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Tax Reforms for Growing Firms?
An Empirical Analysis using Corporate Tax Filing Data in Japan*

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Abstract

Using tax filing data of Japanese business enterprises from 2014 to 2020, we investigate whether the 2015–2018 tax base reforms in Japan benefited growing firms or not. We estimate the sensitivity of backward-looking effective tax rates (ETRs) and their components with respect to firms' sales growth, R&D intensity, loss carryforwards, and other characteristics. We find that ETRs initially decreased for growing and R&D intensive firms, but then turned to increase for them while ETRs increased after the reforms for loss-making firms. The reforms did not benefit growing firms in the long run due to ongoing reforms and firms' responses to them.

Keywords: Corporate tax filing data; Effective tax rate; Firm growth
JEL classification: H32, H25, L25

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1 Introduction

Macroeconomic growth is the aggregate consequence of individual firms' growth. Given firm growth is not uniform but heterogeneous, the literature has been paying an attention to the mechanisms specifically encouraging and discouraging firms to grow. The corporate tax system is one potential mechanism affecting firm growth as corporate taxes are levied only on profits which are possibly earned by growing firms. This is the basic rationale that reducing the corporate tax burden could benefit growing firms and the macroeconomy.

Here, as an important institutional detail, the reduction in the corporate tax burden is conducted not only by lowering the statutory corporate tax rates but also by narrowing the tax bases. Since all the firms face the same tax rate (except for small and medium-sized enterprises, SMEs, which face lower tax rates than large firms in many countries), lowering the statutory tax rates benefit all firms with positive income, regardless of their growth rate. In contrast to this simple mechanics, the implications of narrowing the tax bases, which are exemplified by tax incentives for capital investment, R&D tax credits, and deduction of loss carryforwards, for growing firms are not necessarily straightforward. This reflects the fact that both the growing and mature (or stagnant) firms might benefit from narrowed tax base. For example, growing firms are likely to conduct efficient investments and use tax incentives, while mature firms are likely to conduct overinvestments and use tax incentives. These illustrations imply that it is an empirical question whether and how changing (i.e., narrowing or expanding) tax base affects the association between the corporate tax burden and firm growth. Such an association is exactly what we examine in this paper.

Since reduction in the corporate tax burden will lead to a loss of revenue and thus restrict government activities, recent corporate tax reforms in many developed countries, in fact, consists of lowering corporate tax rates and expanding the tax bases to avoid a loss of revenue (Devereux et al, 2002). Thus, it is not clear whether such corporate tax reforms benefit growing firms. In this paper, focusing on the Japanese corporate tax reforms implemented over the period from 2015 to 2018, which aimed at encouraging firm growth by lowering tax rates and expanding tax bases, we empirically examine how this specific tax reform affects the average corporate tax burden and whether tax base reforms as a part of this reform benefited growing firms or not.

To measure the tax burden on individual firms with positive pre-tax profit, many preceding studies (e.g., Gupta and Newberry 1997; Richardson and Lanis 2007; Kraft 2014) use the effective tax rate (ETR), which is defined as the ratio of a firm's tax payments divided by its accounting profit. ETRs are influenced not only by statutory corporate tax rates (adjusted for tax credits) but also by the tax base such as the taxable income-to-pre-tax profit ratio. Since the ETR is informative to capture the overall tax burden, some preceding studies (e.g., Powers et al. 2016; Tang et al. 2017; Fernandes-Rodriguez et al. 2021) use the ETR and examine the relationship between the ETR and the firm's growth rate by regressing the former on the latter. However, to evaluate the effects of a tax reform

package on ETRs, it is necessary to comprehensively take into account how the multiple dimensions of the package affect each component of ETRs. Suppose that corporate tax rates are lowered and tax incentives (such as tax credits and accelerated depreciation) for capital investment are reduced in the reform package, firms with strong motives for investment might be less likely to use tax incentives and hence face higher ETRs than before. Such a tax reform package results in a higher ratio of taxable income to pre-tax profits and a lower ratio of tax credit to taxable income while the statutory tax rates are reduced. Therefore, while we examine the relationship between the ETR and the firm's growth rate following preceding studies, we further examine the relationship between each component of ETR and the firm growth rate by regressing the former on the latter. To our knowledge, most prior studies examining the effects of specific tax reforms on ETRs do not explore the ETR components through which firm characteristics affect overall ETRs.[1] The present paper seeks to address this gap in the literature by providing new insights into how specific components of ETRs change depending on firm characteristics.

The Japanese economy offers an excellent field for examining how a tax reform package affects the average corporate tax burden and whether tax base reforms benefited growing firms or not. Between 2015 and 2018, the Japanese government implemented a set of tax reforms that specifically aimed at fostering high growth firms. These reforms were composed of lowering statutory corporate tax rates and several tax base reforms. To avoid a reduction in corporate tax revenue due to lower statutory corporate tax rates, most tax base reforms broadened tax bases by, for example, decreasing the rate for loss deductions, expanding the pro forma standard tax, and eliminating certain investment incentives. However, some tax reforms provided a part of firms with narrower tax bases than before. For example, R&D tax reform provided a narrower tax base to SMEs and a part of large firms with a high R&D intensity. Also, the tax reform of investment incentives provided a narrower tax base to SMEs.

In this paper, we conduct a detailed empirical analysis focusing on these specific changes to Japan's tax system during 2015 and 2018. We use comprehensive corporate tax filing data that give us information on various components of ETRs, such as corporate income tax rates and bases (taxable income and total amount of tax credits), as well as matched financial data that allow us to estimate the tax base for the pro forma standard tax (such as a firm's value added and capital). Further, to assess whether and how the 2015-2018 tax reforms benefited growing firms, we analyze the link between firm characteristics such as sales growth using overall ETRs and their individual components.

A unique feature of the present study is the data we use for our analysis. First, most prior studies have relied on data for listed firms and often focus patterns specific to multinational firms (e.g.,

[1] Examples include analyses of the U.S. Tax Reform Act of 1986 (Gupta and Newberry 1997), Australia's Ralph Review Tax Reform of 1997 (Richardson and Lanis 2007), Germany's Corporate Tax Reform of 2008 (Kraft 2014), and the U.S. Tax Cuts and Jobs Act of 2017 (Henry and Sansing 2020).

Dyreng et al. 2017; Chen et al. 2020). In contrast, we have access to corporate tax filing data that allows us to examine both listed and unlisted firms. Given the limited number of empirical studies in this field covering a wide range of firms (notable exceptions are Buyl and Roggeman 2019 and Dobridge et al. 2023), our use of this dataset comprising a range of firms represents a significant contribution to the field. Second, by combining tax filing data with financial statement information for each firm, we are able to empirically examine how a specific tax reform impacts ETRs. This approach allows us to explicitly analyze the individual relationships between the ETR components and firm characteristics, providing a more detailed and comprehensive understanding of the effects of tax reforms.

We start by estimating the sensitivity of ETRs to various firm characteristics representing firm growth and performance. Specifically, we estimate the statistical associations between firms' ETRs and their sales growth, R&D intensity, and loss carryforward while controlling for firms' total assets, age, and other relevant characteristics. The analysis is conducted using cross-sectional data for each year from 2015 to 2020. To account for differences in the tax system for large firms and SMEs, we estimate this sensitivity separately for the two groups of firms.

Next, after examining how these sensitivities evolve over time, we repeat the analysis using the individual components of ETRs as dependent variables. Specifically, we focus on three components: (i) the tax rate, calculated as the ratio of corporate income tax net of tax credits to taxable income (i.e., the tax base); (ii) the ratio of taxable income to accounting pre-tax profit; and (iii) the ratio of pro forma standard taxes (i.e., the taxes levied on capital and value-added) to accounting pre-tax profit.

Our empirical results can be summarized as follows. First, we find that the annual average ETR of all firms increased a little after the tax reform for both large firms and SMEs. This indicates that the effects of the broadening of the tax base slightly exceeded those of the reduction in tax rates.

