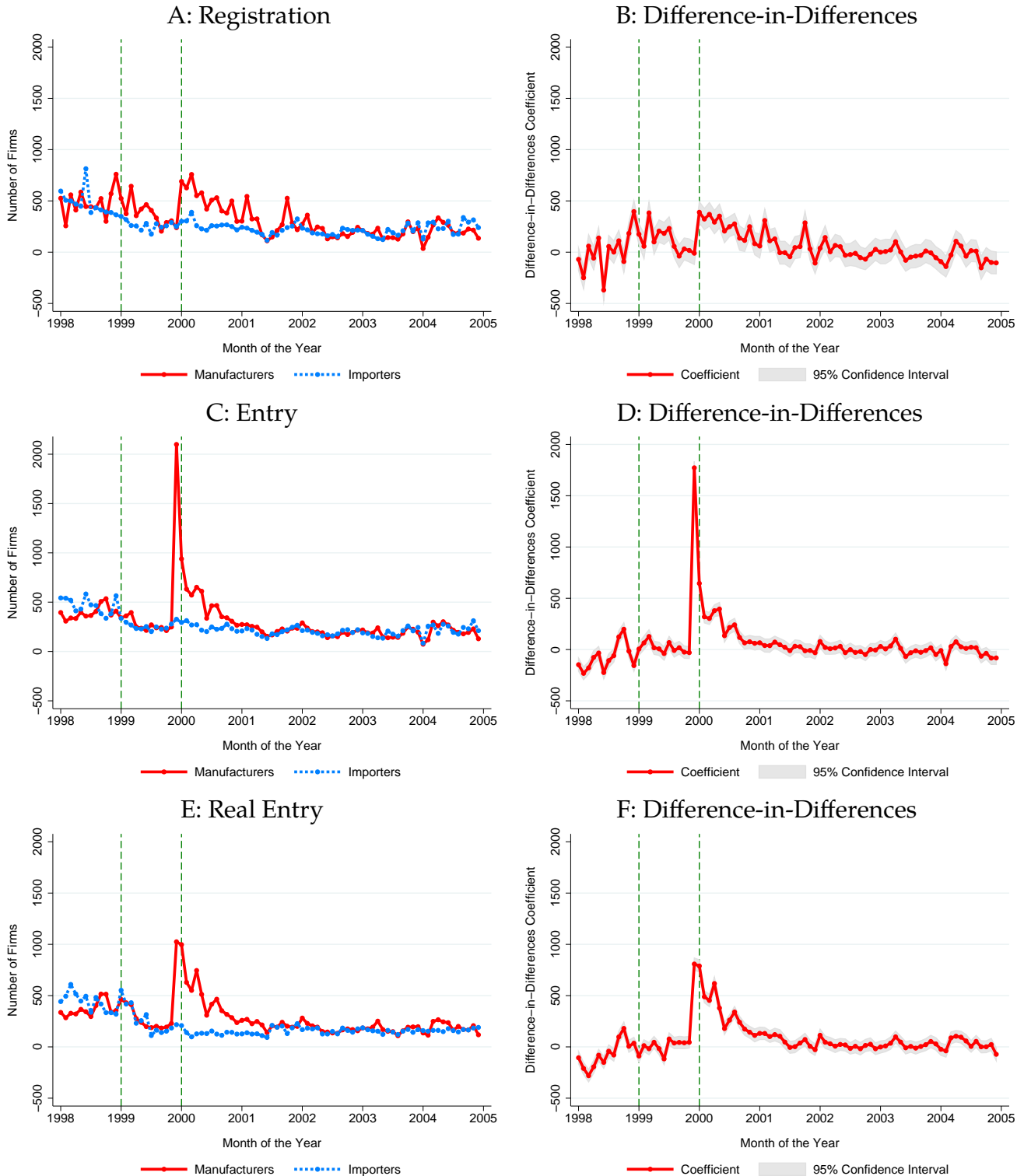
Notes: The figure compares the evolution of taxable sales reported by manufacturers and importers between July 1997 and June 2004. To construct Panel A, I regress the log of taxable sales on the full set of firm and period fixed effects, dropping the dummy for July 1997. I plot the coefficients on the time dummies of these regressions, run separately for the two groups of firms. The marker for each period, accordingly, approximates the average within-firm sales growth relative to July 1997 for the corresponding group of firms. Year t on the horizontal axis indicates the month July of the year. Panel B plots the difference-in-differences analogue of Panel A. Vertical dashed lines in the figure demarcate three important event during the period: the extension of VAT to distributor and retailers (1998); energy sector (1999); and services (2000). The last event is almost contemporaneous with the enforcement survey, which was announced by the end of May 2000.

FIGURE V: TAXABLE SALES RESPONSE BY INDUSTRY



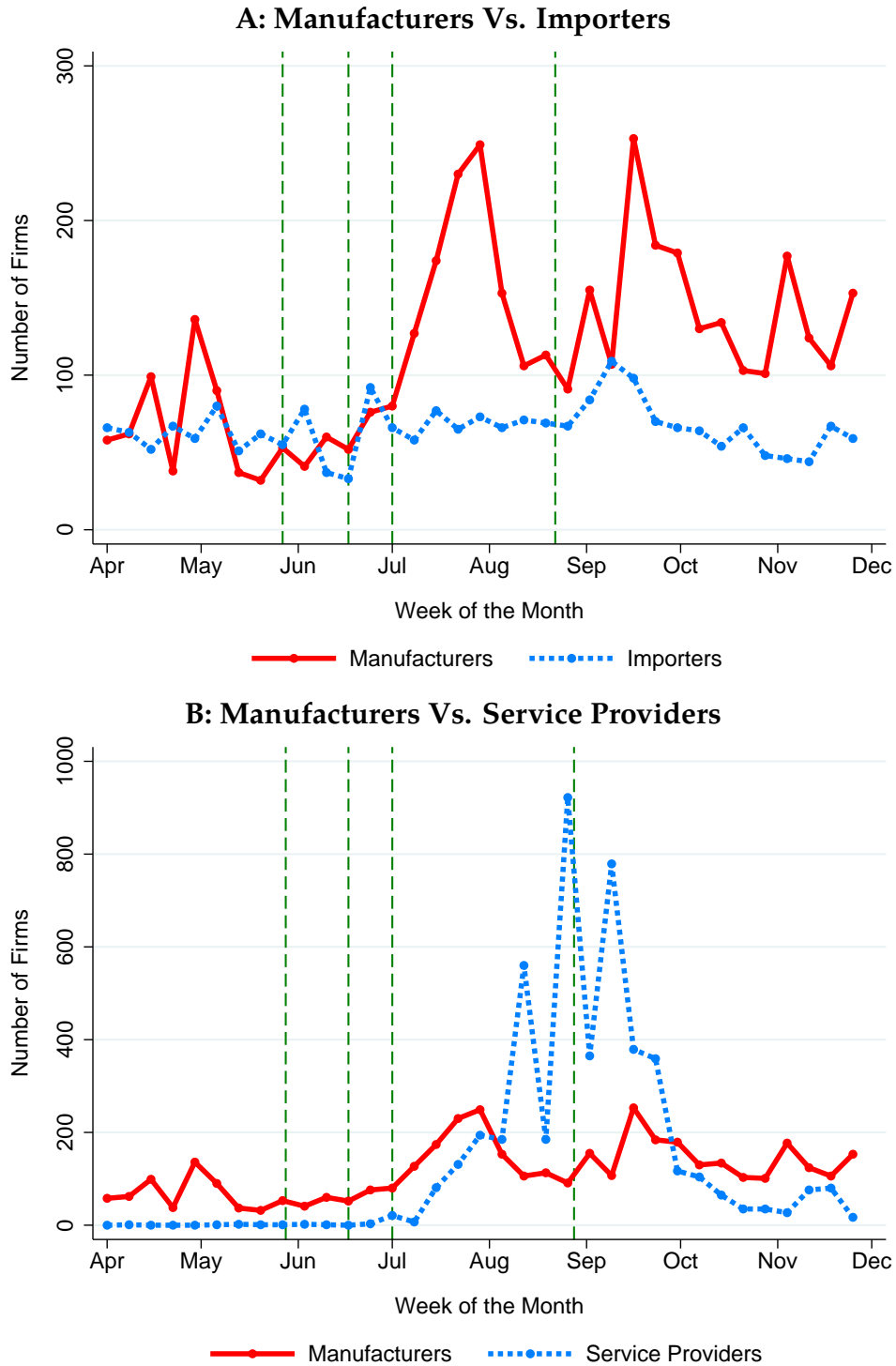
Notes: The figure breaks down the taxable sales response reported in Table II by industry. I estimate equation (4) restricting the sample to firms of one industry only. Panel A plots the $Manuf \times Post$ coefficient and 95% confidence interval around it from these regressions, comparing it against the baseline coefficient of 0.48 (see column (1) of the table). Panel B and C replicates the exercise, showing the $Manuf \times 1998$ and placebo coefficients respectively. The placebo regressions are run on the period 2004-2010, defining 2006 and after as the post period. The industry classifications used here comes from the 2-digit aggregation scheme of the HS Code. The scheme along with the description of the industries is shown in Table A.I.

