Does the electronic filing system (e-tax) reduce tax evasion? Evidence from Japanese corporations

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Abstract

With the rapid progress of Information and Communication Technology (ICT), the digitalization of administrative processes in governments has gained much attention. The electronic filing (e-tax) for corporate tax returns is one of the practical examples. This paper investigates the effect of introducing an e-tax on tax evasion behavior using a policy reform in Japan that mandates large corporations to adopt e-tax. We apply difference-in-differences methods to find that the introduction of e-tax reduces amendments to declaration, which can potentially become unintentional tax evasion, by about one-third. On the other hand, we cannot find any evidence that e-tax reduces intentional tax evasion.

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1 Introduction

Corporate tax is a significant source of government revenue, however, tax evasion that uses complex tax codes and procedures has been a hot topic. Economic studies on corporate tax evasion and avoidance have been growing since the 2000s (see, e.g., Davies and Studnicka, 2023). In practice, the digitalization of administrative processes, such as electronic tax filing (referred to as 'e-tax'), has gained attention with the advancement of information and communication technology (ICT). In this paper, we examine how the use of e-tax relates to corporations' tax evasion behavior.

It is widely acknowledged that digitalization can enhance efficiency across various sectors. Especially, many studies have accumulated about the effectiveness of transitioning traditional, paper-based government procedures into digital services (e.g., Irani et al. (2008), Janssen and Estevez (2013), Jacobs (2017), Effah and Nuhu (2017), Dobrolyubova et al. (2019), Wandaogo (2022)).

Since Allingham and Sandmo (1972) formalized taxpayers' deliberate underreporting behavior, many theoretical studies on the tax evasion have been accumulated. While the first phase of the research has focused only on individual behavior, Marrelli (1984) shed light on the tax evasion of risk-averse firm. Sandmo (2005) and Desai and Dharmapala (2006, 2009) present the theoretical framework on this issue. Looking at surveys in this field, Cowell (1990) marks the starting point. This theoretical framework is substantiated by a multitude of empirical studies. Notably, Lee et al. (2015) present a well-structured survey that integrates both theoretical and empirical aspects in this field. Furthermore, Beer et al. (2020) contribute to this literature with their survey, which specifically focuses on the tax avoidance strategies of multinational firms, particularly within the context of international tax avoidance.

The empirical analysis of tax avoidance/evasion behavior can be categorized into two primary trends. One of the primary areas of interest lies in identifying the factors that influence corporate tax evasion. For example, Lisowsky (2010) reveals a positive relationship between tax shelter likelihood and factors like profitability and firm size. Additionally, certain studies explore whether the characteristics of executives impact tax evasion behaviors, as observed in the works of Armstrong et al. (2012) and Olsen and Stekelberg (2016). Cai and Liu (2009) conclude that firms operating in more competitive environments tend to engage in higher levels of tax avoidance.

Another research focus involves examining the outcomes of corporate tax evasion. While Graham and Tucker (2006) contend that tax avoidance can enhance firm value by reducing cash flow, Desai and Dharmapala (2009) find no substantial connection between the two. Furthermore, there is ongoing debate surrounding whether tax evasion affects firm risk. In any case, consensus regarding the consequences of tax evasion remains elusive.

Wang et al. (2020) offer not only a comprehensive survey but also a roadmap for

future research. Their work encompasses a broad spectrum of corporate tax evasion behaviors, including motivations, measurement techniques, and the characteristics of such behavior. While the Effective Tax Rate (ETR) has commonly served as a proxy for identifying tax evasion, the authors caution that it can occasionally yield imprecise results. Notably, they propose the use of penalties for tax evasion or underpayment as an alternative measurement approach. CHOW et al. (2018) are distinctive in its utilization of this measurement approach. They acknowledge the challenge of partially observing tax evasion behaviors, often attributed to inherent secrecy or the limited enforcement capacity of resource-constrained tax authorities. In response, they emphasize the advantages of the Chinese institutional framework in detecting illicit activities. In comparing the outcomes of various empirical analyses, they suggest that the ETR may not be an ideal proxy for discerning aggressive tax evasion practices.

In the field of tax declaration, there are generally three main types of costs for taxpayers. Firstly, there's the cost associated with reporting income and other financial information in tax declarations. Secondly, the process of physically submitting paper documents at the tax office can be burdensome. Thirdly, frequent interactions between taxpayers and tax officials may potentially lead to bribery or corruption. Okunogbe and Pouliquen (2022) emphasize these aspects and argue that digitalizing the tax filing process (i.e., e-tax) helps to reduce these costs. They also posit that the advantages of adopting e-tax are more pronounced in developing countries compared to developed ones. Using data from Tajikistan firms, they find that e-tax reduces the time spent on tax procedures, leading to increased compliance among firms that may have previously engaged in tax evasion. Kochanova et al. (2020) also consider the cost reduction aspect from the perspective of the tax office. Their research suggests that the adoption of e-tax systems correlates with a higher income tax revenue to GDP ratio and decreased tax compliance costs.

Some researchers explore the link between e-tax and firms' tax payment behavior. They have largely found that the introduction of e-tax systems leads to a reduction in tax evasion (e.g., Okunogbe and Pouliquen (2022) in Tajikistan, Otekunrin et al. (2021) and Bello et al. (2022) in Nigeria). However, there has been limited research conducted in developed countries on this subject. Uyar et al. (2021) and Allam et al. (2023) are a few exceptions. Both of them conduct cross-country analyses including several developed countries. Uyar et al. (2021) conduct fixed effect analysis to find the advantage of e-tax system. Allam et al. (2023) conduct a factor analysis of the characteristics of government that influence tax evasion behavior. Both of them use country-level panel data, and the size of the 'shadow economy' is used as a proxy for tax evasion. Tiantian et al. (2023) studies the impact of digital transformation on tax avoidance and evasion using China's A-share listed tourism companies data. Putting more emphasis on tax avoidance, they find that digital transformation can reduce tax avoidance by improving the quality of corporate internal control.

The purpose of this study is to examine whether the introduction of e-tax reduces tax evasion, utilizing corporate-level administrative data in Japan. This paper investigates the effect of introducing e-tax on tax evasion behavior using a policy reform in Japan that mandates large corporations to adopt e-tax in tax return. Specifically, we examine two outcome variables on tax evasion: one derived from the original dataset capturing illegal behaviors, and the other measuring non-compliance, which may indicate potential future tax evasion. This study contributes to the existing literature in two key aspects. First, it addresses the two critical trending issues: digitization of administrative services and corporate tax evasion. As we have reviewed, a lot of literature confirm the importance of digitization in various fields, including in administrative services. Also, the causes and the consequences of corporate tax evasion have gained much attention in economics literature, but most of them are held in developing countries. Although it is possible that digitalizing admin service, especially tax procedure can affect the probability/possibility of corporate tax evasion, there are few studies addressing this relationship. Existing literature in developed countries on this topic has weaknesses in identification, particularly with respect to the choice of observation units, the utilization of proxies, and the applied econometric methodologies. The second novelty of this paper lies in overcoming these limitations in identification. This is the first study to utilize micro-level administrative data at the corporation level to address these issues. As highlighted by Wang et al. (2020), proxies employed to identify tax evasion can be biased. To mitigate this, We employ two proxies to measure tax evasion: one derived from the raw dataset and the other originally established based on the tax system. Moreover, We focus on a quasi-exogenous policy reform that took place in 2020 and apply advanced econometric methodologies in response to some recent published papers. To sum up, this paper makes contributions to the existing literature by carefully examining the causal inference of e-tax on corporate tax evasion in a developed country, Japan.

The findings of this paper are summarized as follows. Considering the existence of pre-trend originated from the structural difference between different size corporations, We employ two methods to control for the trends: detrended event study (see Dustmann et al., 2022) and regressions with unit-specific trend term (see, e.g., Miller, 2023 for a broader discussion, and Bostwick et al., 2022 for empirical practice). As a result, We find the introduction of e-tax reduces amendment of declaration, which can potentially become unintentional tax evasion, by about one-third. This supports the benefits of implementing electronic filing. On the other hand, there are no statistically significant evidence that e-tax reduces the probability of being fined, which is regarded as malicious (intentional) tax evasion in this context. The robustness of these results are confirmed by conducting some additional analysis.

The remainder of the paper proceeds as follows. Section 2 reviews the institutional background of e-tax and proposes the hypothesis; Section 3 describes the data structure. The econometric specifications are described in Section 4. In Section 5, the estimation

results are shown and robustness of the result is discussed, and section 6 concludes.

