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Abstract

Using the pro forma standard taxation system introduced in Japan on April 1, 2004 as a natural experiment, we empirically examine how firms reacted to this exogenous institutional change, which burdened all firms holding stated capital of larger than 100 million yen with additional tax payments. Then, we determine whether such a reaction (if any) systematically resulted in firm growth. Our results are as follows. First, firms that originally held capital above the threshold became more likely to reduce their capital to the threshold level, or below, after the announcement of the new tax system. Second, firms that exhibit losses, hold smaller assets, have lower liquidity, and/or would benefit more from a tax point of view by reducing their capital were more likely to do so. Third, firms that reduced their capital showed a higher exit rate and ex-post lower growth in size, as measured by total and tangible assets, number of employees, and sales. Quantitatively, firms that reduced their capital decreased their assets, employment, and sales by 15%, 11%, and 4%, respectively, on average, within two years of the capital reduction, as compared with those that did not. Fourth, while the debt-to-total assets ratio of firms that reduced their capital did not change in comparison with firms that did not do so, the former did show a relative increase in the share of total assets made up of liquid assets. These results imply that the policy-induced capital reduction had substantial negative impacts on firm growth, and resulted in firms changing the balance of their asset holdings in favor of liquid assets.

Keywords: Tax avoidance, Pro forma standard taxation, Firm growth, Liquidity holding

JEL classification: H32, H25, L25

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1. Introduction

Taxation affects firm dynamics, including investments (Jorgenson 1963) and capital structure (DeAngelo and Masulis 1980) and, thus, firm growth. As a typical example, firms facing higher corporate tax revise their projections of future net cash in-flows and decrease their capital investments. On the other hand, such a change in taxation could also lead to firms increasing their leverage because the higher corporate tax effectively strengthens the tax shield of debt. Furthermore, depending on what we use as a basis for taxation (e.g., capital, labor, profit, etc.), extant studies have predicted that taxation will affect production and, thus, growth in systematic ways (Atkeson et al. 1999).

While theoretical predictions under such standard economic models are relatively straightforward, they are not easy to test empirically owing to endogeneity issues and data limitations. In order to examine the economic implications of taxation empirically, we need to be able to employ a clean institutional variation associated with a tax system, individual (i.e., firm and/or household) responses to such shocks, and its consequences over long periods.

Related to this discussion on taxation and firm dynamics, most countries impose some taxes only on agents with income or revenue above some specific threshold, tax credits are provided only to agents with income or revenue below some threshold, and tax rates vary in a stepwise manner over multiple threshold values. Taking advantage of these institutional features and using highly disaggregated data, recent studies have investigated the relationship between taxation and its economic impact on agents, and found that agents respond to a shock in a taxation system by avoiding tax payments through “bunching.” Here, after changing their status at a minimum or maximum, but sufficient level in order to avoid tax payments, agents become clustered just above or below the threshold. Many studies have provided evidence supporting this mechanism in the case of income tax (Saez 2010; Chetty et al. 2013), value-added tax (Onji 2009; Liu and Lockwood 2015), and tax monitoring (Almunia and Lopez-Rodriguez 2015).

Although theoretical predictions concerning firms’ responses to a change in a tax system are straightforward, and the existence of bunching as a response from agents is largely confirmed, it is still not clear whether such tax avoidance distorts agents' real behavior. On the one hand, a group of studies point out that such an induced response by agents against a change in a tax system would not result in sizable distortions, at least in the short run, simply because agents also face various other constraints and frictions, which prevent them from behaving optimally (Kleven and Waseem 2013). On the other hand, several other studies (Heider and Ljungqvist 2012; Princen 2013; Moore 2014; Hebous and Ruf 2015) report a distortion in firm leverage induced by the change in tax system. How agents respond to such policy-induced changes remains an open question.

From the point of view of examining this research question, Japan provides an almost ideal institutional situation owing to its implementation of the "Pro forma standard taxation" system. This system was introduced as part of Japan's corporate tax reform in 2004, and is an example of a change that may have caused such bunching behavior to avoid paying tax. The system requires that firms pay tax if their stated capital is greater than 100 million JPY. Based on the assumption that firms will try to avoid taxation by reducing their capital to the threshold, or below (i.e., 100 million JPY) and using Japanese firm-level data, Hattori (2016) shows that bunching does occur below the threshold. Doi (2016) and Nakata (2016) also discuss how firms change employment, debt financing, and location, possibly as a result of the pro forma standard taxation system. However, our understanding is that the mechanism leading to tax avoidance and the causal impact of the tax reform is not clear.

Against this background, using detailed Japanese firm-level panel data, which incorporate comprehensive firm-level information, and employing the exogenous tax reform shock announced in 2002–2003, and introduced in 2004, as a natural experiment, we first investigate whether the reform induced tax such avoidance behavior. Furthermore, in order to describe the mechanism inducing firms to commit such tax avoidance, we examine firms that are more likely to do so. After confirming the existence of tax avoidance by means of capital reduction, we then investigate whether such policy-induced tax avoidance had any real effects on firm performance and dynamics.

For the first analysis, we test whether firms that originally held capital strictly greater than the threshold (i.e., 100 million JPY) suddenly showed a higher probability of reducing their capital to a level equal to or smaller than the threshold just after the announcement of the pro forma standard tax system. In order to confirm whether this holds only for a specific type of capital reduction from above to below (or equal to) the threshold, we also estimate the probability of a capital reduction occurring within a range greater than and within a range equal to or smaller than the threshold. We find that only capital reductions from greater than the threshold to equal to or below the threshold increased after the introduction of tax system. The other two cases showed no systematic change in the probabilities of a capital reduction over the time horizon. This is clear evidence of the existence of tax avoidance through capital reduction.

For the second analysis, we examine what type of firms are more likely to reduce their capital, and find that smaller firms, firms exhibiting losses, firms with lower liquidity, and/or firms facing a larger tax benefit from reducing their capital are more likely to do so. We present a simple theoretical illustration based on borrowing constraints, showing that firms with lower performance have poor investment opportunities and need less stated capital to raise external finance. Hence, they are more likely to reduce their capital in response to the introduction of the pro forma tax. This prediction is consistent with our empirical results, especially in the case of the higher probability of capital reduction for loss-generating firms.

Given that we confirm the tax avoidance by a specific group of firms, we further examine the causal effect of such tax avoidance on firm dynamics. Using a propensity-score-matching difference-in-differences estimation, we find that the policy-induced capital reduction had negative causal impacts on firms' asset size, employment, sales, outstanding debt, firm survivability, tangible asset, and liquidity asset. However, there were no significant impacts on their debt-to-assets ratios, R&D intensity, and ROA, although there were partly positive effects on TFP. The effect on firm size is economically significant. For example, on average, firms that reduced their capital decreased their assets, employment, and sales by 15%, 11%, and 4%, respectively, during the two years after the capital reduction, as compared with those that did not reduce their capital. Apart from the size of firms measured by these metrics, the results also suggest that firms that committed to the capital reduction were induced to hold a larger proportion of liquid assets (i.e., liquidity asset ratio) in their balance sheet. To summarize, we confirm that the introduction of the pro forma standard taxation induced a certain group of firms to reduce their capital significantly, resulting in a lower growth rate and a higher liquidity holding.

In addition to our clean identification strategy employing a quasi-natural experiment associated with a tax reform in Japan, the contributions of the present study are at least twofold. First, the study contributes to the strand of literature on the effects of corporate tax on firms' finance and liquidity holdings by presenting new evidence associated with the introduction of a taxation system on firms' capital structure and asset portfolio (i.e., shares of liquid assets and tangible assets) in Japan. Second, the study contributes to the strand of literature on the consequences of discontinuities in the choice sets of agents by providing new evidence associated with the real effects of tax avoidance on firm growth, induced by the introduction of a specific tax system.

The rest of the paper is organized as follows. In section 2, we provide a brief background to the pro forma taxation system, which we use as a natural experiment device, and the practical procedure of capital reduction in Japan. Section 3 overviews related literature, and section 4 provides a theoretical illustration of this mechanism, leading to the hypotheses tested in the study. In section 5, we discuss the data used in our analysis. The empirical framework and results are presented in section 6. Lastly, section 7 concludes the paper, including potential avenues for future research.

2. Background Information

2.1. Pro forma standard taxation system in Japan

The Japanese pro forma taxation system was first announced on December 13, 2002, and then introduced in the fiscal year starting April 1, 2004. This tax system requires that firms with stated capital greater than 100 million JPY pay additional taxes in the following two categories. First, firms need to pay 0.2% of the sum of the stated capital and auxiliary items on the capital when their stated capital exceeds 100 million JPY. Second, these firms also need to pay 0.48% of their value-added.

These two categories of tax payments were newly introduced with the pro forma standard taxation system (see Table 1).[1]

An important feature of this tax system is that only stated capital is referenced when identifying who needs to pay the additional tax. Given the system does not take into account reported profits, which is used as a tax base for corporate tax, the system is supposed to equally incur tax on all firms. However, it was reported that some major Japanese firms attempted to reduce their capital to a level below the threshold to avoid paying the newly introduced tax. This means that firms for which the cost associated with capital reduction is not sufficiently large could avoid such tax burden introduced by the pro forma standard taxation system. Such capital reduction induced by an exogenous institutional change is what we use as a natural experiment in the present paper.

We should note that in this sense, we do not intend to evaluate the overall economic implication associated with the standard pro forma taxation system, but aim at examining the cause and consequence of the capital reduction induced by the exogenous institutional change. Evidently, if a group of firms found it costly to reduce capital, those firms need to incur additional tax payment due to the pro forma taxation system. As a result, Japanese government can obtain additional tax revenue. Such an additional tax burden may also expedite the exits of inefficient firms. It goes out of the scope of the present study to evaluate these economic benefits as well as examine the cause and consequence of the capital reduction induced by the system.

2.2. Capital reduction in Japan

In order to reduce stated capital in Japan, firms first need to obtain the agreement of their shareholders at a general meeting of shareholders. Once they have done so, firms need to announce the capital reduction to all creditors at least one month prior to the reduction. Then, firms can officially register the capital reduction. As such, a series of official procedures are required to reduce capital,

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[1] The total tax payment under the pro forma standard taxation system is calculated as the sum of three different kinds of tax: 7.2% of taxable income, 0.48% of value-added, and 0.2% of the compressed paid-up capital (the sum of stated capital and capital reserve).

which takes time to complete.