FIGURE VI: PARTICIPATION RESPONSE



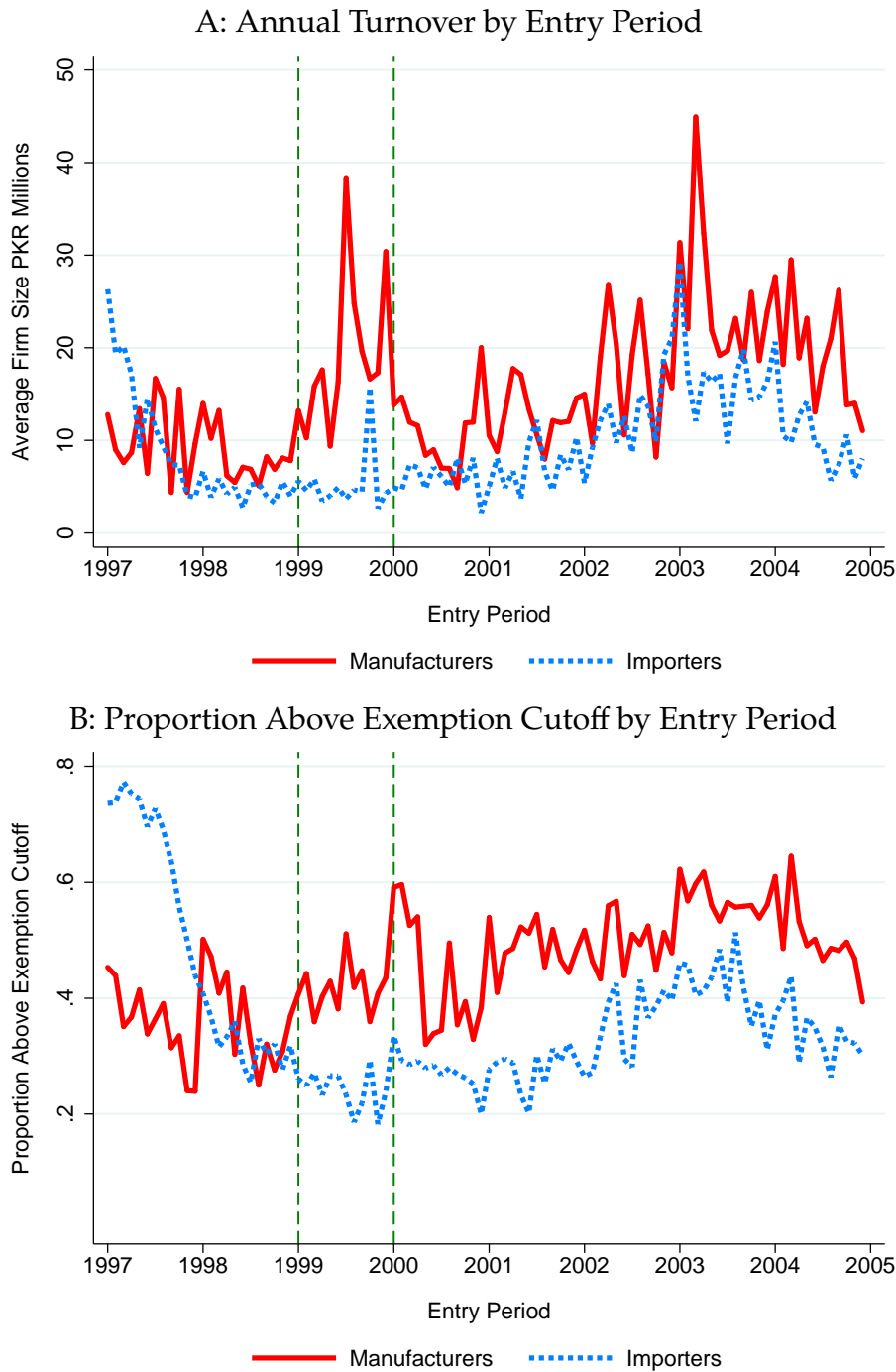
Notes: The figure illustrates the effects of the increasing exposure to VAT and tax survey on firms' entry into the formal sector. The LHS panels show the numbers of firms who register (Panel A), file their first return (Panel B), and file their first positive-activity return (Panel C) in the month indicated on the horizontal axis. The RHS panels plot the corresponding difference-in-differences analogue of the two series. Year t on the horizontal axis indicates the month July of the year. The vertical dashed lines demarcate the start of the financial years 1999 and 2000. VAT was extended to the energy sector in 1999 and to the services sector in 2000; the tax survey was announced on May 24, 2000.

FIGURE VII: WEEKLY REGISTRATION OF NEW FIRMS (APRIL TO DECEMBER 2000)



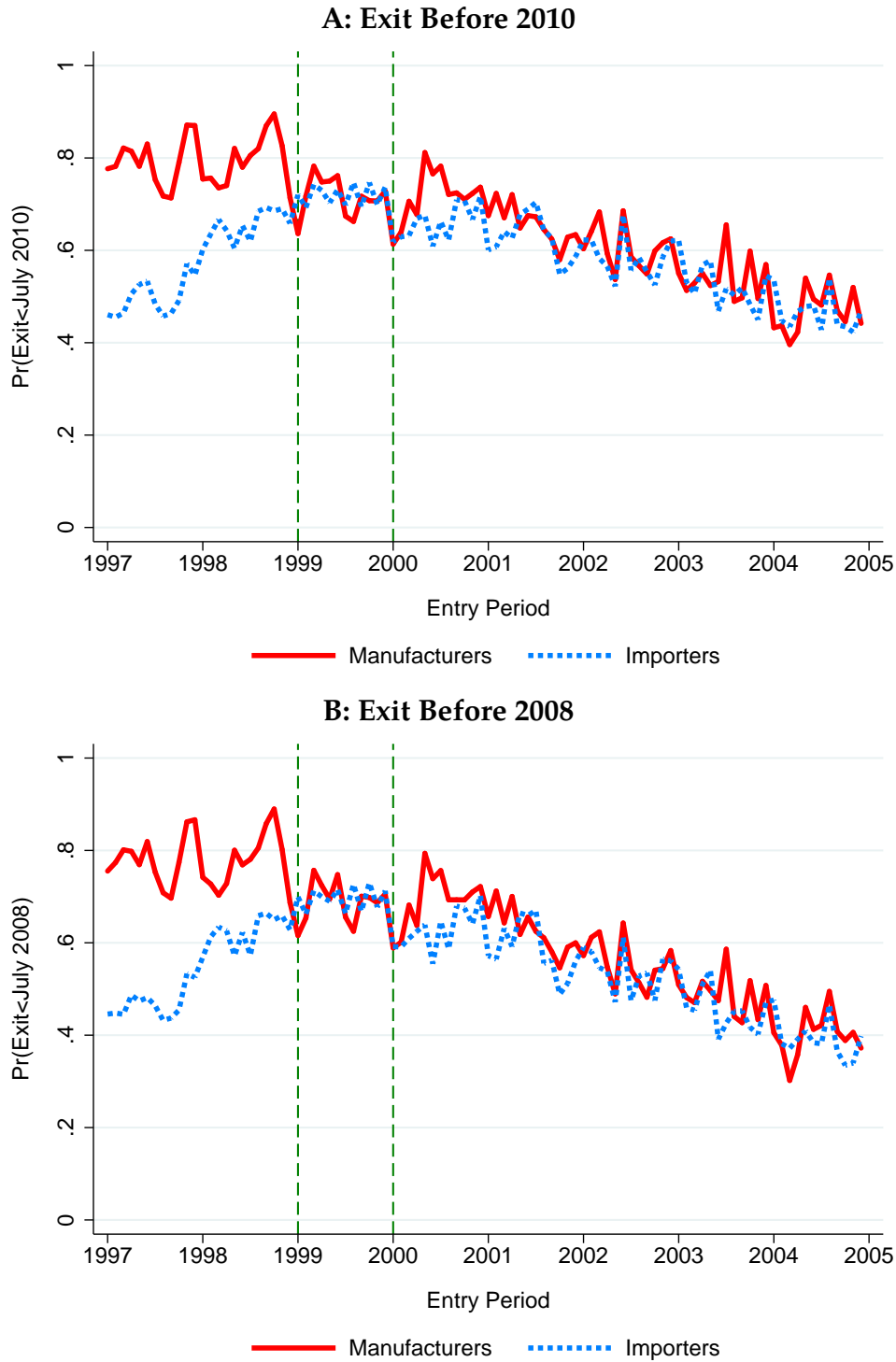
Notes: The figure explores if the large influx of manufacturing firms into the formal sector around July 2000 was caused by the extension of VAT to services or by the enforcement survey. It plots the number of new firms who register in the given week, zooming in on the period between the 1st of April and the 1st of December 2000. Panel A compares manufacturers to importers and Panel B to service providers. Vertical lines in the plots denote four important dates during this period: the government announces the tax survey on May 24 and the extension of VAT to services on June 17; the extension takes effect on July 1; and the traders end their resistance to the survey on August 21.