2 Background

2.1 Japanese Local Corporate Tax System

In Japan, there are two tax categories: national taxes paid to the national government and local taxes paid to regional authorities. Furthermore, local taxes are classified into those paid to the prefectural government and those paid to the municipal government. This paper specifically focuses on the 'corporate business tax', a tax imposed on corporations by prefectural governments (local corporate tax). In Japan, there are two primary methods of tax payment. First is the self-assessment tax payment method, where taxpayers calculate and pay their tax amounts themselves. This method applies to various taxes, including (both national and local) corporate tax, income tax, consumption tax, inheritance tax, prefectural inhabitants' tax, and municipal inhabitants' tax. The second method is the levy taxation method, where the government, either national or local, calculates the tax amount and notifies the taxpayer for payment. In the context of local corporate tax, every corporation is obligated to report its financial status, encompassing income, expenses, capital, and more as a part of the tax payment process. This entire procedure is referred to as 'tax return'. Typically, all profit-oriented corporations are legally required to complete this tax return annually. If any errors or inaccuracies are identified, there are generally two methods of correction. The first involves voluntary declarations, wherein corporations identify mistakes and rectify them in their tax return. On the other hand, when corporations fail to notice or intentionally neglect these errors, the government adjusts the owed taxes, then corporations follow it. Typically, tax returns document a business's financial status for the previous or current year, and the corresponding tax liability is calculated based on this information. Nevertheless, tax amendments, whether initiated by the taxpayers themselves or by the government, can refer to previous years. Hence, a year gap between the filing year (FY) and the business year (BY) can occur. For example, if a corporation files its tax return for BY2019 in FY2020 and later discovers an error in the tax return for BY2016, it can promptly make tax amendments for that business year. Ideally, one corporation makes one tax return for each business year without mistakes in reporting. However, Japanese tax law provides a grace period for mistakes in reporting. That is, even if a corporation makes a mistake in first tax return on a certain BY, it is not penalized as long as it voluntary conducts tax adjustment before the notice of investigation by the tax office. In other words, there are penalties for late tax adjustment or intentional tax evasion. Japanese local tax law provides fines for tax evasion actions, including under-reporting, failure to report, or intentional concealment (for specific criteria and detailed penalties, see Table 1). According to the definition by The Ministry of Internal Affairs and Communications,

Table 1: Fines on Tax Evasion and the Criteria

Fine	Case where	Additional Tax Rate
on Underpayments	an amendment or correction is filed for a in-due return	10%, 15%(progressive)
on Non-declarations	(1) a post-due return or correction is filed (2) an amendment is filed with respect to a post-due return or correction	15%, 20%(progressive)
on Serious Violations	a disguise or a concealment	35%, 40%(for more serious)

Note : This table is created by the authors based on MIC (nd). See the original website for more detailed information.

fine is "a kind of administrative sanction imposed on companies that fail to properly fulfill their tax filing obligations in order to promote the establishment and development of the tax filing system" (MIC, nd).

Historically, corporations have to fill in paper documents to report their financial information and physically visit the tax office to submit these documents. With the increasing need for digitalization, the Japanese government introduced the electronic filing system for national taxes, known as "e-tax", in 2004. The electronic system for local corporate tax, known as "eL-tax", started in 2005 across several prefectures and expanded to encompass all prefectures by 2006. This system allows corporations to file their taxes without physically visiting the tax office, which possibly leads to the reduction of the compliance costs.

As a part of the 2018 tax reform, it was announced that large corporations (i.e., those with capital exceeding 100 million JPY) would be required to adopt the electronic filing system for tax returns starting from the business year commencing on or after April 1, 2020[1]. We can regard this system reform as an exogenous shock that compels large corporations to adopt eL-tax. We will elaborate on this in the context of the identification strategy for this research.

2.2 Hypothesis : e-tax and Tax Evasion

There are two possible benefits of expanding e-tax in terms of reducing cost for a certain sector. First, e-tax system can contribute to reducing corporations' cost because

[1]More precisely, these corporations are also obliged to adopt electronic filing system since April, 2020. Domestic corporation whose amount of stated capital or amount of capital contribution exceeds 100 million JPY at the beginning of the fiscal year. Or, aggregated corporations, mutual corporations, investment corporations, and special purpose corporations.

corporations with e-tax can make tax return without visiting tax office. Besides, filing paper-based document itself is rather costly. If this cost reduction makes much sense for a corporation, it is assumed that the probability of making unintentional mistakes would decrease, and if any mistakes, it can make tax adjustments quickly before the notice of investigation by the tax office. Anyway, these would result in decreasing unintentional tax evasion.

Second, the local government's tax office also can reduce the administrative cost as a greater number of corporations adopt e-tax. While corporate tax information has been electronically managed, the majority of filings were done through paper-based formats. In such cases, the government incurs the cost of digitizing paper tax return forms. This cost is expected to diminish as more corporations introduce e-tax. If this process works, the government can allocate more resources to other facets of corporate taxation, such as more thorough reviews of each corporation's tax return data to identify suspected tax evasion. If corporations are aware of this dynamic and it is perceived to be an increase in the possibility of tax evasion being discovered, they may stop attempts on tax evasion. Additionally, even without any reduction in the government costs, only if the corporations' subjective risk of tax evasion being discovered would increase, expanding e-tax would result in decreasing intentional tax evasion.

It is expected that the introduction of e-tax will reduce tax evasion behavior of corporations through these two paths. We try to distinguish these two types of tax evasion, namely intentional and unintentional, and to derive policy implications. How these types of evasion are defined is related to data processing. This is discussed in detail in the next section.

3 Data

We access to the datasets of "Academic infrastructure development of administrative data from local governments and application for economic analysis" in Center for Research and Education in Program Evaluation, the University of Tokyo. We use administrative data at the corporation level in a specific prefecture for fiscal years 2016 to 2022.

3.1 Sample Construction

The raw data is the tax record on corporate business tax and corporate inhabitant tax for a prefecture. This paper only uses corporate business tax records since penalties for illegal tax evasion in the broad sense, which can be identified in the dataset, are imposed only on the corporate business tax. The raw data contains corporations that are not obligated to pay taxes (e.g., religious organizations) and special declarations (e.g., prior tax declarations). Since these are not the subject of this analysis, We omitted them from the dataset. In filing tax returns, each corporation is required to state the dates of start

and end of its business, and they are free to determine the duration of their business for a period not exceeding one year. Most Japanese corporations use a fiscal year (FY) that begins in April, and accordingly, the "business year" (BY) for tax returns is often set from April to the following March. This paper uses the "business" established by each corporation as the basic unit, and processes multiple tax returns filed for the same business on a single line. For example, we combine in one observation the records of immediate tax returns filed for the business from April of one year to March of the following year, and the records of amended returns filed after the fact. In the following subsection, we explain how we treat the main variables which will be used in the analysis in this sampling process.

3.2 Variables

The explanatory variable in the analysis is a binary dummy variable, assigned a value of 1 if the corporation utilizes e-tax in their tax declaration. In the data aggregation process, We specifically consider whether the corporation used e-tax in their initial declaration for the relevant business year, as the first declaration matters to distinguish whether the corporation conducts tax evasion.

Narrowly defined 'tax evasion activities' are not numerous and it is difficult for the authorities to observe them rigorously. Therefore, in this paper, we employ a broad definition of tax evasion and define two types of dependent variables. As explained, each corporation is expected to make one tax return for each business year without mistakes in reporting. In this ideal case, a company's tax return for a single business year is completed only by filing a tax return. In other words, a declaration that is subsequently amended through ex post facto adjustments can be regarded as a form of non-compliance. We assign a dummy; $amendment_{it}$, which takes 1 if corporation i makes this kind of mistake in compliance in business year t. We set the other dependent variable in stricter standard; $fine_{it}$. Under-reporting, failure to report, or intentional concealment are illegal under Japanese local tax law and subject to fines. We assign a value of 1 if a fine has been levied on a corporation's tax return at least once within a given business year, namely, We group observations by ID and BY, then take the max of $fine_{it}$. Those with $fine_{it}$ is supposed to be a subset of those with $amendment_{it}$[2]. While $fine_{it}$ represents 'tax evasion' in the narrow sense, $amendment_{it}$ does not necessarily imply illegality. However, it is considered a form of 'tax evasion' in the sense that it has the potential to become an illegal action.