Technically, there are two typical effects on a firm's balance sheet after a capital reduction. First, if a firm holds accumulated losses in its balance sheet, it can offset these losses by reducing its stated capital. In this case, there is no actual impact on the size of the firm's balance sheet because the net wealth (i.e., the sum of capital and accumulated losses) does not change. Second, if a firm does not hold any accumulated losses, it needs to decrease the size of its assets to reduce its capital, unless it increases its debt by an amount equal to or more than that of the capital reduction. Note that creditors, from which firms need to obtain agreement on a capital reduction, usually include banks and other financial institutions. These institutions typically use the levels of stated capital and paid-up capital, the latter of which consists of stated capital and the capital reserve, as important measures of debtors' credit worthiness, especially for smaller firms, which do not disclose their financial information. Therefore, the two types of capital reduction can potentially affect a firm's creditworthiness in different ways and, thus, we should, ideally, treat the two types separately. Unfortunately, owing to data limitations, we cannot distinguish between these two cases and, thus, treat them equivalently.[2] Nonetheless, given that the first type of capital reduction (i.e., offsetting accumulated losses by reducing capital) does not have a negative impact on the size of a firms' balance, we believe that mixing the two types will give us somewhat conservative estimates of the negative impact on firm growth. Therefore, if we can still see negative impacts on firm growth as a result of a capital reduction, we can be highly confident that the second type of capital reduction leads to lower firm growth.

3. Related Literature

This study is related to two broad strands of literature. First, it contributes to the literature on the effects of corporate tax on firms' borrowing and capital structure. Debt confers a tax benefit on firms when interest payments can be deducted from taxable income. The static trade-off theory posits

2 More precisely, our data set only contains information on the sum of earned reserve, which accounts for the accumulated loss, and the capital reserve. One possible approach is to measure the change in the sum of these two items before and after the capital reduction and, thus, roughly identify whether the capital reduction is of the first or second type.

that firms balance the benefits of tax shields and the costs of default in deciding on leverage. The dynamic trade-off theory combines the static trade-off theory with an explicit contingent-claims model on how the firm's debt is priced. Despite clear predictions for each theory, their empirical relevance has been long debated. One reason for the mixed results lies in a variety of endogeneity problems in identifying exogenous shocks to tax rates. Some recent studies overcome such endogeneity problems using a variety of identification strategies, and find a significant impact of tax on leverage. However, its impact on real firm performance, such as asset size and investment, is still mixed. Heider and Ljungqvist (2015) use a difference-in-differences (DID) approach that exploits staggered corporate income tax changes across U.S. states, finding that firms respond to a rise in tax rates by increasing leverage, but that they do not respond to a decrease in the rates. This is consistent with the dynamic trade-off theory. They further find that firms that increase their leverage in response to a rise in tax rates keep their total assets unchanged. Princen (2012) and Hebous and Ruf (2015) based their experiments on the introduction of an allowance for corporate equity (ACE) in Belgium and other countries to conduct DID analyses. Both studies find a significant negative effect of ACE on leverage. While Princen (2012) does not examine the real impact of ACE, Hebous and Ruf (2015) find that the higher capitalization of multinational affiliates due to the ACE systems is associated with increases in passive investment in the form of intra-group lending, but not with production investment. The present study contributes to this strand of literature by presenting new evidence on the impact of the introduction of a tax on equity in Japan on firms' borrowing and capital structure, as well as on firm performance.

Next, this study also contributes to the literature on the consequences of kinks and notches (i.e., discontinuities in the choice sets of agents) introduced by tax policies and transfers. Most existing studies observe bunching in the distribution of the relevant size measures. For example, Onji (2009) and Liu and Lockwood (2015) observe bunching in terms of sales because of the thresholds for VAT in Japan and the UK, respectively. Saez (2010) finds bunching in the distribution of earnings due to the Earned Income Tax Credit (EITC) in the United States. Almunia and Lopez-Rodriguez (2015) obtain evidence of bunching in revenue brought about by tax monitoring in Spain. These studies do not explicitly analyze the real effects of tax kinks or notches on, for example, labor supply or firm performance. However, they obtain some evidence suggesting that at least part of the bunching is a result of agents' underreporting income or masquerading the firm size by splitting firms (e.g., Liu and Lockwood, 2015; Almunia and Lopez-Rodriguez, 2015)

On the other hand, several recent studies have estimated the real responses of agents to tax kinks or notches. Chetty et al. (2013) examine the effects of the EITC on the labor supply. They find that individuals in areas where EITC knowledge is supposed to be high change their wage earnings sharply in order to obtain larger EITC refunds, relative to those in areas where EITC knowledge is supposed to be low. Furthermore, these responses come primarily from intensive-margin earnings increases (i.e., increases in hours of work or earnings conditional on working) in the phase-in region. Kleven and Waseem (2013) develop a framework to estimate the structural elasticity of earnings with respect to (one-minus) the marginal tax rate using the bunching mass (below the notches), as well as the optimization frictions using the missing mass (above the notches). Using data on Pakistan, they obtain a modest estimated elasticity, while observing large bunching and optimization frictions. Our study contributes to this strand of literature by providing new evidence on the real effects on firm performance of tax avoidance that moves the firm from above to below the threshold. Furthermore, in contrast to preceding studies, we use a quasi-natural experiment: the tax reform creates a notch and, thus, provides a clean identification of real responses to tax changes.

Several recent studies have studied the "pro forma" taxation in Japan, as we do here. Hattori (2016) uses data from the Basic Survey of Japanese Business Structure and Activities (BSJBSA), and finds that the proportion of firms that decreased their equity began to increase one year ahead of the introduction of the pro forma taxation. He also conducts a difference-in-differences (DID) analysis by choosing as the treatment group those firms whose equity remained above the threshold and, hence, were taxed. His control group is those firms that remained below the threshold and, hence, were not taxed. His findings show that the treatment group reduced the proportion of taxable value-added in the sum of materials and sales costs after the introduction of the pro forma taxation, as compared with the control group. Doi (2016) also uses data from the Survey and conducts a DID analysis using the same control and treatment groups as those of Hattori. He finds that the treatment group increased the percentage of the incidence on labor after the introduction of the tax, as compared with the control group. Although their difference-in-differences analyses capture some aspects of the effects of the pro forma taxation, they do not consider the effect of the taxation in promoting equity reduction and its consequences on firm performance, as we do here. Nakata (2016) examines whether differences in the effective corporate tax rate among prefectures, which emerged owing to the introduction of the pro forma taxation, affect firms' location choices. She finds that the tax rate affects the location choice of newly established firms that are burdened with the pro forma tax, but not that of untaxed firms. Similarly to the above-mentioned two studies, Nakata (2016) does not consider possible tax avoidance behavior by restricting equity to below the threshold.

4. Theoretical illustration

In this section, we provide a brief theoretical sketch leading to several predictions of firms' reactions to the change in the tax scheme. Note that we do not intend to develop a comprehensive model accounting for firms' general responses to the change, but simply illustrate firms' behavior in order to guide our empirical analysis.

We consider a firm under a borrowing constraint. Let π, K, B, and E denote the firm's profit, physical capital, debt, and equity (or "paid-up capital"), respectively. Then, the firm's profit is given by the following equation:

$$\pi = AK^{\alpha} - RK. \tag{1}$$

In equation (1), A denotes revenue productivity and R is the rental rate on capital. We assume that the depreciation rate is zero and, hence, R represents the interest rate as well.

First, suppose that the firm chooses K and B to maximize π, given E, under the following balance sheet constraint and the borrowing constraint:

$$K = B + E \tag{BS}$$

$$\emptyset A K^{\alpha} \geq (1+R)B, \quad 0 \leq \emptyset \leq 1. \tag{BC}$$

BC naturally arises from the imperfect enforcement of credit contracts (e.g., Buera et al. 2011). The parameter $\emptyset$ captures the extent of frictions in the financial market owing to the imperfect enforcement of credit, spanning economies with no credit markets ($\emptyset = 0$) and those with perfect credit markets ($\emptyset = 1$).

In this setup, the optimal K is obtained as follows:

$$K(A,E) = \begin{cases} K^U(A) & if \quad A \leq \bar{A}(E) \\ K^C(A,E) & Otherwise \end{cases}. \tag{2}$$

In equation (2), $K^U(A) = \left(\frac{\alpha A}{R}\right)^{\frac{1}{(1-\alpha)}}$, $K^C(A,E)$ is implied by the binding equation (BC), where equality holds, and $\bar{A}(E)$ is the solution to $K^U(A) = K^C(A,E)$. Specifically, $K^C(A,E)$ and $\bar{A}(E)$ are defined as follows:

$$\emptyset A(K^C(A,E))^{\alpha} = (1+R)(K^C(A,E) - E)$$

$$\emptyset \bar{A}(E)\left(\frac{\alpha \bar{A}(E)}{R}\right)^{\frac{\alpha}{(1-\alpha)}} = (1+R)\left(\left(\frac{\alpha \bar{A}(E)}{R}\right)^{\frac{1}{(1-\alpha)}} - E\right).$$

Figure 1 illustrates the optimal level of K against A for specific parameter sets. The BC constraint is more likely to bind when A is higher and E is lower.

Suppose that the firm's initial equity is E^H, and that the firm is taxed on equity at the rate of τ under the pro forma standard taxation system if its equity remains E^H, but that the firm can avoid tax by decreasing its equity to E^L ($E^L < E^H$). However, the firm has to sell its assets unless it can borrow enough funds for capital reduction. The optimal level of K, given E, does not change as a result of the taxation, but the maximized profit is reduced by the degree of taxation:

$$\pi_{taxed}(E^H) = \pi(E^H) - \tau E^H. \quad (3)$$

Figure 2 illustrates the maximized profit for E^L and that for E^H before and after the taxation, showing that for firms with relatively small A, their profit increases by decreasing their equity, thereby avoiding taxes. Such firms are induced to choose E^L by the taxation system. Among the firms that choose E^L, for those whose A is relatively large, the borrowing constraint is binding and, hence, they reduce K. To examine the effects of taxation on debt, we illustrate the optimal level of B in Figure 3, showing that among the firms that choose E^L, those who decrease K decrease B as well (except for those with relatively small A).

Here, we obtain some testable implications. First, under the environment where the stated capital is used as one tax base, firms with lower productivity are more likely to reduce their capital. These firms do so simply because it is less harmful for them to lose the ability to obtain financing by reducing their capital, because they expect lower productivity shocks in future. Second, the model suggests that firms that reduce their capital tend to be smaller in size (i.e., a smaller optimal level of physical capital), which is interpreted as lower growth. Third, the latter firms also show lower levels of debt.