Second, we find that the relationships between ETRs and firms' sales growth and R&D intensity initially evolved in favor of growing and R&D intensive firms. For instance, we find that, over the course of the tax reforms, the link between ETRs and sales growth became negative for both large firms and SMEs.

Third, based on the estimated sensitivity of ETRs components with respect to sales growth, we find that the negative relationship between ETRs and sales growth reflects the expansion of the pro forma standard tax for large firms and the special tax treatment of capital investments for SMEs. For large firms, the negative link between ETRs and sales growth stems from the ratio of pro forma standard tax to pre-tax profit. This ratio becomes smaller for firms with higher sales growth because the tax base for pro forma standard tax (e.g., capital) is only weakly linked to firms' sales growth in the short run, while pre-tax profits grow with their sales. In addition, the increase in the pro forma standard tax rate under the reforms further reinforces this negative association. For SMEs, the negative

link between ETRs and sales growth stems from the tax base. Growing firms, which often make larger capital investments, enjoy a narrower tax base and thus face lower ETRs due to the special tax treatment of capital investments. Reflecting a similar mechanism, both for large firms and SMEs, a higher R&D intensity is associated with lower ETRs due to R&D tax credits. Furthermore, the reduction in the loss deduction rate and the increase in the pro forma standard tax rate on capital for large firms also weakens the negative link between ETRs and the loss carryforward, since shrinking (and thus possibly loss-making) large firms encounter a broader tax base and thus higher ETRs.

Fourth, on the one hand, the narrower loss deduction for large firms continuously made loss-making firms pay a larger tax burden, which is consistent with the aim of the reforms. On the other hand, the negative links between ETRs and sales growth as well as R&D intensity both for large firms and SMEs consistent with the aim of the tax reforms were in fact observed only temporarily. The negative link between ETRs and sales growth is weakened by the abolition of tax incentives for investment for both large firms and SMEs and the strong sensitivity of the tax base for the pro forma standard tax to the long-run sales growth for large firms. Meanwhile, the negative link between ETRs and R&D intensity is weakened, in the case of large firms, by restrictions on the use of R&D tax credits and the rise in the pro forma standard tax rate on capital that R&D-intensive firms are likely to use.

It is worth noting that, while not directly related to how the tax base reforms benefited growing firms, the estimated links between ETRs and firm size (i.e., total assets) and firm age also suggest that larger and older firms may be finding ways to avoid the pro forma standard tax in response to those reforms. Specifically, as firms are larger and older (i.e., more established), they tend to limit increases in their pro forma standard tax ratio, which is a component of ETRs. Taken together, the second to fourth results indicate that the 2015-2018 tax base reforms in Japan did not provide long-term benefits to growing firms. This suggests that the annual average ETR of growing firms were initially lower than that of all firms, but increased to the same level as that of all firms in the long run.

While there have been numerous ad-hoc discussions about the actual impact of these pro-growth tax reforms, our study is the first to provide a systematic, direct evaluation of the 2015-2018 tax reforms in Japan. Our empirical findings highlight the importance of implementing a cohesive set of reforms that align with policy objectives and take firms' responses to institutional changes into account. We conclude that the 2015-2018 tax reforms were not thoughtfully designed to achieve the intended policy goals; rather, they appear to have been a carelessly implemented patchwork of inconsistent measures.

The remainder of this study is organized as follows. Section 2 provides an overview of the 2015-2018 tax reforms aimed at promoting firm growth. Section 3 explains the data and the empirical approach that we use to examine the link between ETRs and various firm characteristics and how these links evolved over the course of the tax reforms. Section 4 then presents the estimation results, while Section 5 concludes.

2 Overview of the 2015–2018 pro-growth corporate tax reforms in Japan

Between FY 2015 and 2018, the Japanese government implemented a series of pro-growth corporate tax reforms aimed at helping the economy overcome deflation and stimulate recovery. These reforms aimed to restructure the corporate tax system in order to lower the tax burden of profitable firms and encourage them to invest aggressively to boost their profitability and growth. To achieve this, the Japanese government followed in the footsteps of its U.S. and European counterparts and simultaneously reduced the tax rate and broadened the tax base. This section provides an overview of the tax rate reduction and broadening of the tax base undertaken as part of these reforms.

2.1 Tax rate reduction

Table 1 shows the tax rates for corporate income before, during, and after the tax reforms. In Japan's corporate tax system, large firms are defined as firms with stated capital of over 100 million yen. Prior to the reforms, these firms were subject to a national corporate tax rate of 25.5% (in FY 2014). As a result of the tax reforms, this was gradually reduced to 23.2% in FY 2018. In addition to the national corporate tax, large firms in Japan are also subject to two types of local corporate income taxes. The first is the inhabitant tax on corporate tax. Since the inhabitant tax rate on income is calculated as 0.173 times the corporate tax rate, it declined through the tax reform. The second is the business tax. The tax rate on income was reduced from 7.2% (in FY 2014) to 3.6% (in FY2016), which was a much larger reduction than the cuts to the corporate tax rate and the inhabitant tax rate. It is worth noting that the reduction in the business tax rate on income was accompanied by an increase in the business tax rate on value added and capital, as we will show in the next subsection.

Meanwhile, SMEs are defined as firms with stated capital of 100 million yen or less. While SMEs are subject to corporate tax and the two types of local corporate tax on income, the tax rates they are subject to differ from those for large firms with respect to most tax items. The corporate tax rate on income of over 8 million yen is the same as that for large firms, while the corporate tax rate on income of 8 million yen or less is a reduced tax rate, which was fixed at 15% before and during the tax reforms (between FY 2014 and FY 2018). As the inhabitant tax rate is proportional to the corporate tax rate, the tax rate for SMEs with higher income declined, while the tax rate for SMEs with lower income remained unchanged during the tax reforms. While the business tax rate on income was 9.59% in principle, (i) firms with stated capital of less than 10 million yen, and (ii) firms with stated capital of 10 million yen or more but that had offices in fewer than three prefectures were subject to the reduced tax rate. However, the business tax rate including the reduced tax rate remained unchanged during the tax reform.

Table 1. Tax rate for corporate income

<table>
<tr><th></th><th>Size of firm</th><th>Type of tax</th><th>FY 2014</th><th>FY 2015</th><th>FY 2016-2017</th><th>Since FY 2018</th></tr>
<tr><td rowspan="3">Large firms</td><td rowspan="3">Stated capital of over 100 million yen</td><td>Corporate tax (national tax)</td><td>25.5%</td><td>23.9%</td><td>23.4%</td><td>23.2%</td></tr>
<tr><td>Corporate inhabitant tax on income (local tax)</td><td colspan="4">0.173×corporate tax rate</td></tr>
<tr><td>Business tax on income (local tax)</td><td>7.2%</td><td>6%</td><td colspan="2">3.6%</td></tr>
<tr><td rowspan="4">SMEs</td><td rowspan="4">Stated capital of 100 million yen or less</td><td>Corporate tax on income of over 8 million yen (national tax)</td><td>25.5%</td><td>23.9%</td><td>23.4%</td><td>23.2%</td></tr>
<tr><td>Corporate tax on income of 8 million yen or less (national tax)</td><td colspan="4">15% (Reduced tax rate)</td></tr>
<tr><td>Corporate inhabitant tax on income (local tax)</td><td colspan="4">0.173×corporate tax rate</td></tr>
<tr><td>Business tax on income (local tax)</td><td colspan="4">9.59%</td></tr>
</table>

Notes:

1. Corporate inhabitant tax rates and business tax rates shown in the table are standard tax rates.
2. The following reduced business tax rates were applied to (i) firms with stated capital of less than 10 million yen and (ii) firms with stated capital of 10 million yen or more but that had offices in fewer than three prefectures (These criteria ware effective until fiscal years beginning before March 31, 2022).
   4.87% for income of 4 million yen or less, 7.3% for income of over 4 million yen but 8 million yen or less, and 9.59% for income over 8 million yen
3. Corporate inhabitant tax rates shown in the table are the values including local corporate tax rates.
4. Business tax rates on income shown in the table are the values including local corporate special tax rates and special corporate business rates.