Another important variable is created as a categorical variable representing capital class. The key determinant for Japanese local corporate tax considerations is the capital threshold of 100 million JPY. Corporations with capital exceeding 100 million JPY are called 'large corporations', and We additionally define three classes for visualization:

[2]There are a few exceptions, such as when a fine is imposed only on the first tax return and the corporation pay it without making any corrections, then $amendment_{it} = 0$ and $fine_{it} = 1$. The number of such observation is sufficiently small.

'middle' for 10 million JPY $\leq$ capital $<$ 100 million JPY, 'small' for 0 JPY $<$ capital $<$ 10 million JPY, and 'zero' for reported capital is zero.

The raw data contains 643,364 observations. After the aggregation process explained above, We excluded records with business years before 2014 and after 2022 due to their unusual trends, which suggested that they might be outliers. As a result of the whole data cleaning process, the number of observations is reduced to $N = 372,160$.

3.3 Descriptive Statistics

Table 2: Sample Size for Each Business Year

BY	2015	2016	2017	2018	2019	2020	2021
Total	53094	54487	55080	55286	55489	55411	43313
capital large	5574	5532	5522	5523	5459	5427	4187
capital middle	20016	20139	20005	19881	19647	19328	15176
capital small	27190	28438	29132	29434	29896	30139	23505
capital zero	314	378	421	448	487	517	445

Note : This table shows sample size for each business year and each capital class. Corporations with capital exceeding 100 million JPY are called 'large corporations', and We define 'middle' for 10 million JPY $\leq$ capital $<$ 100 million JPY, 'small' for 0 JPY $<$ capital $<$ 10 million JPY, and 'zero' for reported capital is zero.

Table 2 displays the sample size for each business year and capital class. Notably, about 55,000 corporations consistently file tax returns for every year in this prefecture. Furthermore, about 10% of these corporations are categorized as large firms, defined by having a capital equal to or exceeding 100 million JPY. The 10% figure is consistent with our expectations, considering this prefecture's central location within that region, and the presence of headquarters for large companies is probable.

Here, it is necessary to acknowledge two potential issues stemming from data constraints. Firstly, in Japanese local corporate taxation, the system of taxation changes dramatically with a threshold of 100 million JPY in capital. Particularly, the burden of the 'pro forma standard taxation' imposed on corporations with capital of 100 million JPY or more (large corporations) is heavy. Consequently, there are some corporations that strategically reduce their capital to evade this tax, which has been a serious problem in Japan. We extract corporations which had been 'large' in fiscal year (FY) $n-1$ and then became 'middle' or 'small" ones in FY n. Table 8 shows the list of the number of such corporations in each year. The proportions of such corporations are largely consistent with Doi et al. (2023). Although the numbers seem sufficiently small, We conduct a subsample analysis by excluding these corporations for a robustness check. Secondly,

the raw dataset includes tax records up to February 2023 (corresponding to the midway through the end of Fiscal Year (FY) 2022). Consequently, some potential tax records, particularly those would have been conducted at the very end of FY2022 with reference to BY2021, are missing from the dataset. This could present a challenge as the trends in both 'amendment' and 'fine' categories may exhibit a declining pattern, primarily because modifications and fines tend to occur at a later stage, sometimes a few years after the prime declaration. These two issues are addressed in Section 5 by performing subsample analysis to confirm robustness.

Table 3: Annual Trends of Main Variables(%)

	2015	2016	2017	2018	2019	2020	2021
e-tax							
capital large	18.59	20.79	32.83	35.09	38.45	85.81	89.59
capital middle	39.67	43.91	52.72	57.10	58.78	63.73	72.37
capital small	45.22	49.65	54.48	59.15	61.54	66.00	71.72
capital zero	3.50	5.03	5.94	6.70	9.86	27.85	53.03
amendment							
capital large	52.60	47.63	42.77	35.20	26.18	20.20	6.26
capital middle	16.80	15.86	13.64	10.37	8.32	6.87	2.63
capital small	6.78	6.38	5.65	4.66	3.84	2.93	1.11
capital zero	13.06	10.05	7.60	7.14	6.78	4.64	2.47
fine							
capital large	7.16	6.65	5.61	3.71	2.42	1.20	0.17
capital middle	2.59	2.17	1.66	1.04	0.73	0.43	0.07
capital small	1.62	1.45	1.27	0.94	0.69	0.58	0.11
capital zero	4.14	1.32	1.43	0.45	0.41	0.00	0.45

Note : This table shows annual trends of main variables of each capital class. Capital classifications remain the same. All variables are 0/1 dummies, so the numbers in the table represent what percentage of corporations use e-tax, do amendment, and are fined, respectively.

Table 3 presents the annual trends of key variables, and Figures 1 and 2 display graphical representations of these trends. We can draw four implications from them. Firstly, corporations with zero capital exhibit an atypical trend, and considering their limited sample size, We have excluded them from the dataset. The number of observations reduces to $N = 369,150$. Secondly, we observe a continuous rise in the adoption of e-tax, with a particularly significant surge in usage by large firms in 2020. This surge aligns with the policy reform detailed in subsection 2.1. Thirdly, there is a noticeable downward

trend observed in both 'amendment' and 'fine' categories over the observation periods. This phenomenon is likely attributed to the characteristic that amendments and fines tend to be conducted at a later stage. Last but not least, there are differences in the trends of outcome variables across different capital classes. It may be due to the fact that there are significant differences in characteristics between large corporations and the rest such as business type or stock management. This presents challenges when attempting to carry out conventional Difference-in-Differences (DID) or event study analyses, as these methods require a robust assumption of parallel trends in outcome variables prior to the introduction of e-tax. Dustmann et al. (2022), which face the similar challenge: the possible existence of pre-trend, offer a solution for conducting a robust analysis to address this issue. Also, Miller (2023) presents guidance for dealing with pre-trend issue in analyzing causal inferences. They will be discussed in the following section.

Figure 1: Annual Trends of e-tax

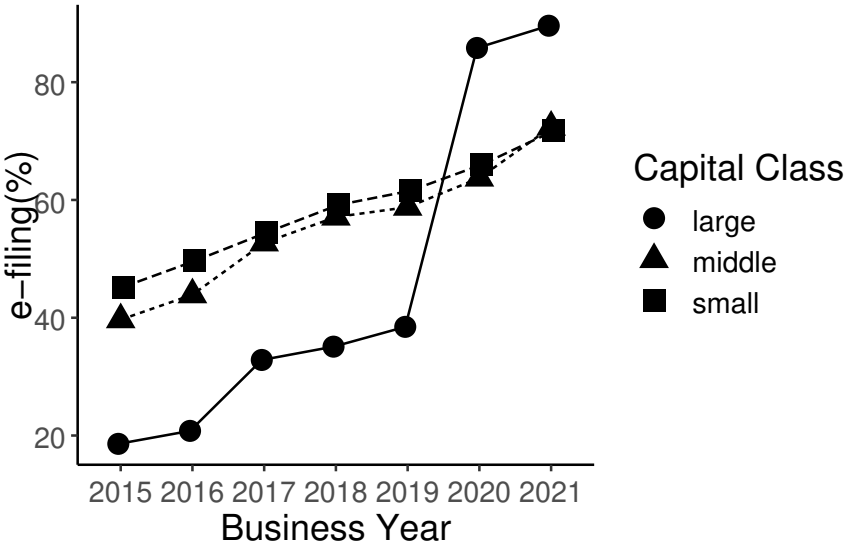
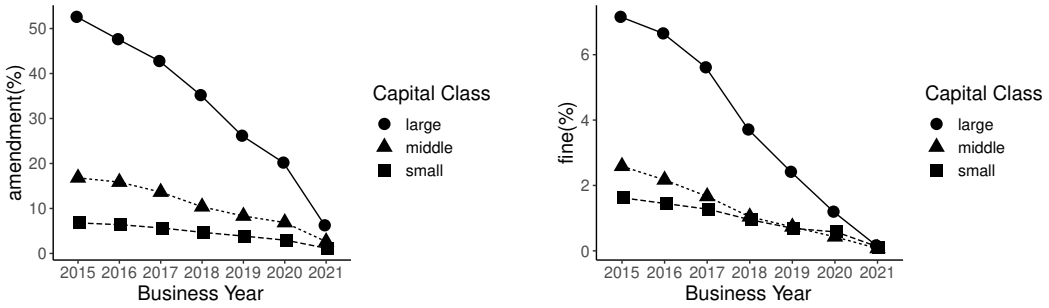


Figure 2: Annual Trends of dependent variables



Note : Records with zero capital are already excluded in these figures. The above figure shows the annual trends of e-tax. The bottom left and right display the trends of amendment and fine, respectively. The units for all vertical axes are %.

