

# Technology, Taxation, and Corruption: Evidence from the Introduction of Electronic Tax Filing\*

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Many e-government initiatives introduce technology to improve efficiency and avoid potential human bias. Electronic tax filing (e-filing) is an important example, as developing countries increasingly adopt online submission of tax declarations to replace in-person submission to tax officials. This paper examines the impact of e-filing on compliance costs, tax payments, and bribe payments using experimental variation and data from Tajikistan firms. Firms that e-file have lower compliance costs, spending five fewer hours each month on fulfilling tax obligations. There are no significant average effects of e-filing on tax or bribe payments, but significant heterogeneity exists across firms by their baseline likelihood of tax evasion. Among firms previously more likely to evade, e-filing doubles tax payments, likely by disrupting collusion with officials. Conversely, among firms less likely to have been evading, e-filing reduces tax payments, suggesting that officials had previously required them to pay more. These firms also pay fewer bribes, as e-filing reduces opportunity for extortion. In all, the results indicate that e-filing reduces compliance costs and makes the distribution of tax payments across firms arguably more equitable.

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# 1 Introduction

Technology is transforming the ways governments deliver services to and interact with citizens across various sectors, from public financial management to social programs to elections and many others ([World Development Report 2016](#)). These e-government initiatives typically seek to improve service delivery and efficiency. Often, they also aim to combat corruption by automating systems and reducing officials' discretion.

Tax administration is an important application of e-government in developing countries. Tax systems in these countries are often characterized by frequent interactions between tax officials and taxpayers because, given limited data sources to monitor compliance, tax officials are often responsible for direct, in-person monitoring of taxpayers. This makes the system more vulnerable to corruption, both in terms of collusion between tax collectors and taxpayers to evade taxes, as well as extortion of taxpayers by tax officials. These manual systems also typically result in high compliance costs which may further discourage compliance. These features of the tax system may contribute to the observed low fiscal capacity in many developing countries ([Gordon and Li, 2009](#), [Besley and Persson, 2014](#)) that limits their ability to provide services and growth-promoting public goods.

A number of governments have responded by adopting electronic filing (henceforth e-filing) of taxes. E-filing refers broadly to online submission of tax declarations, typically replacing in-person submission to tax officials.<sup>1</sup> As of 2015, 32 percent of developing countries had introduced e-filing and its prevalence continues to grow rapidly ([World Development Report 2016](#)).<sup>2</sup> The most common feature of tax reforms reported in the 2015 World Bank Doing Business Indicators was the introduction or enhancement of electronic systems for filing and paying taxes, with 26 economies implementing such changes ([World Bank,](#)

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<sup>1</sup> Mail submission is also possible but less common in low income countries with unreliable postal systems.

<sup>2</sup> E-filing use increases with national income. It is present in 85 percent of high-income countries and in 65 percent of middle-income countries ([World Development Report 2016](#)).

2016). Given the rising prevalence of e-filing, it is increasingly important to understand its impact.

In this paper, we examine the impact of e-filing adoption using data from small and medium sized businesses in Dushanbe, the capital city of Tajikistan. Since e-filing was available to all firms, we implement an encouragement design whereby we provide a randomly selected group of firms in-depth training on e-filing as well as logistical help in completing the different steps involved in the e-filing registration process. Ninety-three percent of firms in this group adopt e-filing, compared with 60 percent in the comparison group. We use this difference to estimate the impact of e-filing adoption on firms.<sup>3</sup>

E-filing may improve tax administration in multiple ways. First, online submission may reduce tax compliance costs by removing the need for time-consuming, anxiety-inducing visits to the tax office, freeing up resources for productive activities. Second, by reducing the frequency of in-person interactions between taxpayers and tax officials, e-filing may reduce collusion between the two parties to reduce tax payments. Third, by removing the need for a tax official to verify submission of tax declarations, e-filing may also protect taxpayers from tax officials holding them up and extorting them. In addition, e-filing may produce system-wide efficiency gains by removing the need for physical collection of forms and data entry. Lastly, by making tax information submitted by taxpayers immediately available electronically, e-filing may increase the ease of data analysis for monitoring.

On the other hand, it is possible that e-filing may not deliver these expected benefits or may even lead to worse outcomes, especially in low income settings with limited information technology coverage and low capacity in other aspects of tax administration. For example, certain taxpayers may experience significant costs of adoption rendering e-filing inaccessible to them (Yilmaz and Coolidge, 2013). For small businesses with limited

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<sup>3</sup> Given the firm-level design, we are unable to examine system-wide efficiency impacts of e-filing.

third-party reporting or other means of verifying income, tax officials may have important private information gathered from field visits and frequent interactions with firms which they use in verifying filing submissions. Since e-filing removes this *ex-ante* check, it may lead to lower tax revenues.

While e-filing may benefit taxpayers by decreasing compliance costs and reducing exposure to extortion, it may also constrain them by reducing opportunities for collusion and tax evasion. As such, the adoption decision will depend on the relative expected costs and benefits to each firm. This suggests that there may be important selection effects in the adoption of e-filing, as well as heterogeneous effects of e-filing on firms by their tax compliance at baseline. Since tax evasion is not directly observable, we use a risk profile score developed by the tax authority as an indicator of likelihood of evasion. Supporting the use of this proxy, we observe that conditional on observable firm characteristics including industry, number of employees and turnover, higher risk scores are correlated with lower tax payments and with higher audit adjustments and penalties. For ease of exposition, we consider firms above the median risk score to be “high-risk firms” and those below the median to be “low-risk firms.”

We find evidence of selection effects in e-filing adoption: one standard deviation increase in a firm’s risk score is associated with a 7 percentage point decrease in its likelihood of e-filing. Further, among the treatment group for whom adoption was almost universal, high-risk firms are 13 percentage points more likely to stop using e-filing within six months. This pattern is consistent with these high-risk firms deriving more benefit from dealing directly with tax inspectors under paper filing, presumably to reduce their tax liabilities.

Next, we examine the impact on our main outcomes (compliance costs, tax payments, and unofficial payments). Firms that e-file because of our intervention save almost five hours on average every month, about 15 percent of the total amount of time spent on

tax-related activities. Overall, we find no significant effects on unofficial payments or on the amount of taxes paid, but this result masks substantial heterogeneity across firms. Among high-risk firms, e-filing leads to a significant increase in taxes paid. This result is consistent with high-risk firms losing opportunities to collude with officials to reduce their taxes, an interpretation further supported by evidence of changes in tax preparation procedures of high-risk firms. Over time, this impact on tax payment fades as more high-risk firms revert to paper filing. In line with this, there is no significant impact of e-filing on unofficial payments measured one year after the intervention.

Among low-risk firms, e-filing adoption leads to a decrease in the amount of taxes paid and in the likelihood of paying bribes. The coexistence of these two effects suggests that at baseline, tax officials had played an important monitoring role in ensuring that these firms paid a minimum amount of tax while also extracting bribes from them. Importantly, these opposing effects on tax payments by high-risk and low-risk firms lead to closing the revenue gap otherwise observable between these two groups. This result holds when controlling for observable differences between high- and low-risk firms. As such, while the intervention does not change the amount of taxes paid, it changes the distribution of tax payments across firms in a way that is arguably more equitable, given the evidence of higher evasion among high-risk firms and reduction of unofficial payments among low-risk firms.

This paper contributes to different areas of the literature: First, it adds to a growing body of work on the role of technology in enhancing state capacity. Recent studies have examined the impact of e-government initiatives in increasing transparency, reducing leakages and monitoring compliance in different government functions ranging from procurement ([Lewis-Faupel et al., 2016](#)) to elections ([Fujiwara, 2015](#)) to social programs ([Banerjee et al., 2017](#), [Muralidharan et al., 2016](#)) and many others ([Olken and Pande, 2012](#), [World Development Report 2016](#)). In the field of taxation, [Ali et al. \(2015\)](#) and [Eissa et al.](#)

(2015) examine the impact of electronic billing machines on tax compliance in Ethiopia and Rwanda respectively. While much of the existing literature across sectors indicates positive effects, this paper highlights the fact that technology may have heterogeneous effects on users based on their compliance behavior prior to the introduction of the technology. Further, when adoption is voluntary, firms and individuals on whom the technology may have the greatest monitoring impact may be the least likely to adopt.

Second, this paper contributes to the rapidly growing literature on taxation in developing countries. To date, this literature has focused largely on taxpayer responses to different types of messaging, third-party reporting and tax policy changes (See [Slemrod, 2017](#) for a review), devoting less attention to interactions between tax officials and taxpayers. Notable exceptions are [Khan et al. \(2016\)](#) and [Amodio et al. \(2017\)](#), who study the impact of performance pay for tax collectors on revenue and bribe payments. Whereas those interventions sought to change the incentives of tax collectors, this paper focuses on changing the opportunities for collusion and extortion between tax officials and taxpayers. Third, and more broadly, this paper contributes to our understanding of corruption and of the effectiveness of strategies to reduce it (see [Olken and Pande, 2012](#) for a review). Similar to [Sequeira and Djankov \(2014\)](#), it differentiates between collusive and coercive corruption and the differential response of firms to both.

Lastly, this study provides some of the first evidence on the causal impact of e-filing. The only other study we are aware of is [Kochanova et al. \(2016\)](#) which uses variation in when different countries introduced e-filing and firm-level outcome data from different waves of the World Bank Enterprise Surveys to determine that, on average, e-filing reduces compliance costs and bribe solicitation, but provides no results on the impact on tax revenue. By using firm-level variation in e-filing adoption that arises from a randomized experiment, this paper avoids endogeneity bias that may be otherwise present.

The rest of this paper proceeds as follows. Section 2 provides background on the tax administration system and the introduction of electronic tax filing in Tajikistan while Section 3 provides details on the experiment design and program implementation. Section 4 outlines a simple conceptual framework for the impact of e-filing and the adoption decision of firms. Section 5 describes the data and Section 6 outlines the empirical specification. Section 7 provides results on e-filing adoption, as well as results on the impact of e-filing on firms. Section 8 concludes and outlines policy implications.

## **2 Context: Tax Administration and Electronic Tax Filing in Tajikistan**

Like many developing countries, Tajikistan<sup>4</sup> faces significant challenges with improving tax administration and reducing corruption, making it an interesting setting to study the introduction of e-filing. Firms face high tax compliance costs: In addition to the turnover tax (filed quarterly),<sup>5</sup> small and medium firms must also file monthly declarations for income tax withholdings on employee salaries and social insurance tax for employees.<sup>6</sup> In addition, they are obliged to conduct a quarterly reconciliation of their tax accounts.

In the absence of e-filing, firms submit their tax declarations in person at local tax offices, spending otherwise productive time waiting in line for multiple checks and signatures from tax officials. On average, firms in the study sample report spending six hours each month fulfilling tax obligations (excluding accounting), with about three hours going towards visits to the tax office. Furthermore, corruption is a major concern in Tajikistan. At

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<sup>4</sup> With a 2015 GDP per capita (current USD) of \$919, Tajikistan is classified as a low-income country in Central Asia (World Development Indicators, 2015).

<sup>5</sup> Firms in the study sample are drawn from the simplified tax regime and as such are subject to a turnover tax rather than a corporate income tax.

<sup>6</sup> The tax rates are 6 percent of turnover, 25 percent of salaries for the social tax, and 13 percent of salaries for the income tax.

the time this project commenced, the [World Bank Enterprise Survey \(2013\)](#) indicated that 32 percent of firms expect to give gifts in meetings with tax officials and 37 percent expect to give gifts to any public officials to “get things done.” Opportunities for corruption in this context may be reinforced by the fact that tax officials are responsible for a portfolio of taxpayers, which means that they interact with the same taxpayers frequently.

These two concerns—improving service delivery for taxpayers by eliminating long wait times for submission of declarations and curtailing corruption by reducing the frequency of interactions with tax officials—were among the primary reasons the tax authority in Tajikistan introduced e-filing. By making it easier for people to file and pay taxes, and by closing off opportunities for corruption, the government expected e-filing would ultimately lead to increased voluntary compliance and thus increased tax revenues. Other motives for introducing e-filing are to improve the quality of tax records by reducing arithmetic mistakes by firms<sup>7</sup> and data entry mistakes by clerks and to improve the efficiency of tax administration by releasing officials from routine work to focus on higher-value activities.

In order to file taxes online, firms must first register for e-filing by submitting application documents to the tax authority. After processing and approval of the application, the firm receives an e-token containing its digital signature which it must use to verify its online declarations. Once a firm registers for e-filing, it can file all taxes online using the e-filing software either on its own computer or at public e-filing terminals located in tax offices.<sup>8</sup> However, firms are still required to visit the tax office quarterly to reconcile their accounts.

Adoption of e-filing by firms was slower than expected following its introduction in 2012. Initially, firms had to purchase e-tokens for \$40 plus an additional \$40 registration fee. Even after the elimination of these fees, only about 30 percent of firms registered

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<sup>7</sup> The online system has in-built formulas to perform calculations automatically based on inputted entries.

<sup>8</sup> Online payment of taxes through e-banking is also available to firms but is separate from the e-filing system: firms that e-file do not have to pay online and vice versa. Although this paper does not study the impact of electronic tax payment, we observe that 66 percent of firms that e-file also pay online.

for e-filing. The low take-up was puzzling given the anticipated benefits from adoption, prompting significant interest in understanding the constraints to adoption and potential ways to address them. Focus group meetings and interviews with both business owners and tax officials indicated firms were not using e-filing for a variety of reasons, including: lack of awareness; lack of trust in the system’s reliability and in the security of information submitted online; difficulties navigating the registration process; and lack of access to computers and internet.<sup>9</sup> In addition, some firms indicated that they did not file online because they preferred to deal directly with the same tax official on a regular basis when submitting their tax declarations (perhaps for benign reasons such as having someone trusted crosscheck their submissions, or perhaps intending to evade tax obligations).