2.2 Broadening of the tax base

Table 2(a) shows the limits for loss carryforward deductions. While in FY 2014 the limit for

loss carryforward deductions for large firms was 80% of income before the deduction of losses, the deduction rate for loss carryforward was gradually reduced to 50% (in FY 2018). The decline in the deduction rate for loss carryforward gradually broadened the tax base for unprofitable enterprises. On the other hand, the limit for loss carryforward deductions for SMEs remained unchanged at 100% of income before the deduction of loss carryforward. Keeping the deduction rate at 100% did not broaden the tax base of unprofitable firms.

Next, Table 2(b) shows the tax rate for pro forma standard taxation. Introduced in FY 2004 as a part of the business tax (a local tax), this tax system aims to make loss-making firms be subject to taxes. Under this system, which targets large firms and does not apply to SMEs, taxes are levied on value added and capital, while the tax rate on income is reduced. When first introduced in FY 2004, the business tax rates were set at 0.48% on value added and 0.20% for capital. The rates remained constant until the pro-growth tax reforms, which brought about an increase in FY 2016 to 1.20% for the tax rate on value added and 0.50% for that on capital, while the business tax rate on income was reduced from 7.2% to 3.6%.

Table 2(c) highlights other institutional changes affecting the tax base. First, the tax reforms reduced the exclusion rate for received dividend income. In FY 2014, firms could deduct 100% of dividends received from domestic corporations when their shareholding ratio was 25% or more, and 50% if their ratio was less than 25%. However, in FY 2015, these rates were reduced to 50% when firms' shareholding ratio was between 25% and 1/3 and to 20% when their shareholding ratio was 5% or less. This change broadened the tax base of firms with a lower shareholding ratio. Second, the tax reforms revised the depreciation method. While firms could previously choose between the straight-line method and the declining-balance method for building equipment and structures, FY2016 saw the mandatory implementation of the straight-line method. This adjustment temporarily broadened the tax base in the early stages of the depreciation period. Third, the reforms phased out tax incentives designed to boost investment in productivity-enhancing equipment. These incentives, introduced in FY 2014, had offered immediate depreciation or tax credits of 5% for machinery and equipment and 3% for building equipment and structures. However, they were scaled back in FY 2016 and eliminated in FY 2017, thereby expanding the tax base for investment-intensive firms. All three institutional changes applied to both large firms and SMEs.

Fourth, in contrast to the previous changes, the tax reforms took a different approach to SME investment incentives. Rather than abolishing them, these measures were restructured. Initially introduced in FY 2014, they offered immediate depreciation or a 10% tax credit (7% for SMEs with stated capital between 30 million and 100 million yen) for machinery and equipment investments. In FY 2017, this system was reorganized into a set of tax incentives aimed at strengthening SMEs' management, with more lenient application conditions. This adjustment lowered the tax base for investment-intensive SMEs. Fifth, the tax reforms revised R&D taxation. In FY 2014, firms could

claim tax credits of 8–12% on general R&D expenses (12% for SMEs). In FY 2017, this range was adjusted to 6–14% (12–17% for SMEs), with the deduction rate now tied to changes in R&D expenditure. For large firms, the impact on their tax based depended on their R&D spending trends, since firms with a higher rate of change in R&D spending could use a higher deduction rate than before and vice versa. However, SMEs were guaranteed at least the same deduction rate as before, even with lower R&D growth, effectively broadening their tax base if they engaged in R&D activities. Note that SMEs with eligibility for these two preferential tax systems are defined as firms with a stated capital of 100 million yen or less and that did not meet the conditions regarding funding from large firms and average income during the past three years

Table 2. Tax base

(a) Limit for loss carryforward deductions

	Size of firm	FY 2014	FY 2015	FY 2016	FY 2017	Since FY 2018
Large firms	Stated capital of over 100 million yen	80% of income before deduction of loss carryforward	65%	60%	55%	50%
SMEs	Stated capital of 100 million yen or less	100% of income before the deduction of loss carryforward				

(b) Tax rate for pro forma standard taxation (a part of business tax)

	Size of firm	Type of tax	FY 2014	FY 2015	Since FY 2016
Large firms	Stated capital of over 100 million yen	Business tax on value-added	0.48%	0.72%	1.20%
		Business tax on capital	0.20%	0.30%	0.50%
SMEs	Stated capital of 100 million yen or less	Not applicable	—		

(c) Other

	Before tax reform (FY 2014)	After tax reform

(1) Reduction of exclusion of received dividend income (dividend received from domestic corporations)	Shareholding ratio of 25% or more: 100% of dividend received was excluded from taxable income. Shareholding ratio of less than 25%: 50%	Shareholding ratio of more than 1/3: 100%. Shareholding ratio of 5% and 1/3: 50%. Shareholding ratio of 5% or less: 20%. (This institution got effective since firms' fiscal years beginning on or after April 1st, 2015)
(2) Revision of depreciation	Building equipment and structure: Straight-line method or declining-balance method	Building equipment and structures: Straight-line method (applied to assets acquired on or after April 1st, 2016)
(3) Abolition of tax incentives for promoting investment in productivity-enhancing equipment	Machinery and equipment: Immediate depreciation or 5% tax credit. Building equipment and structures: Immediate depreciation or 3% tax credit. Limit of tax credit: 20% of corporate tax amount.	Reduced in FY 2016 and eliminated in FY 2017.
(4) Restructuring of additional tax incentives for promoting investment by SMEs	Machinery and equipment: Immediate depreciation or 10% tax credit (7% for SMEs with stated capital of more than 30 million yen and 100 million yen or less). Limit of tax credit: 20% of corporate tax amount.	In FY 2017, this system was reorganized into a set of tax incentives aimed at strengthening SMEs' management, with more lenient application conditions.
(5) Revision of R&D taxation	[1] Tax credit of 8–10% of general R&D expenditure (12% for SMEs), 12% of special R&D expenditure (collaborative and commissioned research). [2] Additional measures: Tax credit of 5–30% of an increase in R&D expenditures, Tax credit of a specific deduction rate of excess R&D expenditures. Limit of tax credit deductions was 30% of corporate tax	[1] Tax credit of 6–14% of general R&D expenditure (12–17% for SMEs); deduction rate depends on rate of change in R&D expenditure. [2] Tax credit of 20% or 30% of special R&D expenditures. [3] Additional measure was limited to tax credit of a specific deduction rate of excess R&D expenditures. Limit of tax credit deductions was 25% of corporate tax amount for [1], 5%

	amount for [1] and 10% of corporate tax amount for [2]. Tax credit exceeding the limit for [1] was carried forward a year later.	corporate tax amount for [2], and 10% of corporate tax amount for [3]. One-year carryforward for [2] was abolished. [2] got effective since firms' fiscal years beginning on or after April 1st, 2015. [1] and [3] got effective since firms' fiscal years beginning on or after April 1st, 2017.

Note: SMEs are defined as firms that have a stated capital of 100 million yen or less and do not meet the following conditions: (i) firms that obtained more than 1/2 of their funding from one large firm, (ii) firms that obtained more than 2/3 of their funding from several large firms, and (iii) firms whose average income during the past three years were more than 1.5 billion yen.

3 Data and Estimation Methods

3.1 Data

To investigate how the tax reforms affect the relationship between the ETR and firm characteristics, we match two types of firm-level data: (1) Corporate tax returns for FY 2014-2020,[2,3] provided by the National Tax Agency. This dataset excludes consolidated filing corporations and foreign corporations. (2) Financial statements for FY 2014–2020, provided by Tokyo Shoko Research. Since the tax returns data do not contain financial data (apart from sales figures), we supplement the tax data with information from the TSR dataset.