4 Empirical Strategy

4.1 A Policy Reform and Identification

The objective of this paper is to examine the causal inference of e-filing on tax evasion. However, it is essential to acknowledge the potential presence of endogeneity in the adoption of e-tax and tax evasion. This, for example, could occur in a scenario where proactive corporations, who prioritize social responsibility, are likely to embrace e-tax for an eco-friendly, paperless system and concurrently fulfill their tax obligations without engaging in tax evasion. Thus, conventional ordinary least-squares (OLS) estimators can be inconsistent. To address this issue, We focus on the policy reform regarding mandatory electronic filing of tax returns for large corporations from BY2020. This can be regarded as an exogenous shock to introduce e-tax. There is a threshold of capital 100 million JPY that clearly determines whether a policy is eligible or not. As we can see in Figure 1, this policy has a strong effect on expanding the use of e-tax by large corporations[3]. In 2020, there were other policy changes regarding corporate business tax, such as a change in the income taxation system and revision of the corporate version of home taxation, none of which are assumed to affect tax evasion practices (see MIC (2019) for detailed information).

This paper uses the policy reform to first conduct an event study analysis. Next, an intention-to-treat analysis and a difference-in-difference with an instrumental variable approach analysis are conducted by introducing a dummy variable indicating whether the policy was targeted or not. Given the differences in intrinsic characteristics across capital classes discussed earlier, each analysis examines ways to control for differences in trends.

4.2 Regression Equations

In this subsection, We set up three equations to identify the impact of e-tax on tax evasion. Let Y_{ict} denote an outcome variable representing tax evasion, $fine_{ict}$ or $amendment_{ict}$, of corporation i in capital class c for business year t.

First, We conduct an event study analysis to explore changes in tax evasion behavior over time due to the policy reform onward BY2020 which force the large corporations to adapt e-tax. The regression equation is:

$$Y_{ict} = \sum_{s \neq 2019} \alpha_s^{ES} I[t = s] D_{ic}^{large} + \gamma_t + \delta_i + \epsilon_{ict} \tag{1}$$

where $I[t = s]$ is an indicator variable which takes 1 if $t = s$. Here, BY2019 (one year before the policy implementation) is a reference year. An indicator variable D_{ic}^{large} takes

[3]More precisely, We conduct an event study analysis with e-tax as the dependent variable. The equation and the result plot is shown in the appendix A. The result supports the effectiveness of the policy

1 if a corporation i is classified as a large corporation. Due to the policy reform we have discussed, large corporations are supposed to introduce e-tax after BY2020 ($s \geq 2020$). The basic event-study plot of estimated coefficients α_s^{ES} in Eq. (4) is displayed in Figure 3, black-circled plots. γ_t is the business year fixed effects, and δ_i is the time-invariant and unobservable fixed effects of corporations. The estimates of the pre-treatment coefficients are statistically significantly positive. This is the serious violation of the assumption of the conventional event study design, which requires the trends of the outcome variable are supposed to be the same in the post-policy periods ($t = 2020, 2021$) between treatment groups and control groups in the absence of any treatment (i.e., the counterfactual case). Nevertheless, considering the substantial differences in characteristics between large corporations (treatments) and other entities (controls), it raises doubts about the appropriateness of directly applying this assumption. To deal with the possibility that treatments and controls evolved differentially prior to the policy reform, We employ the de-trended event study design introduced in Dustmann et al. (2022). The estimation method is as follows.

Firstly, run the Eq. (1) to obtain the estimates: $\widehat{\alpha_t}^{ES}(\forall t)$ defining $\widehat{\alpha}_{2019}^{ES} = 0$ as this is the reference in the regression. Second, use the $\widehat{\alpha_t}^{ES}$ for the pre-policy years 2015-2019 to fit a linear time trend. Run the following equation in OLS;

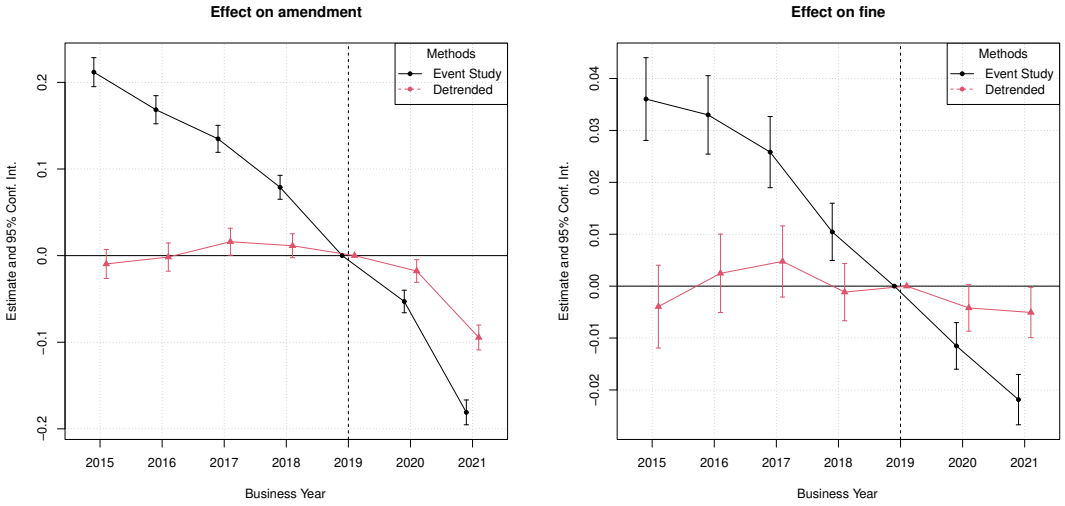
$$\widehat{\alpha_t}^{ES} = \beta_0 + \beta_1(pre\_time_t)$$

to obtain $\hat{\beta}_0, \hat{\beta}_1$, where pre_time_t is a numeric variable of BY, as $2015 \equiv 1$ to $2019 \equiv 5$. Using them, We get the following equation to forecast the $\widehat{\alpha_t}^{ES}$ based on the pre-trend values;

$$\widetilde{a_t}^{ES} = \hat{\beta}_0 + \hat{\beta}_1(time_t)$$

putting all the $time_t$, which is a numeric variable of BY as $2015 \equiv 1$ to $2021 \equiv 7$, we get the predicted values for the estimates; $\widetilde{\alpha_t}^{ES}(\forall t)$. The values of $\widehat{\alpha_t}^{ES} - \widetilde{\alpha_t}^{ES}$ can be interpreted as the deviations from the linear time trend allowing for the heterogeneous trend between capital classes. They are plotted in Figure 3, red-triangled ones.

Figure 3: Detrended Event Study Plot of Each Variable



Note : These are the event study plots. The black-circled ones are the estimated coefficients $\widehat{\alpha_t}^{ES}$ and their 95% confidence intervals of Eq. (1). The red-triangled ones are those of a detrended event study introduced in Dustmann et al. (2022). That is, the point estimates are the deviations from the predicted value calculated by pre-policy periods' values, $\widehat{\alpha_t}^{ES} - \widetilde{\alpha_t}^{ES}$. And the bars are their confidence intervals. The left plot shows the estimates on *amendment*, and the right one is that on *fine*. Here, BY2019 is a reference year because the policy reform was implemented from BY2020.

Next, We conduct a regression analysis employing the cross term of the 'after' dummy D_t^{after} (taking 1 for t $\geq$ 2020) and the 'large' dummy D_{ic}^{large}. That is:

$$Y_{ict} = \alpha^{ITT} D_t^{after} \cdot D_{ic}^{large} + \sum_c \beta_c Trend_c + \gamma_t + \delta_i + \epsilon_{ict} \tag{2}$$

The second term, $Trend_c$ captures capital class-specific linear time trends. This term controls for differences in trends between different capital classes, making all corporations comparable. The validity of controlling for this kind of 'unit-specific trends' is argued in Miller (2023). It insists researchers control for them when pre-trend is assumed to reflect an omitted variable in the trend that may bias the main estimate. Many recent empirical papers employ this method. For example, Alsan and Goldin (2019) and Bessho and Hirota (2023) control for municipality-specific time trends, and Bostwick et al. (2022) control for university-specific time trends to eliminate the omitted variables bias.

The term α^{ITT} represents the intention-to-treat (ITT) effect of the policy implementation.