### 3 Experiment Design

The experimental treatment arms of this study aimed to address those barriers to e-filing identified by firms. Firms were randomly assigned into two treatment groups (and one control group). In the intensive treatment arm (Group A), firms received training and information about e-filing intended to increase awareness and trust in the system. In the training session, they learned about e-filing availability, its benefits, and registration procedures, and participated in an interactive demonstration of the e-filing system. In addition, these firms received logistical support in registering for e-filing to mitigate the hindrances firms willing to use e-filing face in accessing the system: a representative of the implementing partner helped firms complete all the steps required for registration.

Firms in the second treatment arm (Group B) received an identical e-filing training session but they did not receive the logistical help for registration. In the control group

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<sup>9</sup> From the baseline survey, 50 percent of firms in our study sample were unaware of the possibility of e-filing and 37 percent did not have high-speed internet on their premises.

(Group C), firms did not receive any e-filing training. However, to hold the delivery format of the treatments constant, these firms received general training on taxation not specific to e-filing.<sup>10</sup> Rather, the training included a review of different tax laws and procedures. Due to a requirement by the Tax Committee, this general tax training included one statement about the availability of e-filing on a slide listing the three modes of filing taxes: “by paper, by mail and electronically.” In addition, firms in this group would have been aware of the existence of e-filing from a reference to it in the invitation materials and from some questions in the baseline survey. This observation is important for interpreting our results since it means Group C is not a pure control group but rather a group with a light information treatment.

This design allows us to answer two broad sets of questions. The first set examines firms’ decisions to adopt e-filing: What is the impact of providing information and training about e-filing? What is the additional impact of helping firms to register? What other firm characteristics predict e-filing adoption? The second set of questions focuses on the impact of using electronic filing on firm outcomes, in particular, compliance costs, tax payments and unofficial payments.

### **3.1 Sampling and Randomization**

The study draws from the universe of firms in Dushanbe that are registered in the tax authority database. All legal entities and individual entrepreneurs that are (i) simplified tax regime payers, (ii) have been active in the system for at least two years (i.e. not new enterprises or liquidated ones), and (iii) not currently e-filing, were eligible for the study. There were 5,218 firms in the tax database meeting these three criteria.

We randomly selected a list of 2,004 firms from this overall population with stratification

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<sup>10</sup> Groups A and B also received this general tax training during their sessions.

on status of the firm (legal entities or individual enterprises) and rayon (tax district). Based on discussions with the tax authority and the implementing partner on expected response rates, we estimated that we needed to contact 2,000 firms to have 1,500 firms attend the training sessions. Since we expected the intervention to be more effective on legal entities which are usually bigger firms than individual enterprises, we over-sampled legal entities to achieve a relative proportion of 75 percent of legal entities to 25 percent of individual enterprises in the study population. We randomly allocated the 2,004 firms into three groups: 802 into Group A, 400 into Group B and 802 into Group C.<sup>11</sup> We conducted the randomization by computer using STATA and stratified using legal status, sector of activity and rayon (tax district). Figure 1 illustrates the experimental design and the sampling strategy.

### 3.2 Program Implementation

The training programs and logistical support were delivered by a Dushanbe-based firm with the support of the tax authority from October to December 2014. Firms were invited to attend a general training on taxation through telephone calls by trained operators.<sup>12</sup> Although we assigned firms randomly into the treatment and control groups before the trainings (to facilitate scheduling into the different training sessions), all firms received invitations following exactly the same script (see Appendix A for the text of the script). Out of the 2,004 firms in the study database, 1,722 (86 percent) received telephone calls and 1,498 (75 percent of the full sample and 87 percent of those invited) attended training. These response rates were balanced across the three treatment groups.

Since the invitations to all firms followed the same protocol, each firm had to decide

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<sup>11</sup> More firms were allocated to Groups A and C than to Group B in order to increase our statistical power to measure the impact of e-filing on firms adopting it since we expected the Group A treatment to have the greatest impact on e-filing adoption.

<sup>12</sup> The tax authority periodically organizes events and trainings for firms, so this program was not unusual.

whether to attend the training before learning its treatment group. Therefore, we are confident that the decision to attend training is orthogonal to treatment status and did not introduce selection bias into the study design. As such, we use the sample of the 1,498 firms that attended training in studying the program's impact, with the caveat that this could slightly limit the external validity of our findings.

The training sessions took place either on the tax authority's premises or in the implementing partner's office. At the beginning of training (before revealing treatment status), the baseline survey was self-administered (completed on paper forms by firm representatives) with detailed instructions and examples provided by implementing partner trainers.

Groups A and B received identical training which included both a general tax presentation and an e-filing presentation and demonstration, with a question-and-answer session at the end. The training for Group C (control group) differed in that it did not include the e-filing presentation and demonstration. On average, training lasted for two hours in Groups A and B and for one hour in Group C. A few days after each training, the implementing partner called back all firms in Group A and assisted interested firms in registering for e-filing. This logistical assistance involved visiting each firm, collecting all necessary documentation, submitting it to the tax authority on the firm's behalf, obtaining the e-token, and installing the software.

## **4 Conceptual Framework**

In this section, we outline a simple framework for thinking about a firm's decision to adopt e-filing. A firm will switch from paper filing to e-filing if the expected discounted value of the benefits associated with e-filing adoption is greater than the cost of adoption. That is,

if:

$$\sum_{t=1}^T \beta \delta^t E((CC_{p,t} - CC_{e,t}) + (UP_{p,t} - UP_{e,t}) + (Tax_{p,t} - Tax_{e,t})) > AC_e \quad (1)$$

where  $CC_{p,t}$  and  $CC_{e,t}$  are compliance costs a firm would face at time  $t$  under paper filing and e-filing respectively. Similarly,  $UP_{p,t}$  and  $UP_{e,t}$  are unofficial payments a firm would make to tax officials at time  $t$  under paper filing and e-filing and  $Tax_{p,t}$  and  $Tax_{e,t}$  are taxes a firm would pay at time  $t$  under paper filing and e-filing.  $AC_e$  is the one-time adoption cost associated with switching to e-filing.  $\beta$  and  $\delta$  are the parameters for present-bias and discount factor respectively.

We expect that  $CC_{p,t} - CC_{e,t} > 0$ , that is, we expect that compliance costs will be lower for firms under e-filing since there is no longer any need to spend time traveling to the tax office (except for those using public terminals) and obtaining approval.<sup>13</sup> Further, we expect that the larger the difference, that is, the greater the potential savings in compliance costs from e-filing, the more likely a firm will be to adopt e-filing (for example, firms with high paper filing compliance costs).

We hypothesize that the change in firms' unofficial payments to tax officials,  $UP_{p,t} - UP_{e,t}$ , will be positive or null because the reduced frequency of interactions between taxpayers and tax officials under e-filing provides fewer opportunities for unofficial behaviors.<sup>14</sup> Qualitative evidence from focus group discussions and interviews indicate that at least two different types of unofficial payments may occur during interactions between taxpayers and

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<sup>13</sup> E-filing does not necessarily reduce compliance costs for firms in all contexts. For example, if firms submit both electronic and paper documents due to legal requirements or lack of trust in the system (Yilmaz and Coolidge, 2013), they may indeed face higher compliance costs. However, we do not think this should be the case in our context given that it is not technically possible to submit a paper and an electronic declaration simultaneously.

<sup>14</sup> Sequeira and Djankov (2014) find significantly higher levels of customs corruption in Maputo ports relative to Durban ports. Online processing of clearance documentation in Durban results in minimal interactions between clearing agents and customs agents compared to higher levels of interaction with in-person submissions in Maputo.

tax officials: (i) coercion (tax officials demanding unofficial payments or creating administrative hurdles to put firms in a position such that they would voluntarily offer a gift), and (ii) collusion (tax officials and taxpayers working together to help taxpayers evade taxes, usually with an unofficial payment for tax officials). Bribe coercion will be more difficult under e-filing since officials will be less able to hold up taxpayers, causing them to submit their declarations late and incur fines. The greater the savings from fewer coerced unofficial payments, the more likely firms are to e-file. In addition, collusion may be more difficult to coordinate if submissions are now done electronically. For firms that voluntarily make unofficial payments to reduce their tax liability, their likelihood of e-filing will depend on the combination of savings from both unofficial payments and tax payments. Since e-filing reduces but does not eliminate interactions with tax officials, these impacts may be muted if tax officials and/or taxpayers adjust their behavior to compensate for fewer opportunities to interact.

The impact on tax payments as a result of e-filing,  $Tax_{p,t} - Tax_{e,t}$ , is ambiguous as it depends on firms' experiences prior to e-filing. Under paper filing, tax officials review firms' declarations and sign before the declaration is considered accepted. Eliminating this interaction between taxpayers and tax officials through e-filing can affect the amount of tax a firm pays in at least two ways.<sup>15</sup> First, tax payments may decrease for firms whom tax officials had previously constrained regarding the minimum amount they could declare. The review during in-person submission may serve as a mini-audit and help to limit evasion as the tax official may have private information about firms which may be useful in estimating how much taxes the firms should pay. Alternatively, this check could be an opportunity for tax officials to force firms to declare more than their actual tax liability.

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<sup>15</sup> It is also possible for lower compliance costs to increase voluntary compliance (by increasing tax morale) or to increase profits (by reducing business costs), which could both lead to higher taxes paid. However, we find no evidence for improved attitudes on taxation issues and the lower compliance costs are small relative to the tax amounts; hence, we do not emphasize these channels.

In interviews and focus group discussions, some firms mentioned that a major consequence of e-filing was the ability to avoid officials forcing these increases in tax payment.<sup>16</sup> In either case, for firms in this category, the introduction of e-filing may lead to lower taxes paid,  $Tax_{p,t} - Tax_{e,t} > 0$ , since tax officials will no longer constrain the minimum amount of taxes firms can declare at the time of submission. The greater the reduction in tax paid under e-filing, the more likely the firm will be to adopt e-filing.

The second channel by which in-person meetings may affect taxes paid is that rather than monitoring the taxes declared by firms, tax officials may actively collude with firms and assist them in completing their declarations to minimize their tax liability. This type of collusion typically involves an unofficial payment to the tax official. The introduction of e-filing increases the transaction costs for this collusion because forms submitted online are not easily changeable (unlike paper declarations that can be easily redone). For firms in this category, e-filing may lead to higher taxes paid,  $Tax_{p,t} - Tax_{e,t} < 0$ , and so these firms will be less likely to adopt e-filing. These two channels may be self-reinforcing because tax officials face incentives to meet revenue targets. If a tax official is colluding with some taxpayers to reduce their tax payments, he may need to compensate by collecting higher tax revenue from others.

Since we are unable to directly observe tax evasion and unofficial payments, it is difficult to know which firms fall into each of the two categories described above. In subsequent analyses of the heterogeneous impact of e-filing, we distinguish firms in the two categories using a risk index developed by the tax authority to identify firms by their likelihood of tax evasion. Section 5 (Data) provides a description of this index. As such, we expect that

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<sup>16</sup> Some examples of comments are: “[Tax inspectors] do not care whether we make a profit or how much was our turnover during the reporting period, they insist on an amount to fulfill their targets. So when filing in person, sometimes they reject a declaration if the amount is too small. Now, by filing online, you don’t depend on tax inspectors.” “After moving to e-filing, we’re more certain of the amount we need to pay. Before, during paper-filing, each time we didn’t know what figures the tax inspector will want us to pay for that filing period.”

firms in the first category (non-collusive firms) will have lower risk scores as they will be less likely to be evading taxes whereas firms in the second category (collusive firms) will have higher risk scores. Figure 2 outlines the expected impact for each of the outcomes for these two categories.

Using this framework, we can also discuss the expected impact of the experimental interventions. The two treatments aim to reduce the adoption costs,  $AC_e$  of e-filing: the lower the adoption costs, the more likely a firm will switch to e-filing. Although firms may register for e-filing free of charge, they would nonetheless face additional costs in accessing the system, such as learning how to use the technology and the time and uncertainty costs associated with registration. The information and training component (Group B) helps firms overcome the hurdle of understanding how to use the system while the additional logistical help with registration (Group A) reduces the time and uncertainty costs of adoption.

The impact of the interventions will depend on firm type. First, firms for which expected benefits of e-filing are greater than the cost of adoption (for which inequality (1) holds) will register when they learn e-filing is available. Given that e-filing was mentioned during the general training provided to all firms (including the control group), all firms of this type in the study sample should register.

Second, firms for which expected returns from e-filing adoption are positive but smaller than the adoption cost (the left-hand term of equation (1) is positive but smaller than  $AC_e$ ) will be impacted by the two treatments designed to reduce adoption cost. As such, we expect that the treatments will increase e-filing adoption for these firms and that the combination of training and logistical help will be more effective.

Finally, the intervention should not have any impact on firms with negative expected returns from e-filing adoption (i.e. firms for which the left-hand term of equation (1) is

negative) as they should not be willing to register regardless of the reduction in adoption costs.<sup>17</sup> One exception would be if the treatment promoted the perception that e-filing was mandatory (We discuss this possibility in the section on mechanisms). Note that since  $Tax_{p,t} - Tax_{e,t}$  is negative for these firms (since we expect that  $CC_{p,t} - CC_{e,t} > 0$  and  $UP_{p,t} - UP_{e,t} > 0$ ), they are likely to be evading tax in the paper system. As a result, we expect firms in this third category to have higher risk scores and thus to be less likely to e-file than firms in the first two categories.