In our analysis, we focus on ordinary corporations and exclude the following firms from the sample. First, we exclude cooperative associations and similar entities due to their lower corporate tax rates. Second, we exclude regulated industries such as finance and utilities (electricity, gas, water, etc.), following previous studies. Third, we exclude firms which, despite positive income, the corporate tax before special deductions like investment or R&D credits is zero, since the reason for the zero corporate tax is unclear. Fourth, we exclude firms for which the ratio of sales in the TSR data to that in the tax return data is less than 0.9 or greater than 1.1. That is, when there is a discrepancy of more than 10% between the sales data in the tax return and TSR datasets, we assume that, for whatever reason, there is considerable inconsistency between the two datasets for that firms. Fifth, we exclude firms whose pre-tax profit is non-positive, because we cannot calculate their ETR. Sixth, we exclude

[2] We could access only to a part of tax returns i.e., Appendix 1, which includes, for example, the information on the total amount of special deductions, but does not include the information on the breakdown of special deductions e.g., investment-related tax credits and R&D tax credits.

[3] We define fiscal year 2014, for example, as the accounting year ending April 2014 through March 2015.

firms with stated capital of 100 million yen or less that meet one of conditions such as firms that obtain 100% of their funding from one large firm with stated capital of 500 million yen or more because they do not belong to both categories of SMEs and large firms that we mentioned before. Seventh, we exclude firms that had changed their firm size category between the large firms and the SMEs at least once during the period FY 2014-2020.

3.2 Definition of ETR, corporate income tax, and pro forma standard tax

We define the effective tax rate (ETR) for SMEs as (corporate income tax / pre-tax profit), while for large firms we define it as ([corporate income tax + pro forma standard tax] / pre-tax profit). The reason why we use different definitions for the two is because part of the business tax on income for large firms was replaced with the pro forma standard tax (the business tax on value-added and capital) when it was introduced in FY 2004. We define corporate income tax as follows:

Corporate income tax = corporate tax + inhabitant tax + business tax on income.

Corporate tax is the corporate tax before the deduction of double taxation credits. Using the items in corporate tax returns, we can decompose corporate tax as follows:

Corporate tax = corporate tax before special deductions
- special deductions + other items.

Corporate tax before special deductions is calculated by firms using the corporate tax rate and their income. Special deductions are tax credits such as investment tax credits and R&D tax credits. Since our dataset does not include details on firms' payments of inhabitant tax and business tax on income, we estimate them using items in the corporate tax returns. Specifically, to calculate the inhabitant tax, we multiply the corporate tax amount by 0.173 (standard tax rate).[4] We calculate the business tax on income as the business tax rate (standard tax rate) on income multiplied by a firm's income. For firms with stated capital of less than10 million yen, we calculate the business tax on income using the reduced business tax rate,[5] while for firms with stated capital of 10 million yen or more, the reduced business tax rate is not taken into account, because we do not have information on the number of

[4] We exclude the per-capita corporate inhabitant tax from our calculations. This particular tax is based on a firm's capital and the number of employees working in offices located within the taxing municipality.

[5] The business tax on income for firms with stated capital of 10 million yen or less is calculated as follows:
Business tax on income = 0.0487×income
if income≦4 million yen
= 0.0487×4 million yen + 0.073×(income – 4 million yen)
if 4 million yen < income≦8 million yen
= 0.0487×4 million yen + 0.073×4 million yen + 0.0959×(income – 8 million)
if income>8 million yen.

prefectures in which the firm operates.

The pro forma standard tax for large firms is the business tax on value added and capital. As information on firms' business tax on value added and capital is not available, we estimate it using the corporate tax returns and the TSR datasets. We calculate the business tax on value added as the business tax rate on value-added multiplied by the taxable value added. Similarly, we calculate the business tax on capital as the business tax rate on capital multiplied by the taxable capital. We define the taxable value added as follows:

Taxable value added = income before the deduction of losses + other income distribution
- deductions for employment stability.

We use income before the deduction of losses from the tax return data. We define other income distribution as the sum of compensation of employees, net interest payments, and rental fees, information for which we obtain from the TSR dataset. Deductions for employment stability are those to lower the burden of the business tax on value added for labor-intensive firms and calculated as a difference between the compensation of employees and 70% of other income distribution (zero if the compensation of employees is less than 70% of other income distribution). We define the taxable capital as 100% of capital if it is 100 billion yen or less. However, we define the taxable capital as the compressed capital based on the specific formulas if it is more than 100 billion yen.[6] Note that the taxable capital for almost all firms is not the compressed capital since firms with capital of over 100 billion yen make up about 1% of all large firms in our sample. We use the sum of the stated capital and the capital reserve as a proxy for capital.

3.3 Components of the ETR

Per definition, the ETR can be decomposed into the following components:

$$\text{ETR} = \frac{\text{Corporate income tax}}{\text{Pre-tax profit}} + \frac{\text{Business tax on VA}}{\text{Pre-tax profit}} + \frac{\text{Business tax on capital}}{\text{Pre-tax profit}} \quad (1),$$

where the business tax on value added (VA) and capital does not apply to SMEs. In addition, the first

[6] Taxable capital is calculated as follows:
Taxable capital= capital if capital≦100 billion yen
= 100 billion yen + 0.5×(capital – 100 billion yen)
if 100 billion yen < capital≦500 billion yen
= 100 billion yen + 0.5×400 billion yen + 0.25×(capital – 500 billion yen)
if 500 billion yen < capital≦1 trillion yen
= 100 billion yen + 0.5×400 billion yen + 0.25×500 billion yen
if capital > 1 trillion yen.

term on the right-hand side can be decomposed into the following components:

$$\frac{\text{Corporate income tax}}{\text{Pre-tax profit}} = \frac{\text{Corporate income tax}}{\text{Income}} \times \frac{\text{Income}}{\text{Pre-tax profit}} \quad (2),$$

where

$$\frac{\text{Corporate income tax}}{\text{Income}} = \frac{\text{Corporate tax before special deductions}}{\text{Income}} - \frac{\text{Special deductions}}{\text{Income}} + \frac{\text{Other items}}{\text{Income}} + \frac{\text{Inhabitant tax}}{\text{Income}} + \frac{\text{Business tax on income}}{\text{Income}} \quad (3).$$

The first three terms in equation (3) are the components of (Corporate tax [National tax] / Income). The first term represents the corporate tax rate that a firm faces. The second term represents the tax credits that a firm uses. As the fourth term is calculated as 0.173×(Corporate tax / Income), it depends on (Corporate tax before special deductions / Income) and (Special deductions / Income). The fifth term represents the business tax rate on income that a firm faces.

3.4 Estimation method

We investigate how the tax reforms affected the link between ETRs and firms' characteristics by estimating the following equation:

$$ETR_{it} = \boldsymbol{x_{it}\beta_t} + \boldsymbol{z_{it}\gamma_t} + \mu_j + \lambda_t + \varepsilon_{it} \quad (4),$$

where $\boldsymbol{x_{it}}$ represents a range of variables for firm *i* in fiscal year *t* that we construct. Specifically, we construct the following six variables. The first is the growth rate of sales, which we use as a proxy for growth opportunities based on the previous studies such as Fernandes-Rodriguez et al. (2021). The sign of the effect of growth rate of sales on ETRs is not clear a priori. The effect is expected to be negative if firms with higher sales growth are more likely to conduct efficient investments and use tax incentives, while it is expected to be positive if firms with lower sales growth are more likely to conduct overinvestments and use tax incentives. The second variable is the growth rate of tangible fixed assets as a proxy for the investment rate (investment / tangible fixed assets) that is used in Dyreng et al. (2017), which we include in case sales growth does not capture the use of investment-related tax incentives. Firms with higher growth in tangible fixed assets are likely to have lower ETRs. It should

be noted, however, that there is a serious discrepancy between investments that qualify for tax incentives and those recorded in firms' financial statements. Since the growth rate of tangible fixed assets that we use is based on firms' financial statements, it might be a poor proxy for firms' opportunity to use investment-related tax incentives. The third variable we use following Dyreng et al. (2017) is the ratio of the loss carryforward to sales ratio, which we regard as a proxy for firms' opportunity for deducting losses or for their potential for making losses, where loss carryforward is the accumulated loss carried forward at the end of the previous year. Firms with a higher loss ratio are expected to be more likely to deduct losses, reducing their ETR. The fourth variable we use based on the previous studies such as Gupta and Newberry (1997) is the R&D expenditure-to-sales ratio. Firms with a higher R&D ratio are expected to be more likely to use R&D tax credits to reduce their ETR. The fifth variable is the natural logarithm of total assets as a proxy for firm size. The sign of the effect of firm size on ETRs is not clear a priori. The effect is expected to be positive if larger firms are more likely to be monitored by the government and required to pay more tax (Zimmermann, 1983), while it expected to be negative if larger firms are more likely to concentrate on tax saving strategies due to being in a better position to hire tax experts (Siegfried, 1972). Finally, the sixth variable is the natural logarithm of firm age as a proxy for maturity. No specific sign is expected regarding the effect of maturity. We calculate the sales growth rate and the loss ratio using the tax return data, while we calculate the other variables using the TSR financial data.