Thirdly, We employ the instrumental variable method in a two-stage least squares (2SLS) model to estimate the local average treatment effect. Let denote E_{ict} an outcome dummy variable representing the use of e-tax. The instrumental variable is Z_{it}. This is a dummy variable that indicates the eligibility for this policy. Namely, Z_{it} takes a value of 1 for large corporations in BY2020 and afterward, which precisely corresponds to the cross term $D_t^{after} \cdot D_{ic}^{large}$ in the previous (ITT) model. In the first stage, E_{ict} is regressed

on an instrumental variable Z_{ict} and, $Trend_c$, and two-way fixed effects. In the second stage, We regress Y_{ict} on E_{ict} (instrumented with Z_{ict}) and $Trend_c$, and two-way fixed effects (γ_t, δ_i) using OLS. That is;

$$\begin{aligned} E_{ict} &= \zeta Z_{ict} + \sum_c \kappa_c Trend_c + \tau_t + \eta_i + \epsilon_{ict} \\ Y_{ict} &= \alpha^{IV} E_{ict} + \sum_c \beta_c Trend_c + \gamma_t + \delta_i + \nu_{ict} \end{aligned} \tag{3}$$

The estimated coefficient of the second stage represents the local average treatment effect on the compliers. That is, it represents the average response of large corporations that adopted e-tax due to the policy reform, an action they might not have taken if the policy reform had not occurred. In this setting, We have one endogenous variable and one excluded instrumental variable. Thus, the estimated equation is just identified with IV. We need to discuss the conventional two conditions that instrumental variables must satisfy: relevancy and exogeneity. Initially, it is evident that a significant number of large corporations commenced using e-tax from BY2020, indicating that Z_{ict} has the relevancy to E_{ict}. The result of the test for the relevancy, i.e., dealing with the 'Weak IV problem' is provided in the following section along with the estimated results. After controlling for fixed effects of ID and year, it is plausible to assume that factors such as being large corporations and having a recent business year do not influence tax evasion behavior besides the introduction of e-tax. In other words, it is reasonable to suppose that Z_{ict} affects Y_{ict} only through E_{ict}, indicating that Z_{ict} satisfies exogeneity.

5 Results

5.1 Main Findings

The results of the event study are shown in Figure 3 and Table 4. In the figure, the red-triangled ones are the coefficients and their confidence intervals of detrended event study. After implementing the detrending process as outlined earlier, the pre-trend bias arising from the disparity in corporate sizes is mitigated, enabling a more insightful discussion of policy effects. As a preliminary examination, a decrease in *amendment* is observed; however, the existence of a policy effect on *fine* remains questionable. The detailed results for the second and fourth columns of Table 4 are presented below, summarized in the following two points. First, there is a statistically significant effect on *amendment*. The number of amendment is reduced by 1.8% points and by 9.5% points in 2020 and 2021 respectively, which means that the policy effect gets larger over time since its implementation. On the other hand, about *fine*, the coefficients of interest are statistically significant at 90% confidence interval, however, the magnitude is quite small. Thus, it is difficult to derive clear implications from the result on fine.

Table 4: Event Study of each variable

	amendment	Detrended amendment	fine	Detrended fine
2015 × large	0.212***	-0.010	0.036***	-0.004
	(0.009)	(0.009)	(0.004)	(0.004)
2016 × large	0.168***	-0.002	0.033***	0.002
	(0.008)	(0.008)	(0.004)	(0.004)
2017 × large	0.135***	0.016**	0.026***	0.005
	(0.008)	(0.008)	(0.003)	(0.003)
2018 × large	0.079***	0.011	0.010***	-0.001
	(0.007)	(0.007)	(0.003)	(0.003)
2020 × large	-0.053***	-0.018***	-0.012***	-0.004*
	(0.007)	(0.007)	(0.002)	(0.002)
2021 × large	-0.181***	-0.095***	-0.022***	-0.005**
	(0.007)	(0.007)	(0.002)	(0.002)
Num.Obs.	369150	369150	369150	369150
R2	0.461	0.461	0.379	0.379
R2 Adj.	0.346	0.346	0.246	0.246
Std.Errors	by: ID	by: ID	by: ID	by: ID
FE:ID	YES	YES	YES	YES
FE:BY	YES	YES	YES	YES

Note : ***, **, * represent that the estimates are statistically significantly different from zero at a significance level of 1%, 5% and 10%, respectively. Standard errors are clustered by ID (corporations). All models control for the business year fixed effects, and the time-invariant and unobservable fixed effects of corporations. The mean of *amendment* and the mean of *fine* of treatment group in BY2019, the year before the treatment are 26.2% and 2.4%, respectively.

Table 5 and 6 show the results of the estimated effect on *amendment* and *fine* respectively. These can be summarized in following four results.

First, as in the case of the detrended event study, there are statistically significant effect on *amendment* but not on *fine*. Comparing the results of models with trend term and without it, say, column (1) and (2), or column (3) and (4), we can see that the linear trend term explain a large fraction of the model, indicating the significance of introducing the term. Next, column (2) of Table 5 tells that the policy reduces the number of amendment by 3.8% points among large corporations. Thirdly, the IV result (column (3) and (4) of Table 5) suggests the number of amendment is reduced by 9.4% points due to the introduction of e-tax through the policy reform, which means the local average treatment effect on compliers. Lastly, it might support the robustness of the

results that the estimation result for *amendment* using IV with trend term (Table 5, column (4)) is close to one in the event study.

Table 5: Effect on *amendment*

	(1)ITT without Trend	(2)ITT	(3)IV without Trend	(4)IV
e-tax	-0.222 ***	-0.038 ***	-0.499 ***	-0.094 ***
	(0.005)	(0.008)	(0.013)	(0.019)
Num.Obs.	369150	369150	369150	369150
R2	0.456	0.463	0.228	0.457
R2 Adj.	0.340	0.348	0.063	0.341
Std.Errors	by: ID	by: ID	by: ID	by: ID
FE:ID	YES	YES	YES	YES
FE:BY	YES	YES	YES	YES
Trend term	NO	YES	NO	YES
Weak IV	-	-	9099.9	2961.0

Note : ***, **, * represent that the estimates are statistically significantly different from zero at a significance level of 1%, 5% and 10%, respectively. Standard errors are clustered by ID (corporations). All models control for the business year fixed effects, and the time-invariant and unobservable fixed effects of corporations. Weak IV is the effective F-statistic based on Olea and Pflueger (2013). The mean of *amendment* of treatment group in BY2019, the year before the treatment is 26.2%.

Table 6: Effect on *fine*

	(1)ITT without Trend	(2)ITT	(3)IV without Trend	(4)IV
e-tax	-0.036***	-0.004	-0.082***	-0.011
	(0.002)	(0.003)	(0.005)	(0.007)
Num.Obs.	369150	369150	369150	369150
R2	0.378	0.379	0.341	0.379
R2 Adj.	0.245	0.246	0.200	0.246
Std.Errors	by: ID	by: ID	by: ID	by: ID
FE:ID	YES	YES	YES	YES
FE:BY	YES	YES	YES	YES
Trend term	NO	YES	NO	YES
Weak IV	-	-	9099.9	2961.0

Note : ***, **, * represent that the estimates are statistically significantly different from zero at a significance level of 1%, 5% and 10%, respectively. Standard errors are clustered by ID (corporations). All models control for the business year fixed effects, and the time-invariant and unobservable fixed effects of corporations. Weak IV is the effective F-statistic based on Olea and Pflueger (2013). The mean of *fine* of treatment group in BY2019, the year before the treatment is 2.4%.

In econometrics context using IV method, checking the validity of the IV is necessary. Particularly, researchers must pay attention to 'Weak IV problem', where an instrumental variable is not sufficiently correlated with the endogenous explanatory variable. Staiger and Stock (1994) or Stock and Yogo (2005) are the commonly used measurement for weak IV test. On these literature, Olea and Pflueger (2013) proposes a robust test for weak instruments, 'effective F-statistic'. And more recently, Windmeijer (2023) supports the robustness of the statistic. In response to it, the effective F-statistics are reported in Table 5 and Table 6. The values indicate an instrument We employ is not weak[4].

5.2 Robustness Checks

This subsection addresses the robustness of the results through four approaches: the smoothness restriction test for the event study, the robust standard error test for instrumental variables, a subsample analysis excluding corporations with capital reductions, and a subsample analysis excluding lagged declarations.

[4]A R package established based on Olea and Pflueger (2013) reports both effective F-statistic and a F-statistic which is robust to heteroscedasticity. As argued in Windmeijer (2023), if there are multiple instruments, there should be inherent difference between them. Then one has to report both stats and discuss the difference. However, We only report the effective F-stat because We have only one instrument and one endogenous variable in this setting.