FIGURE VIII: FIRM SIZE BY ENTRY PERIOD



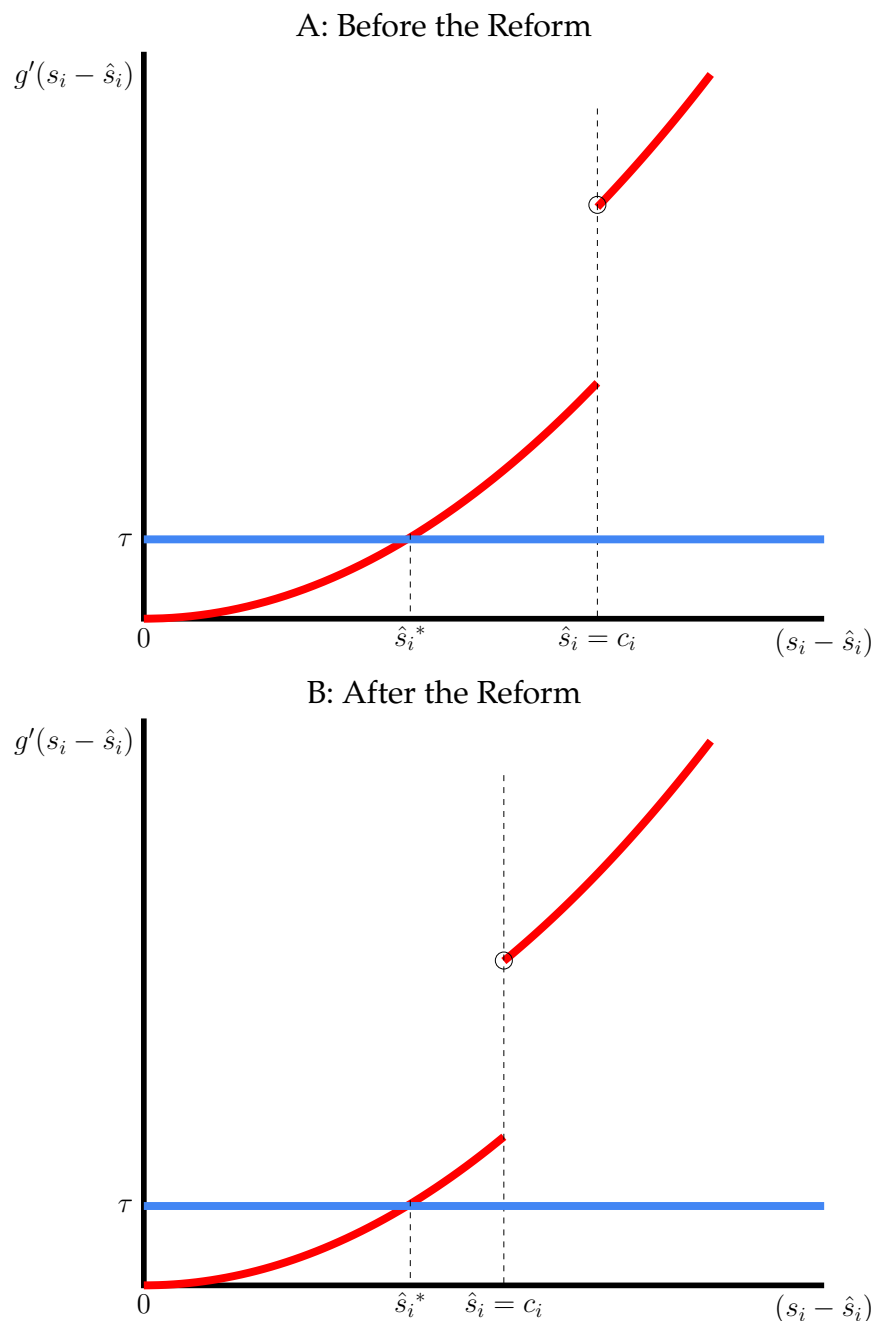
Notes: The figure investigates if firms who came into the formal sector in response to the increasing exposure to VAT and enforcement survey were any different from the other firms. Panel A plots the first-year turnover of firms by their entry period. The first-year here is defined as the tax year immediately succeeding the one in which a firm files its first VAT return. For example, if a firm files its first return in August 2000, its first-year turnover is the aggregate value of its sales in the tax year 2001-02. While doing this exercise, I drop firms whose first-year turnover exceeds PKR 1 billion. Panel B of the figure depicts the proportion of firms whose first-year turnover is above the exemption cutoff. Note that the exemption cutoff applies only to manufacturers. I use the same cutoff for importers. Vertical lines in the plots denote important events during this period: VAT was extended to the energy sector in July 1999 and to the services sector in July 2000; and the enforcement survey commences from the end of May 2000.

FIGURE IX: EXIT PROBABILITY BY ENTRY PERIOD



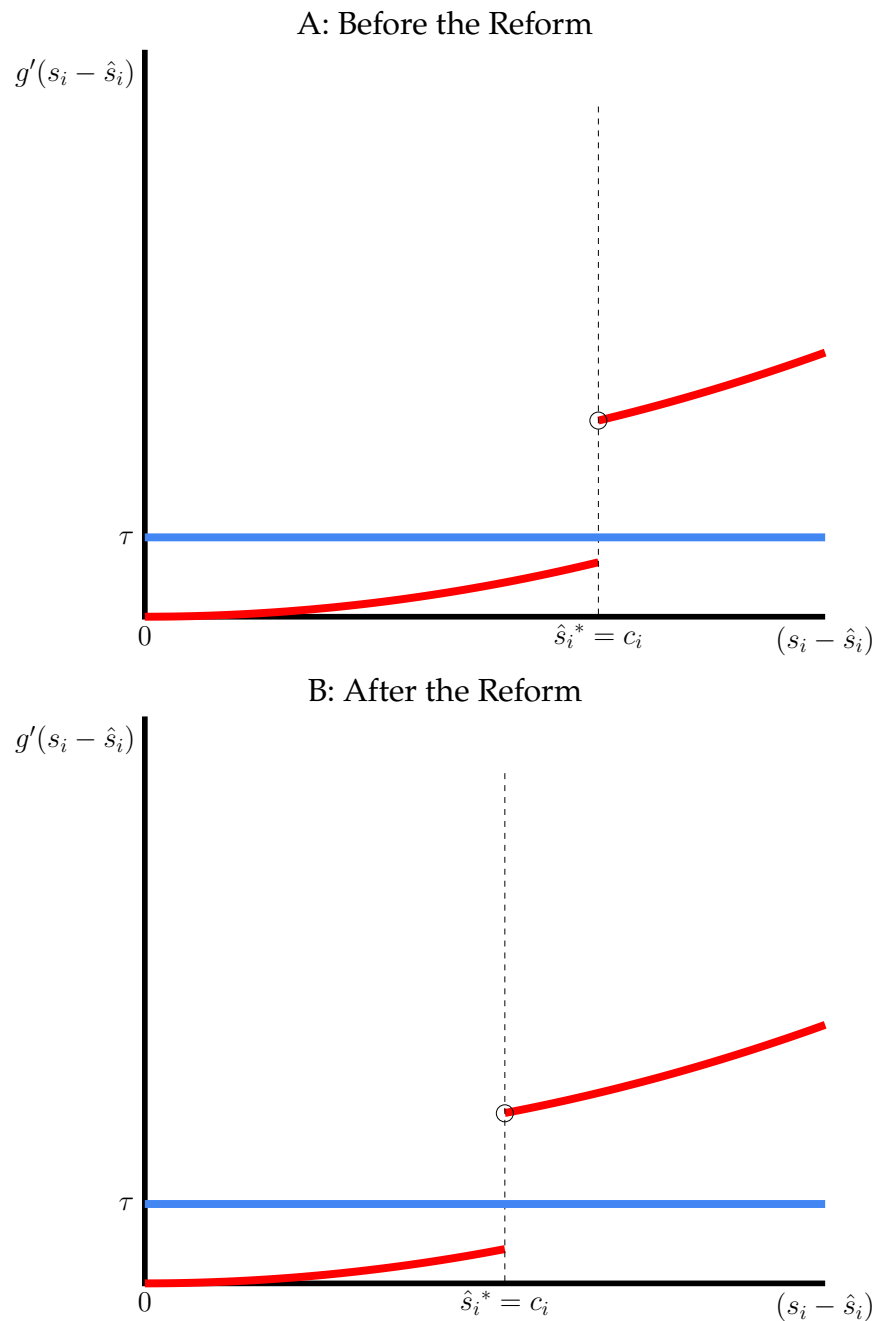
Notes: The figure explores if firms who came into the formal sector in response to the increasing exposure to VAT and tax survey were any different from the other firms. It plots the proportion of firms who exit before the given cutoff date by their entry month. The cutoff date is the 1st of July 2010 for Panel A and the 1st of July 2008 for Panel B. Vertical lines in the plots denote important events during this period: VAT was extended to the energy sector in July 1999 and to the services sector in July 2000; and the enforcement survey commences from the end of May 2000.