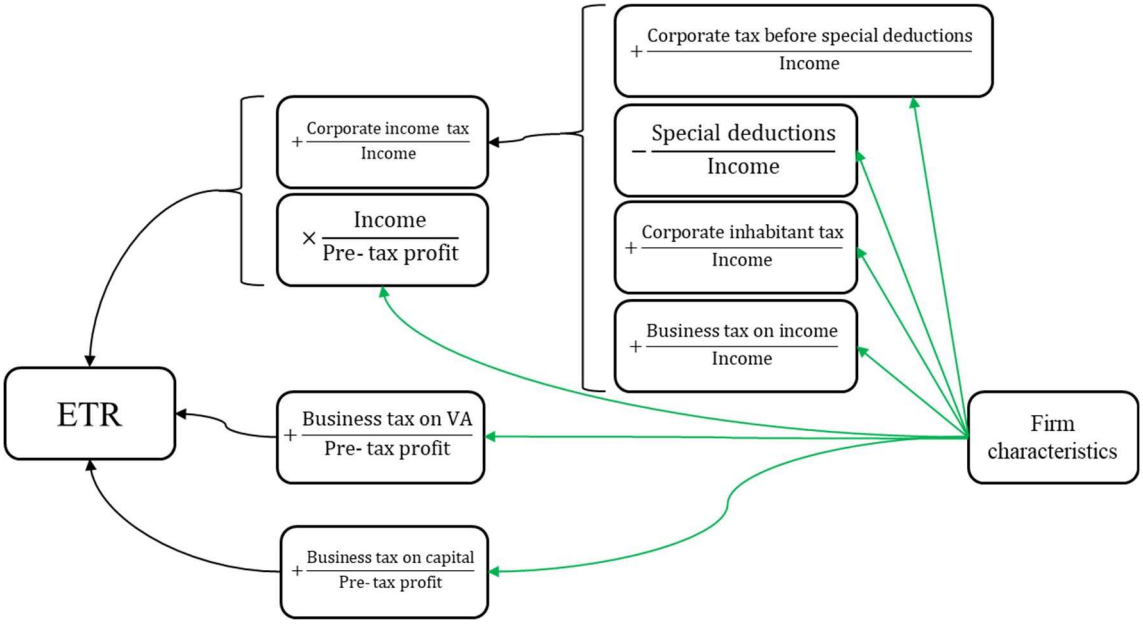
Next, $\boldsymbol{z_{it}}$ represents other firm characteristics. Specifically, these are dividends received, directors' compensation, provisions for bonuses, provisions for severance pay, provisions for doubtful accounts, and entertainment expenses, all expressed as a ratio of total assets. We calculate these variables using the TSR financial data. Since part of the dividends received from the domestic and foreign companies is not added to income as revenue, firms with a higher ratio of dividends received are expected to have a lower ETR. On the other hand, regarding the other characteristics, firms with a higher ratio are expected to have a higher ETR since part of directors' compensation and entertainment expenses as well as the full amount of provisions for bonuses, severance pay, and doubtful accounts are not deducted from income as costs. Finally, μ_j, λ_t, and ε_{it} represent industry and year fixed effects as well as the error term.

The institutional changes implemented as part of the pro-growth tax reforms took effect for fiscal years starting April 1, 2015, or later. In our sample, the data for FY 2015 covers firms whose fiscal year ended between April 2015 and March 2016. Among these firms, only firms whose fiscal years ends in March fully reflect the impact of the tax reforms. As a result, the impact of the tax reforms is fully reflected only in the data from FY 2016 onward. Moreover, since the institutional changes were rolled out gradually from FY 2015 to FY 2018, their impact should appear only gradually in the data. We therefore estimate the coefficients for $\boldsymbol{x_{it}}$ and $\boldsymbol{z_{it}}$ on a year-by-year basis.

As illustrated in Figure 1 shows, individual firm characteristics do not affect the ETR

directly but do so indirectly through the components of the ETR. To investigate through which components each characteristic affects firms' ETR, we also estimate equation (4) by replacing the ETR with each component of the ETR.

Figure 1. The ETR, ETR components, and firm characteristics



Note that we convert part of the variables as follows. First, we replace (Corporate tax before special deductions / Income), (Inhabitant tax / Income), and (Business tax on income / Income) with the maximum corporate tax rate, the maximum inhabitant tax rate, and the maximum business tax rate on income respectively (the minimum reduced tax rates for SMEs) when firms' income is zero or less. Second, we replace (Special deductions / Income) with zero when firms' income is zero or less. Third, we replace the ETR, (Business tax on VA / Pre-tax profit), (Business tax on capital / Pre-tax profit), (Corporate tax before special deductions / Income), (Special deductions / Income), (Inhabitant tax / Income), and (Business tax on income / Income) with one when they take values of more than one. Fourth, for firms whose sales growth rate or tangible fixed assets growth rate falls into the bottom or top 1%, we replace the growth rate(s) respectively with the 1st percentile or 99th percentile of that variable. Fifth, for firms whose (Income / Pre-tax profit), loss carryforward ratio, R&D expenditure ratio, ratio of dividends received, directors' compensation ratio, ratio of provisions for bonuses, ratio of provisions for severance pay, ratio of provisions for doubtful accounts, or entertainment expenses ratio falls into the top 1%, we replace the value with the 99th percentile of that variable.

3.5 Basic statistics

Table 3 presents the basic statistics for our variables for SMEs and large firms over the period FY 2015–2020.