In the recent econometric context, it is argued that researchers need to take a careful consideration on the parallel trend assumption when conducting DID or event study analysis (see, e.g., Kim et al. (2018), Freyaldenhoven et al. (2019), Borusyak et al. (2021), Sun and Abraham (2021), Roth (2022), and Rambachan and Roth (2023)). Above all, Rambachan and Roth (2023) propose two diagnoses for robust inference and sensitivity analysis when parallel trends might be violated: a relative magnitude test and a smoothness restriction test. The latter is related to the detrended event study analysis in this paper because We extrapolate the linear time trend to discern deviations from the trend and derive implications. Therefore, We conduct the smoothness restriction test, which estimates how much of the deviation from a linear extrapolation of the pre-treatment differences in trends is allowed to make the results consistent. The estimation result is shown in Figure 6. The blue plot is the estimated 95% confidence interval (CI) of the treatment effect (i.e., $\bar{\alpha}_{post}$: the average of the estimated coefficients of post-treatment periods), while the red ones are the CIs of it allowing for violations of the pre-period parallel trends up to a parameter M. On *amendment*, we can see that $M \approx 0.003$ is the threshold which would make it unable to reject the null effect. In other words, the results would be significant if the deviation from the linear extrapolation of the estimated pre-trend is up to 0.003% points. The "breakdown value" of $M = 0.003$ is quite small compared to literature which conduct this test (e.g., Rambachan and Roth (2023), Di Iasio and Wahba (2023)) This implies that the outcome relies on a (relatively) strong assumption of linearity. On *fine*, no statistically significant result can be drawn even in the original estimation (Figure 6).

Additionally, We check the robustness of the IV estimation results on *amendment*. With a R package recently updated, we can obtain the confidence interval which is robust to the weakness of instruments. The result (only on *amendment* with trend term) is shown in Figure 6 in the appendix. The left-most plot of Figure 6 is the coefficient and its 95% confidence interval of standard Two-Way Fixed Effect model, and the rests are those of 2SLS model. For 2SLS, from left to right: the results with analytic standard errors (SEs), Anderson-Rubin SEs (Anderson and Rubin (1949)), and varid-t-ratio SEs (Lee et al. (2022)). Particularly, it is known that IV estimates with analytic SEs are imprecise than OLS estimates (Lal et al. (2023)). Anderson-Rubin test is designed to be robust to weak IV, however, Lee et al. (2022) reinforce this argument and propose more robust standard errors stating that their confidence intervals have shorter length than those of Anderson and Rubin (1949). The results of all the tests show that the IV estimates are robust in this analysis.

Thirdly, as discussed in subsection 3.2, We conduct the subsample analysis by excluding corporations that reduce capital as a robustness check. Following this filtering, the number of observations contracts to $N = 367,676$. All the equations and methods are the same as those of main analysis. Table 9 to 11 are the estimated results (in appendix, subsample analysis i). Although there are slight differences in the magnitude of the coef-

ficient, especially on *amendment*, the results support the robustness of the main analysis as a whole.

Tax adjustments, whether initiated by the taxpayers themselves or by the government, can refer to previous years. Hence, a few years gap between the filing year (FY) and the business year (BY) can occur. Here, it is essential to note that some declarations from recent business years are missing in the raw data due to the timing of its receipt. Given the condition that a *fine* could be imposed in later periods, the absence of records from recent business years may create bias into the results. This discussion can also be applied to *amendment*. Given the potential for missing records from recent years due to the timing of data receipt, We apply a filter, retaining only those records where the tax return was filed in the current or subsequent year for a given business year. This filtering process aims to (at least theoretically) establish comparable conditions for recent and past business years. This robustness check excludes the records corresponding to the gray shaded areas in the Table 7 (i.e., 'lagged' declarations). This filtering process results in the exclusion of approximately 25,000 records, reducing the number of observations to $N = 343,675$. All the equations and methods are the same as those of main analysis. Table 12 to 14 are the estimated results (in appendix, subsample analysis ii). Although there are slight differences in the magnitude of the coefficient, especially on *amendment*, the results support the robustness of the main analysis as a whole.

Table 7: Each Business and Declaration Timing

FY \ BY	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**
2016	48966	784	0	0	0	0	0
2017	3816	49481	818	0	0	0	0
2018	125	3963	50043	828	0	0	0
2019	75	103	3943	50071	841	0	0
2020	63	89	183	4232	50197	726	0
2021	40	50	73	123	4357	50461	771
2022	9	17	20	32	94	4224	42542

Note : This table shows the distributions of business year (corresponding to columns: BY) and year when the tax return for that business was filed (corresponding to rows: FY). Observations in the gray shaded areas are the records of returns filed after two years or more from the business year. They are excluded from the sample as a robustness check.

6 Discussion and Conclusion

This paper investigates the causal relationship between electronic filing and tax evasion using a corporation-level panel data. Adopting a broad definition of 'tax evasion', We

establish two proxies, namely 'amendment' and 'fine'. The focal point of the analysis is a policy reform mandating large corporations to adopt e-tax. We conduct (detrended) event study analysis, intention-to-treat analysis, and IV-DID analysis utilizing the policy reform as a quasi-exogenous shock. Above all, it is noteworthy that this paper utilizes two methods to address the difference in trends between large corporations and the rest, considering significant disparities in characteristics such as business type and stock management. One approach involves de-trending the event study coefficients based on the trend prior to the policy reform. The other involves including a unit-specific linear trend term as an explanatory variable within each group. The robustness of the results are confirmed by applying multiple empirical methodologies and by conducting subsample analysis in line with institutional and declarative features.

The main results and their interpretations are summarized as follows. It is estimated that the introduction of e-tax reduces *amendment* by about 9.5% points. In BY2019, just prior to the policy implementation, the percentage of large corporations making amendment was 26.2%. Therefore, a decrease in amendment by 9.5% points means that e-tax reduces the percentage of amendment by more than one-third. Considering the fact that *amendment* is defined as ex post facto amendments, the result can also be rephrased as follows: e-tax increases the probability of a corporation completing one tax return for each business year without mistakes in reporting by more than one-third. This can be interpreted as that e-tax system leads to a reduction in corporate compliance costs, potentially decreasing future unintentional 'tax evasion' by more than one-third, which seems sufficiently large impact. On the other hand, there is no statistically significant evidence that e-tax reduces *fine*. This implies a lack of sufficient evidence regarding the impact of e-tax on reducing malicious (intentional) tax evasion and serious errors in tax declarations. The corporate business tax is important as it contributes substantially to local tax revenue, yet its administrative costs are widely acknowledged as being high. While the need for digitizing the tax declaration procedure has been recognized, the corresponding benefits had not been thoroughly examined (at least in developed countries). The paper contributes to the discussion on introduction of e-tax system to tax declarations. Specifically, it may reveal that e-tax can reduce costs on the corporate side by simplifying the procedure (although it cannot go further as to change 'malicious' corporations' behavior), thereby advancing discussions on promoting the adoption of e-tax in developed countries. Additionally, this study has the potential to contribute to related future research in two ways. Firstly, it introduces two proxies designed to identify tax evasion in a broader sense. Secondly, it employs empirical methods to address factors like potential differences in corporations' sizes and checks for robustness aligned with the taxation structure.

This paper has mainly two limitations regarding data usability. First, the data contains only recent records, and the policy reform We focus on has also been implemented recently. As repeatedly discussed, there can be a few years gap between a certain business

year and the time when fine is imposed on or the amendment is filed. This feature naturally bares downward trend in dependent variables, which makes it difficult to identify causal inference. Although We address the issue by adopting detrended event study and controlling for capital class-specific linear time trends and they seem to work, there is room for discussion on this still. Second, the raw data We accessed may not include a sufficient number of variables. There is a possibility that time-variant factors, such as changes in corporate management structure (Fernandez-Bastidas, 2023), may impact the probability of tax evasion. The limited number of variables is a constraint as the data originates from administrative tax records, and as a result, We cannot completely rule out the possibility of omitted variable biases. Additionally, the absence of variables or proxy indicators related to the cost of implementing e-tax limits the richness of policy implications. If available, such variables could enhance the analysis by enabling a comparison of the cost and benefits, including the effect of reducing tax evasion, associated with e-tax. These points are worth exploring further in future research.