In the next section, we empirically examine the impact of the pro forma taxation system in Japan and check whether the above-mentioned model predictions are supported. Note that because we have extensive data on a variety of firm attributes, and far more than those employed in the model, we also discuss, in detail, the mechanism through which firms reduce their capital, and real impacts of such reductions. Note that the tax benefit from a capital reduction is always positive in the model because we only consider tax on capital. However, it is not clear whether the tax benefit is positive for all firms. Thus, we calculate the tax benefit for each firm in our empirical investigation.

5. Data and Methodology

5.1. Data overview

The data set used in this study is provided by the Basic Survey of Japanese Business Structure and Activities (BSJBSA), published by the METI. It covers all enterprises in Japan with more than 50 employees and with paid-up capital of over 30 million JPY. The data are produced annually, and include around 30,000 firms each year. We use data for the period 1996–2007 in order to include the periods six years before and after the introduction of the tax reform, between 2002 and 2004.

Note that for our analysis, we need to include a sufficient length of time before and after the introduction of the tax reform. First, we need to use the data prior to the reform to check for any pre-trend in terms of capital reduction. If such a trend occurs, it is likely that there are other factors driving firms' capital reductions. Thus, in order to treat the pro forma taxation system as an exogenous institutional change, having a significant impact on firm behavior, we need to confirm that no prior trend exists. Second, we need to use the data following the introduction of the taxation system because we examine firms' reactions to the tax reform and the consequences of the reform on firm dynamics. Note that we exclude the financial crisis period starting around 2007 from our analysis so that our estimates are not contaminated by its effects. We also exclude firms belonging to the electricity, gas, and insurance industries, where different tax schemes are applied.[3]

5.2. Variable definition

First, using the above-mentioned data, we define $CAPRED1_{it}$ as a dummy variable, taking the value one if (i) firm *i*'s capital at year *t* - 1 is greater than the threshold (100 million JPY) and (ii) firm *i*'s capital at year *t* is equal to or smaller than the threshold. Then, the variable takes the value zero if (i) firm *i*'s capital at year *t* - 1 is greater than the threshold and (ii)′ firm *i*'s capital at year *t* is

[3] As shown in Table 1, firms belonging to the electricity, gas, and insurance industries apply a different tax rate and tax basis (i.e., revenue instead of income).

still greater than the threshold. The latter case (i.e., that satisfying (i) and (ii)′) includes firms that did not reduce their capital, as well as those that did reduce their capital, but remained above the threshold. In this sense, $CAPRED1_{it}$ accounts for the case in which a firm reduced its capital from a level above the threshold to that equal to or below the threshold.

Second, in a similar fashion, we define $CAPRED2_{it}$ as a dummy variable that takes the value one if (iii) firm *i*'s capital at year *t* - 1 is greater than the threshold, the firm reduced its capital in year *t*, and its capital at year *t* is still greater than the threshold. Then, $CAPRED2_{it}$ takes the value zero if either (iii)′ firm *i*'s capital at year *t* - 1 is greater than the threshold, the firm reduced its capital in year *t*, and its capital at year *t* is equal to or smaller than the threshold, or (iii)″ firm *i* did not reduce its capital in year *t*. In this sense, $CAPRED2_{it}$ denotes the case in which a firm reduced its capital within the range above the threshold.

Third, we define $CAPRED3_{it}$ as a dummy variable taking the value one if (iv) firm *i*'s capital at year *t* - 1 is equal to or smaller than the threshold and (v) firm *i* reduced its capital in year *t*. Then, $CAPRED3_{it}$ takes the value zero if (iv) firm *i*'s capital at year *t* - 1 is equal to or smaller than the threshold and (v)′ firm *i* did not reduce capital in year *t*. In this sense, $CAPRED3_{it}$ denotes the case in which a firm reduced its capital within the range below the threshold. Figure 4 summarizes the definitions of these three dummy variables.

We let X_{it-1} denote the vector of firm *i*'s attributes in year *t* - 1. First, in order to represent a firm's performance in terms of its profitability, we define $LOSS_{it-1}$ as a dummy variable taking the value one if firm *i* shows a loss, measured as the net profit, in year *t* - 1, and 0 otherwise. As an alternative measure to $LOSS_{it-1}$, we define the ratio of pre-tax profit to total assets (ROA_{it-1}). Second, in order to account for firm size, we define $ASSET_{it-1}$, which is the natural logarithm of firm *i*'s total assets recorded in their financial statements as of the end of year *t* - 1. Third, in order to account for a firm's liquidity holding, we employ $LIQRATIO_{it-1}$, which denotes the ratio of liquid assets to total assets as of the end of year *t* - 1. Fourth, in order to measure the marginal benefit a firm can obtain by reducing its capital from above to below the threshold, we define TAX_{it-1}, which represents the ratio of how much of a tax payment the firm can avoid by reducing its capital in year t - 1. This value of potential tax avoidance is computed as the difference between the amount of tax a firm has to pay under the pro forma standard taxation system and the amount it has to pay when it avoids the taxation. First, as we have already mentioned, the amount of the tax payment under the pro forma standard taxation system is calculated as the sum of three different kind of taxes: 7.2% of taxable income, 0.48% of value-added, and 0.2% of the compressed paid-up capital (the sum of stated capital and the capital reserve). We use current profit, which is replaced with zero if it is negative, as a proxy for taxable income. The proxy for value-added is calculated as the sum of current profit and factor income (the sum of wages, rental payments, and interest payments), which is also replaced with zero if it is negative.[4] Since the value of the capital reserve is unavailable in our data, we assume that all firms divide their paid-up capital equally between stated capital and the capital reserve. Then, we estimate paid-up capital as twice the value of the stated capital, calculating the compressed paid-up capital (tax base) according to the pro forma standard taxation rules.[5,6] Second, the amount of tax payment when avoiding the pro forma standard taxation is calculated as 9.6% of taxable income. Similarly to the above computation, we use current profit as a proxy for taxable income. Given that there are a small number of outliers in the data, we winsorize the top 1% for $LIQRATIO_{it-1}$ and the top and bottom 1% for ROA_{it-1}. Table 2 summarizes each variable.

6. Empirical analysis

6.1. Reaction to the introduction of the pro forma standard taxation

As a first analysis, we examine how firms reacted to the exogenous tax reform, which burdened all the firms holding stated capital larger than 100 million JPY with an additional tax payment.

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4 We deduct the part of wages exceeding 70% of factor income from value-added, following the pro forma standard taxation rules.

5 The corporation law in Japan allows firms not to include less than half of paid-up capital in stated capital.

6 The tax base is calculated as the sum of 100% of the part of paid-up capital less than or equal to 100 billion JPY, 50% of the part of paid-up capital less than or equal to 500 billion JPY (and more than 100 billion JPY), and 25% of the part of paid-up capital less than or equal to 1 trillion JPY (and more than 500 billion JPY). The part of paid-up capital greater than 1 trillion JPY is excluded from the tax base.

Focusing on the event that firms with capital greater than this threshold at year *t* - 1 reduced their capital in year *t* to a level equal to or smaller than the threshold, we examine how the probability of this event varied over the sample periods. The transition of this capital reduction probability is obtained by estimating the following firm-level equation:

$$CAPRED1_{it} = \sum_{j=1996}^{2007} \beta_j \, YEAR_j + \varepsilon_{it}. \tag{4}$$

Note that in this estimation, we limit our sample to firms holding capital above the threshold in year *t* – 1, and estimate the probability that these firms reduce their capital to a level below or equal to the threshold in year *t*. More precisely, we use only observations where (i) $CAPRED1_{it} = 1$ and (ii) $CAPRED1_{it} = 0$, with no capital reduction. Thus, we exclude firms that reduced their capital, but that remained above the threshold (i.e., those with $CAPRED2_{it} = 1$), which are included in the sample of firms with $CAPRED1_{it} = 0$, from the estimation. We choose this sample to compare firms with $CAPRED1_{it} = 1$ to firms that did not reduce their capital. Including firms with $CAPRED2_{it} = 1$ would contaminate our analysis attempting to identify the determinants of a specific type of capital reduction (i.e., $CAPRED1_{it} = 1$).

Second, we examine how the probability that firms with capital greater than the threshold at year *t* - 1 reduced their capital in year *t* to a level greater than the threshold varied over the sample periods. Given that such capital reduction does not result in effective tax avoidance, we presume that there was no specific change in the probability of capital reduction over the sample periods. Similarly to equation (4), this transition of capital reduction probability can be obtained by estimating the following firm-level equation:

$$CAPRED2_{it} = \sum_{j=1996}^{2007} \beta_j \, YEAR_j + \varepsilon_{it}. \tag{5}$$

Note that, similarly to the case in equation (4), we limit our sample to firms holding capital above the threshold in year $t - 1$, and estimate the probability that these firms reduce their capital to a level above the threshold in year t. More precisely, we use observations satisfying (i) $CAPRED2_{it} = 1$ and (ii) $CAPRED2_{it} = 0$, with no capital reduction. Thus, we exclude $CAPRED1_{it} = 1$, which is included in the sample of $CAPRED2_{it} = 0$, from the estimation. Thus, we use firms that did not reduce their capital for comparative purposes.

Third, we examine how the probability that firms having capital equal to or smaller than the threshold at year t - 1 reduced their capital in year t varied over the sample periods. Given that firms that originally had capital below the threshold are exempt from the additional tax payment, unless they increased their capital beyond the threshold, we presume that there was no specific change to the probability of capital reduction over the sample periods. Similarly to equation (4), this transition of capital reduction probability can be obtained by estimating the following firm-level equation:

$$CAPRED3_{it} = \sum_{j=1996}^{2007} \beta_j \, YEAR_j + \varepsilon_{it}. \tag{6}$$

Note that, slightly differently to the cases in equations (4) and (5), we use observations satisfying (i) $CAPRED3_{it} = 1$ and (ii) no capital reduction.[7]

Figure 5 shows the estimated β_j for j = 1996–2007. Here, we use the estimated β_{2001} to standardize the estimate results in other years. The estimates in each year are all measured as the deviation from β_{2001}, and the confidence band is constructed for $(\beta_j - \beta_{2001})$. The upper panel shows the results from equations (4) and (5), and the lower panel accounts for equations (4) and (6).