Table 3. Basic statistics

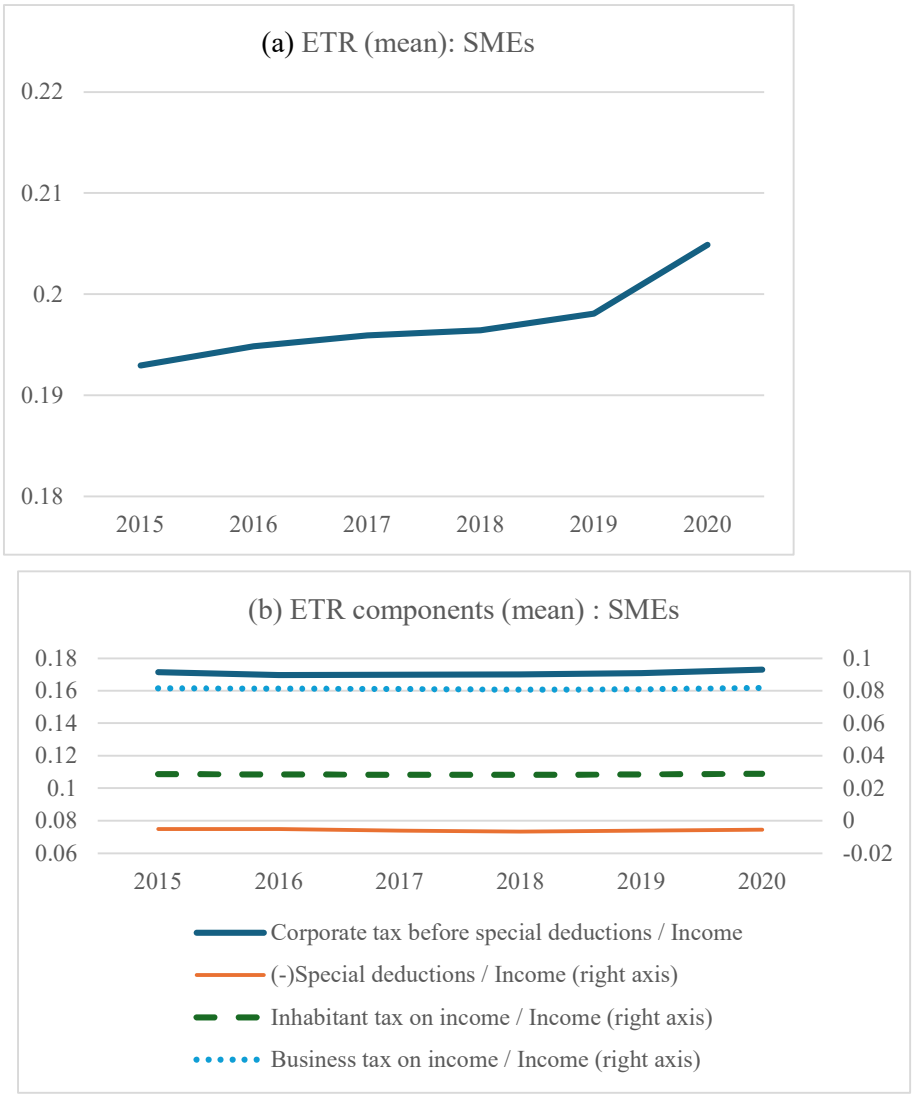
FY 2015–2020

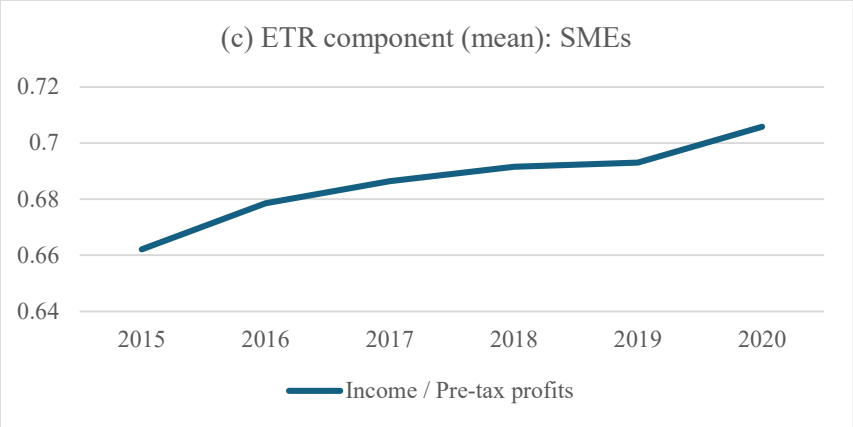
	SMEs		Large firms	
	Mean	Standard deviation	Mean	Standard deviation
Effective tax rate (ETR)	0.197	0.175	0.332	0.174
Corporate tax before special deductions / Income	0.171	0.031	0.235	0.008
Special deductions / Income	0.006	0.014	0.013	0.023
Inhabitant tax on income / Income	0.029	0.006	0.039	0.008
Business tax on income / Income	0.081	0.021	0.042	0.012
Income / Pre-tax profit	0.686	0.590	0.901	0.498
Business tax on VA / Income			0.029	0.072
Business tax on capital / Income			0.035	0.105
Natural logarithm of firm age	3.427	0.599	3.888	0.549
Natural logarithm of total assets	5.133	1.631	9.527	1.535
Growth rate of sales	0.099	0.416	0.103	0.570
Growth rate of tangible fixed assets	0.259	1.485	0.090	0.733
R&D expenditure / Sales	0.0001	0.002	0.004	0.019
Loss carryforward / Sales	0.070	0.290	0.042	0.323
Dividends received / Total assets	0.0002	0.002	0.002	0.005
Directors' compensation / Total assets	0.109	0.162	0.004	0.020
Provisions for bonuses / Total assets	0.0005	0.005	0.002	0.005
Provisions for severance pay / Total assets	0.0001	0.001	0.001	0.002
Provisions for doubtful accounts / Total assets	0.0002	0.001	0.0001	0.001
Entertainment expenses / Total assets	0.014	0.025	0.0004	0.001
	968,223		33,944	

We especially focus on the ETR and its components. Figure 2(a) shows the mean ETR of SMEs. It indicates that while the ETR of SMEs on average gradually rose between FY 2015 and FY 2020, the increase is only 1.2 percentage points. Next, Figures 2(b) and (c) show the means of various ETR components for SMEs by year. As can be seen in Figure 2(b), there is little change in (Corporate tax before special deductions / Income), (Inhabitant tax on corporate tax), (Business tax on income / Income), and (Special deductions / Income) during this period. This implies that the tax rate reduction, abolition of tax incentives for promoting investment in productivity-enhancing equipment, and

revision of R&D taxation had little effect on SMEs. On the other hand, as Figure 2(c) shows, firms' (Income / Pre-tax profit) tended to increase. This is consistent with the broadening of the tax base and the fact that the share of SMEs with positive income increased as SMEs' pre-tax profit increased over the years (Figure 2(d)). Taken together, the figures indicate that the increase in the ETR over the period FY 2015–2020 reflects the expansion of the taxbase.

Figure 2. ETR, ETR components, pre-tax profits: SMEs





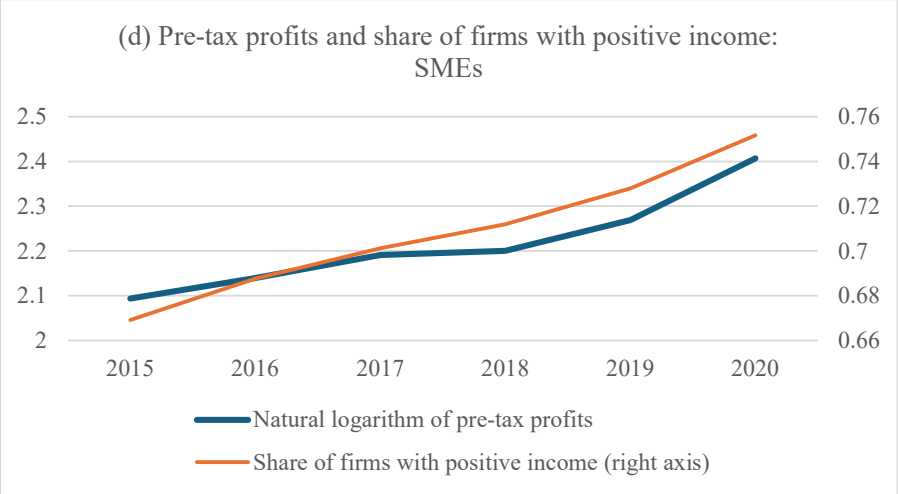
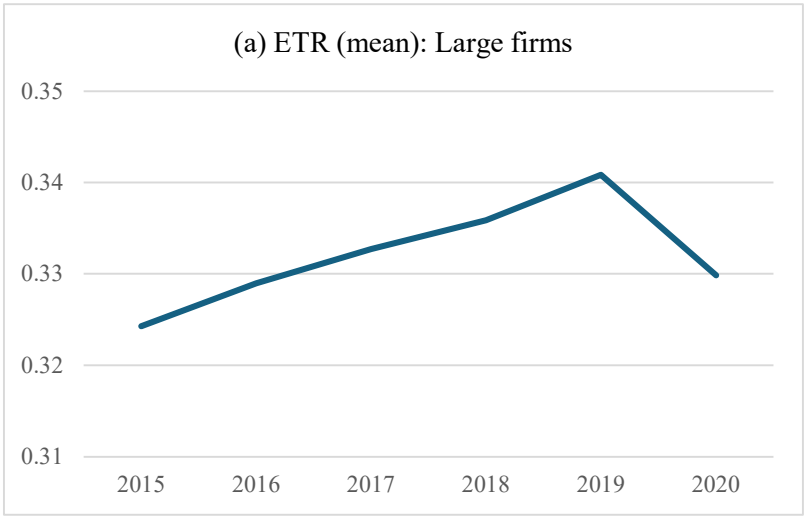
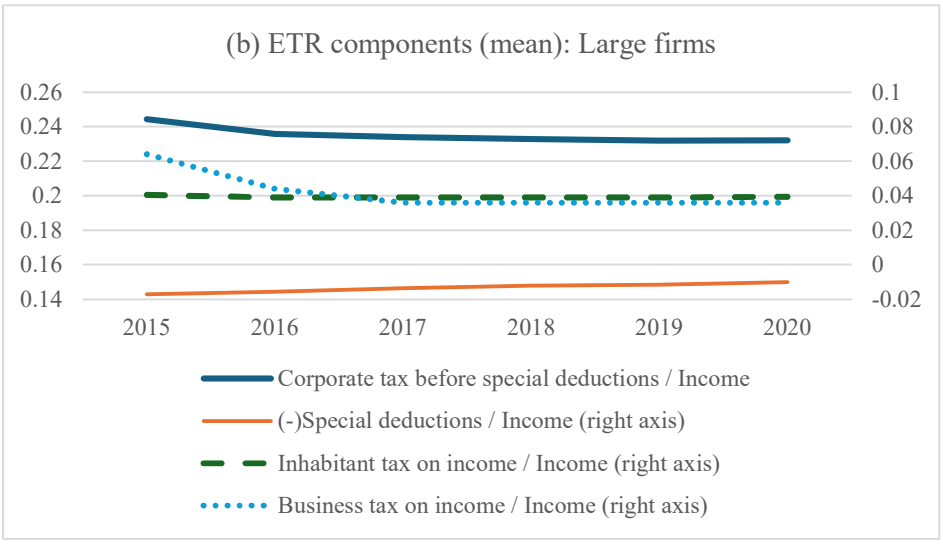