FIGURE X: EFFECT OF INCREASED WITHHOLDING ON A HIGH-EVASION-COST FIRM



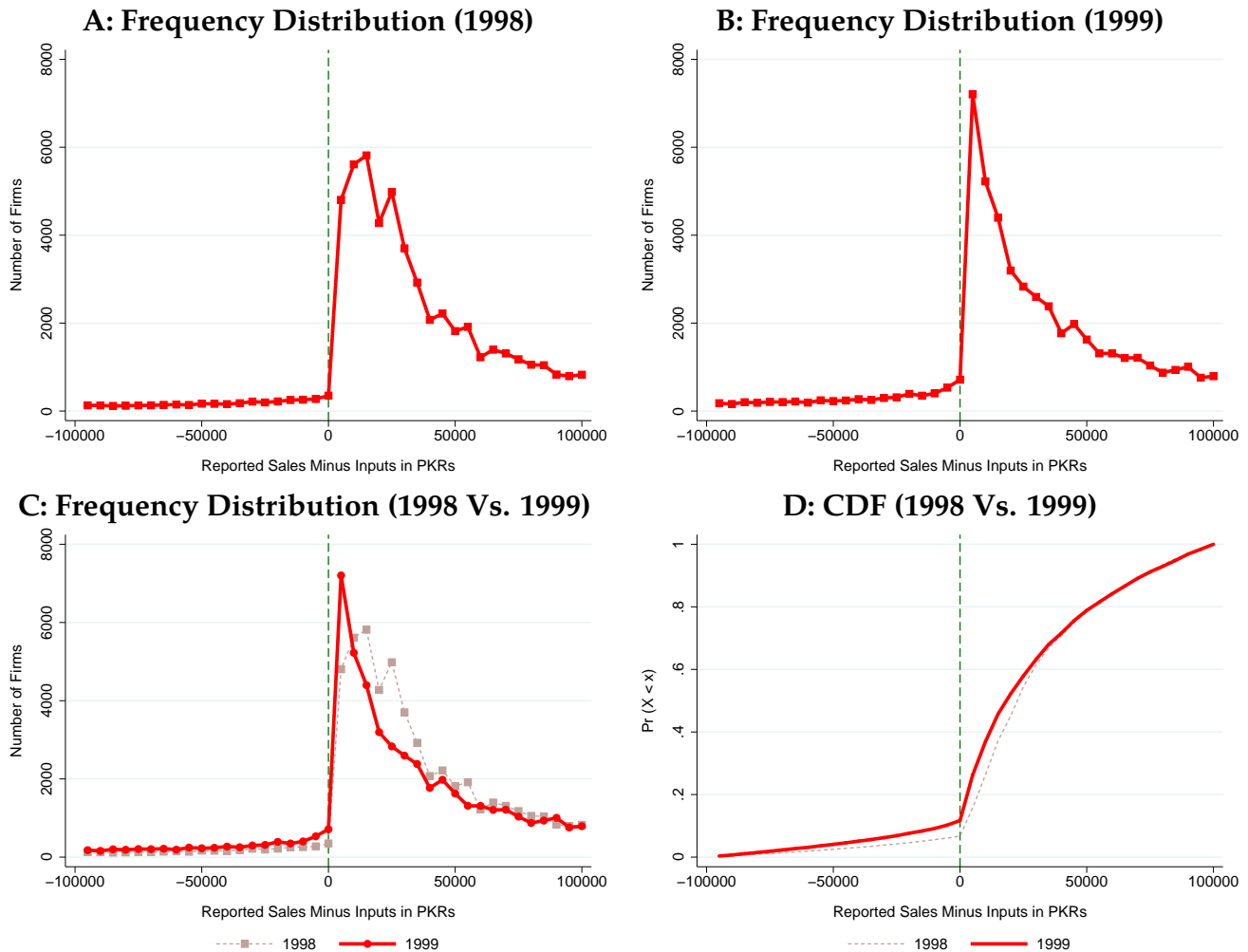
Notes: What happens when more inputs of a firm become taxable? This figure explores the behavior of a high-evasion-cost firm to such a reform. The plots show marginal evasion costs faced by the firm as a function of the amount evaded. At the origin, reported sales equal true sales and the evasion is zero. Evasion increases as we move toward right. At the point denoted by the long dashed vertical line, reported sales equal taxable inputs costs of the firm, and as a consequence its tax liability becomes zero. Marginal evasion costs jump at the point, as the tax administration is more likely to select firms who report negative liability for audit. When more inputs of the firm become taxable, the zero-liability point shifts to the left (long dashed vertical line in Panel B). Note that the change has no effect on the firm as its optimal sales choice was already to the left of the new zero-liability point. But the taxable liability reported by the firms $\tau(\hat{s}_i - c_i)$ will shrink as c_i is higher now.

FIGURE XI: EFFECT OF INCREASED WITHHOLDING ON A LOW-EVASION-COST FIRM



Notes: What happens when more inputs of a firm become taxable? This figure explores the behavior of a low-evasion-cost firm to such a reform. The plots show marginal evasion costs faced by the firm as a function of the amount evaded. At the origin, reported sales equal true sales and the evasion is zero. Evasion increases as we move toward right. At the point denoted by the long dashed vertical line, reported sales equal taxable inputs costs of the firm, and as a consequence its tax liability becomes zero. Marginal evasion costs jump at the point, as the tax administration is more likely to select firms who report negative liability for audit. When more inputs of the firm become taxable, the zero-liability point shifts to the left (long dashed vertical line in Panel B). After the reform, the firm increases its reported sales such that the new \hat{s}_i^* equals the increased c_i . The increase in reported sales means that the government collects more revenue in aggregate (input plus output) from the firm.

FIGURE XII: BUNCHING AT ZERO TAX LIABILITY



Notes: The figure explores if the discontinuity in evasion costs at the zero-liability point induces firms to bunch towards the right of the point. Panel A-C plot the distribution of $\hat{s}_i - c_i$ in bins of 5,000 rupees. Vertical dashed line denote the point where reported taxable sales equal reported taxable input costs and the tax liability becomes zero. The tax liability is negative to the left of this point. Panels A and B show the distribution for 1998 and 1999, the years immediately before and after energy inputs such as electricity and gas were made taxable. Panel C compares the two distributions, displaying the leftwards shift of the 1999 distribution. Panel D shows the leftwards shift formally. It plots the corresponding Cumulative Distribution Functions, illustrating that the 1999 distribution is stochastically (first-order) dominated by the 1998 distribution at all points.

TABLE I: SUMMARY STATISTICS

	Manufacturers			Importers			Others		
	1997	2000	2003	1997	2000	2003	1997	2000	2003
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
<u>A: Complete Panel</u>									
# Observations	133,877	203,773	228,293	38,053	121,848	141,377	6,945	149,004	197,410
Reported Sales:									
<i>Mean</i>	6.367	6.016	7.848	2.181	2.000	2.557	3.374	1.675	2.138
<i>Median</i>	0.476	0.441	0.547	0.828	0.550	0.596	0.926	0.159	0.194
<i>75th Percentile</i>	2.854	2.030	2.295	2.045	1.597	1.811	2.722	0.752	0.894
<i>90th Percentile</i>	13.726	10.042	11.074	4.735	4.033	4.937	7.741	2.615	3.112
<i>99th Percentile</i>	88.986	88.184	111.449	22.620	22.503	30.761	35.807	27.183	28.269
<u>B: Balanced Panel 1</u>									
# Observations	64,667	65,448	65,250	9,195	9,703	9,706	2,756	2,953	2,941
Reported Sales:									
<i>Mean</i>	8.465	11.373	17.329	3.181	4.477	5.045	3.798	4.086	5.049
<i>Median</i>	0.750	0.991	1.380	1.282	1.511	1.495	1.141	1.406	1.596
<i>75th Percentile</i>	4.386	4.776	6.677	3.196	4.040	4.499	3.378	3.913	4.191
<i>90th Percentile</i>	20.062	21.149	33.057	7.502	9.482	11.782	9.391	9.822	9.428
<i>99th Percentile</i>	119.017	172.919	235.177	28.720	49.657	58.463	36.746	43.379	63.315
<u>C: Balanced Panel 2</u>									
# Observations	24,972	24,972	24,972	1,908	1,908	1,908	396	396	396
Reported Sales:									
<i>Mean</i>	12.297	18.631	27.032	3.543	5.936	6.151	7.638	9.191	9.276
<i>Median</i>	1.078	1.483	2.078	1.458	1.645	1.728	2.458	3.942	4.117
<i>75th Percentile</i>	7.081	8.945	12.981	3.450	4.536	5.843	6.185	10.515	9.875
<i>90th Percentile</i>	27.331	37.499	54.312	8.608	12.621	16.377	25.478	29.774	20.520
<i>99th Percentile</i>	174.985	276.431	346.271	31.315	85.784	66.379	52.628	52.879	68.634

Notes: The table reports the descriptive statistics of the two main variables used in the empirical analysis. I report the number of observations and five moments of the reported taxable sales distribution at three different points in time. I show the statistics separately for manufacturers, importers, and all other firms excluding exporters. The Balanced Panel 1 sample in Panel B contains the firms who file VAT return at least once in every quarter during the period 1997-2003. These firms remain in the sample throughout the period but may not file the return every tax period. In distinction, the Balanced Panel 2 sample in Panel C has a more stringent criterion, including only those firms who file VAT return in every month during the period 1997-2003.

TABLE II: TAXABLE SALES RESPONSE

	All Firms		Balanced Panel 1		Balanced Panel 2	
	(1)	(2)	(3)	(4)	(5)	(6)
<u>A: 1997-2003</u>						
<i>Manuf</i> × <i>Post</i>	0.481 (0.016)	0.498 (0.022)	0.440 (0.029)	0.438 (0.036)	0.434 (0.068)	0.416 (0.081)
<i>Manuf</i> × 1998		0.024 (0.018)		-0.004 (0.027)		-0.035 (0.057)
Observations	1,288,552	1,288,552	429,510	429,510	153,873	153,873
<u>B: 2004-2010</u>						
<i>Manuf</i> × <i>Post</i>	0.013 (0.015)		0.029 (0.018)		0.037 (0.055)	
Observations	1,293,097		742,846		200,414	

Notes: The table reports the results from the difference-in-differences model (4). The standard errors are in parenthesis, which have been clustered at the firm level. The sample includes both manufacturers and importers. Balanced Panel 1 sample in columns (3)-(4) contains only the firms who file their VAT return at least once in every quarter included in the sample period. In distinction, the Balanced Panel 2 sample includes a firm only if it files its VAT return every tax period included in the sample. The results in Panel B are from a placebo specification exactly similar to one in Panel A but estimated on the 2004-2010 period. The *Post* dummy indicates a tax period (month) after June 1999 in Panel A and June 2006 in Panel B.