First, from Figure 5, regardless of whether we use $CAPRED1_{it}$, $CAPRED2_{it}$, or $CAPRED3_{it}$ as the dependent variable, there is no specific trend in the estimated $(\beta_j - \beta_{2001})$ prior to j = 2001. This means that firms did not have any systematic change in the probability of their reducing their capital before the introduction of the pro forma standard taxation system. Second, the

7 We exclude from our analysis firms with capital equal to or smaller than 100 million JPY and that increased their capital to a level above 100 million JPY. Note that the percentage of firms in this category is very low (about 0.9%) in our sample.

estimated $(\beta_j - \beta_{2001})$ after j = 2001 is positive and statistically significantly different from zero only in the case of $CAPRED1_{it}$. Given that this is not the case for either $CAPRED2_{it}$ or $CAPRED3_{it}$, neither of which used capital reduction to contribute to tax avoidance, this result implies that the hike in $(\beta_j - \beta_{2001})$ for the case of $CAPRED1_{it}$ clearly reflects firms' intention to avoid the pro forma tax. Calculating $\sum_{j=2002}^{2007}(\beta_j - \beta_{2001})$, we find that 8.2% of firms reduced their capital during the six years after the announcement of the tax system.

6.2. Which firms were more induced to avoid tax through capital reduction?

In order to identify a more detailed mechanism that induced firms to avoid tax through capital reduction, while considering, for example, the earlier theoretical illustration, we augment the equations estimated in the previous section with firm attributes. Following the same sample selection criteria for equations (4), (5), and (6), we separately estimate the following three equations after including the firm-level fixed-effect η_i:

$$CAPRED1_{it} = \sum_{j=1996}^{2007}\beta_j\ YEAR_j + \sum_{j=1996}^{2007}\gamma_j\ YEAR_j \times X_{it-1} + \eta_i + \varepsilon_{it} \quad (7)$$

$$CAPRED2_{it} = \sum_{j=1996}^{2007}\beta_j\ YEAR_j + \sum_{j=1996}^{2007}\gamma_j\ YEAR_j \times X_{it-1} + \eta_i + \varepsilon_{it} \quad (8)$$

$$CAPRED3_{it} = \sum_{j=1996}^{2007}\beta_j\ YEAR_j + \sum_{j=1996}^{2007}\gamma_j\ YEAR_j \times X_{it-1} + \eta_i + \varepsilon_{it}. \quad (9)$$

First, the three panels in Figure 6 (a) show the estimated γ_j associated with $LOSS_{t-1}$, $ASSET_{t-1}$, and $LIQRATIO_{t-1}$, respectively, for j = 1996–2007 in the case of (7) and (8). As in the previous section, we use the estimated γ_{2001} to standardize the estimates in other years. First, we find that there is no specific trend in the estimated $(\gamma_j - \gamma_{2001})$ associated with $LOSS_{t-1}$, $ASSET_{t-1}$, and $LIQRATIO_{t-1}$ prior to the announcement (i.e., t = 2001) of the pro forma taxation system. Second, however, the estimated $(\gamma_j - \gamma_{2001})$ associated with these three firm attributes show a significant change after 2001, specifically only in the case of $CAPRED1_{it}$. Given that this is not the case for $CAPRED2_{it}$, for which capital reduction did not contribute to tax avoidance, this implies that the above-mentioned three firm attributes are the key drivers of tax avoidance; that is, smaller firms ($ASSET_{t-1}$), firms with lower liquidity ($LIQRATIO_{t-1}$), and firms exhibiting a loss ($LOSS_{t-1}$) in year t - 1 tended to avoid tax by reducing their capital.

Given the implication of the theoretical illustration provided in the previous section, the results associated with $ASSET_{t-1}$, $LIQRATIO_{t-1}$, and $LOSS_{t-1}$ suggest that firms with lower performance do not need to keep large capital, which helps to raise external finance. It could also be conjectured that firms without enough ability to incur the additional tax payment are more likely to reduce their tax payments by reducing their capital. Note that although it is not shown here, we confirmed that the results for equation (9) were similar to those of equation (8). That is, there is no specific trend in the estimated $(\gamma_j - \gamma_{2001})$ associated with these firm attributes, either prior to or after the announcement of the pro forma taxation system.

Second, Figure 6 (b) shows the estimated γ_j associated with TAX_{t-1} for j = 1996–2007 in the case of (7) and (8). Although there is no specific trend in the estimated $(\gamma_j - \gamma_{2001})$ associated with TAX_{t-1} before the announcement (i.e., t = 2001) of the taxation system in the case of $CAPRED1_{it}$ and $CAPRED2_{it}$, the estimated $(\gamma_j - \gamma_{2001})$ show a significant change after 2001, specifically only in the case of $CAPRED1_{it}$. Our assumption that firms that have more to gain by reducing their capital have a stronger incentive to do so is supported by this result. Note that the results in the three panels in Figure 6 (a) are obtained after controlling for firm-level heterogeneity in terms of the tax benefit. In other words, the above results jointly suggest that firms with lower performance have a clear incentive to reduce their capital to avoid paying the pro forma taxation if there is no difference in the tax benefit attached to each firm. This further confirms that our empirical results are fairly consistent with the implications obtained from our theoretical sketch.

Note that even if firms do not exhibit losses, they could still have an incentive to avoid tax because the size of capital is related to the tax burden, as explained in Table 1. In order to be more specific, we define $GAIN_{it-1}$ as a dummy variable taking the value one if firm i shows a profit, measured as the net profit, in year t - 1, and 0 otherwise. We include the interaction terms between the year dummy and both $LOSS_{it-1}$ and $GAIN_{it-1}$, omitting the single term of the year dummy. Figure 7 shows the estimated coefficients associated with the two groups of the interaction terms (i.e., $YEAR_j \times LOSS_{it-1}$ and $YEAR_j \times GAIN_{it-1}$). As shown in the figure, we can see the sudden increase in $\gamma_j - \gamma_{2001}$ for the two interaction terms over the periods after *t* = 2001. Note that, although this result implies that firms, in general, did attempt to change their behavior in terms of capital reduction, there is a statistically significant difference between the coefficients associated with $YEAR_j \times LOSS_{it-1}$ and those with $YEAR_j \times GAIN_{it-1}$, as we confirmed in the first panel of Figure 6 (a).

6.3. Impact on firm growth

In the previous section, we confirmed that firms with specific attributes committed to tax avoidance through capital reduction. In order to test how such an endogenous capital reduction affected subsequent firm growth, we conduct a difference-in-differences estimation using treatment (i.e., firms that reduced their capital) and control samples, matched using propensity score matching (PSM).

To set up the treatment and control samples, we implement propensity score matching based on the estimated probability associated with the capital reduction from a level greater than the threshold to that equal to or smaller than the threshold (i.e., $CAPRED1_{it} = 1$). We estimate the probability associated with $CAPRED1_{it} = 1$ and predict the propensity score associated with it for observations satisfying (i) $CAPRED1_{it} = 1$ (i.e., actually reducing their capital) and (ii) $CAPRED1_{it} = 0$, with no capital reduction. Note, first, that as we need to examine the policy-induced capital reduction after *t* = 2001, we focus our sample periods on *t* = 2002, 2003, 2004, 2005, 2006. Second, we exclude firms that split from *t* = 2002 to 2008. There is some anecdotal evidence suggesting that some firms split in order to avoid the tax payment. Because the capital reduction might not have any real impact on firm activities if it is purely the consequence of a split, we exclude those cases from this analysis. The percentage of firms in this category is about 9% in our sample. Third, we exclude firms that experienced multiple capital reductions over the sample periods so that we can cleanly identify the impact of a capital reduction.

As potential explanatory variables for the probit estimation, we employ the following six industry-level fixed-effects: manufacturing (*manufact*), retail and wholesale (*wholesal*), construction (*construct*), restaurant (*restaurant*), and service (*service*), using the mining industry as the base category in addition to the variables $LOSS_{t-1}$, $ASSET_{t-1}$, $LIQRATIO_{t-1}$, and TAX_{t-1}. We run five probit estimations for each of t = 2002, 2003, 2004, 2005, and 2006 in order to implement the propensity score matching separately in each year.

Table 3 summarizes the results of the five probit estimations. From the estimated coefficients, we can confirm that smaller firms, firms with lower liquidity and larger potential tax benefits, and firms exhibiting losses are more likely to reduce their capital (i.e., to be $CAPRED1_{it} = 1$), which is consistent with the findings presented in the previous section.

Using the estimated propensity score, we choose the treatment group as those firms holding capital in year *t* - 1 above the threshold and that reduced their capital below (or equal to) the threshold (i.e., $CAPRED1_{it} = 1$). Then, we match them with the control group of firms holding capital above the threshold in year *t* – 1 and that did not reduce their capital in year *t* (i.e., $CAPRED1_{it} = 0$, with no capital reduction) in the same year. Table 4 summarizes the balancing property before and after the matching. We can clearly see that the matched samples are well balanced in terms of their characteristics.

Finally, using the matched sample, we estimate the difference-in-differences of the four groups of 12 outcome variables, detailed below, between the treatment (i.e., $CAPRED_{it} = 1$) and control ($CAPRED_{it} = 0$, with no capital reduction) groups over the pre-event and post-event periods. We should note that Hattori (2016) and Doi (2016) point out firms which incurred additional tax burden due to the pro forma taxation system reduced the proportion of taxable value-added and inecreased the percentage of the incidence on labor. Our difference-in-difference estimation, thus captures the causal impact of capital reduction induced by the institutional change on the firm characteristics of treatment group and the impact of additional tax due to the pro forma taxation system on the firms characteristics of control group.

As the first group of the outcome variables measuring firm growth in terms of size, we use the natural logarithm of total assets ($ASSET_t$), the natural logarithm of the number of employees (EMP_t), the natural logarithm of sales ($SALES_t$), the natural logarithm of tangible assets ($TANGIBLE_t$), and the natural logarithm of liquid assets ($LIQUID_t$). The second group of variables accounts for firms' financing activities, which are measured by the natural logarithm of total debt ($DEBT_t$) and the ratio of total debt to total assets ($DEBTRATIO_t$). The third group of variables accounts for the composition of firms' asset portfolios, which is measured by the ratio of tangible assets to total assets ($TANRATIO_t$) and the ratio of liquid assets to total assets ($LIQRATIO_t$). The fourth group of variables measures firms' innovative activity, which is measured by the natural logarithm of R&D investment (RD_t) and the ratio of R&D investment to sales ($RDRATIO_t$).[8] Finally, the fifth group accounts for firms' performance. To measure performance, we use TFP (TFP_t), measured using the method proposed in Good et al. (1997)[9], ROA (ROA_t), the ratio of value-added to sales (VA_t), and the survival probability ($SURVIVE_t$). Given that there are few outliers in the data, we winsorize the top 1% for $DEBTRATIO_{it-1}$, $TANRATIO_{it-1}$, $LIQRATIO_{it-1}$, and $RDRATIO_{it-1}$, and the top and bottom 1% for ROA_{it-1} and VA_t. For each variable, except $SURVIVE_t$, we estimate the difference between the treatment and control groups from the previous year (t - 1) and the treatment firms' capital reduction in year *t*, *t* + 1, and *t* + 2. For $SURVIVE_t$, we use the window from *t* - 1 to *t* + 2.