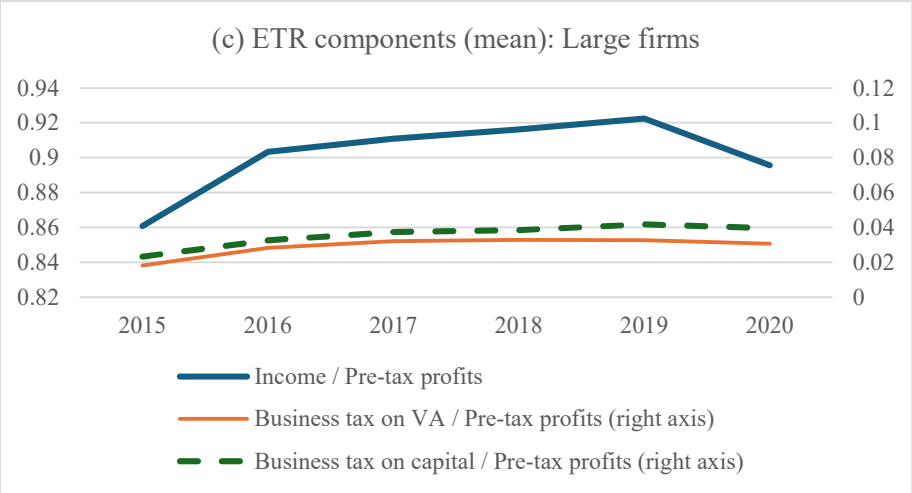
Figure 3(a) presents the mean ETR of large firms. As can be seen, while the ETR of large firms increased between FY2015 and FY 2019 (by 1.7 percentage points), it then decreased again from FY 2019 to FY2020 (by 1.1 percentage points). As a result, the increase between FY 2015 and FY 2020 was a modest 0.6 percentage points. Next, Figures 3(b) and (c) show the means of the ETR components of large firms by year. As indicated in Figure 3(b), (Corporate tax before special deductions / Income) and (Business tax on income / Income) on average gradually decreased between FY2015 and FY2019 and between FY 2015 and FY2017, respectively, while -(Special deductions / Income) gradually increased on average. These trends imply that large firms were affected by the tax rate reduction, the abolition of tax incentives for promoting investment in productivity-enhancing equipment, and the revision of R&D taxation. On the other hand, as Figure 3(c) shows, while (Income / Pre-tax profits) increased between FY 2015 and FY 2019, it then decreased from FY 2019 to FY 2020. The increase between FY 2015 and FY 2019 is consistent with the decline in the deduction rate of losses to broaden the tax base. Meanwhile, the reason for the decrease from FY 2019 to FY 2020 is that the share of large firms with positive income decreased as pre-tax profits decreased from FY 2019 onward (Figure 3(d)). As Figure 3(c) also shows, (Business tax on VA / Pre-tax profits) and (Business

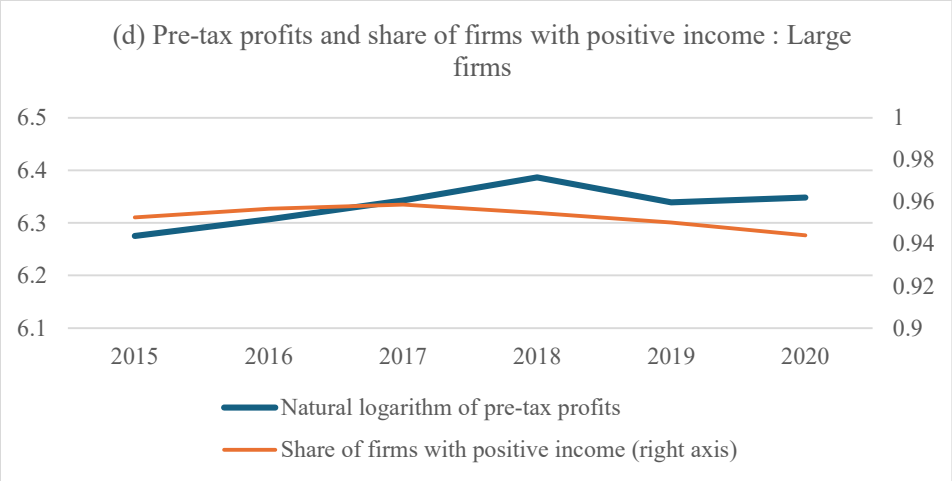
tax on capital / Pre-tax profits) gradually increased between FY2015 and FY2018 and between FY 2015 and FY2019, respectively. These trends are consistent with the expansion of pro forma standard taxation. In sum, the increase in the ETR over the period FY 2015–2020 indicates that the effects of the broadening of the tax base slightly exceeded those of the reduction in tax rates.

Figure 3. ETR, ETR components, pre-tax profits: Large firms









4. Estimation results

4.1 Effect of sales growth on the ETR

SMEs

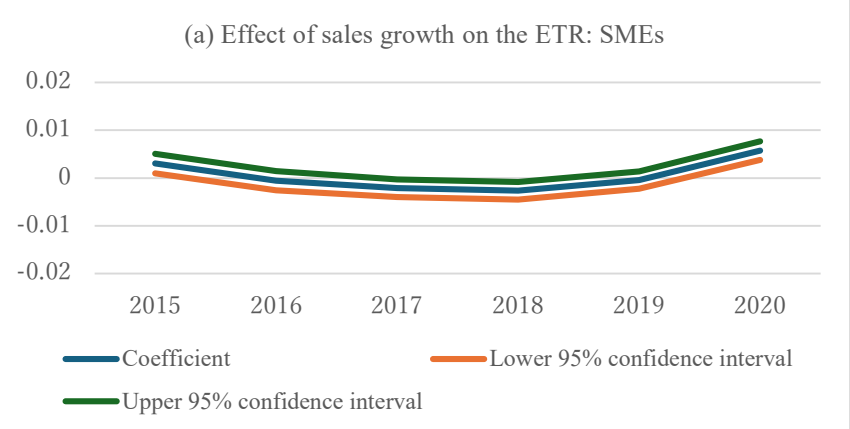
Figure 4(a) shows the estimated coefficients on the sales growth rate and their 95 percent confidence intervals in equation (4) when we use the ETR as the dependent variable and SMEs as the sample. It shows that the coefficient was significantly positive in FY 2015, turned significantly negative in FY 2017−2018, and then significantly positive again in FY 2020. Thus, the ETR was temporarily smaller in FY 2017−2018 for SMEs with higher sales growth rates.