## 5 Data

We rely on three main sources of quantitative data. First, we use administrative data from the tax authority on firm characteristics (such as number of employees, legal status, industry and district), e-filing use, and tax behavior (such as monthly tax declarations and payments). These data include all 1,498 firms in the study sample as well as the additional 506 firms originally selected but that did not participate in the training.

The other two sources are the baseline survey of firms conducted prior to the trainings and the endline survey conducted about one year later. The surveys include information on firm characteristics and economic behavior, as well as experiences of firms with the tax administration process (such as compliance costs). All 1,498 firms in the study sample completed the baseline survey.

The endline survey differed from the baseline by including more questions and in that enumerators administered it in person at the firm’s premises (as opposed to the brief, self-administered baseline survey at the beginning of the training sessions). Eighty-four percent of the study sample (1,263 firms) completed the endline survey. Twelve percent of

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<sup>17</sup>Note that as  $AC_e \rightarrow 0$  (and  $t \rightarrow \infty$ ), inequality (1) simplifies to:  $E(CC_p + UP_p + Tax_p) > E(CC_e + UP_e + Tax_e)$ , which is never true for these firms.

the sample did not complete the survey because the firm was liquidated, while the remaining four percent proved untraceable or had moved outside Dushanbe. There were no significant differences in attrition across treatment groups at the endline survey (Appendix Table A1). In addition to these data, the study relies on extensive interviews and focus groups with tax officials and firms at different stages of the project to design the intervention, understand potential channels of impact and interpret findings.

Table 1 shows summary statistics for some variables from the administrative data and the baseline survey. Firms have a median of two employees (including the entrepreneur) and an average of three. In 40 percent of firms, the entrepreneur is the only employee. About 42 percent each are in the trade and services sector. Women own eight percent of firms. Table 1 also shows that randomization achieved balance across the different treatment groups for most variables.<sup>18</sup> P-values of joint orthogonality tests obtained from regressing the treatment variable against different firm characteristics also indicate that the variables are not systematically correlated with the treatment. Since the analysis will emphasize heterogeneous results by firms' baseline risk score, Table 1 also includes randomization checks for the two subgroups (firms above and below the median risk score). As Section 7 will describe, the information and training only treatment has no significant impact on e-filing adoption; therefore Table 1 combines Groups B and C as the control and compares with Group A. Appendix Table A2 provides randomization balance tables for the original three groups. Analogous to Table 1, Appendix Table A3 shows that randomization balance persists in the sample surveyed at endline consistent with the non-differential attrition across groups.

At baseline, we measure firms' tax compliance costs using the number of visits to the

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<sup>18</sup> Firms' compliance costs are a notable exception. Firms in Group A visited the tax office 6.53 times compared to 6.4 times in the control group. Results from the endline survey show a reduction in the number of visits in Group A so, if anything, the results may underestimate the reduction in compliance costs due to e-filing.

tax office in the last six months, the amount of time spent on different activities during visits to the tax office,<sup>19</sup> and the amount of time spent calculating taxes and completing tax forms. Compliance cost measurement at endline is similar to at baseline, except that the endline survey also includes time spent on tax accounting.

In both baseline and endline surveys, we measure unofficial payments using a survey question asking how often it is true that firms “in their line of business” typically have to make unofficial payments to tax officials and create a dummy variable for firms saying it is “always true” or “often true.”<sup>20</sup>

Our main measure of unofficial payments in the endline survey is a list experiment (Kuklinski et al., 1997). In response to the same question about *how many* actions on a given list a company had taken in the last year to “solve or prevent problems with the Tax Administration,” half of the respondents receive a list of four options that are neutral and legal.<sup>21</sup> The other half receive a list of five options that includes “making unofficial payments” as an additional option. The difference between the average numbers selected by firms presented with the longer list and by those presented with the shorter list gives a measure of how common it is for firms to make unofficial payments.

To measure tax payments, we aggregate monthly payments from administrative records from the tax authority to obtain the total amount of tax paid over the course of the year. Given the long tail in the distribution of taxes paid, we also use the inverse hyperbolic sine function of total taxes paid as well as the median tax amount paid in that year. As an alternative measure, we use firms’ self-reports of their tax payments in two focal months

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<sup>19</sup> We ask firms separately about each of the following: Time to travel (both directions); Staying in line; Attendance at tax inspector office for checking reports and submission; Staying in line to sign tax reports by a head of tax office; Obtaining tax payments reconciliation act; Calculation of tax due and filling in tax reports at tax office; and Other.

<sup>20</sup> The question is worded in this manner to avoid asking firms about their own behavior as corruption is a sensitive topic.

<sup>21</sup> The four items on the short list are: 1. Received help from trade associations, 2. Had detailed discussions with tax officials, 3. Provided additional documents, 4. Pursued court action.

of the year (June and December).

## 5.1 Risk Score

We use the firm’s risk score at baseline as a proxy for its likelihood of evading taxes. Like many tax administrations, Tajikistan’s Tax Committee uses a risk-scoring system to assess firm risk as part of its audit strategy.<sup>22</sup> Risk-based audits help administrators allocate limited resources to cases likely to yield significant revenue while reducing the monitoring burden on compliant firms (less likely targets for an audit). A firm’s risk score is the product of a proprietary algorithm incorporating observed firm characteristics and results of prior audits on other firms. Similar to those of most countries (both developed and developing), Tajikistan’s tax authority keeps confidential the details of the risk-scoring process to prevent taxpayers engaging in strategic behavior in order to avoid an audit. That said, risk criteria incorporated into basic models for small firms in different countries include, *inter alia*, the sector(s) of activity and business structure, quality of record keeping, past compliance behavior, cost ratios and deductions from gross revenue, and comparisons with industry and sector averages (Loeprick and Engelschalk, 2011).

To investigate empirically this variable’s correlates in our setting, we regress firms’ risk scores at baseline against different firm characteristics from administrative and survey data. Table 2 indicates that risk score is negatively correlated with operating in the trade sector and with having had a recent audit, whereas it is positively correlated with claiming to have no other employees besides the entrepreneur and with the amount of tax adjustments and penalties from the prior audit. In addition, we find two pieces of evidence suggesting that the risk score is predictive of non-compliance. First, we find that, controlling for observable firm characteristics such as industry, gender of owner, number of employees

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<sup>22</sup> Khwaja et al, (2011) provide examples from dozens of countries’ experiences with risk-based audits.

and (survey data report of) turnover, firms with higher risk scores at baseline (2014) paid lower taxes in 2015 (Table A4, Columns 3 and 4). Second, we find that, controlling for firm characteristics, risk score at baseline is positively correlated with the total amount of audit adjustments and penalties in the following year, conditional on an audit occurring (Table A4, Column 6). These effects are statistically significant for the inverse hyperbolic sine function of total taxes and audit penalties, suggesting that the long tails are of particular importance.

The tax authority only calculates risk scores for legal entities (75 percent of the sample), so it is unavailable for individual entities.<sup>23</sup> Unfortunately, the risk score variable was not available to us at the time of randomization; hence we were unable to stratify upon it. Nevertheless, from Table 1 we find that, within the two subgroups, most variables are balanced, with a few exceptions: Among the low-risk group, firms in group A are smaller and have slightly higher risk scores (both at 10-percent level).<sup>24</sup> As with the full sample, p-values of the joint F-test indicate that the variables are not jointly correlated with the treatment group.

## 6 Empirical Specification

We use Equation (2) below to examine the relative impact of the two treatments in promoting e-filing adoption as well as the firm characteristics associated with adoption:

$$D_i = \beta_0 + \beta_1 T_{A,i} + \beta_2 T_{B,i} + \alpha X_i + \lambda S_i + \epsilon_i \quad (2)$$

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<sup>23</sup> Since randomization was stratified on legal status, this characteristic is perfectly balanced among the different treatment groups.

<sup>24</sup> We control for these variables in robustness checks and find no significant difference on our main results.

where  $D_i$  is an indicator variable for whether a firm registers for and uses e-filing,  $T_{A,i}$  and  $T_{B,i}$  are indicators for the training with logistical help and the training alone treatments respectively.  $\beta_1$  and  $\beta_2$  estimate the causal effects of receiving the two treatments respectively on adoption and the difference between them,  $\beta_1 - \beta_2$ , estimates the differential impact of the provision of logistical support in addition to the training.  $S_i$  is a vector of strata dummies (one dummy for each triplet of the following business characteristics): legal status (individual entrepreneur or legal entity), sector of activity (manufacturing, trade or services), and rayon (four tax districts in Dushanbe) (Bruhn and McKenzie, 2009). To examine firm characteristics associated with adoption, we include in Equation (2) a range of firm-level variables  $X_i$ , in particular, the measures of firms' compliance costs, unofficial payments, and the proxy for their likelihood of evading taxes (as discussed above).

To assess the impact of e-filing, we can use a variant of Equation (2) above in which we replace  $D_i$  with  $Y_i$ , the outcome variables of interest, to estimate the effect of assignment into either of the two treatment groups (the intent-to-treat estimate). We control for baseline measures of outcome variables when available. In addition, we use Equation (3) below to estimate the effect of e-filing on firms that adopted it as a result of the program by using assignment to Group A (the intensive treatment arm) only as an instrumental variable (IV) for adopting e-filing (Local Average Treatment Effect estimate), since assignment to Group B has no effect on e-filing adoption. As such, in the IV estimates, the effective control group consists of Groups B and C (and not Group C alone).

$$Y_i = \beta_0 + \gamma \widehat{Efile} + \pi Y_{i,t=0} + \lambda S_i + \epsilon_i \quad (3)$$

where  $Y_i$  are outcome measures such as compliance costs, unofficial payments, and tax payments.  $Y_{i,t=0}$  are baseline measures of the outcome variable.

We assess the differential impact of e-filing by firms' risk profiles (above and below

the median of the tax authority risk score) using Equation (4) below which includes an interaction of e-filing and an indicator for a firm having below-median risk score (*LowRisk*) and an interaction of e-filing and an indicator for a firm having above-median risk score (*HighRisk*).

$$Y_i = \beta_0 + \gamma \widehat{Efile} * LowRisk + \alpha \widehat{Efile} * HighRisk + \rho HighRisk + \pi Y_{i,t=0} + \lambda S_i + \epsilon_i \quad (4)$$

$\gamma$  and  $\alpha$  are the coefficients of interest and give the impact of adopting e-filing among low-risk firms and high-risk firms respectively. For assignment to Group A to be a valid instrument in Equations (3) and (4), it must affect outcomes only by inducing firms to e-file and not have a direct effect. For example, it must not be the case that receiving a visit by the implementing firm (as part of the logistical help) caused firms to think that their tax declarations were under greater scrutiny. While we are unable to explicitly rule out a direct effect, we think this is unlikely because firms were accustomed to receiving visits from the tax authority (over two times a year on average). Further, given the opposite pattern of results observed for high-risk and low-risk firms, the logistical help would need to have affected these firms in opposite ways.

## 7 Results and Discussion

### 7.1 Adoption of Electronic Tax Filing

By December 2015, about one year after program implementation, 93 percent of firms in Group A had registered for e-filing and used it at least once, relative to 63 percent in Group B and 59 percent in the control group. The combination of training and logistical support for registration was successful in increasing e-filing adoption by 34 percentage points relative to the control group (Table 3, Panel A). On the other hand, there was no

significant difference between the adoption rates for firms in Groups B and C, indicating that e-filing training and demonstration did not promote e-filing adoption compared to the brief mentions of e-filing the firms in the control group encountered.

The large (30 percentage point) difference between the impacts of the treatments in Groups A and B indicates that the logistical help with registration addressed an important constraint to e-filing. This may be due to a number of reasons including reducing the hassle costs of navigating a complex registration process (Currie, 2004) or helping firms overcome procrastination. One additional possibility is that firms in Group A may have felt coerced to register for e-filing due to the follow-up support the implementing firm offered.

The lack of a significant difference between Group B and the control group could be because neither of the two interventions had any impact on firms or because control group firms' limited exposure to information on e-filing had effects as strong as the e-filing training. While there are currently no data available about a randomly selected pure control group to investigate these two possibilities, we can compare the study treatment groups to two groups of firms not included in the study: first, those firms not contacted at all after reaching the required number of firms,<sup>25</sup> and second, contacted firms that declined to participate in the training.<sup>26</sup> In both groups, the e-filing adoption rate is about two-thirds of that of the control group at 39 percent and 44 percent respectively, suggesting that the brief mentions of the availability of e-filing in the control group had a significant effect not dissimilar to the effect of detailed training on e-filing procedures and demonstration. Indeed, 80 percent of firms in the control group indicated that they had found out about e-filing from the general tax training session they attended, only five percentage points lower than the share of Group B firms that found out about e-filing through the detailed

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<sup>25</sup> This group is not necessarily random because the implementing firm may have selected certain types of firms to call before others.

<sup>26</sup> This group is also not necessarily random as firms with particular characteristics may have declined to participate.

training sessions (Table 3, Panel B).<sup>27</sup>

We examine whether firms' compliance costs, experiences with unofficial payments, and their propensity to evade taxes affect their likelihood of adopting e-filing as outlined in the conceptual framework. Since almost all firms in the treatment group adopt e-filing, we run Equation 2 using only Groups B and C and present the results in Table 4 to show which firm characteristics are associated with e-filing adoption. The first two columns of Table 4 provide results for all firms while the third column covers only legal entities.<sup>28</sup> We find a positive association between e-filing adoption and number of hours spent on tax preparation, supporting the hypothesis that firms with higher compliance burdens under paper filing would be more willing to switch.