Table 5 summarizes the DID estimation results. Each panel accounts for the DID estimation of firm size, financing, asset portfolio, innovative activity, and performance. First, we can see that the capital reduction in the period 2004–2006 resulted in lower growth in firm size. Except for the case of $LIQUID_t$ over t - 1 to t + 1, various dimensions of firm size shrink owing to the capital reduction. This implies that the capital reduction during the period 2002–2006, which could be largely induced

8 We replace missing values of R&D investment with zero.
9 See the Appendix for the calculation of TFP.

by the introduction of the pro forma standard taxation system, given the empirical results presented in the previous section, had a negative impact on firm growth. As we have already shown, the theoretical model incorporating borrowing constraints predicts that firms with low revenue productivity tend to reduce the size of their equity and physical capital, which is consistent with the present empirical result. Notably, the negative effects of capital reduction on firm size, except for $SALES_t$, tend to increase over time. This finding suggests that these negative effects are not mechanical, for example, paying a dividend at the time of the capital reduction ("capital reduction for compensation"). Moreover, the quantitative impacts of a capital reduction on firm size are substantial. Firms that reduced their capital decreased their assets, employment, and sales by 15%, 11%, and 4%, respectively, over the two years after the capital reduction, as compared with those that did not reduce their capital.

Second, $DEBT_t$ became smaller owing to the capital reduction. This result is also consistent with the theoretical prediction in the previous section, suggesting that capital affects the cost or availability of external finance. Interestingly, in spite of this smaller debt size, $DEBTRATIO_t$ was not affected by the capital reduction. This means that the capital structure itself was not affected. In fact, the quantitative impact of the capital reduction on debt is 15%, the same size of that on assets.

Third, somewhat complementing the second result, the share of liquid assets in total assets ($LIQRATIO_t$) held by firms increased as a result of the capital reduction, whereas the share of tangible assets ($TANRATIO_t$) decreased. One interpretation of these results is that firms that reduced their capital faced a larger need to hold cash in their balance sheet owing to a reduced ability to access external finance. As mentioned above, as a surprising result, firms' capital structure (i.e., $DEBTRATIO_t$) is not affected by a capital reduction. The higher liquidity ratio due to the capital reduction implies that firms were actually facing lower credit availability, but maintained their debt ratio by holding larger liquidity. This also shows the difficulty of employing the debt ratio as an outcome variable to represent firms' ability to obtain finance. As suggested by this result, firms could face a higher financial burden even when they are keeping their debt ratio constant. Fourth, firms' innovative activities were barely affected by a capital reduction. Note, however, that we replace the missing value of R&D investment with zero, which may potentially cause a bias in the results.

Fifth, the impact of a capital reduction on firm performance is somewhat mixed. On the one hand, TFP_t increases owing to the capital reduction when we use the windows from *t* - 1 to *t* and *t* - 1 to *t* + 2. On the other hand, firms' survivability becomes worse off. We have several remarks on these mixed results. First, the improvement of TFP over the two windows from *t* - 1 to *t* and *t* - 1 to *t* + 2 could reflect a reduction in inputs (i.e., asset and employment). What we can infer from this estimate is that, at least over the three-year window, such lower inputs might lead to an improvement in productivity through higher labor intensity or capital utilization. In order to confirm if this is true for longer periods, we need to employ data accounting for such periods, which we leave for future research.[10]

7. Conclusion

In this study, using the pro forma standard taxation system as a natural experiment, we empirically examine how firms reacted to this exogenous institutional change and how such a reaction systematically resulted in firm growth. Our estimation results are as follows. First, firms that originally held capital above the threshold were more likely to reduce their capital to the threshold level, or below, after the announcement of the new tax system. The accumulated number of firms that reduced their capital after the announcement of the tax reform accounts for 8.2 % of all firms present one year prior to the announcement. Second, we find that firms holding smaller assets, exhibiting lower performance, and/or those with a larger tax benefit were more likely to reduce their capital to avoid the additional tax burden, which is consistent with the theoretical sketch we provided in this paper. Third, firms that reduced their capital showed ex-post lower growth in size, measured by total and tangible assets, the number of employees, and sales, as well as a higher exit rate. Quantitatively, firms that reduced their capital decreased their assets, employment, and sales by 15%, 11%, and 4%, respectively, on average,

10 Other issues we need to check include (i) other variations of matching, (ii) a placebo analysis, and (iii) a DID analysis for the case where companies split.

two years after the capital reduction, as compared with those that did not reduce their capital. Fourth, while the debt-to-total assets ratio of firms that reduced their capital did not change compared with those that did not do so, the former firms did relatively increase their share of liquid assets in their total assets. These results jointly imply that the policy-induced capital reduction had substantial negative impacts on firm growth, and drove firms to hold more liquid assets.

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Appendix: The multilateral TFP index

TFP level of firm *i* in industry *j* in year *t*, $TFP_{i,j,t}$ is defined in comparison with the TFP level of a hypothetical representative firm in the benchmark year t_0 in industry *j*. In the presenting paper, the benchmark year t_0 is set to the year 1995 and the firm-level TFP level is calculated as follows, using the multilateral TFP index method developed by Good et al. (1997):.

$$\mathrm{LN}(\mathrm{TFP}_{i,j,t}) = \left\{\mathrm{LN}(Q_{i,j,t}) - \overline{\mathrm{LN}(Q_{J,t})}\right\} - \sum_{k=1}^{n}(S_{i,k,j,t} + \overline{S_{k,J,t}})\left\{\mathrm{LN}(X_{i,k,j,t}) - \overline{\mathrm{LN}(X_{k,J,t})}\right\}$$

for $t = t_0$

$$\mathrm{LN}(\mathrm{TFP}_{i,j,t}) = \left\{\mathrm{LN}(Q_{i,j,t}) - \overline{\mathrm{LN}(Q_{J,t})}\right\} - \frac{1}{2}\sum_{k=1}^{n}(S_{i,k,j,t} + \overline{S_{k,J,t}})\left\{\mathrm{LN}(X_{i,k,j,t}) - \overline{\mathrm{LN}(X_{k,J,t})}\right\}$$

$$+ \sum_{s=t_0+1}^{t}\left\{\overline{\mathrm{LN}(Q_{J,s})} - \overline{\mathrm{LN}(Q_{J,s-1})}\right\} - \sum_{s=t_0+1}^{t}\sum_{k=1}^{n}\frac{1}{2}(\overline{S_{k,J,s}} + \overline{S_{k,J,s-1}})\left\{\overline{\mathrm{LN}(X_{k,J,s})} - \overline{\mathrm{LN}(X_{k,J,s-1})}\right\}$$

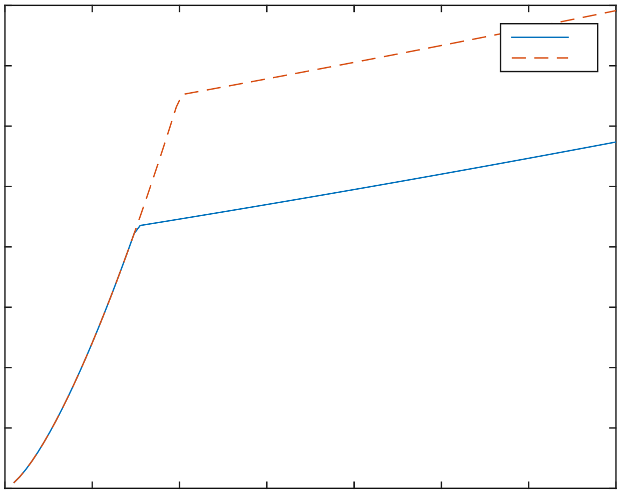
for $t > t_0$

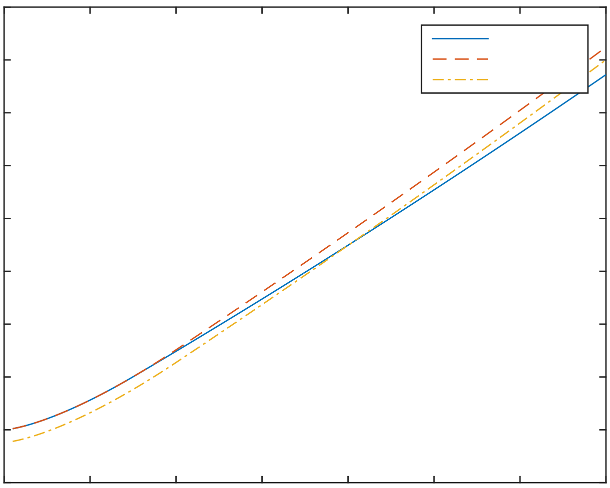
$$\mathrm{LN}(\mathrm{TFP}_{i,j,t}) = \left\{\mathrm{LN}(Q_{i,j,t}) - \overline{\mathrm{LN}(Q_{J,t})}\right\} - \frac{1}{2}\sum_{k=1}^{n}(S_{i,k,j,t} + \overline{S_{k,J,t}})\left\{\mathrm{LN}(X_{i,k,j,t}) - \overline{\mathrm{LN}(X_{k,J,t})}\right\}$$

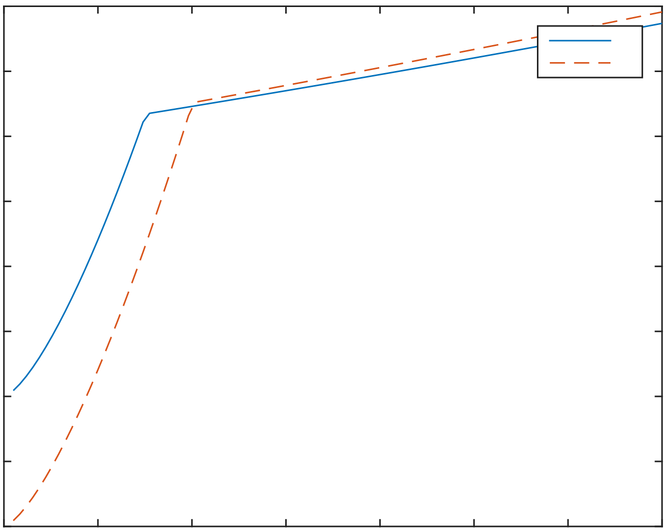
$$- \sum_{s=t+1}^{t_0}\left\{\overline{\mathrm{LN}(Q_{J,s})} - \overline{\mathrm{LN}(Q_{J,s-1})}\right\} + \sum_{s=t+1}^{t_0}\sum_{k=1}^{n}\frac{1}{2}(\overline{S_{k,J,s}} + \overline{S_{k,J,s-1}})\left\{\overline{\mathrm{LN}(X_{k,J,s})} - \overline{\mathrm{LN}(X_{k,J,s-1})}\right\}$$

for $t < t_0$

where $Q_{i,j,t}$ stands for the real output (real sales) of firm *i* (in industry *j*) in year *t*, $X_{i,k,j,t}$ represents the real input of production factor *k* of firm *i* (in industry *j*) in year *t*, and $S_{i,j,k,t}$ is the cost share of production factor *k* at firm *i* (in industry *j*) in year *t*. $\overline{LN(Q_{J,t})}$ denotes the arithmetic average of the log value of the output, in year *t*, of all firms in industry *j* to which firm *i* belongs, while $\overline{LN(X_{k,J,t})}$ stands for the arithmetic average of the log value of the input of production factor *k*, in year *t*, of all firms in industry *j* to which firm *i* belongs. Finally, $\overline{S_{k,J,t}}$ is the arithmetic average of the cost share of the input of production factor *k*, in year *t*, of all firms in industry *j* to which firm *i* belongs.