TABLE III: TAXABLE SALES RESPONSE OVER TIME

Year \leq	1999 (1)	2000 (2)	2001 (3)	2002 (4)	2003 (5)	2004 (6)	2005 (7)
<i>Manuf</i> \times <i>Post</i>	0.249 (0.014)	0.233 0.014	0.332 0.014	0.395 0.015	0.450 0.016	0.489 0.016	0.490 0.017
<i>Manuf</i> \times 2000		0.206 (0.013)					
<i>Manuf</i> \times 2001			0.198 (0.011)				
<i>Manuf</i> \times 2002				0.195 (0.011)			
<i>Manuf</i> \times 2003					0.190 (0.011)		
<i>Manuf</i> \times 2004						0.008 (0.012)	
<i>Manuf</i> \times 2005							0.030 (0.019)
Observations	360,669	569,495	799,627	1,042,084	1,288,552	1,516,133	1,673,981

Notes: The table investigates the dynamics of the taxable sales response. I partition the *Manuf* \times *Post* dummy in model (4) into two dummies: *Manuf* \times *Post* and *Manuf* \times *Year*. I estimate the model on the complete panel sample, restricting it to the period 1997-*Year*, where *Year* is the financial year indicated in the title of the column. The *Manuf* \times *Year* dummy captures the additional sales response in the given financial year. The standard errors are in parenthesis, which have been clustered at the firm level. The sample includes both manufacturers and importers. The *Post* dummy indicates a tax period (month) after June 1999.

TABLE IV: TAXABLE SALES RESPONSE AFTER DROPPING LARGE FIRMS

	All Firms		\leq 99th Percentile		\leq 95th Percentile		\leq 90th Percentile	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<u>A: 1997-2003</u>								
<i>Manuf</i> \times <i>Post</i>	0.440 (0.029)	0.438 (0.036)	0.434 (0.029)	0.437 (0.035)	0.444 (0.030)	0.440 (0.036)	0.479 (0.031)	0.493 (0.038)
<i>Manuf</i> \times 1998		-0.004 (0.027)		0.005 (0.027)		-0.008 (0.028)		0.025 (0.029)
Observations	429,510	429,510	422,783	422,783	396,086	396,086	365,003	365,003
<u>B: 2004-2010</u>								
<i>Manuf</i> \times <i>Post</i>	0.029 (0.018)		0.021 (0.018)		-0.006 (0.019)		-0.037 (0.020)	
Observations	742,846		729,695		683,412		628,291	

Notes: The table illustrates that the results in Table II are not driven by large firms. I estimate the difference-in-differences model (4) after dropping firms larger than the cutoff indicated in the heading of each column. The model is estimated on the Balanced Panel 1 sample, so that the composition of the sample stays fixed throughout the period of estimation. I define large firm on the basis of predetermined firm characteristics, taking average annual sales reported in the financial years 1997 and 1998 as the measure of its size. The standard errors are in parenthesis, which have been clustered at the firm level. The results in Panel B are from a placebo specification exactly similar to one in Panel A but estimated on the 2004-2010 period. The *Post* dummy indicates a tax period (month) after June 1999 in Panel A and June 2006 in Panel B.

TABLE V: PARTICIPATION RESPONSE

Year	Registration			Entry			Real Entry		
	# Obs.	# Counter.	% Difference	# Obs.	# Counter.	% Difference	# Obs.	# Counter.	% Difference
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1999	5,349	3,382	0.582 (0.061)	3,541	3,478	0.018 (0.030)	3,489	3,417	0.021 (0.032)
2000	5,993	3,277	0.829 (0.061)	7,714	3,157	1.443 (0.035)	6,549	1,772	2.696 (0.061)
2001	3,728	2,454	0.519 (0.077)	2,780	2,321	0.198 (0.048)	2,717	1,725	0.575 (0.059)
2002	2,563	2,516	0.019 (0.081)	2,404	2,420	-0.007 (0.044)	2,207	1,994	0.107 (0.054)
2003	2,252	2,294	-0.018 (0.083)	2,251	2,220	0.014 (0.048)	2,059	1,853	0.111 (0.056)
2004	2,556	2,941	-0.131 (0.070)	2,525	2,625	-0.038 (0.041)	2,337	1,908	0.225 (0.052)

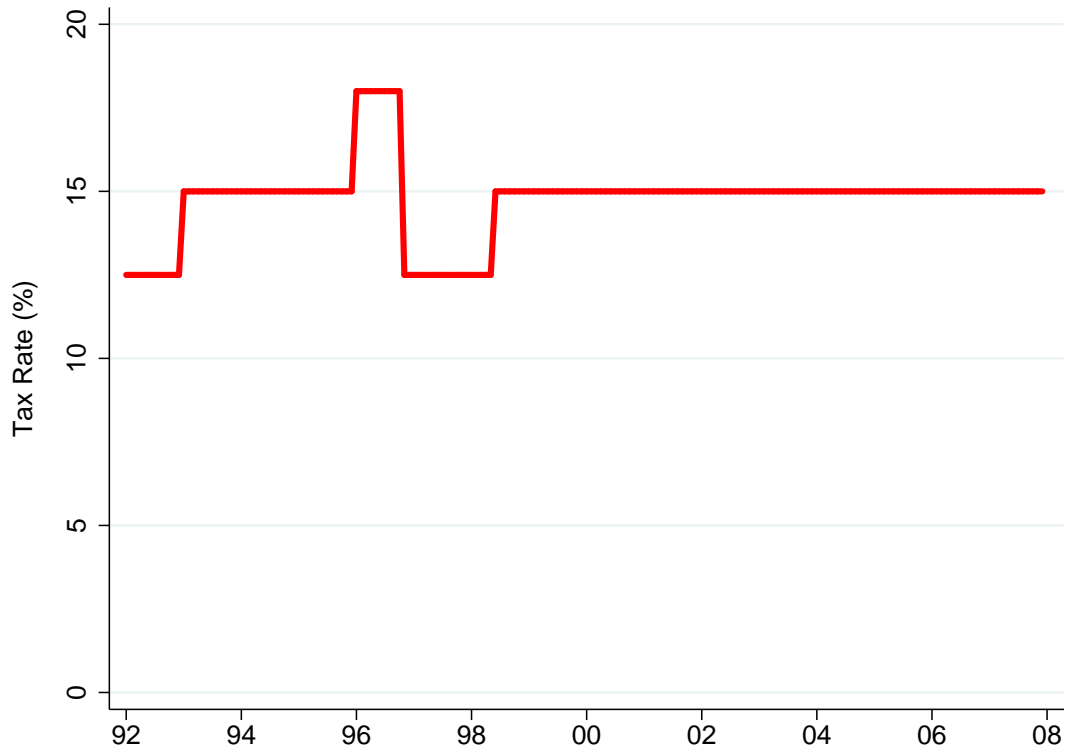
Notes: Does the tightening of enforcement caused indirectly by the expansion of VAT and directly by the tax survey force informal firms into the formal sector? The table investigates this. Column (2) reports the number of manufacturing firms who register in the financial year indicated in the first column. Column (3) reports the corresponding numbers for importers, whom I take as the counterfactual for manufacturers (see Figure VI). The difference between the two numbers as a percentage of the counterfactual is reported in Column (3). I calculate the standard error on the difference using a nonparametric bootstrap procedure. I first create a vector of errors as the difference between the monthly registration of manufacturers and importers. I then create a bootstrapped registration series for manufacturers by adding scrambled errors to the registration series of importers. Finally, I calculate the difference between the bootstrapped and counterfactual series for each financial year. The standard error is the average percentage difference between the two series. I draw 100 bootstrapped series for this purpose. Columns (4)-(10) are created analogously, only difference being that I investigate the outcomes entry and real entry in place of registration. Entry here is defined as the month a firm files its first return and real entry as the month the firm files its first positive-activity return.