In addition, we find that firm size is strongly associated with e-filing adoption: one-(wo)man businesses are significantly less likely to e-file and, among firms with employees, e-filing increases with the number of employees, suggesting that firms with more complex taxes are more likely to adopt.

Unlike our priors, we find no significant correlation between e-filing adoption and firms stating that bribe payment is common (our baseline proxy for firms that pay bribes) in Table 4. Since this measure does not distinguish between voluntary and involuntary bribes, we interact it with the risk score, as firms with higher risk scores are more likely to be voluntarily paying bribes in exchange for tax evasion support from tax officials, but find no significant effects (regressions not shown). This could be because this measure of bribes is too noisy (given the potential bias in responding directly to a sensitive question) or because no relationship between e-filing use and bribe payments exists once you control for risk score and other firm characteristics.

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<sup>27</sup> The other main source of information about e-filing for the control group was business networks (17 percent). In contrast, almost all firms in Group A learned about e-filing from the intervention trainings.

<sup>28</sup> Since risk score is only available for legal entities, column 2 assigns the mean value for legal entities to individual enterprises.

Importantly, Table 4 shows that firms with higher risk scores are significantly less likely to adopt e-filing. One standard deviation increase in the risk score is associated with a 7.2 percentage point decrease in a firm’s likelihood of e-filing. This result is consistent with more risky firms preferring to deal directly with tax inspectors with whom they have ongoing relationships and are able to collude to pay less in taxes. Among Group A firms, this relationship does not exist (almost all firms in this group registered for e-filing). We analyze the differential selection into e-filing use by firm risk by assessing complier characteristics and calculating the relative likelihood that compliers are high-risk firms (Angrist and Jörn-Steffen, 2008). This statistic, given by the ratio of the “first stage”<sup>29</sup> among high-risk firms to the overall “first stage,” ( $0.381/0.349=1.09$ ) shows that compliers are 9 percent more likely to be high-risk firms. This pattern is consistent with the possibility that firms in Group A may have perceived the treatment as meaning e-filing was mandatory, thereby bringing in almost all firms, including those that would otherwise not have registered voluntarily.

Lastly, we find that other firm characteristics, such as having a female owner, prior exposure to e-filing, a firm’s level of comfort with technology (measured by an index of whether a firm has high-speed internet, uses email for business communications, and maintains accounting records electronically), and having an accountant do not predict e-filing adoption.

## 7.2 Impact of Electronic Tax Filing

This section examines the impact of e-filing on compliance costs, unofficial payments, and tax payments as outlined in the conceptual framework. Table 5 presents estimates of the impact of e-filing using assignment to Group A as an instrumental variable for e-filing

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<sup>29</sup> The “first stage” is the share of compliers and is given by the adoption rate in Group A minus the adoption rate in the control group

use.<sup>30</sup> The top panel shows results for the overall sample, the middle panel shows results for legal entities alone, while the bottom panel shows heterogeneous results for firms above and below the median risk score.

We find a significant impact of e-filing on compliance costs as shown in Table 5 (columns 1 and 2). Firms that e-file as a result of the program visit the tax authority 1.4 times fewer each month. In all, e-filing reduces the time firms spend on tax-related activities by 4.7 hours a month. As shown in Table 7 (column 6), this effect is concentrated in activities that involve visiting the tax authority office (submitting tax returns and obtaining the reconciliation act). As such, e-filing does fulfill the intended goal of reducing tax compliance costs of firms. The time savings corresponds to 15 percent of the overall 33 hours firms report spending on tax-related activities. A “naive” cost effectiveness analysis comparing program costs to the amount of money firms save from lower compliance costs<sup>31</sup> (using the average wage of an accountant in our sample) shows that potential benefits from compliance costs reduction more than compensate program costs after 7 months (Appendix C and Appendix Table A6 detail program costs and calculations).

Using our two measures of unofficial payments, we find no overall impact of e-filing, but observe different patterns by firm risk profile. For the survey question about how widespread unofficial payments are (Table 5 column 3), we find no overall impact either in the full sample or among legal entities. However, we find a decrease of 23.6 percentage points (only marginally statistically significant with  $p=0.103$ ) among low-risk firms and a positive impact of 16 percentage points (not statistically significant) among high-risk firms and the difference between the two coefficients is significant ( $p=0.035$ ).

Similarly, using the list experiment, we find opposite results for high- and low-risk

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<sup>30</sup> For simplicity, we only present the instrumental variables results. ITT results are qualitatively similar (scaled down by a factor of about 3) and available upon request.

<sup>31</sup> A full cost effectiveness analysis would account for other benefits such as savings in tax administration costs.

firms. With the list experiment, since we measure the outcome at a group (rather than individual) level, we are unable to use the instrumental variable framework and instead analyze group-level differences to report intent-to-treat (ITT) estimates. Table 6 (columns 1 and 2) shows the results for the full sample. Among firms in the combined control group (Group B and Group C), firms presented with the longer list (including “making unofficial payments” to settle problems with the Tax Authority) report carrying out 1.194 actions on average compared with 1.119 among those presented with the shorter list. This difference (0.075) is statistically significant, indicating that 7.5 percent of those in the control group reported unofficial payments. In contrast, in Group A the difference is 0.02, which is not statistically significant. Comparing the results from the treatment and control groups in a difference-in-differences framework, we find a 5.5 percentage point lower prevalence of unofficial payments in Group A but this difference is not significant.

In columns 3-6 of Table 6 we analyze results from the list experiment separately for low-risk and high-risk firms. Among low-risk firms, using the same framework described above, we find a large (18 percentage point) difference in the share of firms that paid bribes between Group A and the combined control group, indicating that the movement to electronic filing and subsequent reduced interactions with tax collectors is effective at reducing unofficial payments. On the other hand, for high-risk firms we observe a positive but not significant impact of assignment to Group A on unofficial payments, indicating that e-filing did not have the same deterrent effect on bribe payments. We discuss potential reasons for these patterns in the following section.

As with unofficial payments, we find no overall impact of e-filing on tax payments, but observe opposite effects for firms above and below the median risk score. The top and middle panels of Table 5 (columns 4-7) show no statistically significant results for the four different measures of taxes paid (total taxes for the year from administrative records,

its inverse hyperbolic transformation, median tax paid, as well as self-reported tax paid). Standard errors are, however, large and we cannot reject small positive or negative impacts.

As described in the conceptual framework, we expect that the impact of e-filing on firms will differ based on firms' experiences at baseline: firms for which meeting with a tax inspector served as a constraint on the minimum payments they could make would reduce their tax payments, whereas firms that received support from tax officials to reduce their tax liability would increase their tax payments. Our heterogeneous analysis of tax payments by firm risk of evasion at baseline provides evidence for this hypothesis, as shown in the bottom panel of Table 5.

All four measures of tax payments show a similar pattern of impact from e-filing: there is a decrease in tax payments among low-risk firms and an increase in taxes paid among high-risk firms. These differences are statistically significant for the median and inverse hyperbolic sine transformation for low-risk firms (measures that are sensitive to having long tails in the distribution) and for the mean, median, and self-reported survey mean for high-risk firms.

These impacts are quantitatively large. Taking the total taxes for the year from the administrative data as an example, column 4 reveals an increase of TJS 25,357 (\$3,600 USD) as a result of e-filing among high-risk firms ( $p=0.046$ ). In contrast, among low-risk firms e-filing adoption results in firms paying TJS 15,099 (\$2,160 USD) less in taxes, but this amount is not statistically significant (for this variable). The estimated impact on firms with above-median risk scores is significantly different than that for firms with below-median risk scores at the 10 percent level ( $p=0.078$ ).

An important implication of these opposite impacts is that e-filing eliminates the tax gap that would otherwise exist between low-risk and high-risk firms. Among firms in the combined control group, high-risk firms pay substantially lower taxes than low-risk firms, a

statistically significant difference of \$2,300 ( $p=0.0018$ ) likely reflecting evasion by high-risk firms. However, among firms in Group A, the difference between high- and low-risk firms falls to \$527 and is not statistically significant. This result implies that e-filing helps to close the revenue gap between firms that were likely to be evading taxes and those that were not, thereby promoting horizontal equity. Although e-filing does not change the total level of taxes paid, it changes the distribution of taxes paid across firms as low-risk firms pay less and high-risk firms pay more. As such, e-filing also has a potential redistribution effect that undoes the effect of tax officials colluding with high-risk firms to pay lower taxes and constraining low-risk firms to cover the shortfall.

We discuss below in Section 7.4 the possibility that other differences between high-risk and low-risk firms may be driving these results. We show that the results hold when we control for observable baseline differences between the two groups, suggesting this is not the case.

### **7.3 Mechanisms**

This section provides additional evidence to understand the divergent results by risk group. The decrease in tax payment for low-risk firms is consistent with tax officials constraining them to an acceptable amount of tax to declare under paper filing. In the combined control group, low-risk firms on average make positive payments more often than high-risk firms (8.3 months a year in contrast to 5.1 times for high-risk firms). Table 7 (column 1) shows that, among low-risk firms, those that e-file pay zero taxes two more months in a year on average, but this effect is not apparent for high-risk firms. The cumulative distribution function of taxes paid (Figure 3) provides additional evidence that interactions with tax officials were likely a constraint on the amounts low-risk firms declared. Figure 3 (Panel B) shows that, among low-risk firms, Group A firms paid lower taxes than control group firms,

but primarily in the lower end of the distribution, which is consistent with the existence of a previous lower bound.

In addition, the simultaneous reduction in both unofficial payments and tax payments for low-risk firms suggests that the unofficial payments were more likely not for collusion to pay lower taxes but for extortion. Less-frequent interaction with tax officials due to e-filing therefore reduces the occurrence of bribe-giving.

Whereas the impact on tax payments for low-risk firms occurs primarily on the extensive margin (number of months paying positive taxes), Table 7 (column 2) indicates that the increase in tax payments for high-risk firms occurs on the intensive margin (the amount of taxes paid, conditional on paying in a given month). Similarly, the cumulative distribution function shows that, among high-risk firms, the higher tax payment among Group A firms relative to the combined control group occurs mostly on the upper end of the distribution (Figure 3, panel C). This pattern would be consistent with high-risk firms—both treatment and control—not being constrained by tax officials on the minimum amount of tax they could pay (unlike low-risk firms). However, with e-filing, treatment firms at the upper-end of the distribution lose support to reduce high levels of tax liabilities.

For high-risk firms, the increase in tax payments is consistent with their losing the opportunity to collude with tax officials to reduce their tax liabilities. From anecdotal evidence, one of the deterrents to evasion under e-filing is higher transaction costs for collusion, because after a firm submits a declaration online it is difficult to change it (unlike declarations filed on paper, which are easy to change). From the survey data, we find some additional evidence consistent with high-risk firms becoming less able to rely on assistance from colluding with tax officials. We find that the amount of time firms spent daily collating records *increases* by 1.2 hours among more risky firms, while among low-risk firms there is no significant impact ( $p=0.042$  for the difference between the two

coefficients) (Table 7 column 5), suggesting that high-risk firms may now need to pay more attention to preparing their tax declaration submissions themselves.

The e-filing enrollment behavior of high-risk firms provides additional insight into the differential impact on tax payment. As noted in the discussion of e-filing adoption results, risk score is negatively correlated with e-filing adoption in the combined control group, suggesting that firms with high risk scores anticipated receiving a negative impact. In addition, we find evidence that firms in the treatment group are more likely to stop e-filing during the course of the year, an effect concentrated among high-risk firms: the drop-out rate for high-risk firms is 21 percent, relative to 9 percent for low-risk firms (Appendix Table A7).<sup>32</sup> In contrast, in the control group, the drop-out rates for high risk and low-risk firms are similar at 3 percent. This finding is consistent with the notion that firms in Group A may have interpreted the logistical support for e-filing registration to mean that registration was compulsory. Given that e-filing led to an increase in tax payment for high-risk firms, it is not surprising that they were more likely to stop using it.

In line with the decline in e-filing among Group A high-risk firms, we examine whether the impact of e-filing on tax payments fades over time. It does. Whereas there is a strong and statistically significant increase in tax payments for Group A high-risk firms from January to June, the analogous result for July to December is smaller and loses statistical significance (Table 7, columns 3 and 4). In contrast, given the more modest drop in e-filing among Group A low-risk firms, the impact on taxes paid from January to June is similar to the impact from July to December and remains statistically significant for the tax payment measures for which it was statistically significant for the full period in Table 5 (regressions available on request).

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<sup>32</sup> Appendix Table A7 shows the differences in the drop-out rate only among firms that registered for e-filing and, as such, the coefficients are descriptive, not causal. The analysis continues only until June 2015 because the data from July to December do not report e-filing use for each month.

The abandonment of e-filing by Group A high-risk firms can also explain the result that, unlike for low-risk firms, among high-risk firms no reduction in bribe payments occurs. Since the survey measuring this outcome took place in January/ February 2016, one year after program implementation, we have only a one-time measure of this outcome, which occurs after a sizable proportion of the high-risk firms have dropped out of e-filing. Since the impact on tax payments has dissipated by then, it is reasonable to assume that any collusion arrangements have resumed, such that we see no negative impact of assignment to the treated group upon the prevalence of bribes. Instead, from the list experiment (Table 6), we observe relatively high levels of bribes (10-14 percent) among high-risk firms in both treated and control groups.

#### **7.4 Robustness Checks**

One potential concern is that, since the baseline risk profile scores of firms is correlated with other firm characteristics (Table 2), if the impacts of e-filing adoption are heterogeneous across these characteristics then initial differences in these characteristics between low- and high-risk firms may be driving our heterogeneous analysis by risk score. For example, suppose that e-filing has greater impacts on firms in a certain sector and results in those firms paying higher taxes. If firms in that sector also have higher risk scores, this effect could drive the heterogeneous results found by risk profile score.