Note. $A = [0.01, 0.7]$, $\alpha = 0.3$, $\emptyset = 0.5, R = 0.05, E^L = 0.8$, $E^H = 1.2$, $\tau = 0.002$. For this parameter sets, firms with $A < 0.40$ reduce equity from E^H to E^L after taxation to raise profits (Figure 2). Among the firms who reduce equity, those with $0.15 < A < 0.4$ reduce physical capital (Figure 1) and those with $0.20 < A < 0.4$ reduce debt (Figure 3).

Figure 4: Definition of $CAPRED1$, $CAPRED2$, $CAPRED3$

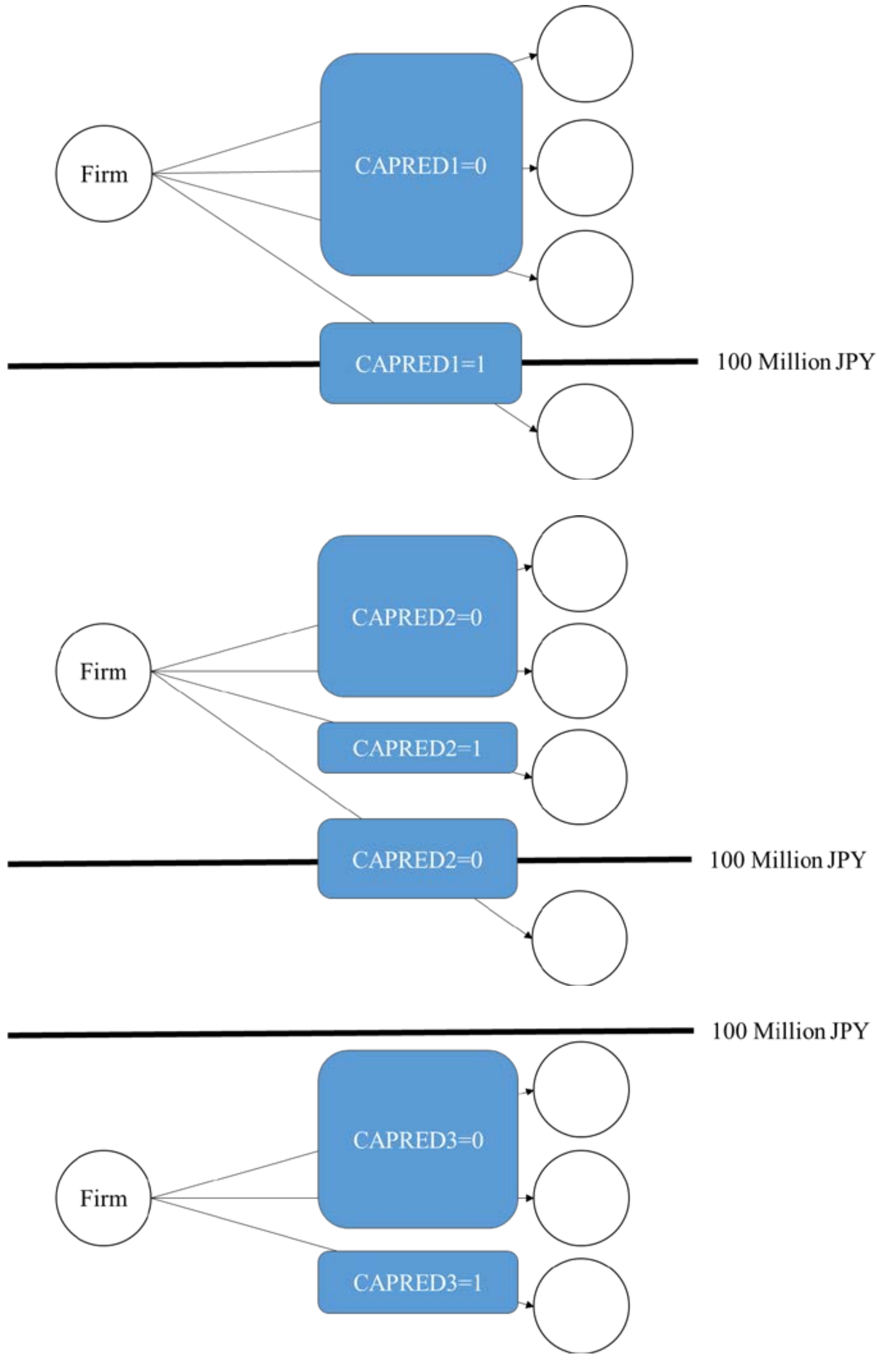
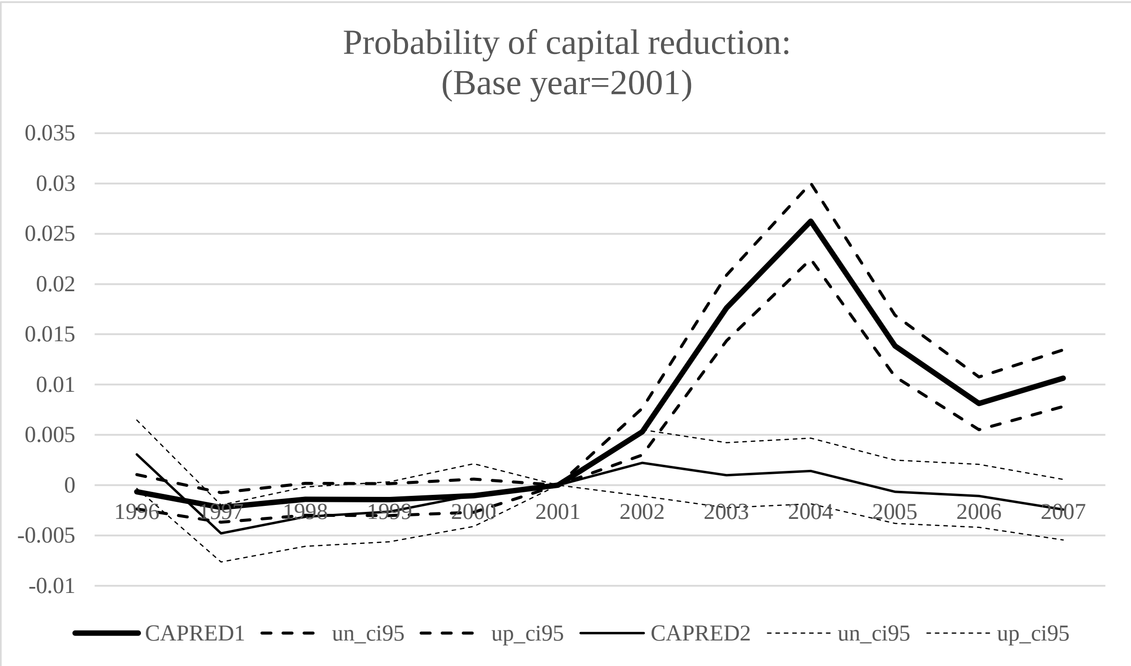