A Online Appendix

A.1 Definition of Variables

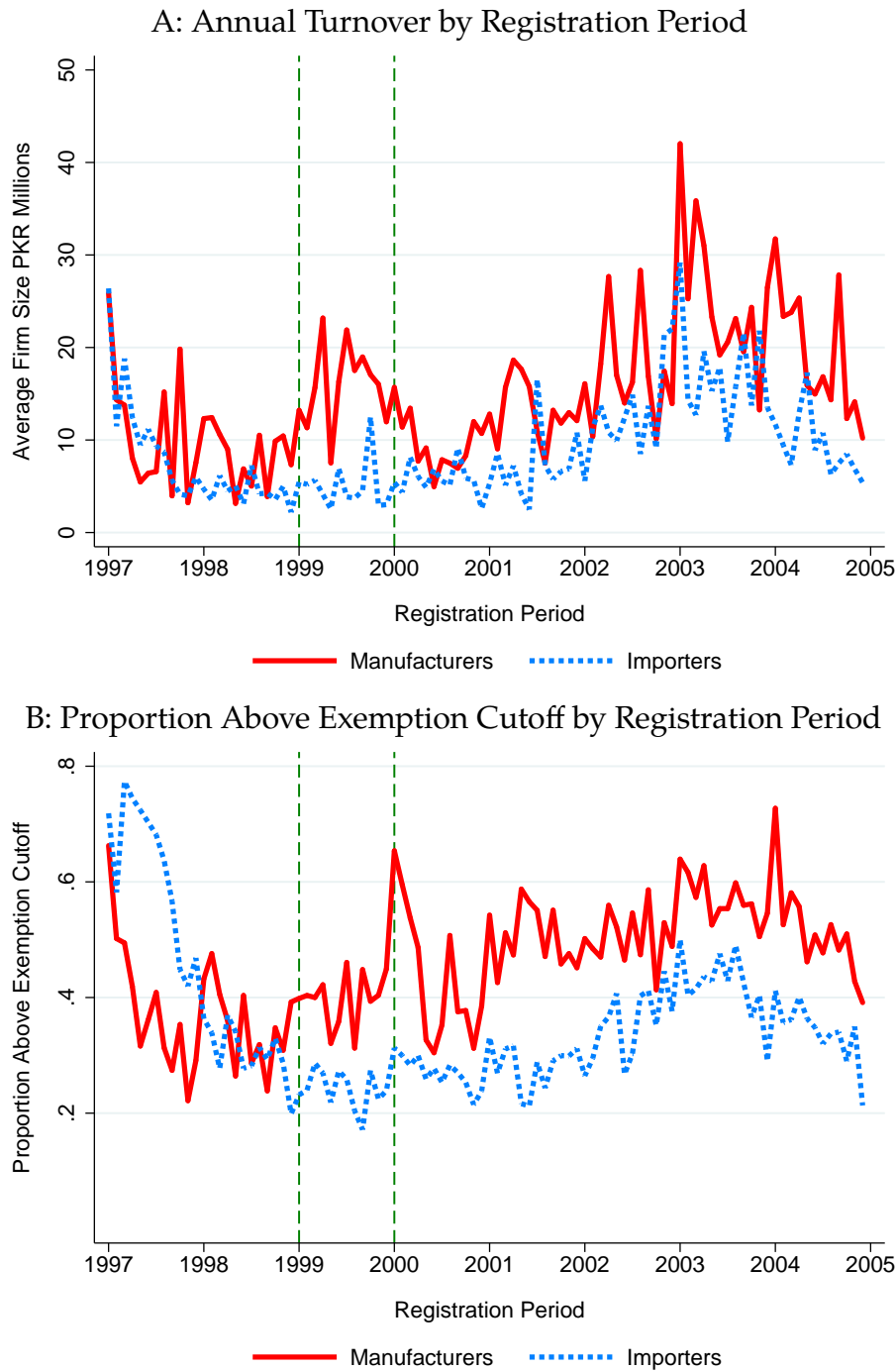
- (i) **Taxable Sales** The value of taxable goods and services supplied by a firm in a given tax period excluding exports.
- (ii) **Taxable Inputs Costs.** The value of taxable intermediates purchased by a firm in the given tax period whether imported or acquired locally.
- (iii) **Manufacturer.** A firm whose principal business activity is the manufacture of goods. Manufacturing is the process whereby a firm converts inputs into a distinct article capable of being put to use differently than inputs and includes any process incidental or ancillary to it.
- (iv) **Importer.** A firm whose principal business activity is the import and subsequent sales of goods. An importers sells the goods in the same state they were imported.
- (v) **Distributor.** Distributors, dealers, and wholesalers form the middle stages of the supply chain. They purchase goods from manufacturers or importers in bulk and supply them down the chain.
- (vi) **Industry.** The Pakistani tax administration uses 4-digit Harmonized Commodity Description and Coding System (HS code) to classify firms into industry. The code, used by customs administrations throughout the world, divides all goods and services into 99 chapters (the first two digits in the code) and 21 sections. The sections broadly correspond to major industries in the country. I take the section a firm falls in as its industry. Table A.I shows the sections, HS code, and description of these industries.
- (vii) **Tax Office.** The variable indicates the tax office whose jurisdiction a firm's head office falls in. These tax offices are located in nine major cities of the country. The tax office fixed effects, accordingly, capture all time-invariant characteristics of both the tax office and city in which a firm carries out its business activity.

FIGURE A.I: STANDARD TAX RATE



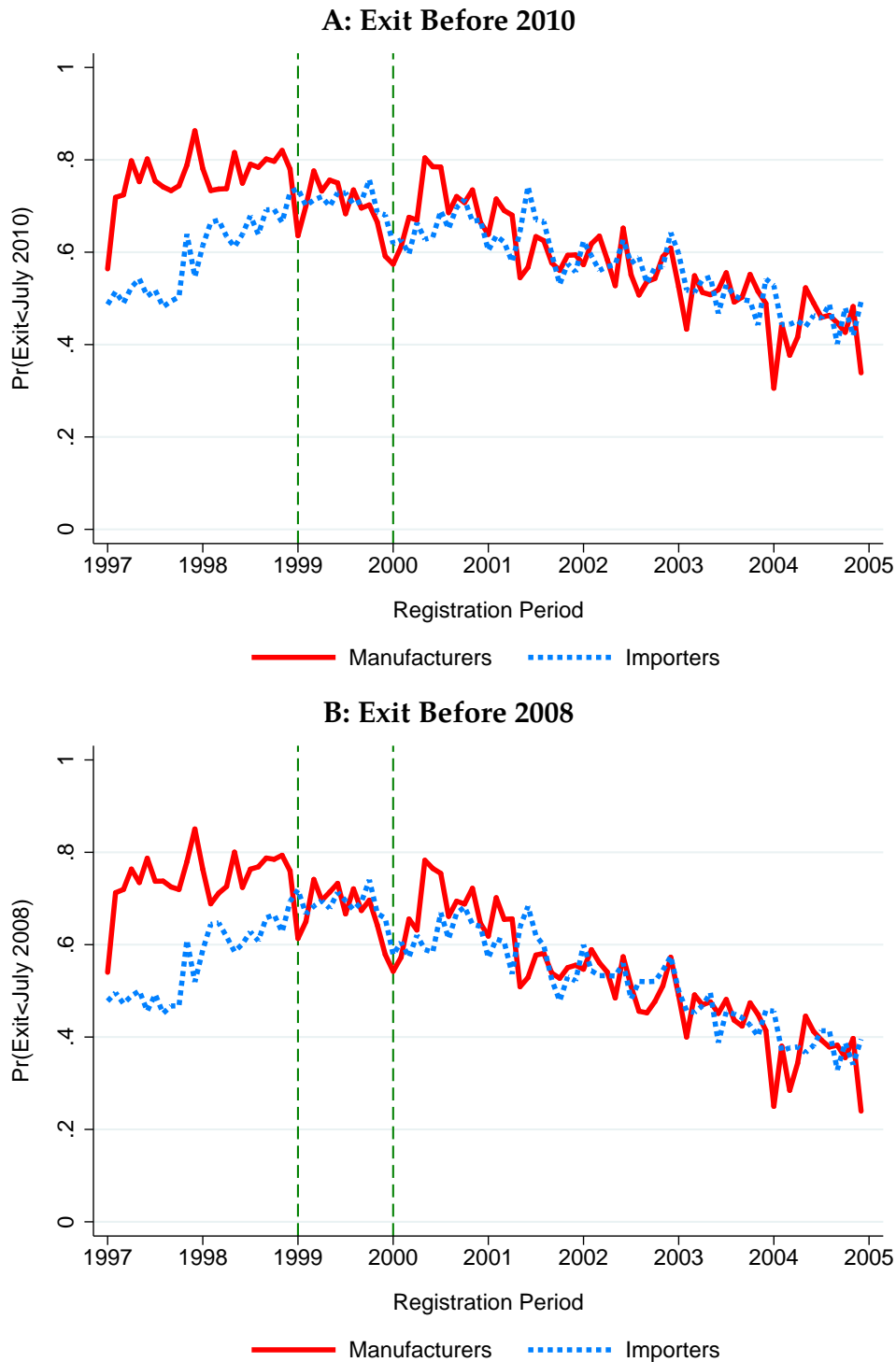
Notes: The figure shows the standard VAT rate in Pakistan from 1992 to 2008. The rate largely stayed at 15%. It was increased to 18% in July 1996, reduced to 12.5% in April 1997, and was brought back to 15% in December 1998.