To examine this possibility, we allow the effect of e-filing adoption to vary with other firm characteristics. To do so, we estimate the following equation for a set of  $H$  potential

explanators  $K_h$ :<sup>33</sup>

$$\begin{aligned}
Y_i = & \beta_0 + \gamma \widehat{Efile} * LowRisk + \alpha \widehat{Efile} * HighRisk + \sum_{h=1}^H \pi_h \widehat{Efile} * LowRisk * K_{h,i} \\
& + \sum_{h=1}^H \mu_h \widehat{Efile} * HighRisk * K_{h,i} + \sum_{h=1}^H \varphi_h K_{h,i} + \rho HighRisk + \lambda X_i + \epsilon_i
\end{aligned} \tag{5}$$

As in previous analyses,  $\widehat{Efile}$  is instrumented by assignment to group A. For the variables  $K_h$ , we use variables that are significantly correlated with the risk scores and across which the effects of e-filing adoption could plausibly be heterogeneous. We use the following variables: *operating in the trade sector* (this sector of activity may benefit more from e-filing adoption), *declaring no employees* (one-(wo)man businesses may have simpler taxes and benefit less from e-filing), *rayon* (interactions with officials may vary across different tax offices) and *monthly amount of time spent on tax related activities* (firms with high tax compliance costs may benefit more from e-filing). All variables  $K_h$  are demeaned so we can still interpret  $\gamma$  and  $\alpha$  as the impact of e-filing on low-risk and high-risk firms respectively, measured at the mean of the other variables.

Results of these estimations are presented in the Appendix Table A8 and show that our main results are robust to the introduction of these additional controls.  $\gamma$  and  $\alpha$  coefficients have similar magnitude and statistical significance as in Table 5.

## 8 Conclusion and Policy Implications

This paper presents some of the earliest evidence on the impact of electronic tax filing. We find that firms' baseline likelihood of tax evasion is an important determinant of their willingness to use e-filing, as well as of the impact e-filing has on them. For firms in a

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<sup>33</sup> We follow the same strategy as in [De Mel et al. \(2009\)](#).

baseline collusive equilibrium with tax officials, e-filing disrupts that collusive relationship and causes them to pay significantly higher taxes. These high-risk firms are also less likely to sign up for e-filing voluntarily and, when they do (potentially due to perceived compulsion), they are more likely to stop e-filing, indicating a preference to continue interacting directly with tax officials. On the other hand, for firms in a non-collusive equilibrium, e-filing results in lower tax payments as tax inspectors no longer constrain them to pay higher taxes (possibly higher than their true liability). At the same time, low-risk firms benefit from e-filing by becoming less exposed to coercive demands for unofficial payments. These opposing patterns of impact on tax payments close the revenue gap that would otherwise exist between high-risk and low-risk firms.

Over time, e-filing use has continued to expand in Tajikistan. The overall impact on tax revenue from the introduction of e-filing (beyond the encouragement design considered in this study) would depend on the distribution of high-risk and low-risk firms among the total population that adopts e-filing and the relative magnitudes of the respective increase and decrease in tax payment among these two groups. Beyond the impact on tax payments, the tax authority stands to derive significant system-wide efficiency gains. Back-of-the-envelope calculations indicate that, at current e-filing rates, the tax authority frees up over 5,800 tax-official-hours each month that can be reallocated to other activities likely higher in marginal productivity than receiving tax declarations.<sup>34</sup>

This study's findings provide lessons extending beyond e-filing to other technologies designed to increase efficiency and reduce corruption. First, our results highlight the importance of selection among potential users. Those who anticipate negative benefits from the new technology due to expected constraints on their behavior may be the least likely

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<sup>34</sup> This calculation assumes that a tax official spends six minutes on each tax declaration. This is a conservative estimate as the firms in our baseline survey report tax officials spending an average of 18 minutes checking their reports.

to adopt. However, this may be the population segment of greatest interest. As a result, governments must weigh carefully the capacity constraints of potential users in adopting a new technology, with the potential of risky types opting out, when deciding whether to make new technologies mandatory. In Tajikistan, while e-filing was not mandatory, updated policies require that firms which start e-filing may not revert to paper filing.

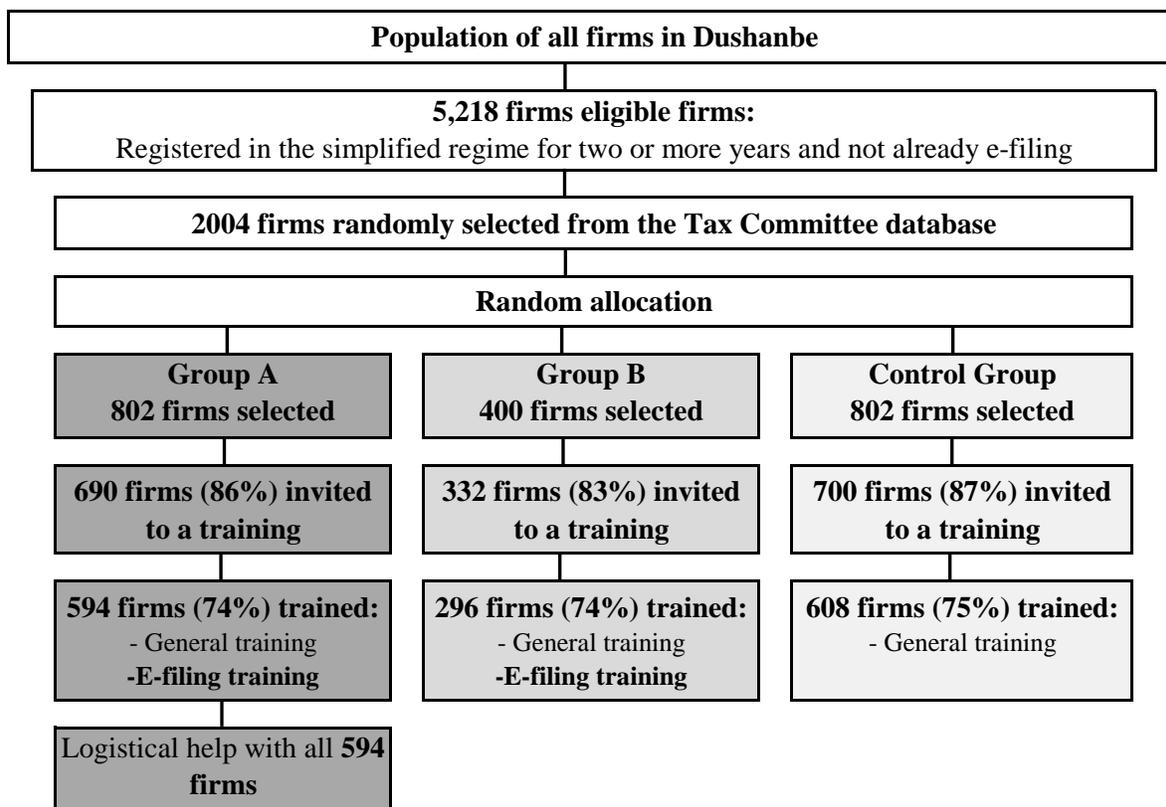
Second, our results underscore the possibility of heterogeneous effects of technology. The impact of technology introduced to replace human discretion will depend on the way that discretion was previously exercised. If discretion produces worse outcomes, technology may improve outcomes (as we find with higher tax payments among high-risk firms and lower bribe payments among low-risk firms). However, if discretion produces desirable outcomes (such as monitoring firms), technology may have an unanticipated effect of producing less desirable outcomes. Lastly, on a related note, our results on the distributional consequences of e-filing emphasize the potential of technology to correct possible patterns of bias resulting from human discretion.

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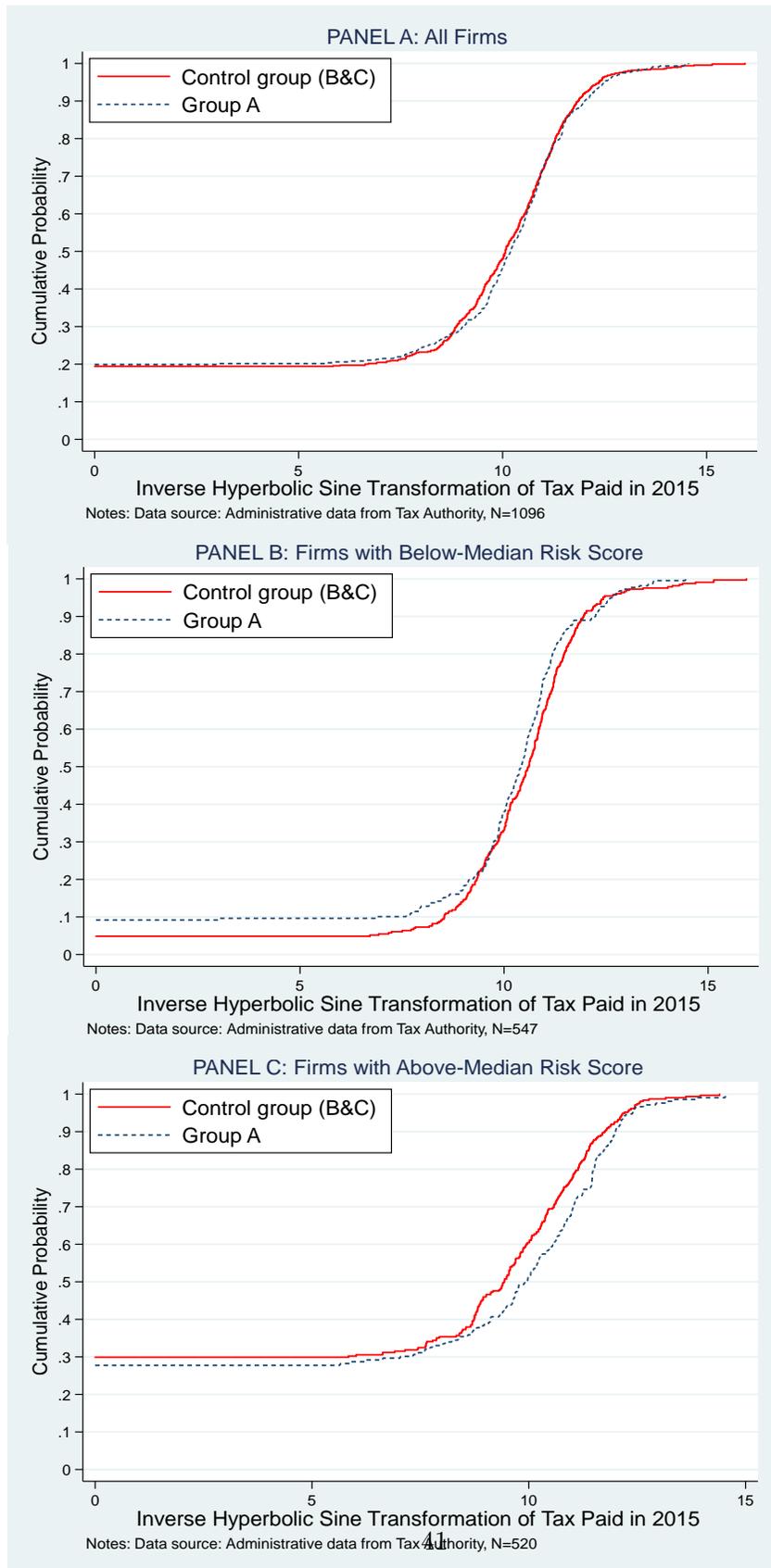
**Figure 1: Study Design and Program Implementation**



**Figure 2: Conceptual Framework**

	<b>Expected Impact of E-filing on:</b>		
	<b>Compliance Costs</b>	<b>Unofficial payments</b>	<b>Tax payments</b>
<b>High-risk firms</b>	Decrease  <i>Taxpayer spends less time on travel and on queues</i>	Decrease (collusion)  <i>Official and taxpayer have less opportunity to collude</i>	Increase  <i>Official and taxpayer have less opportunity to collude</i>
<b>Low-risk firms</b>	Decrease  <i>Taxpayer spends less time on travel and on queues</i>	Decrease (coercion)  <i>Official has less opportunity to hold up taxpayer</i>	Decrease  <i>Official is less able to require taxpayer to increase tax paid</i>

**Figure 3: CDF of Tax Paid in 2015 (Inverse Hyperbolic Sine Transformation) for the Whole Sample and by Risk Profile Score**