Figure 5: Probability of capital reduction



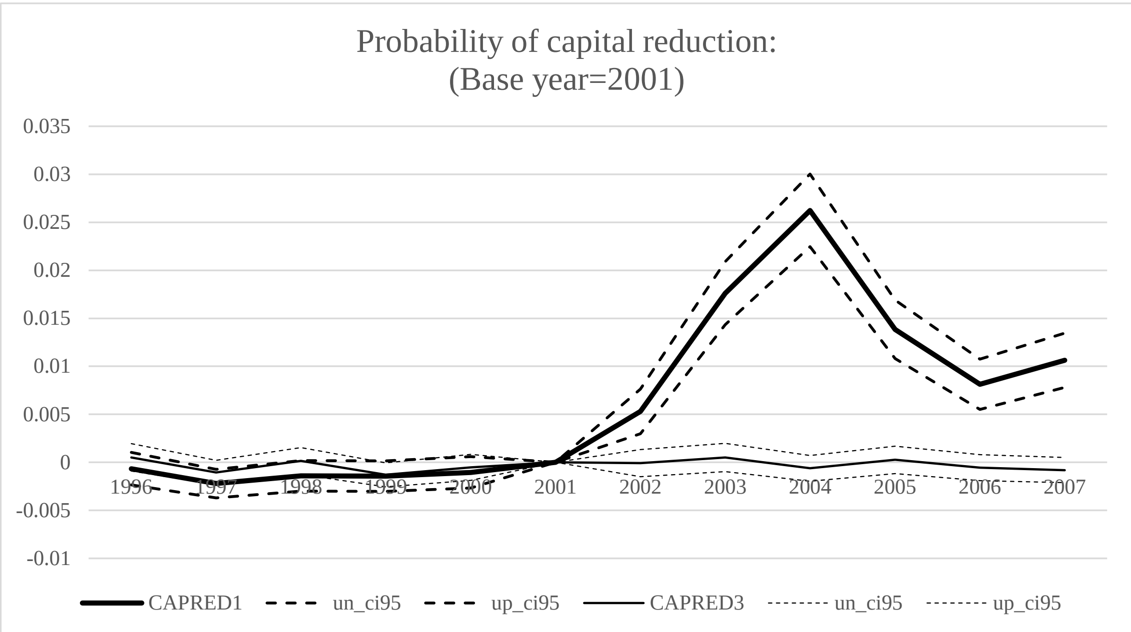
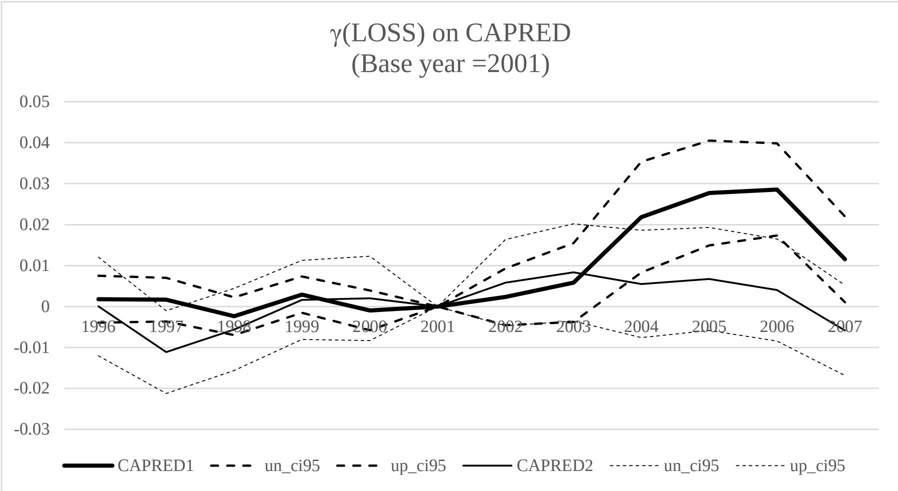
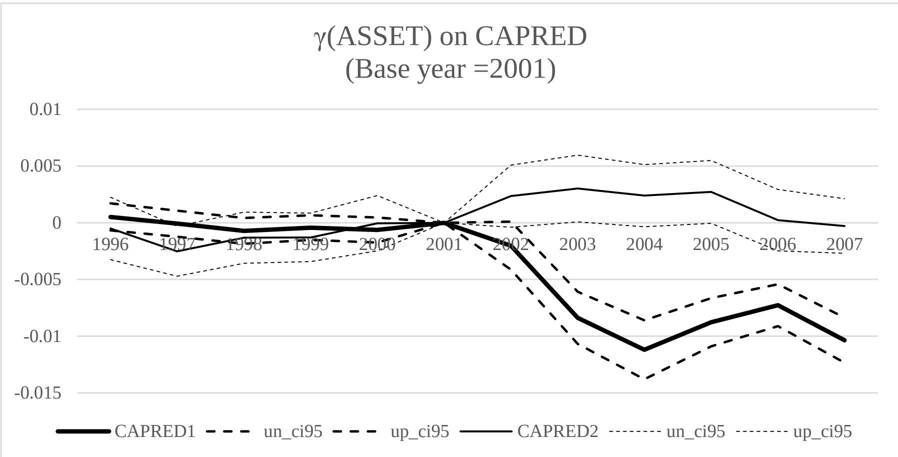


Figure 6 (a): Impact of firm attributes





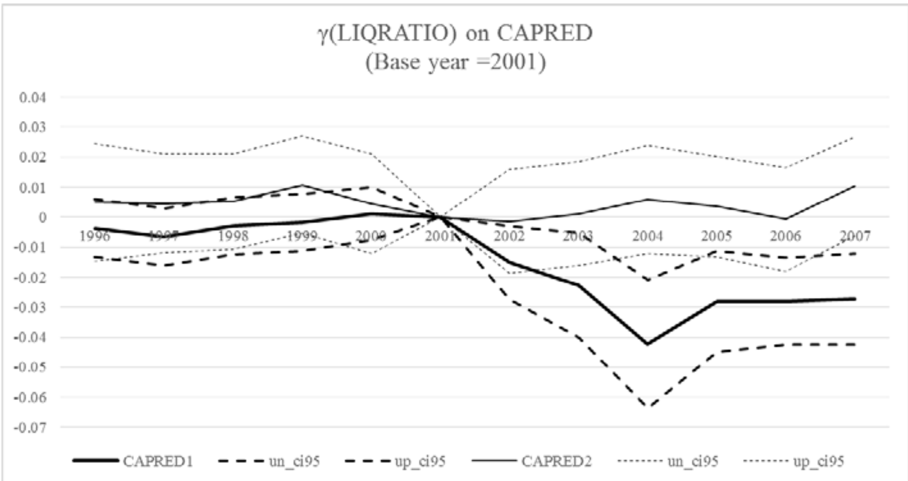


Figure 6 (b): Impact of firm attributes

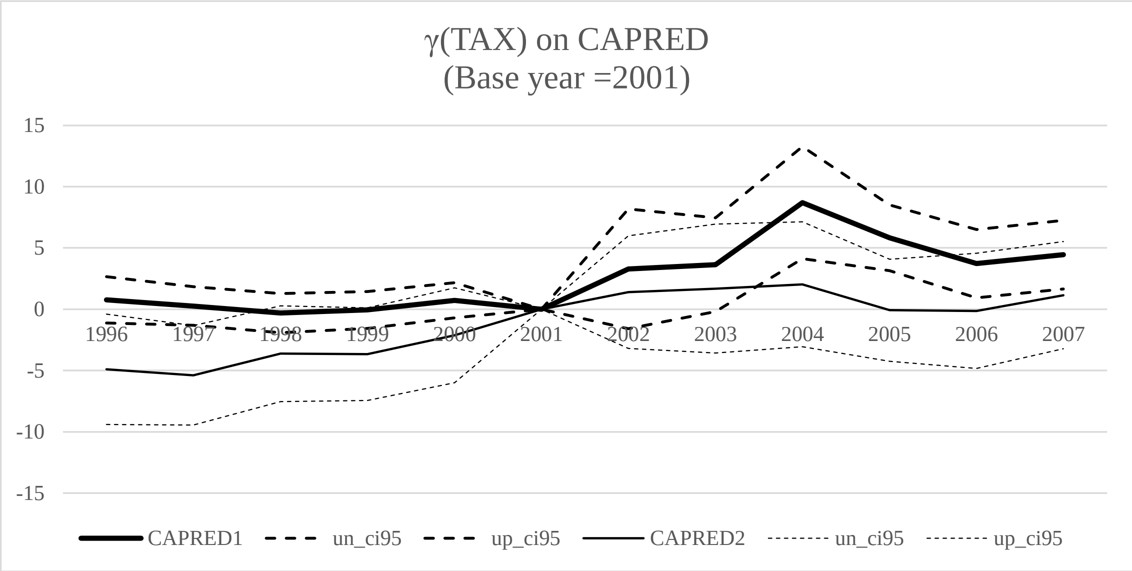
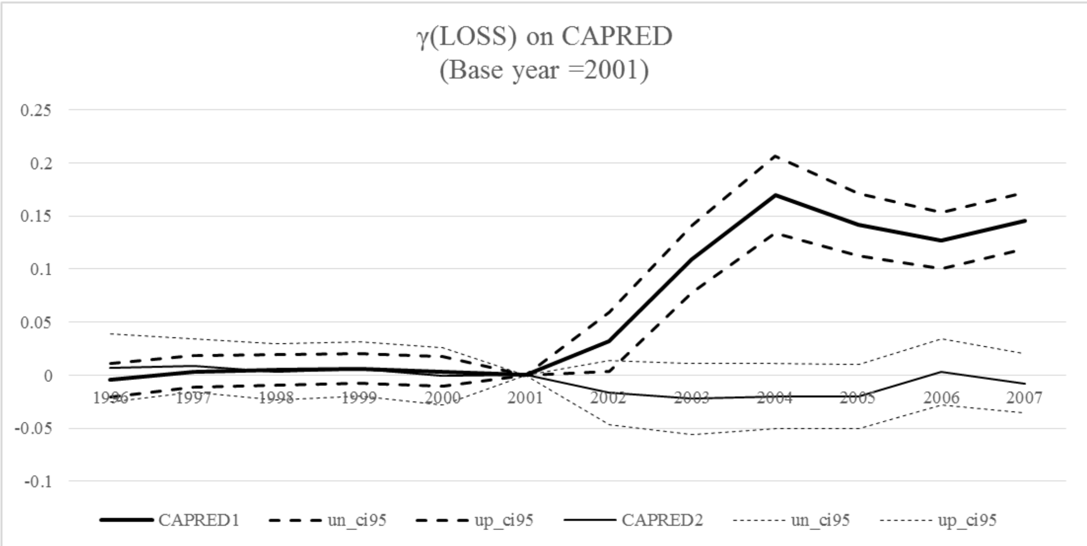


Figure 7: Impact of “loss” and “gain”



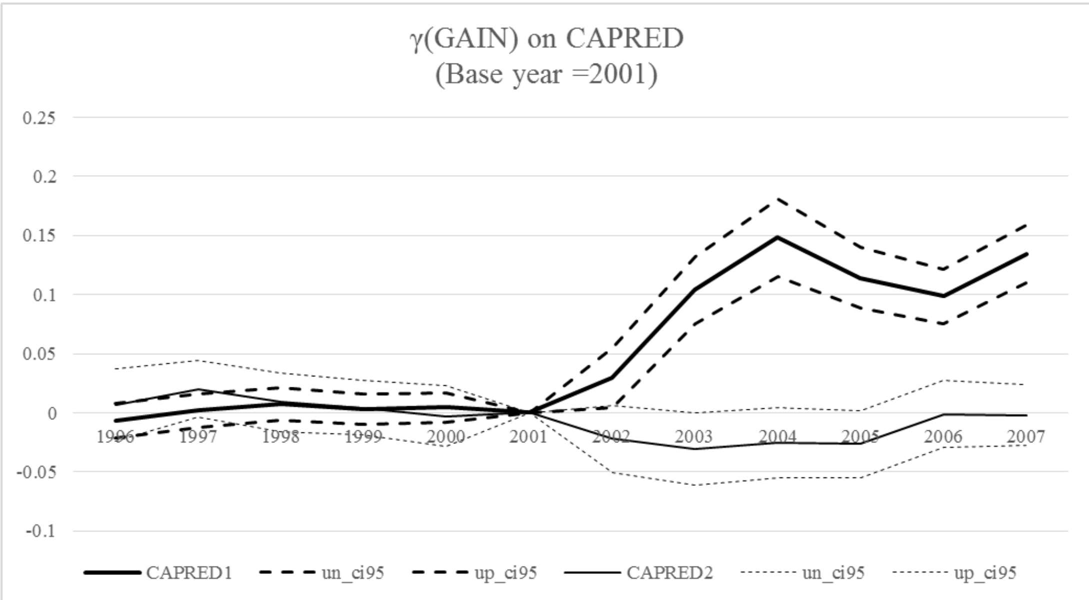


Table 1: The pro-forma taxation system

<table>
<tr><td rowspan="10">Corporate tax in prefecture level</td><td colspan="4">In the case of capital is greater than 100 million JPY</td></tr>
<tr><td>Income tax</td><td></td><td>Income</td><td>×7.2%</td></tr>
<tr><td rowspan="2">Pro-forma standard taxation</td><td>(on value-added)</td><td>Value-added: Factor payment
+ profit</td><td>×0.48%</td></tr>
<tr><td>(on capital)</td><td>Capital
+ auxiliary items (capital reserve)</td><td>×0.2%</td></tr>
<tr><td colspan="4">In the case of capital is 100 million JPY or smaller than 100 million JPY</td></tr>
<tr><td colspan="4">(not in the case that firms are in electricity, gas, or insurance industry)</td></tr>
<tr><td>Income tax</td><td></td><td>Income</td><td>×9.6%</td></tr>
<tr><td colspan="4">(in the case that firms are in electricity, gas, or insurance industry)</td></tr>
<tr><td>Revenue tax</td><td></td><td>Revenue</td><td>×1.3%</td></tr>
</table>