FIGURE A.II: FIRM SIZE BY REGISTRATION PERIOD



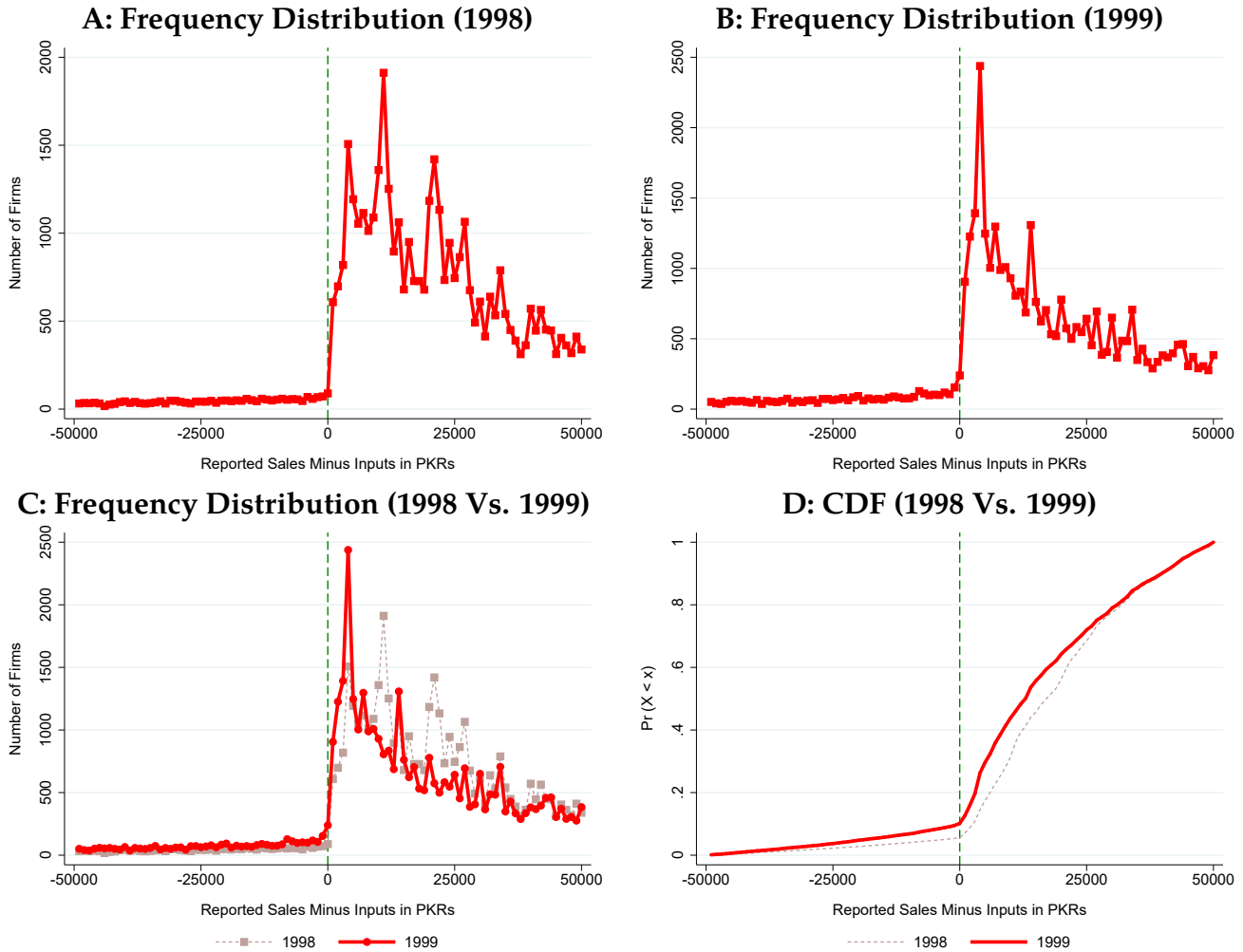
Notes: The figure investigates if firms who came into the formal sector in response to the increasing exposure to VAT and enforcement survey were any different from the other firms. It replicates the analysis in Figure VIII but takes the period a firm registers in as its period of entry. Panel A plots the first-year turnover of firms by their entry period. The first-year here is defined as the tax year immediately succeeding the one in which a firm files its first VAT return. For example, if a firm files its first return in August 2000, its first-year turnover is the aggregate value of its sales in the tax year 2001-02. While doing this exercise, I drop firms whose first-year turnover exceeds PKR 1 billion. Panel B of the figure depicts the proportion of firms whose first-year turnover is above the exemption cutoff. Note that the exemption cutoff applies only to manufacturers. I use the same cutoff for importers. Vertical lines in the plots denote important events during this period: VAT was extended to the energy sector in July 1999 and to the services sector in July 2000; and the enforcement survey commences from the end of May 2000.

FIGURE A.III: EXIT PROBABILITY BY REGISTRATION PERIOD



Notes: The figure investigates if firms who came into the formal sector in response to the increasing exposure to VAT and enforcement survey were any different from the other firms. It replicates the analysis in Figure IX but takes the period a firm registers in as its period of entry. It plots the proportion of firms who exit before the given cutoff date by their entry month. The cutoff date is the 1st of July 2010 for Panel A and the 1st of July 2008 for Panel B. Vertical lines in the plots denote important events during this period: VAT was extended to the energy sector in July 1999 and to the services sector in July 2000; and the enforcement survey commences from the end of May 2000.

FIGURE A.IV: BUNCHING AT ZERO TAX LIABILITY



Notes: The figure explores if the discontinuity in evasion costs at the zero-liability point induces firms to bunch towards the right of the point. Panel A-C plot the distribution of $\hat{s}_i - c_i$ in bins of 1,000 rupees. Vertical dashed line denote the point where reported taxable sales equal reported taxable input costs and the tax liability becomes zero. The tax liability is negative to the left of this point. Panels A and B show the distribution for 1998 and 1999, the years immediately before and after energy inputs such as electricity and gas were made taxable. Panel C compares the two distributions, displaying the leftwards shift of the 1999 distribution. Panel D shows the leftwards shift formally. It plots the corresponding Cumulative Distribution Functions, illustrating that the 1999 distribution is stochastically (first-order) dominated by the 1998 distribution at all points.

TABLE A.I: INDUSTRY DESCRIPTION

Industry Label (1)	HS Code Heading (2)	Industry Description (3)
1	1600-2499	Food and Beverages
2	2800-3899	Chemicals
3	3900-4099	Plastics
4	4100-4399	Leather
5	4400-4699	Wood Products
6	4700-4999	Paper and Paperboard
7	5000-6399	Textile
8	6400-6799	Footwear
9	6800-7099	Cement and Cement Products
10	7100-7199	Jewelry
11	7200-8399	Metal and Metal Products
12	8400-8599	Machinery
13	8600-8999	Vehicles and Vehicle Parts
14	9000-9299	Medical or Surgical Instruments
15	9300-9399	Arms and Ammunitions
16	9400-9699	Furniture
17	9700-9899	Restaurants

Notes: The table displays the HS code and description of the industry variable used in Figure V. The HS code used by the Pakistani tax administration divides all goods and services into 99 chapters (the first two digits in the code) and 21 sections. The sections broadly correspond to major industries in the country. I drop firms belonging to four industries (sections) from the sample where VAT on manufacturing was extended after 1996. First column reports the Industry Label used in the horizontal axis of Figure V. The second column shows the range of HS codes included in the industry and the third column the industry description. Note that arms and ammunitions is largely a cottage industry in Pakistan, wherein firearms are manufactured by artisans of small firms.

TABLE A.II: CHARACTERISTICS OF INDUSTRIES WITH BELOW-AVERAGE RESPONSE

	Average Firm Size (1)	Low Initial Capital (2)	Input to Output Ratio (3)	Input \leq 0.05* Output (4)	Voluntary Registered (5)	Sales Growth (6)
<i>Below-Average</i>	-0.319 (0.028)	0.076 (0.019)	-0.413 (0.052)	0.097 (0.013)	-0.130 (0.019)	
<i>Below-Average</i> \times <i>Post</i>						0.019 (0.040)
Observations	244,005	244,005	91,067	244,005	244,005	143,052

Notes: The table explores the characteristics of firms in four industries where taxable sales response is weaker than the average (see Figure V). These industries are labeled 5 (Wood Products), 8 (Footwear), 15 (Arms and Ammunition), and 16 (Furniture) in the diagram. Column (1)-(5) report the results from the regression of outcome variable mentioned at the top of the column on a dummy indicating that the firms belongs to one of these four industries. Initial Capital is the amount of capital reported by a firm at the time of its registration, a proxy for firm size. For the definition of other variables please see Appendix A. The final column reports the results from the difference-in-differences model (4) estimated on the period 1997-1998 only, with the latter year defined as the *Post* period. The idea behind the column is to show that taxable sales reported by firms in the four industries behaved similar to the other firms in the pre-99 period.

TABLE A.III: TAXABLE SALES RESPONSE AFTER DROPPING LARGE FIRMS

	All Firms		\leq 99th Percentile		\leq 95th Percentile		\leq 90th Percentile	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<u>A: 1997-2003</u>								
<i>Manuf</i> \times <i>Post</i>	0.440 (0.029)	0.438 (0.036)	0.436 (0.029)	0.433 (0.036)	0.449 (0.030)	0.452 (0.037)	0.457 (0.032)	0.462 (0.039)
<i>Manuf</i> \times 1998		-0.004 (0.027)		-0.004 (0.028)		0.006 (0.028)		0.010 (0.030)
Observations	429,510	429,510	422,790	422,790	396,466	396,466	365,996	365,996
<u>B: 2004-2010</u>								
<i>Manuf</i> \times <i>Post</i>	0.029 (0.018)		0.018 (0.018)		-0.016 (0.019)		-0.041 (0.019)	
Observations	742,846		730,279		686,161		633,237	

Notes: The table illustrates that the results in Table II are not driven by large firms. I estimate the difference-in-differences model (4) after dropping firms larger than the cutoff indicated in the heading of each column. The model is estimated on the Balanced Panel 1 sample, so that the composition of the sample stays fixed throughout the period of estimation. I define large firm on the basis of predetermined firm characteristics, taking annual sales reported in the financial year 1997 as the measure of its size. The standard errors are in parenthesis, which have been clustered at the firm level. The results in Panel B are from a placebo specification exactly similar to one in Panel A but estimated on the 2004-2010 period. The *Post* dummy indicates a tax period (month) after June 1999 in Panel A and June 2006 in Panel B.