**Table 1 : Descriptive Statistics and Balance Checks**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	<b>All sample</b>			<b>Below median of 2014 risk profile score (low risk)</b>			<b>Above median of 2014 risk profile score (high risk)</b>		
	Mean [SD]	Diff. in	N	Mean [SD]	Diff. in	N	Mean [SD]	Diff. in	N
	Control group (B&C)	Group A		Control group (B&C)	Group A		Control group (B&C)	Group A	
<b>PANEL A: Administrative data from Tax Committee (2014)</b>									
Legal entities <sup>β</sup>	0.729 [0.445]	-	1,498	1 [0]	-	547	1 [0]	-	520
Sector of activity is Trade <sup>β</sup>	0.415 [0.493]	-	1,498	0.374 [0.485]	-	547	0.248 [0.432]	-	520
Sector of activity is Services <sup>β</sup>	0.42 [0.494]	-	1,498	0.495 [0.501]	-	547	0.582 [0.494]	-	520
Sector of activity is Manufacturing	0.116 [0.321]	0.012 (0.011)	1,498	0.1 [0.301]	-0.003 (0.017)	547	0.113 [0.317]	0.012 (0.021)	520
Female owner	0.076 [0.266]	0.023 (0.015)	1,498	0.07 [0.255]	0.007 (0.023)	547	0.048 [0.215]	0.032 (0.024)	520
No employee	0.406 [0.491]	-0.01 (0.025)	1,498	0.195 [0.396]	0.003 (0.035)	547	0.469 [0.5]	-0.025 (0.045)	520
Number of employees	3.287 [3.443]	-0.127 (0.171)	1,498	4.271 [3.71]	-0.57* (0.306)	547	3.257 [3.781]	0.108 (0.331)	520
The firms was audited in 2014	0.037 [0.188]	-0.006 (0.009)	1,498	0.067 [0.25]	-0.023 (0.019)	547	0.016 [0.126]	0.014 (0.014)	520
Risk profile score in 2014 <sup>λ</sup>	62.6 [28.9]	0.1 (1.7)	1,067	41.3 [10.5]	1.6* (0.9)	547	85.1 [24.7]	-0.3 (2.1)	520
Risk profile score in 2014 above	0.486 [0.5]	-0.015 (0.031)	1,067	0 [0]	0.000 (0.000)	547	1 [0]	0.000 (0.000)	520
<b>PANEL B: Baseline Survey Data (2014)</b>									
Firm has an accountant	0.73 [0.444]	0.028 (0.023)	1,498	0.799 [0.401]	-0.032 (0.037)	547	0.762 [0.427]	0.041 (0.036)	520
Share of technological practices implemented	0.538 [0.437]	0.024 (0.021)	1,498	0.639 [0.422]	-0.011 (0.038)	547	0.665 [0.402]	0.074** (0.036)	520
Number of visits to tax authority office in Jan-Jun 2014	6.382 [0.948]	0.13** (0.056)	1,498	6.514 [1.027]	0.109 (0.101)	547	6.444 [1.111]	0.158 (0.106)	520
Time spent on tax related activities during a typical month (hours)	6.185 [2.926]	0.131 (0.162)	1,483	6.26 [2.852]	-0.005 (0.241)	544	6.657 [3.195]	0.188 (0.359)	513
Number of times tax inspectors visited the company in Jan-Jun 2014	1.324 [0.948]	-0.027 (0.054)	1,498	1.271 [0.871]	-0.044 (0.107)	547	1.199 [0.879]	0.022 (0.08)	520
Ever used e-filing (with another company)	0.14 [0.348]	-0.013 (0.018)	1,498	0.198 [0.399]	-0.037 (0.034)	547	0.177 [0.382]	0.000 (0.035)	520
Think that it is common for firms to make informal payments	0.18 [0.385]	0.004 (0.02)	1,498	0.255 [0.437]	-0.046 (0.035)	547	0.174 [0.379]	0.019 (0.035)	520
<b>P-values of joint orthogonality tests<sup>α</sup></b>	0.658			0.526			0.553		

Notes: Columns 1, 4, 7: Standard deviations presented in brackets. Columns 2, 5, 8: coefficients and standard errors (in parentheses) from an OLS regression of the firm owner/firm characteristic on a treatment variable (group A), controlling for strata dummies. β: variables used for stratification. λ: Risk profile scores only calculated for legal entities. α: P-values of joint orthogonality tests obtained from regressions of the treatment dummy on all the variables in the right-hand column (not used for stratification) and testing for all coefficients are jointly equal to zero. \*\*\*, \*\*, \* indicate significance at 1, 5 and 10%.

**Table 2: Baseline Correlates of Risk Profile Score**

	(1)	(2)	(3)	(4)
<i>Dependent variables:</i>				
	<b>Risk Profile Score in 2014</b>		<b>Above median of Risk Profile Score in 2014</b>	
<b><u>Administrative data</u></b>				
<i>Sector of activity: omitted = manufacturing</i>				
Trade	-6.161** (2.783)	-6.598** (2.748)	-0.115** (0.048)	-0.120** (0.047)
Services	-0.607 (2.565)	-0.826 (2.536)	-0.016 (0.044)	-0.019 (0.044)
Female owner	-1.924 (3.396)	-2.389 (3.392)	-0.078 (0.061)	-0.085 (0.061)
No employee	20.330*** (2.147)	20.399*** (2.138)	0.299*** (0.036)	0.300*** (0.036)
Number of employees	0.120 (0.240)	0.240 (0.238)	0.006 (0.005)	0.007 (0.005)
The firm was audited in 2014		-20.187*** (3.231)		-0.264*** (0.069)
Amount of fine following an audit in 2014 (in TJS/1000)		0.150*** (0.034)		0.002*** (0.000)
<b><u>Baseline survey data</u></b>				
Firm has an accountant	3.353 (2.089)	3.038 (2.068)	0.041 (0.037)	0.037 (0.037)
Share of technological practices implemented	3.144 (2.030)	3.229 (2.011)	0.029 (0.038)	0.030 (0.038)
Number of visits to tax authority office in Jan-Jun 2014	-1.029* (0.586)	-0.921 (0.596)	-0.011 (0.013)	-0.010 (0.013)
Time spent on tax related activities during a typical month (hours)	0.288 (0.271)	0.303 (0.269)	0.008* (0.004)	0.008* (0.004)
Number of times tax inspectors visited the company in Jan-Jun 2014	0.514 (0.739)	0.398 (0.741)	0.003 (0.015)	0.002 (0.014)
Ever used e-filing (with another company)	2.063 (2.270)	2.075 (2.261)	-0.000 (0.041)	-0.000 (0.041)
Think that it is common for firms to make informal payments	-2.594 (2.052)	-2.411 (2.033)	-0.083** (0.036)	-0.080** (0.036)
Observations	1,057	1,057	1,057	1,057
R-squared	0.203	0.221	0.141	0.151
Mean Dependent Variable	63.864	63.864	0.494	0.494

Notes: OLS regressions with standard errors presented in parentheses controlling for dummies for the tax Rayon. \*\*\*, \*\*, \* indicate significance at 1, 5 and 10%.

**Table 3: Impact on E-filing Adoption**

	Mean [SD] Control group	Difference between control group and [...] Group A    Group B		N	P-values of the test Group A= Group B
<b><i>PANEL A: Administrative data from TC (Aug 2014-Dec 2015)</i></b>					
Used E-filing	0.59 [0.492]	0.337*** (0.023)	0.038 (0.033)	1498	0.000***
Used E-filing conditional on survival	0.641 [0.48]	0.34*** (0.022)	0.042 (0.035)	1275	0.000***
Still using e-filing in Dec 2015	0.548 [0.498]	0.238*** (0.027)	0.046 (0.034)	1498	0.000***
<b><i>PANEL B: Endline survey data (Feb 2016)</i></b>					
Firm used electronic filing to submit tax reports in 2015	0.564 [0.496]	0.439*** (0.022)	0.038 (0.037)	1263	0.000***
Found out about e-filing during intervention training	0.796 [0.403]	0.202*** (0.018)	0.054* (0.029)	1263	0.000***
Found out about e-filing from business network	0.17 [0.376]	-0.169*** (0.017)	-0.047* (0.027)	1263	0.000***
Found out from another source (other training, tax Committee publication...)	0.033 [0.18]	-0.033*** (0.008)	-0.007 (0.013)	1263	0.011**

Notes: Column 1: Standard deviations presented in brackets. Columns 2-3: coefficients and standard errors (in parentheses) from an OLS regression of the firm owner/firm characteristic on treatment dummies, controlling for strata dummies. \*\*\*, \*\*, \* indicate significance at 1, 5 and 10%.

**Table 4: Determinants of E-filing Adoption in Groups B and C**

<i>Dependent variable:</i>	(1)	(2)	(3)
	<i>Firm used E-Filing</i>		
	<i>Group B &amp; C All Sample</i>	<i>Group B &amp; C Only Legal entities</i>	
<i>Treatment variables</i>			
Group B (Training alone)	0.026 (0.033)	0.033 (0.033)	0.015 (0.040)
<i>Administrative data (baseline)</i>			
Female owner	-0.009 (0.063)	-0.009 (0.063)	0.010 (0.081)
No employee	-0.133*** (0.040)	-0.092** (0.041)	-0.147*** (0.052)
Number of employees	0.018*** (0.005)	0.018*** (0.005)	0.017*** (0.005)
The firms was audited in 2014	-0.034 (0.084)	-0.068 (0.085)	0.001 (0.085)
Standardized risk profile score in 2014 <sup>λ</sup>		-0.072*** (0.019)	-0.060*** (0.019)
<i>Survey data (baseline)</i>			
Firm has an accountant	0.059 (0.038)	0.062 (0.038)	0.039 (0.048)
Share of technological practices implemented	0.023 (0.043)	0.031 (0.043)	0.013 (0.049)
Number of visits to tax authority office in Jan-Jun 2014	0.012 (0.017)	0.008 (0.017)	0.005 (0.016)
Time spent on tax related activities during a typical month (hours)	0.010** (0.005)	0.011** (0.005)	0.011* (0.006)
Number of times tax inspectors visited the company in Jan-Jun 2014	-0.016 (0.017)	-0.018 (0.017)	-0.039* (0.022)
Ever used e-filing (with another company)	-0.018 (0.050)	-0.016 (0.050)	-0.029 (0.052)
Think that it is common for firms to make informal payments	-0.006 (0.043)	-0.010 (0.043)	0.036 (0.047)
Observations	894	894	634
R-squared	0.173	0.188	0.161
Mean Dep Var in control	0.590	0.590	0.563

Notes: Robust standard errors in parentheses. Omitted group are firms in the control group that received a general tax training. Regressions include fixed effects for strata.  $\lambda$ : for individual entities there are no risk profile scores so missing values were replaced by the mean of the variable. \*\*\*, \*\*, \* indicate significance at 1, 5 and 10%.

**Table 5: Impact of E-filing Adoption on Main Outcomes**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
<b><u>Dependent variables:</u></b>	# visits per month to tax authority office in 2015	Total time spent on tax- related activities by month in 2015 (hours)	Think that it is common for firms to make informal payments	Tax paid in 2015 <sup>α</sup> (Admin. data) (in TJS)	Inverse hyperbolic of tax paid in 2015 (Admin. data)	Median of Tax paid in 2015 <sup>α</sup> (Admin. data)	Tax paid in 2015 <sup>α</sup> (Survey data) (in TJS)
<b><u>E-filing Impact, Overall Sample:</u></b>							
E-filing Impact (IV) (all firms)	-1.4*** (0.1)	-4.7*** (1.1)	0.07 (0.084)	5,857 (8,735)	0.087 (0.631)	-155 (474)	-4,395 (22,286)
Observations	1,263	1,252	1,263	1,498	1,498	1,498	1,263
Mean outcome control group (B&C)	0.8	33.5	0.613	28,062	8.827	1,605	32,786
Mean outcome group A	0.3	31.9	0.632	29,996	8.83	1,551	30,806
<b><u>E-filing Impact, Legal Entities Sample:</u></b>							
E-filing Impact (IV) (Legal Entities)	-1.5*** (0.1)	-4.8*** (1.2)	-0.025 (0.093)	7,217 (10,937)	-0.049 (0.771)	-216 (591)	-6,980 (28,230)
Observations	934	925	934	1,096	1,096	1,096	934
Mean outcome control group (B&C)	0.8	34.1	0.617	30,971	8.404	1,660	38,192
Mean outcome group A	0.3	32.4	0.608	33,533	8.41	1,586	35,082
<b><u>Impact by Baseline Risk Profile Score:</u></b>							
E-filing Impact (IV) for below- median risk score	-1.6*** (0.1)	-7.0*** (1.9)	-0.236 (0.144)	-15,099 (18,966)	-1.920** (0.910)	-1,896* (1,023)	-59,215 (51,804)
E-filing Impact (IV) for above- median risk score	-1.3*** (0.1)	-2.8* (1.5)	0.161 (0.119)	25,357** (12,728)	1.060 (1.075)	1,145* (671)	35,866* (19,399)
P-val difference (Low risk / High risk)	0.031	0.085	0.035	0.078	0.034	0.013	0.081
Observations	934	925	934	1,067	1,067	1,067	934
<b><u>Mean Outcome in control group (B&amp;C) for:</u></b>							
... Firms below median risk score	0.8	34.4	0.637	39,686	10.076	2,295	53,095
... Firms above median risk score	0.8	33.7	0.596	23,645	7.151	1,090	22,241
<b><u>Mean Outcome in group A for:</u></b>							
... Firms below median risk score	0.3	32.2	0.5690	36,116	9.529	1,785	37,140
... Firms above median risk score	0.3	32.6	0.652	32,433	7.604	1,455	32,803

Note: The first two parts of the table present results from 2SLS regressions measuring the impact of e-filing adoption (instrumented by assignment to group A) on outcomes presented in columns. The second part of the table presents results from 2SLS regressions measuring the heterogeneous impact of e-filing adoption (instrumented by assignment to group A) by risk profile scores. For the heterogeneous analysis, samples include only legal entities because individual enterprises do not have risk scores. Robust standard errors in parentheses. All regressions include control dummies for strata.  $\alpha$ : truncated at the 99th percentile. \*\*\*, \*\*, \* indicate significance at 1, 5 and 10%.