Appendix

A. Event Study of e-tax

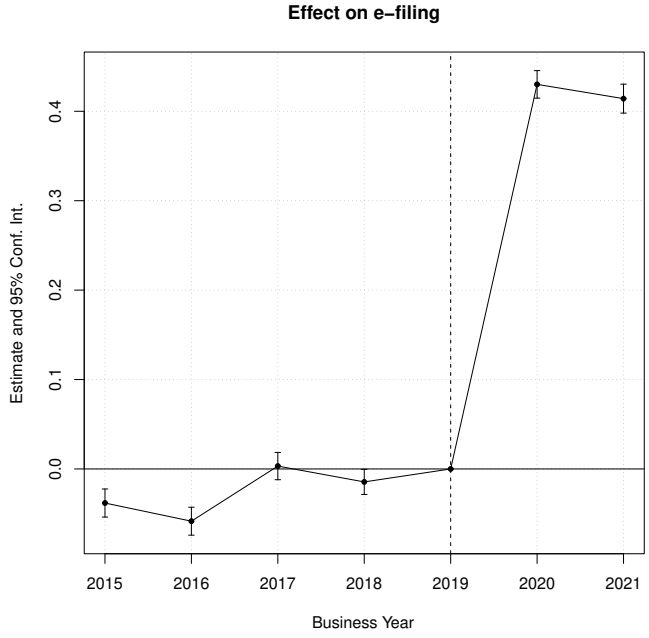
This paper focuses on a policy reform mandating large corporations to adopt e-tax from BY2020, as discussed in subsection 4.1. To assess the impact of the policy on the usage of e-tax, We perform event study analysis as outlined below. The regression equation is almost the same as Eq. (1) in main analysis. That is;

$$E_{ict} = \sum_{s \neq 2019} \alpha_s^{ES} I[t = s] D_{ic}^{large} + \gamma_t + \delta_i + \epsilon_{ict} \tag{4}$$

We use a dummy variable for e-tax, denoted as 1 if a corporation uses e-tax in the relevant business year, as a dependent variable. All other notations and methods are the same as Eq. (1). The primary coefficients α_s^{ES} after the policy reform ($s = 2020, 2021$) capture the extent to which the usage of e-tax is increased or decreased as a result of the policy change.

Brief result (event study plot) is shown in the following figure. There are statistically significant and sufficiently large increase in the usage of e-tax after BY2020. This supports the effectiveness of the policy reform, which in turn supports the validity of the analysis in this paper.

Figure 4: Event Study Plot of e-tax

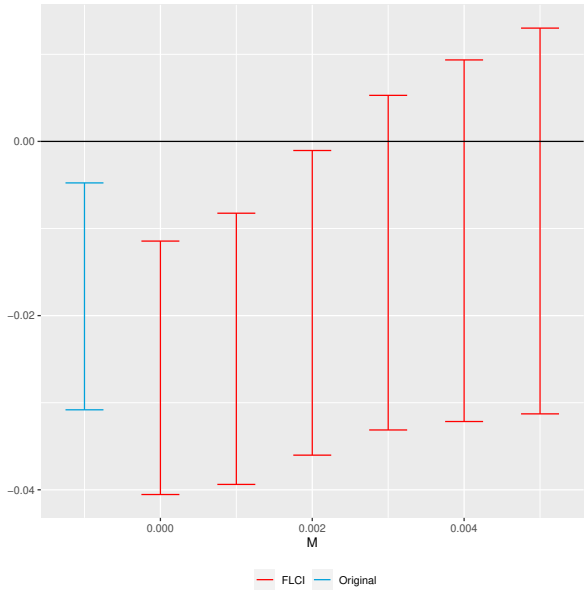


Note : This is the basic event study plot, i.e., the estimated coefficients $\widehat{\alpha_t}^{ES}$ of Eq. (4). Each dot is the point estimate and bars show 95% confidence intervals. Here, BY2019 is a reference year because the policy reform was implemented from BY2020.

B. Robustness Checks

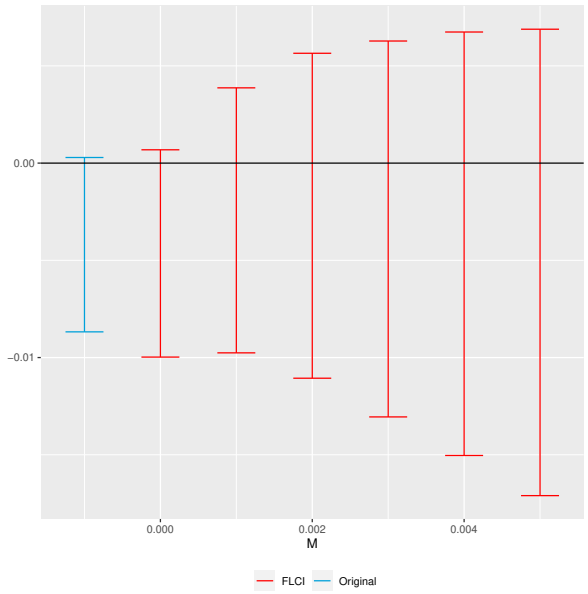
Smoothness Restriction Test

Figure 5: Smoothness Restriction Test of detrended *amendment*



Note : The blue plot is the estimated 95% confidence interval (CI) of the treatment effect (i.e., $\bar{\alpha}_{post}$: the average of the estimated coefficients of post-treatment periods), while the red ones are the CIs of it allowing for violations of the pre-period parallel trends up to a parameter M.

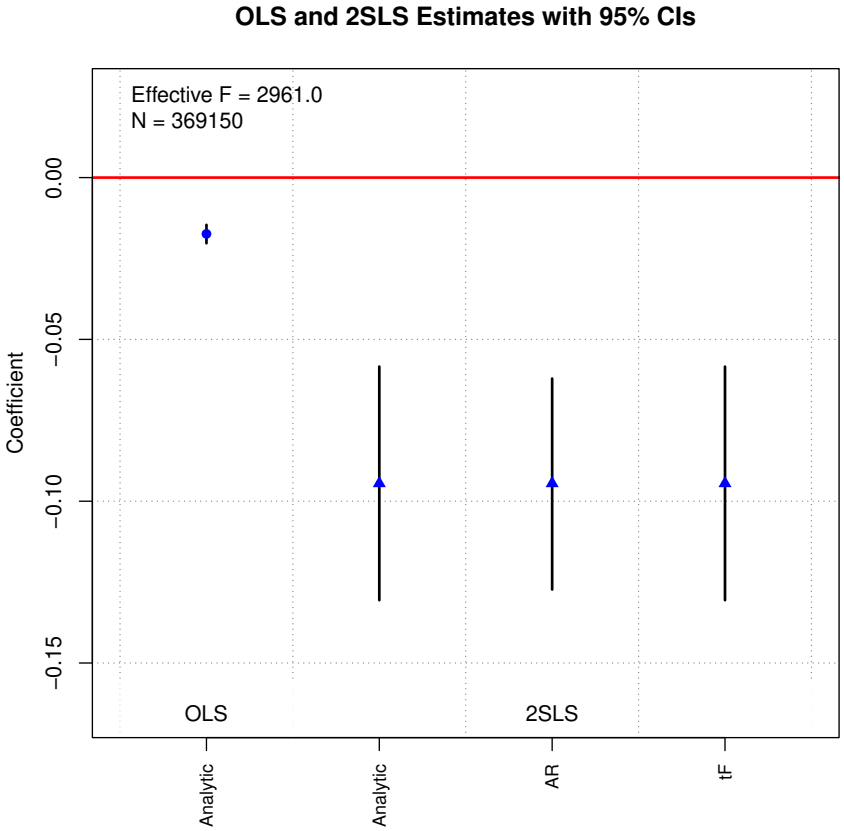
Figure 6: Smoothness Restriction Test of detrended *fine*



Note : The blue plot is the estimated 95% confidence interval (CI) of the treatment effect (i.e., $\bar{\alpha}_{post}$: the average of the estimated coefficients of post-treatment periods), while the red ones are the CIs of it allowing for violations of the pre-period parallel trends up to a parameter M.

IV with Robust Standard Errors

Figure 7: Confidence Intervals with Robust Statistics



Note : This figure shows the estimation results on *amendment* using IV method. The blue points (both circle and triangle) are the point estimates, and black bars show the 95% confidence intervals. The left-most plot is that of standard Two-Way Fixed Effect model, and the rests are those of 2SLS model. For 2SLS, from left to right: the results with analytic standard errors (SEs), Anderson-Rubin SEs (Anderson and Rubin (1949)), and varid-t-ratio SEs (Lee et al. (2022)).