TABLE A.IV: TAXABLE SALES RESPONSE

	All Firms		Balanced Panel 1		Balanced Panel 2	
	(1)	(2)	(3)	(4)	(5)	(6)
<u>A: 1997-2003</u>						
<i>Manuf</i> × <i>Post</i>	0.476 (0.019)	0.479 (0.026)	0.389 (0.037)	0.396 (0.044)	0.436 (0.093)	0.435 (0.101)
<i>Manuf</i> × 1998		0.005 (0.020)		0.013 (0.033)		-0.002 (0.059)
Observations	782,044	782,044	244,776	244,776	75,844	75,844
<u>B: 2004-2010</u>						
<i>Manuf</i> × <i>Post</i>	-0.004 (0.023)		-0.018 (0.027)		-0.084 (0.117)	
Observations	563,457		324,566		73,792	

Notes: The table report the results from the difference-in-differences model (4). The standard errors are in parenthesis, which have been clustered at the firm level. Here I drop the firms from the sample who combine more than one production stages, for example manufacturing and distribution. The sample includes both manufacturers and importers. Balanced Panel 1 sample in columns (3)-(4) contains only the firms who file their VAT return at least once in every quarter included in the sample period. In distinction, the Balanced Panel 2 sample includes a firm only if it files its VAT return every tax period included in the sample. The results in Panel B are from a placebo specification exactly similar to one in Panel A but estimated on the 2004-2010 period. The *Post* dummy indicates a tax period (month) after June 1999 in Panel A and June 2006 in Panel B.

TABLE A.V: TAXABLE INPUTS RESPONSE

	All Firms		Balanced Panel 1		Balanced Panel 2	
	(1)	(2)	(3)	(4)	(5)	(6)
<u>A: 1997-2003</u>						
<i>Manuf</i> × <i>Post</i>	0.367 (0.020)	0.411 (0.027)	0.454 (0.032)	0.501 (0.039)	0.479 (0.067)	0.501 (0.083)
<i>Manuf</i> × 1998		0.065 (0.021)		0.086 (0.031)		0.043 (0.064)
Observations	772,879	772,879	205,584	205,584	65,458	65,458
<u>B: 2004-2010</u>						
<i>Manuf</i> × <i>Post</i>	-0.104 (0.019)		-0.099 (0.022)		-0.041 (0.069)	
Observations	792,859		368,017		89,093	

Notes: The table report the results from the difference-in-differences model (4). The outcome variable here is the log of taxable input costs instead of the log of taxable sales as in Table II. As I am unable to apportion inputs used in taxable sales and exports, I drop from the sample all firms who export even once in the sample period. The standard errors are in parenthesis, which have been clustered at the firm level. The sample includes both manufacturers and importers. Balanced Panel 1 sample in columns (3)-(4) contains only the firms who file their VAT return at least once in every quarter included in the sample period. In distinction, the Balanced Panel 2 sample includes a firm only if it files its VAT return every tax period included in the sample. The results in Panel B are from a placebo specification exactly similar to one in Panel A estimated on the 2004-2010 period. The *Post* dummy indicates a period after June 1999 in Panel A and June 2006 in Panel B.

TABLE A.VI: TAXABLE SALES RESPONSE

	All Firms		Balanced Panel 1		Balanced Panel 2	
	(1)	(2)	(3)	(4)	(5)	(6)
<u>A: 1997-2003</u>						
<i>Manuf</i> × <i>Post</i>	0.492 (0.018)	0.510 (0.024)	0.465 (0.033)	0.473 (0.039)	0.425 (0.072)	0.408 (0.089)
<i>Manuf</i> × 1998		0.026 (0.019)		0.015 (0.030)		-0.034 (0.064)
Observations	999,111	999,111	263,221	263,221	80,874	80,874
<u>B: 2004-2010</u>						
<i>Manuf</i> × <i>Post</i>	-0.029 (0.018)		-0.029 (0.022)		0.008 (0.060)	
Observations	823,540		392,719		92,459	

Notes: The table report the results from the difference-in-differences model (4). The sample here is the same as in the last table, wherein I report the corresponding taxable inputs response. The standard errors are in parenthesis, which have been clustered at the firm level. The sample includes both manufacturers and importers. Balanced Panel 1 sample in columns (3)-(4) contains only the firms who file their VAT return at least once in every quarter included in the sample period. In distinction, the Balanced Panel 2 sample includes a firm only if it files its VAT return every tax period included in the sample. The results in Panel B are from a placebo specification exactly similar to one in Panel A estimated on the 2004-2010 period. The *Post* dummy indicates a period after June 1999 in Panel A and June 2006 in Panel B. Single-activity firms only

TABLE A.VII: TAXABLE SALES RESPONSE

	All Firms		Balanced Panel 1		Balanced Panel 2	
	(1)	(2)	(3)	(4)	(5)	(6)
<u>A: 1997-2003</u>						
<i>Manuf</i> × <i>Post</i>	0.440 (0.030)	0.459 (0.044)	0.420 (0.059)	0.421 (0.070)	0.274 (0.150)	0.208 (0.173)
<i>Manuf</i> × 1998		0.025 (0.036)		0.002 (0.054)		-0.122 (0.124)
Observations	1,288,552	1,288,552	429,510	429,510	153,873	153,873
<u>B: 2004-2010</u>						
<i>Manuf</i> × <i>Post</i>		-0.032 (0.020)		-0.007 (0.025)		0.124 (0.063)
Observations	1,293,097		742,846		200,414	

Notes: The table report the results from the difference-in-differences model (4). Here I include *Industry*, *Period*, and *Industry* × *Period* fixed effects into the model, allowing firms in each industry to have their own trend over time. The standard errors are in parenthesis, which have been clustered at the firm level. The sample includes both manufacturers and importers. Balanced Panel 1 sample in columns (3)-(4) contains only the firms who file their VAT return at least once in every quarter included in the sample period. In distinction, the Balanced Panel 2 sample includes a firm only if it files its VAT return every tax period included in the sample. The results in Panel B are from a placebo specification exactly similar to one in Panel A estimated on the 2004-2010 period. The *Post* dummy indicates a period after June 1999 in Panel A and June 2006 in Panel B.

TABLE A.VIII: TAXABLE SALES RESPONSE

	All Firms		Balanced Panel 1		Balanced Panel 2	
	(1)	(2)	(3)	(4)	(5)	(6)
<u>A: 1997-2003</u>						
<i>Manuf</i> × <i>Post</i>	0.504 (0.020)	0.522 (0.028)	0.485 (0.034)	0.477 (0.041)	0.505 (0.073)	0.459 (0.087)
<i>Manuf</i> × 1998		0.027 (0.022)		-0.013 (0.031)		-0.087 (0.060)
Observations	1,288,552	1,288,552	429,510	429,510	153,873	153,873
<u>B: 2004-2010</u>						
<i>Manuf</i> × <i>Post</i>		-0.036 (0.017)		-0.021 (0.020)		0.060 (0.058)
Observations	1,293,097		742,846		200,414	

Notes: The table report the results from the difference-in-differences model (4). Here I include *Tax Office*, *Period*, and *Tax Office* × *Period* fixed effects into the model, allowing firms in each region to have their own trend over time. The standard errors are in parenthesis, which have been clustered at the firm level. The sample includes both manufacturers and importers. Balanced Panel 1 sample in columns (3)-(4) contains only the firms who file their VAT return at least once in every quarter included in the sample period. In distinction, the Balanced Panel 2 sample includes a firm only if it files its VAT return every tax period included in the sample. The results in Panel B are from a placebo specification exactly similar to one in Panel A estimated on the 2004-2010 period. The *Post* dummy indicates a period after June 1999 in Panel A and June 2006 in Panel B.

TABLE A.IX: VAT REVENUE (1997-2003)

Year	Including Energy		Excluding Energy		Including Energy as an Intermediate Good	
	PKR Mill.	Percent Increase	PKR Mill.	Percent Increase	PKR Mill.	Percent Increase
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1997	29,085	-	28,106	-	28,601	-
1998	30,735	5.67	29,484	4.90	30,116	5.29
1999	49,666	61.60	36,795	24.80	43,633	44.88
2000	65,011	30.89	43,976	19.52	54,758	25.50
2001	73,782	13.49	49,502	12.57	61,709	12.69
2002	89,534	21.35	54,859	10.82	71,230	15.43
2003	93,292	4.20	55,886	1.87	73,950	3.82

Notes: The table reports the domestic VAT collected in Pakistan from 1997 to 2003. I compile these data from Table 33 of the 2001-02 and Tables 32 of the 2003-04 and 2004-05 FBR Year Books. These books are available online [here](#). Columns (2), (4), and (6) report aggregate non-import VAT revenue in PKR millions. The standard VAT rate changed during the sample period for two brief episodes (see Figure A.I). To make the revenue comparable across years, I normalize the standard rate to 15% for the entire period. More specifically, I multiply the 1997 revenue by a factor $0.15/0.125$ and the 1998 revenue by a factor of $0.15/0.142$, where 0.142 is the weighted average of the standard VAT rate in 1998. Columns (3), (5), and (7) show the corresponding year-on-year increase from the previous year. Columns (2) and (3) do not exclude any commodity. Columns (4) and (5), on the other hand, exclude three commodities of the energy sector: electricity, gas, and POL products. Columns (6) and (7) include 33% of revenue from electricity, 66% of revenue from gas, and 70% of revenue from POL products. These proportions represent the fraction of electricity, gas, and POL products used in manufacturing as intermediate goods. These proportions have been calculated from the data in the Pakistan Economic Survey 2005-06 (Table 14). The survey can be accessed [here](#).

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