**Table 6: Impact on Informal Payments Using a List Experiment**

	(1)	(2)	(3)	(4)	(5)	(6)
	All Sample		Below median of 2014 risk profile score		Above median of 2014 risk profile score	
	Group B&C	Group A	Group B&C	Group A	Group B&C	Group A
<b><i>Short list (4 questions without the question on informal payments):</i></b>						
Mean	1.119	1.146	1.109	1.182	1.088	1.075
SE	0.02	0.027	0.03	0.046	0.027	0.035
N	361	246	138	99	136	80
<b><i>Long list (5 questions, including the question on informal payments):</i></b>						
Mean	1.194	1.166	1.252	1.143	1.187	1.214
SE	0.029	0.033	0.05	0.05	0.051	0.06
N	397	259	151	98	134	98
<b><i>Difference short list - long list:</i></b>						
Difference	0.075**	0.02	0.143**	-0.039	0.098*	0.139*
SE Difference	0.036	0.042	0.06	0.068	0.057	0.074
P-value T-test Difference	0.038	0.643	0.017	0.569	0.087	0.06
<b><i>Difference in Difference with Control group:</i></b>						
Difference in Difference		-0.055		-0.182**		0.041
SE Difference		0.056		0.092		0.093
P-value T-test Difference		0.326		0.048		0.658

Note: Endline survey data, Feb 2016. Columns 3-6: samples include only legal entities because individual enterprises do not have risk scores. \*\*\*, \*\*, \* indicate significance at 1, 5 and 10%.

**Table 7: Impact of E-filing Adoption: Mechanisms**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	<b>Administrative data</b>				<b>Survey data</b>		
<u>Dependent variables:</u>					Monthly time spent by type of task: (hours)		
	# months with a positive amount of tax paid in 2015	Tax paid in 2015 divided by # of payments	Tax paid in Jan- June 2015	Tax paid in Jul- Dec 2015	<i>Collate records</i>	<i>Submit tax returns and get reconciliation act (including travel time)</i>	<i>Prepare primary documents used for tax purposes</i>
<b><u>E-filing Impact, Overall Sample:</u></b>							
E-filing Impact (IV) (all firms)	-0.16 (0.72)	2,936** (1,397)	3,725 (4,693)	242 (4,515)	-0.04 (0.4)	-3.33*** (0.14)	-1.35 (0.97)
Observations	1,498	1,267	1,498	1,498	1,252	1,252	1,252
Mean outcome control group (B&C)	7.38	3,772	13,766	14,331	21.78	1.69	9.49
Mean outcome group A	7.31	4,578	14,998	14,482	21.78	0.59	8.99
<b><u>E-filing Impact, Legal Entities Sample:</u></b>							
E-filing Impact (IV) (Legal Entities)	-0.42 (0.84)	4,077** (1,897)	4,386 (5,882)	426 (5,647)	0.29 (0.47)	-3.54*** (0.18)	-1.51 (1.09)
Observations	1,096	881	1,096	1,096	925	925	925
Mean outcome control group (B&C)	6.54	4,441	14,973	16,046	22.26	1.84	9.44
Mean outcome group A	6.44	5,606	16,536	16,295	22.36	0.6	8.89
<b><u>Impact by Baseline Risk Profile Score:</u></b>							
E-filing Impact (IV) for below- median risk score	-2.3* (1.2)	2,669 (2,785)	-12,106 (10,145)	-9,030 (9,235)	-0.7 (0.7)	-3.9*** (0.3)	-2.4 (1.7)
E-filing Impact (IV) for above- median risk score	0.9 (1.1)	6,270** (2,821)	18,089** (7,169)	7,944 (6,604)	1.2* (0.6)	-3.2*** (0.2)	-0.8 (1.4)
P-val difference (Low risk / High risk)	0.051	0.382	0.016	0.139	0.042	0.025	0.479
Observations	1,067	880	1,067	1,067	925	925	925
<b><u>Mean Outcome in control group (B&amp;C) for:</u></b>							
... Firms below median risk score	8.279	4,509	20,104	19,783	22.37	1.85	9.67
... Firms above median risk score	5.11	4,344	10,460	13,073	22.13	1.82	9.18
<b><u>Mean Outcome in group A for:</u></b>							
... Firms below median risk score	7.67	5,379	17,054	17,540	22.14	0.61	8.9
... Firms above median risk score	5.47	5,926	16,786	15,766	22.61	0.58	8.870

Note: The first two parts of the table present results from 2SLS regressions measuring the impact of e-filing adoption (instrumented by assignment to group A) on outcomes presented in columns. The second part of the table presents results from 2SLS regressions measuring the heterogeneous impact of e-filing adoption (instrumented by assignment to group A) by risk profile scores. For the heterogeneous analysis, samples include only legal entities because individual enterprises do not have risk scores. Robust standard errors in parentheses. All regressions include control dummies for strata.  $\alpha$ : truncated at the 99th percentile. \*\*\*, \*\*, \* indicate significance at 1, 5 and 10%.

## Appendix Tables

**Table A1: Attrition at Endline Survey**

	Mean [SD] Control group	Difference between control group and [...]		N	P-values of the test:	
		Group A	Group B		Group A= Group B	Group A= Group B= 0
Survey completed and firm still operating	0.84 [0.366]	0.007 (0.021)	0 (0.026)	1498	0.786	0.932
Survey completed and firm liquidated	0.127 [0.333]	-0.008 (0.019)	-0.023 (0.023)	1498	0.506	0.586
Survey not completed: not available or not found	0.023 [0.15]	0.009 (0.009)	0.023* (0.014)	1498	0.307	0.226
Survey not completed: moved to another town	0.01 [0.099]	-0.008* (0.004)	0 (0.007)	1498	0.205	0.11

Notes: Endline survey data 2015. Column 1: Standard deviations presented in brackets. Columns 2-3: coefficients and standard errors (in parentheses) from an OLS regression of the firm owner/firm characteristic on treatment dummies, controlling for strata dummies. \*\*\*, \*\*, \* indicate significance at 1, 5 and 10%.

**Table A2: Balance Checks by Initial Treatment Groups**

	Mean [SD]	Difference between		N	P-values of the test Group A= Group B
	Control group	control group and [...]	Group A		
<b>PANEL A: Administrative data from Tax Committee (2014)</b>					
Legal entities <sup>β</sup>	0.734 [0.442]	-	-	1,498	-
Sector of activity is Trade <sup>β</sup>	0.413 [0.493]	-	-	1,498	-
Sector of activity is Services <sup>β</sup>	0.419 [0.494]	-	-	1,498	-
Sector of activity is Manufacturing	0.11 [0.313]	0.02 (0.012)	0.025* (0.014)	1,498	0.699
Female owner	0.072 [0.259]	0.027 (0.016)	0.012 (0.019)	1,498	0.474
No employee	0.414 [0.493]	-0.019 (0.027)	-0.03 (0.033)	1,498	0.754
Number of employees	3.257 [3.431]	-0.089 (0.189)	0.119 (0.24)	1,498	0.376
The firms was audited in 2014	0.036 [0.187]	-0.006 (0.01)	0.000 (0.013)	1,498	0.642
Risk profile score in 2014 <sup>λ</sup>	62.1 [28.7]	1 (1.8)	2.8 (2.3)	1,067	0.433
Risk profile score in 2014 above median <sup>λ</sup>	0.481 [0.5]	-0.004 (0.033)	0.034 (0.04)	1,067	0.351
<b>PANEL B: Baseline Survey Data (2014)</b>					
Firm has an accountant	0.72 [0.449]	0.044* (0.025)	0.047 (0.03)	1,498	0.903
Share of technological practices	0.547 [0.432]	0.016 (0.023)	-0.023 (0.028)	1,498	0.159
Number of visits to tax authority office in Jan-Jun 2014	6.373 [0.978]	0.136** (0.061)	0.02 (0.066)	1,498	0.095*
Time spent on tax related activities during a typical month (hours)	6.043 [2.681]	0.279* (0.166)	0.461** (0.227)	1,483	0.451
Number of times tax inspectors visited the company in Jan-Jun 2014	1.334 [0.989]	-0.032 (0.059)	-0.016 (0.063)	1,498	0.808
Ever used e-filing (with another company)	0.127 [0.333]	0.000 (0.019)	0.04 (0.025)	1,498	0.111
Think that it is common for firms to make informal payments	0.184 [0.388]	0.000 (0.022)	-0.014 (0.026)	1,498	0.591
<b>P-values of joint orthogonality tests:</b>		0.515	0.157		

Notes: Column 1: Standard deviations presented in brackets. Columns 2-3: coefficients and standard errors (in parentheses) from an OLS regression of the firm owner/firm characteristic on treatment dummies, controlling for strata dummies.  $\beta$ : variables used for stratification.  $\lambda$ : Risk profile scores are only calculated for legal entities. \*\*\*, \*\*, \* indicate significance at 1, 5 and 10%.

**Table A3: Balance Checks on Endline Survey Sample**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	<b>All sample</b>			<b>Below median of 2014 risk profile score (low risk)</b>			<b>Above median of 2014 risk profile score (high risk)</b>		
	Mean [SD]	Diff. in	N	Mean [SD]	Diff. in	N	Mean [SD]	Diff. in	N
	Control group (B&C)	Group A		Control group (B&C)	Group A		Control group (B&C)	Group A	
<b>PANEL A: Administrative data from Tax Committee (2014)</b>									
Legal entities <sup>β</sup>	0.737 [0.44]	-	1,263	1 [0]	-	486	1 [0]	-	448
Sector of activity is Trade <sup>β</sup>	0.401 [0.49]	-	1,263	0.346 [0.477]	-	486	0.252 [0.435]	-	448
Sector of activity is Services <sup>β</sup>	0.425 [0.495]	-	1,263	0.512 [0.501]	-	486	0.567 [0.496]	-	448
Sector of activity is Manufacturing	0.124 [0.33]	0.008 (0.012)	1,263	0.104 [0.306]	0.004 (0.018)	486	0.119 [0.324]	0.011 (0.023)	448
Female owner	0.08 [0.272]	0.018 (0.017)	1,263	0.073 [0.26]	0.007 (0.025)	486	0.044 [0.206]	0.021 (0.023)	448
No employee	0.392 [0.488]	-0.015 (0.026)	1,263	0.197 [0.399]	0.003 (0.037)	486	0.422 [0.495]	-0.04 (0.047)	448
Number of employees	3.396 [3.563]	-0.157 (0.191)	1,263	4.294 [3.795]	-0.703** (0.321)	486	3.519 [3.967]	0.16 (0.375)	448
The firms was audited in 2014	0.03 [0.172]	-0.009 (0.009)	1,263	0.062 [0.242]	-0.03* (0.018)	486	0.015 [0.121]	0.011 (0.014)	448
Risk profile score in 2014 <sup>λ</sup>	61.9 [27.8]	-0.7 (1.7)	934	41.7 [10.5]	1.7* (0.9)	486	83.6 [24.1]	-1.4 (2.2)	448
Risk profile score in 2014 above	0.483 [0.5]	-0.025 (0.033)	934	0 [0]	0.000 (0.000)	486	1 [0]	0.000 (0.000)	448
<b>PANEL B: Baseline Survey Data (2014)</b>									
Firm has an accountant	0.73 [0.444]	0.04 (0.025)	1,263	0.796 [0.404]	-0.026 (0.039)	486	0.752 [0.433]	0.074* (0.038)	448
Share of technological practices	0.544 [0.438]	0.035 (0.023)	1,263	0.664 [0.417]	-0.026 (0.04)	486	0.651 [0.408]	0.108*** (0.039)	448
Number of visits to tax authority office in Jan-Jun 2014	6.398 [0.994]	0.13** (0.062)	1,263	6.536 [1.067]	0.086 (0.106)	486	6.459 [1.149]	0.183 (0.119)	448
Time spent on tax related activities during a typical month (hours)	6.139 [2.709]	0.111 (0.162)	1,252	6.117 [2.35]	0.075 (0.236)	483	6.686 [3.171]	0.019 (0.36)	442
Number of times tax inspectors visited the company in Jan-Jun 2014	1.309 [0.924]	-0.038 (0.059)	1,263	1.26 [0.832]	-0.061 (0.114)	486	1.167 [0.874]	0.048 (0.088)	448
Ever used e-filing (with another company)	0.152 [0.359]	-0.01 (0.02)	1,263	0.208 [0.406]	-0.04 (0.036)	486	0.185 [0.389]	0.017 (0.039)	448
Think that it is common for firms to make informal payments	0.186 [0.389]	0.005 (0.022)	1,263	0.26 [0.439]	-0.053 (0.037)	486	0.178 [0.383]	0.009 (0.037)	448
<b>P-values of joint orthogonality tests:</b>	0.558			0.4			0.292		

Notes: Columns 1, 4, 7: Standard deviations presented in brackets. Columns 2, 5, 8: coefficients and standard errors (in parentheses) from an OLS regression of the firm owner/firm characteristic on a treatment variable (group A), controlling for strata dummies. β: variables used for stratification. λ: Risk profile scores only calculated for legal entities. \*\*\*, \*\*, \* indicate significance at 1, 5 and 10%.

**Table A4: Correlation between 2014 Risk Score and 2015 Tax Paid and Audits Results**

	(1)	(2)	(3)	(4)	(5)	(6)
					Total audit fine in 2015 (in TJS 1000)	Inverse hyperbolic of total audit fine in 2015 (in TJS 1000)
<b><i>Dependent variables:</i></b>						
	<u>Tax paid in 2015</u>		<u>Inverse hyperbolic of tax paid in 2015</u>			
Risk Profile Score in 2014	346 (1,904)	539 (2,416)	-1.287*** (0.119)	-1.229*** (0.144)	1.8 (2.1)	0.037** (0.017)
The firm was audited in 2015					58.5*** (9.1)	10.582*** (0.119)
<b><i>Controlling for:</i></b>						
- Trade, Services, gender, no employee, number of employees and tax office.	yes	yes	yes	yes	yes	yes
- Index of profit and turnover in Jun and Dec 2015		yes		yes		
Observations	1,424	934	1,424	934	1,424	1,424
R-squared	0.202	0.505	0.335	0.368	0.190	0.978
Mean Dependent Variable	33073	35969	8.561	9.118	6.9	1.249

Notes: OLS regressions with standard errors presented in parentheses. \*\*\*, \*\*, \* indicate significance at 1, 5 and 10%.