Subsample Analysis i : Excluding Corporations with Capital Reductions

Table 8: The Number of Corporations that Reduce Their Capital in each Fiscal Year

FY	2016	2017	2018	2019	2020	2021	2022
count	-	127	231	164	265	444	254

Note : This table reports the number of corporations that reduce their tax, especially, corporations which had been 'large' in fiscal year (FY) $n-1$ and then became 'middle' or 'small' ones in FY n. Here, the upper row corresponds to FY n. The value of FY2016 is missing because the dataset starts from that year (i.e., no information about FY2015).

Table 9: Event Study of each variable without capital-reduct corp.

	amendment	amendment_detrended	fine	fine_detrended
2015 × large	0.215***	-0.006	0.038***	-0.002
	(0.009)	(0.009)	(0.004)	(0.004)
2016 × large	0.172***	0.002	0.035***	0.004
	(0.008)	(0.008)	(0.004)	(0.004)
2017 × large	0.136***	0.017**	0.027***	0.006*
	(0.008)	(0.008)	(0.004)	(0.004)
2018 × large	0.080***	0.013*	0.011***	-0.001
	(0.007)	(0.007)	(0.003)	(0.003)
2020 × large	-0.056***	-0.020***	-0.011***	-0.004
	(0.007)	(0.007)	(0.002)	(0.002)
2021 × large	-0.184***	-0.098***	-0.022***	-0.005*
	(0.007)	(0.007)	(0.003)	(0.003)
Num.Obs.	367676	367676	367676	367676
R2	0.462	0.462	0.379	0.379
R2 Adj.	0.346	0.346	0.246	0.246
Std.Errors	by: ID	by: ID	by: ID	by: ID
FE:ID	YES	YES	YES	YES
FE:BY	YES	YES	YES	YES

Note : This table is the result of a subsample analysis that excludes records of corporations that have reduced their capital to less than 100 million JPY. ***, **, * represent that the estimates are statistically significantly different from zero at a significance level of 1%, 5% and 10%, respectively. Standard errors are clustered by ID (corporations). All models control for the business year fixed effects, and the time-invariant and unobservable fixed effects of corporations. The mean of *amendment* and the mean of *fine* of treatment group in BY2019, the year before the treatment are 26.2% and 2.4%, respectively.

Table 10: Effect on *amendment* without capital-reduct corp.

	ITT without Trend	ITT	IV without Trend	IV
e-tax	-0.226***	-0.040***	-0.501***	-0.098***
	(0.005)	(0.008)	(0.013)	(0.019)
Num.Obs.	367676	367676	367676	367676
R2	0.457	0.463	0.226	0.457
R2 Adj.	0.340	0.348	0.060	0.341
Std.Errors	by: ID	by: ID	by: ID	by: ID
FE:ID	YES	YES	YES	YES
FE:BY	YES	YES	YES	YES
Trend term	NO	YES	NO	YES
Weak IV	-	-	9361.0	2981.4

Note : This table is the result of a subsample analysis that excludes records of corporations that have reduced their capital to less than 100 million JPY. ***, **, * represent that the estimates are statistically significantly different from zero at a significance level of 1%, 5% and 10%, respectively. Standard errors are clustered by ID (corporations). All models control for the business year fixed effects, and the time-invariant and unobservable fixed effects of corporations. Weak IV is the effective F-statistic based on Olea and Pflueger (2013). The mean of *amendment* of treatment group in BY2019, the year before the treatment is 26.2%.

Table 11: Effect on *fine* without capital-reduct corp.

	ITT without Trend	ITT	IV without Trend	IV
e-tax	-0.037***	-0.004	-0.082***	-0.009
	(0.002)	(0.003)	(0.005)	(0.008)
Num.Obs.	367676	367676	367676	367676
R2	0.378	0.380	0.342	0.380
R2 Adj.	0.245	0.247	0.201	0.247
Std.Errors	by: ID	by: ID	by: ID	by: ID
FE:ID	YES	YES	YES	YES
FE:BY	YES	YES	YES	YES
Trend term	NO	YES	NO	YES
Weak IV	-	-	9361.0	2981.4

Note : This table is the result of a subsample analysis that excludes records of corporations that have reduced their capital to less than 100 million JPY. ***, **, * represent that the estimates are statistically significantly different from zero at a significance level of 1%, 5% and 10%, respectively. Standard errors are clustered by ID (corporations). All models control for the business year fixed effects, and the time-invariant and unobservable fixed effects of corporations. Weak IV is the effective F-statistic based on Olea and Pflueger (2013). The mean of *fine* of treatment group in BY2019, the year before the treatment is 2.4%.

Subsample Analysis ii : Excluding Lagged Declarations

Table 12: Event Study of each variable without lagged declarations

	amendment	amendment_detrended	fine	fine_detrended
2015 × large	0.208***	-0.017*	0.036***	-0.006
	(0.009)	(0.009)	(0.004)	(0.004)
2016 × large	0.163***	-0.010	0.032***	0.000
	(0.009)	(0.009)	(0.004)	(0.004)
2017 × large	0.135***	0.015*	0.027***	0.004
	(0.008)	(0.008)	(0.004)	(0.004)
2018 × large	0.079***	0.011	0.012***	0.000
	(0.007)	(0.007)	(0.003)	(0.003)
2020 × large	-0.049***	-0.013*	-0.010***	-0.003
	(0.007)	(0.007)	(0.002)	(0.002)
2021 × large	-0.184***	-0.095***	-0.022***	-0.005*
	(0.007)	(0.007)	(0.002)	(0.002)
Num.Obs.	343675	343675	343675	343675
R2	0.454	0.454	0.358	0.358
R2 Adj.	0.336	0.336	0.220	0.220
Std.Errors	by: ID	by: ID	by: ID	by: ID
FE:ID	YES	YES	YES	YES
FE:BY	YES	YES	YES	YES

Note : This table is the results of a subsample analysis that excludes records of returns filed after two years or more from the business year. ***, **, * represent that the estimates are statistically significantly different from zero at a significance level of 1%, 5% and 10%, respectively. Standard errors are clustered by ID (corporations). All models control for the business year fixed effects, and the time-invariant and unobservable fixed effects of corporations. The mean of *amendment* and the mean of *fine* of treatment group in BY2019, the year before the treatment are 26.2% and 2.4%, respectively.

Table 13: Effect on *amendment* without lagged declarations

	ITT without Trend	ITT	IV without Trend	IV
e-tax	-0.222***	-0.041***	-0.496***	-0.100***
	(0.005)	(0.008)	(0.013)	(0.020)
Num.Obs.	343675	343675	343675	343675
R2	0.449	0.456	0.215	0.448
R2 Adj.	0.330	0.338	0.045	0.329
Std.Errors	by: ID	by: ID	by: ID	by: ID
FE:ID	YES	YES	YES	YES
FE:BY	YES	YES	YES	YES
Trend term	NO	YES	NO	YES
Weak IV	-	-	8788.1	2693.9

Note : This table is the results of a subsample analysis that excludes records of returns filed after two years or more from the business year. ***, **, * represent that the estimates are statistically significantly different from zero at a significance level of 1%, 5% and 10%, respectively. Standard errors are clustered by ID (corporations). All models control for the business year fixed effects, and the time-invariant and unobservable fixed effects of corporations. Weak IV is the effective F-statistic based on Olea and Pflueger (2013). The mean of *amendment* of treatment group in BY2019, the year before the treatment is 26.2%.

Table 14: Effect on *fine* without lagged declarations

	ITT without Trend	ITT	IV without Trend	IV
e-tax	-0.036 ***	-0.005	-0.081 ***	-0.013
	(0.002)	(0.003)	(0.005)	(0.008)
Num.Obs.	343675	343675	343675	343675
R2	0.358	0.359	0.315	0.358
R2 Adj.	0.218	0.220	0.166	0.219
Std.Errors	by: ID	by: ID	by: ID	by: ID
FE:ID	YES	YES	YES	YES
FE:BY	YES	YES	YES	YES
Trend term	NO	YES	NO	YES
Weak IV	-	-	8788.1	2693.9

Note : This table is the results of a subsample analysis that excludes records of returns filed after two years or more from the business year. ***, **, * represent that the estimates are statistically significantly different from zero at a significance level of 1%, 5% and 10%, respectively. Standard errors are clustered by ID (corporations). All models control for the business year fixed effects, and the time-invariant and unobservable fixed effects of corporations. Weak IV is the effective F-statistic based on Olea and Pflueger (2013). The mean of *fine* of treatment group in BY2019, the year before the treatment is 2.4%.

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