Table 2: Summary statistic

1996-2007

		Paid-up Capital (t-1) is greater than 100 million JPY		Paid-up Capital (t-1) is equal to or smaller than 100 million JPY
	sample	CAPRED1=1 & No capital reduction	CAPRED2=1 & No capital reduction	CAPRED3=1 & No capital reduction
CAPRED	mean	0.0098	0.0108	0.0030
1, 2, 3	sd	0.0987	0.1031	0.0551
LOSS	mean	0.1921	0.1926	0.1471
	sd	0.3940	0.3944	0.3542
ROA	mean	0.0126	0.0125	0.0145
	sd	0.0499	0.0501	0.0434
ASSET	mean	9.2882	9.3002	7.7967
	sd	1.3990	1.3992	0.9521
LIQRATIO	mean	0.5679	0.5680	0.5823
	sd	0.2058	0.2056	0.2008
TAX	mean	0.0005	0.0005	0.0007
	sd	0.0016	0.0016	0.0018
	obs	102,472	102,567	161,153

Table 3: Probit estimation

Base=mining industry

	Dependant variable: CAPRED1					
	2002		2003		2004	
	Coef.	Z-stat	Coef.	Z-stat	Coef.	Z-stat
LOSS	0.13	0.98	0.15	1.44	0.24	2.53 **
ASSET	-0.28	-4.65 ***	-0.30	-6.52 ***	-0.22	-5.9 ***
LIQRATIO	-0.93	-3.18 ***	-0.61	-2.83 ***	-0.86	-4.6 ***
TAX	-48.00	-0.99	43.85	1.52	135.20	5.04 ***
manufact	2.69	0.02	2.54	0.03	2.85	0.04
wholesal	2.89	0.02	3.00	0.04	3.11	0.04
construct	3.22	0.03	3.51	0.04		
trans			3.07	0.04		
restaurant	2.64	0.02	3.00	0.04	2.96	0.04
service	2.73	0.02	2.74	0.03	2.89	0.04
_cons	-2.17	-0.02	-1.98	-0.02	-2.59	-0.03
Log likelihood	-240.44		-443.16		-568.68	
Obs	5,237		5,222		5,112	
Untreated	5,192		5,121		4,969	
Treated	45		101		143	

***significant at 1%, **significant at 5%, *significant at 10%

	Dependant variable: CAPRED1			
	2005		2006	
	Coef.	Z-stat	Coef.	Z-stat
LOSS	0.36	3.15 ***	0.60	4.21 ***
ASSET	-0.21	-4.41 ***	-0.25	-3.79 ***
LIQRATIO	-0.51	-2.17 **	-0.21	-0.65
TAX	64.66	2.29 **	-25.86	-0.57
manufact	2.50	0.02	2.14	0.01
wholesal	2.85	0.03	2.63	0.02
construct			3.02	0.02
trans	3.17	0.03		
restaurant	2.50	0.02	2.82	0.02
service	2.63	0.02	1.70	0.01
_cons	-2.79	-0.02	-2.54	-0.02
Log likelihood	-342.83		-209.41	
Obs	5,095		4,945	
Untreated	5,023		4,903	
Treated	72		42	

***significant at 1%, **significant at 5%, *significant at 10%

Table 4: Balancing property

2002-2006

	Unmatched sample					Matched sample			
	Mean			T test		Mean			T test
	Controls	Treated	Diffence	T-stat		Controls	Treated	Diffence	T-stat
LOSS	0.1644	0.3325	0.1681	8.99	***	0.3424	0.3325	-0.0099	-0.30
ASSET	9.2869	8.3961	-0.8908	-13.76	***	8.3802	8.3961	0.0160	0.21
LIQRATIO	0.5493	0.4919	-0.0573	-5.64	***	0.4875	0.4919	0.0044	0.27
TAX	0.0004	0.0015	0.0010	15.06	***	0.0013	0.0015	0.0002	0.97
manufact	0.5727	0.3821	-0.1906	-7.67	***	0.3747	0.3821	0.0074	0.22
wholesal	0.3075	0.4169	0.1094	4.71	***	0.4293	0.4169	-0.0124	-0.36
construct	0.0064	0.0174	0.0110	2.71	***	0.0149	0.0174	0.0025	0.28
trans	0.0032	0.0099	0.0067	2.32	**	0.0074	0.0099	0.0025	0.38
restaurant	0.0145	0.0496	0.0351	5.76	***	0.0397	0.0496	0.0099	0.68
service	0.0940	0.1241	0.0301	2.05	**	0.1340	0.1241	-0.0099	-0.42
obs	25,208	403				403	403		

***significant at 1%, **significant at 5%, *significant at 10%

Table 5: DID estimation

Outcome: Size	Controls	Treated	Difference	T-stat	
ASSET(t) - (t-1)	0.0184	-0.0524	-0.0709	-4.21	***
ASSET(t+1) - (t-1)	0.0185	-0.0740	-0.0926	-4.63	***
ASSET(t+2) - (t-1)	0.0323	-0.1132	-0.1455	-5.61	***
EMP(t) - (t-1)	0.0152	-0.0570	-0.0722	-3.98	***
EMP(t+1) - (t-1)	0.0167	-0.0568	-0.0735	-3.73	***
EMP(t+2) - (t-1)	0.0560	-0.0547	-0.1108	-4.90	***
SALES(t) - (t-1)	0.0366	-0.0095	-0.0461	-3.16	***
SALES(t+1) - (t-1)	0.0491	0.0019	-0.0473	-2.56	**
SALES(t+2) - (t-1)	0.0588	0.0140	-0.0448	-1.95	*
TANGIBLE(t) - (t-1)	-0.0081	-0.0956	-0.0874	-3.30	***
TANGIBLE(t+1) - (t-1)	-0.0022	-0.1761	-0.1740	-4.58	***
TANGIBLE(t+2) - (t-1)	-0.0244	-0.2453	-0.2210	-4.92	***
LIQUID(t) - (t-1)	0.0415	-0.0071	-0.0487	-2.23	**
LIQUID(t+1) - (t-1)	0.0336	-0.0038	-0.0375	-1.53	
LIQUID(t+2) - (t-1)	0.0706	-0.0077	-0.0783	-2.51	**

***significant at 1%, **significant at 5%, *significant at 10%

Outcome: Borrowing	Controls	Treated	Difference	T-stat	
DEBT(t) - (t-1)	-0.0072	-0.0739	-0.0667	-3.30	***
DEBT(t+1) - (t-1)	-0.0106	-0.1099	-0.0994	-4.16	***
DEBT(t+2) - (t-1)	-0.0115	-0.1618	-0.1502	-4.90	***
DEBTRATIO(t) - (t-1)	-0.0199	-0.0148	0.0051	0.60	
DEBTRATIO(t+1) - (t-1)	-0.0186	-0.0245	-0.0059	-0.61	
DEBTRATIO(t+2) - (t-1)	-0.0250	-0.0335	-0.0085	-0.74	

***significant at 1%, **significant at 5%, *significant at 10%

Outcome: Asset portfolio	Controls	Treated	Difference	T-stat	
TANRATIO(t) - (t-1)	-0.0027	-0.0150	-0.0123	-2.38	**
TANRATIO(t+1) - (t-1)	-0.0014	-0.0279	-0.0265	-3.83	***
TANRATIO(t+2) - (t-1)	-0.0096	-0.0391	-0.0295	-3.59	***
LIQRATIO(t) - (t-1)	0.0045	0.0153	0.0108	1.93	*
LIQRATIO(t+1) - (t-1)	0.0057	0.0285	0.0228	3.15	***
LIQRATIO(t+2) - (t-1)	0.0130	0.0398	0.0268	3.19	***

***significant at 1%, **significant at 5%, *significant at 10%

Outcome: Innovative activity	Controls	Treated	Difference	T-stat
RD(t) - (t-1)	0.0258	-0.0050	-0.0308	-0.59
RD(t+1) - (t-1)	0.0847	0.0023	-0.0824	-1.23
RD(t+2) - (t-1)	0.0315	-0.0268	-0.0583	-0.95
RDRATIO(t) - (t-1)	0.0001	0.0003	0.0002	0.76
RDRATIO(t+1) - (t-1)	0.0001	0.0004	0.0003	0.70
RDRATIO(t+2) - (t-1)	-0.0003	0.0003	0.0006	1.32

***significant at 1%, **significant at 5%, *significant at 10%

Outcome: Performance	Controls	Treated	Difference	T-stat	
TFP(t) - (t-1)	0.0051	0.0206	0.0155	1.65	*
TFP(t+1) - (t-1)	0.0084	0.0201	0.0116	1.19	
TFP(t+2) - (t-1)	-0.0009	0.0264	0.0273	2.54	**
ROA(t) - (t-1)	0.0149	0.0180	0.0030	0.50	
ROA(t+1) - (t-1)	0.0156	0.0152	-0.0004	-0.07	
ROA(t+2) - (t-1)	0.0131	0.0158	0.0028	0.46	
VA(t) - (t-1)	-0.0035	0.0002	0.0036	0.85	
VA(t+1) - (t-1)	-0.0058	-0.0044	0.0014	0.28	
VA(t+2) - (t-1)	-0.0097	-0.0068	0.0029	0.55	
SURVIVE(t+2) - (t-1)	-0.0447	-0.0993	-0.0546	-3.01	***

***significant at 1%, **significant at 5%, *significant at 10%