**Table A5: Impact on E-filing Adoption by Baseline Risk Profile Scores**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	<b>All sample</b>			<b>Below median of 2014 risk profile score (low risk)</b>			<b>Above median of 2014 risk profile score (high risk)</b>		
	Mean [SD]	Diff. in	N	Mean [SD]	Diff. in	N	Mean [SD]	Diff. in	N
	Control group (B&C)	Group A		Control group (B&C)	Group A		Control group (B&C)	Group A	
<b><i>PANEL A: Administrative data from TC (Aug 2014-Dec 2015)</i></b>									
Used E-filing	0.604 [0.489]	0.325*** (0.02)	1,498	0.626 [0.485]	0.321*** (0.032)	547	0.547 [0.499]	0.39*** (0.035)	520
Used E-filing conditional on survival	0.658 [0.475]	0.326*** (0.019)	1,275	0.681 [0.467]	0.32*** (0.029)	488	0.592 [0.492]	0.365*** (0.035)	474
Still using e-filing	0.563 [0.496]	0.224*** (0.024)	1,498	0.614 [0.488]	0.248*** (0.037)	547	0.537 [0.499]	0.209*** (0.042)	520
<b><i>PANEL B: Endline survey data (Feb 2016)</i></b>									
Firm used electronic filing to submit tax reports in 2015	0.579 [0.494]	0.427*** (0.019)	1,263	0.526 [0.5]	0.475*** (0.031)	486	0.53 [0.5]	0.488*** (0.032)	448
Found out about e-filing during intervention training	0.815 [0.388]	0.185*** (0.015)	1,263	0.792 [0.406]	0.202*** (0.025)	486	0.796 [0.403]	0.211*** (0.026)	448
Found out about e-filing from business network	0.154 [0.362]	-0.154*** (0.014)	1,263	0.176 [0.382]	-0.172*** (0.024)	486	0.152 [0.36]	-0.158*** (0.024)	448
Found out from another source (other training, tax Committee publication...)	0.03 [0.172]	-0.031*** (0.006)	1,263	0.031 [0.174]	-0.03*** (0.01)	486	0.052 [0.222]	-0.053*** (0.014)	448

Notes: Columns 1, 4, 7: Standard deviations presented in brackets. Columns 2, 5, 8: coefficients and standard errors (in parentheses) from an OLS regression of the firm outcome on a treatment variable (group A), controlling for strata dummies. Columns 4 to 9: Sample restricted to legal entities because risk profile scores only calculated for legal entities. \*\*\*, \*\*, \* indicate significance at 1, 5 and 10%.

**Table A6: Cost-Effectiveness Analysis (only Accounting for Reduced Compliance Costs)**

	<b>Control Group</b>	<b>Group A</b>	<b>Group B</b>
Number of firms	608	594	296
Number of training conducted	12	36	16
<b>Program costs (in USD):</b>			
Training organization (specific by group)	7,573	10,167	4,931
Logistical help to register to e-filing (group A only)	0	4,696	0
<b>Total program costs</b>	<b>7,573</b>	<b>14,863</b>	<b>4,931</b>
<b>Cost effectiveness analysis:</b>			
Cost per firm included in treatment (in USD)	12	25	17
Additional cost with respect to control Group (in USD)		13	
Program impact on e-filing adoption (from table 3)		0.34	
<b>Cost per additional e-filing adoption (in USD)</b>		<b>37</b>	
Program impact on compliance costs (in hours saved) (from Table 5)		-4.7	
Amount of money saved monthly by firms <sup>a</sup> (in USD)		5.5	
<b>Number of months for private benefits in term of time saved to exceeded program costs</b>		<b>7</b>	

Note: Training costs include direct costs of organizing trainings (trainers' salaries, equipment rental, calls to invite participants) and costs to develop training materials. Costs related to the logistical help to register include costs to call and visit firms for the software installation and costs related to firms' registrations. Exchange rate from Oanda.com on January 1st 2016: USD 1 = TJS 6.99. <sup>a</sup>: assuming the wage of the person in charge of tax declaration is in average USD 178 per month or USD 1.11 per hour.

**Table A7: Share of Firms that Dropped Out from E-filing**

	(1)
	<b>Among those who registered for e-filing before June 2015:</b>
	<b>Stopped e-filing at some point after registration</b>
Group A x Below median risk profile score in 2014	0.060** (0.030)
Group A x Above median risk profile score in 2014	0.172*** (0.032)
Above median risk profile score in 2014	-0.029 (0.027)
Observations	623
R-squared	0.144
<i>Mean Dependent variable in control group (B&amp;C) for:</i>	
...all firms (with a risk profile score)	0.028
...firms below median risk profile score in 2014	0.031
...firms above median risk profile score in 2014	0.024
<i>Mean Dependent variable in group A for:</i>	
...all firms (with a risk profile score)	0.151
...firms below median risk profile score in 2014	0.089
...firms above median risk profile score in 2014	0.215

Notes: OLS regressions with standard errors presented in parentheses controlling for gender of the owner, no employees, number of employees, strata dummies and all baseline survey variables presented in Table 2. Risk profile scores only calculated for legal entities. \*\*\*, \*\*, \* indicate significance at 1, 5 and 10%.

**Table A8: Heterogeneous Impact by Baseline Risk Profile Score Including Additional Controls**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Tax paid in 2015 <sup>a</sup>					Inverse hyperbolic of tax paid in 2015				
E-filing Impact (IV) for below-median risk score	-12,821 (20,536)	-11,116 (17,728)	-15,762 (19,950)	-16,833 (19,834)	-10,194 (20,443)	-1.677* (0.925)	-1.676* (0.885)	-1.854** (0.915)	-1.952* (0.999)	-1.543 (1.013)
E-filing Impact (IV) for above-median risk score	25,016** (12,738)	29,879** (13,143)	31,741** (14,669)	26,276** (13,108)	38,812** (15,771)	1.026 (1.077)	2.031** (0.881)	1.080 (1.110)	0.981 (1.093)	2.098** (0.894)
P-val difference (Low risk / High risk):	0.121	0.068	0.064	0.074	0.065	0.057	0.003	0.043	0.049	0.008
Controlling for heterogeneity of E-filing impact with variable:	No		Technological Practices Implemented	Time spent on tax	All variables together	No		Technological Practices Implemented	Time spent on tax	All variables together
Observations	Trader 1,067	employee 1,067	1,067	1,057	1,057	Trader 1,067	employee 1,067	1,067	1,057	1,057
R-squared	0.049	0.106	0.046	0.046	0.087	0.119	0.287	0.128	0.120	0.262

Note: 2SLS regressions measuring the heterogeneous impact of e-filing adoption (instrumented by assignment to group A) by risk profile score. Samples include only legal entities because individual enterprises do not have risk scores. Robust standard errors in parentheses. All regressions include control dummies for strata.  $\alpha$ : truncated at the 99th percentile. \*\*\*, \*\*, \* indicate significance at 1, 5 and 10%.

# Appendices

## A Script Used to Invite Firms to Training

Good day. My name is “OPERATOR NAME”. We are calling you from company “IMPLEMENTING PARTNER NAME” LLC. Our company in cooperation with the Tax Committee and the International Finance Corporation is holding a seminar. Your company - LLC “COMPANY NAME” is in the short-list of taxpayers we are inviting to participate in our training. Training will take place on “DATE AND TIME” at “PLACE”. All participants will be given training and guidance materials on tax and taxation. Some firms will be selected to be registered for e-filing system free of charge. Due to limited resources, we cannot register all firms now, so the firms selected will be based on chance as chosen by a computer program. In this regard, please prepare and bring the following documents:

- Copy of the registration certificate
- Extract from the Unified State Registry
- Passport copy of Director
- Company Seal

This training will provide important information but it is optional and there will be no penalty for your firm if you do not attend. Thanks in advance for your participation. Telephone number for inquiries and information: xxx-xx-xx

## B Measurement of Key Variables and Outcomes

*Baseline administrative data:*

- Legal entities: equal 1 if the firm is a legal entity (75% of the sample) and 0 if it is an individual enterprise.
- Sector of activity: Sector of activity reported by the firm when registering
- Female owner: the firm owner is a woman
- Number of employees: Number of employees reported by the firm to the tax authority
- The firm was audited in 2014: equal 1 if the tax administration reported that the firm was audited in 2014.
- Amount of fine following an audit in 2014 (in TJS/1000): amount of fine in 2014 in TJS/1000, as reported in administrative data. Equal zero if the firm was not audited in 2014.

- Risk score in 2014: Risk score calculated by the tax authority in 2014 (see section on Data for a detailed description of the risk score)

*Baseline survey data: (self-administered survey)*

- Firm has an accountant: the firm reported that an accountant (full-time or part-time) is responsible for tax accounting (as opposed to the firm owner himself).
- Share of technological practices implemented: Share of technological practices implemented by the firm from the following list: “the firm has high speed internet on premises,” “the firm uses emails for business communication,” and “the firm maintains accounting and tax records in your organization electronically using a specialized program (such as Excel).”
- Number of visits to tax authority office in Jan-Jun 2014: Number of times any employees of the firm visited a tax authority office between January and June 2014.
- Time spent on tax-related activities during a typical month (hours): This variable is the sum of the total amounts of time spent during a typical month (in January-June 2014) on tax report preparation and on visiting a tax office (including travel time).
- Number of times tax inspectors visited the company in Jan-Jun 2014: number reported by the firm owner
- Ever used e-filing (with another company): Equals 1 if the respondent reported that he/she had ever used e-filing to submit a tax document with another company.
- Think that it is common for firms to make informal payments: answered that the following statement is always or often true: “It is common for firms in my line of business to have to pay some irregular ‘additional payments/gifts’ to tax officials.”

*E-filing use and registration:*

- Used E-filing: equal 1 if the firm used e-filing at any time during the study period.

*Firm outcomes from endline survey data:*

- Number of visits per month to tax authority office in 2015: sum of all visits reported by the firm owner to any tax office and for any reason.
- Total time spent on tax-related activities by month in 2015 (hours): This variable is the sum of the total amounts of time spent during a typical month in 2015 on the following activities:
  - Collate records
  - Submit tax returns (including travel time)

- Get the reconciliation act
- Prepare primary documents used for tax purposes
- Think that it is common for firms to make informal payments: answered that the following statement is always or often true: “It is common for other companies to have to pay some irregular ‘additional payments/gifts’ to tax officials.”
- Tax paid in 2015: Total amount of tax paid in 2015, calculated using the average (declared) amount of tax paid across two focal months of 2015 (June and December) multiplied by 12.

*Firm outcomes from administrative data:*

- Tax paid in 2015: Sum of all taxes paid in 2015 using monthly administrative data.
- Inverse hyperbolic of tax paid in 2015: Inverse hyperbolic sine transformation of tax paid in 2015. It is defined by  $\log(y_i + (y_i^2 + 1)^{1/2})$ .
- Median of Tax paid in 2015
- Number of months with a positive amount of tax paid in 2015

*List Experiment:*

Respondents were asked the following question:

*“Now, I will read a list of various actions that a company can take to solve or prevent problems with the Tax Administration. After I read the entire list, I would like you to tell me **how many of these actions your company took in 2015**”.*

50 percent of the sample had to choose among a short list of answers (which did not include unofficial payments) and 50 percent among a longer list (which included unofficial payments). The selection was random and was stratified on firm legal and treatment status.

Short list of answers (50% of sample)	Long list of answers (50% of sample)
1. Received help from trade associations	1. Received help from trade associations
2. Had detailed discussions with tax officials	<b>2. Made unofficial payments or provided free services/goods</b>
3. Provided additional documents	3. Had detailed discussions with tax officials
4. Pursued court action	4. Provided additional documents
	5. Pursued court action

## C Cost Effectiveness Analysis Using Time Saved by Firms

Administering the program (organizing the trainings, inviting firms, and providing logistical support for e-filing registration to Group A firms) cost \$25 per firm in Group A, compared to \$17 per firm in Group B and \$12 per firm in Group C (Table A6). Given the 34 percentage point difference in take-up between Group A and the control group, and the \$13 per firm difference in program costs, the cost per additional e-filing adoption in Group A relative to the control group is \$37. The lack of any significant difference between adoption in Group B and the control group indicates that the relevant aspect of Group A treatment was the logistical help with registration.

The difference in program costs per firm between Group A and Group B (cost of logistical support for registration) is \$8 per firm. Given the 30 percentage point difference between Group A and Group B, the cost per additional e-filing adoption in Group A relative to Group B is \$27.

We can compare the program costs to the benefits accruing to firms from the reduction in compliance costs. Data limitations preclude our calculating other potential benefits of the program such as savings in tax administration costs. In addition, from the government's perspective, we detect no significant average effects on tax revenue (although any revenue impact would be a transfer from firms to the government). Table 5 estimates that firms save 4.7 hours each month they would otherwise have spent on tax-related activities. From survey data, the average wage of the person in charge of tax declaration in firms is \$178 per month (or \$1.11 per hour), creating an estimated \$5.5 savings per firm each month. As such, it would take five to seven months for private benefits in terms of time saved to exceed program costs. Although firms may not necessarily be willing to pay the full costs of the program,<sup>35</sup> these results provide guidance for a social planner on types of interventions that may be considered in promoting e-filing adoption. Appendix Table A6 provides details on the cost effectiveness analysis.

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<sup>35</sup> Take-up remained quite low when firms had to pay \$40 to register and obtain a token.