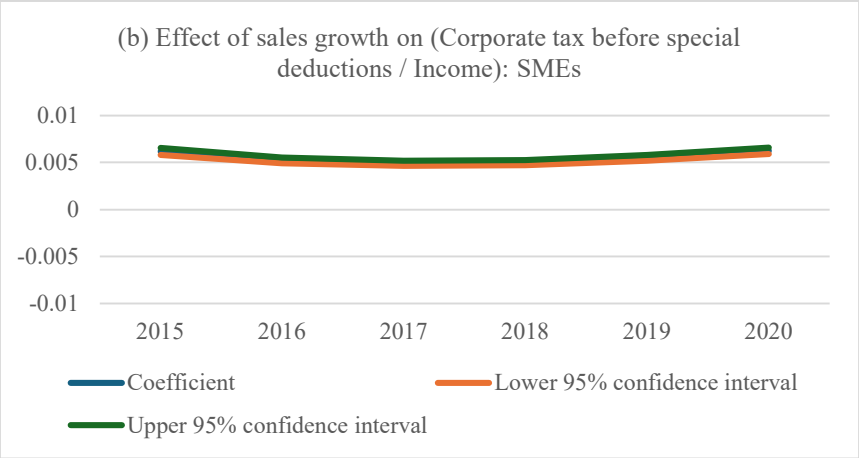
Figures 4(b) to (f) show the results when we use each component of the ETR as the dependent variable. First, Figures (b) to (d) show that the coefficients on the sales growth rate are positive and significant for (Corporate tax before special deductions / Income), (Inhabitant tax on corporate tax / Income), and (Business tax on income / Income) throughout the period, with little

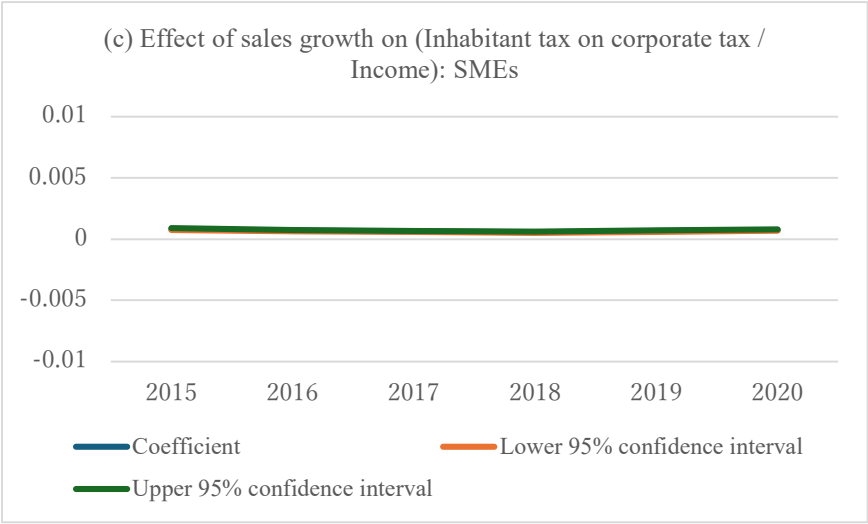
change in the size over time. Since SMEs' corporate tax, inhabitant tax, and business income tax rates increase with income, SMEs with higher sales growth rates faced higher rates for these taxes. Second, Figure 4(e) shows that the sales growth rate always had a positive and significant effect on (Special deductions / Income), with little change in the magnitude of the effect. This result suggests that SMEs with higher sales growth rates are more likely to conduct productivity-enhancing investments and hence to use investment tax credits. Third, Figure 4(f) shows that, with the exception of FY2020, the sales growth always had a significant negative effect on (Income / Pre-tax profits), with the magnitude of the effect stronger in FY2017−2018 and weaker thereafter. This result suggests that SMEs with higher sales growth rates were more likely to use preferential tax treatment. The reason for the strong effect in FY 2017−2018 is that the number of firms that used immediate depreciation for building equipment, machinery and equipment increased during this period, reflecting the reorganization of investment incentives for SMEs and the relaxation of requirements for immediate depreciation in FY 2017. However, the number of firms using immediate depreciation decreased in FY 2019, since the tax incentives for investment in productivity-enhancing equipment introduced in FY 2014 were phased out over the period FY 2016-2017, so that the taxable base expanded, which gradually outweighed the positive effect of the relaxation of requirements for immediate depreciation.

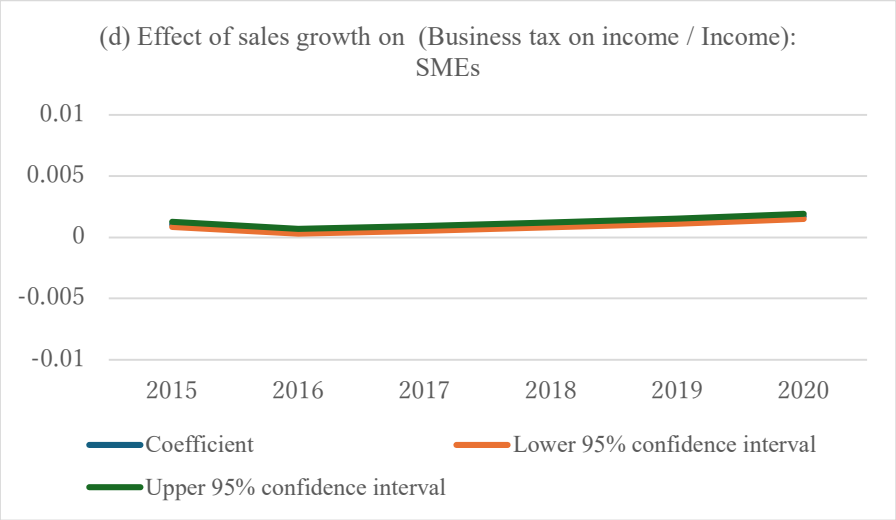
In sum, SMEs with higher sales growth rates were subject to lower ETRs in FY 2017−2018, reflecting the expansion of investment tax incentives for SMEs, which resulted in lower income-to-pre-tax-profit ratios for such firms. This pro-growth effect declined after FY 2019 because the general investment promotion tax was phased out.

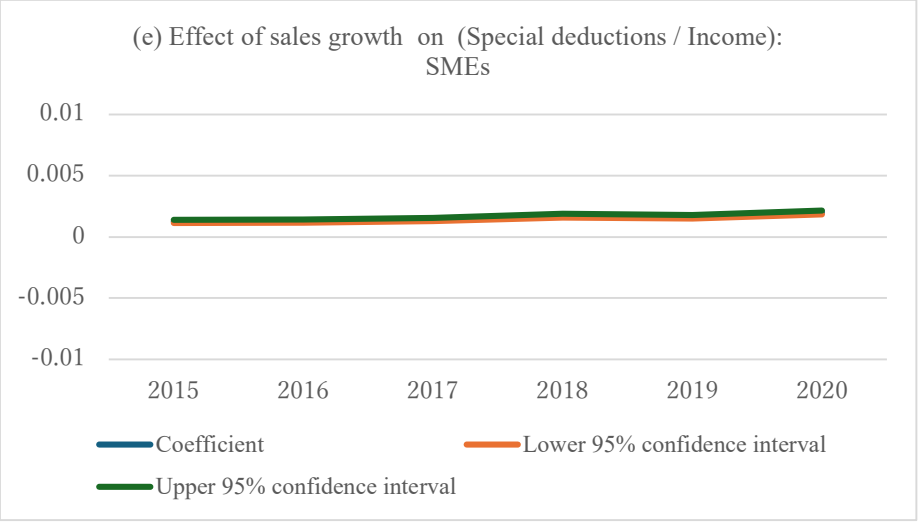
Figure 4. Estimated effect of sales growth on the ETR and its components: SMEs

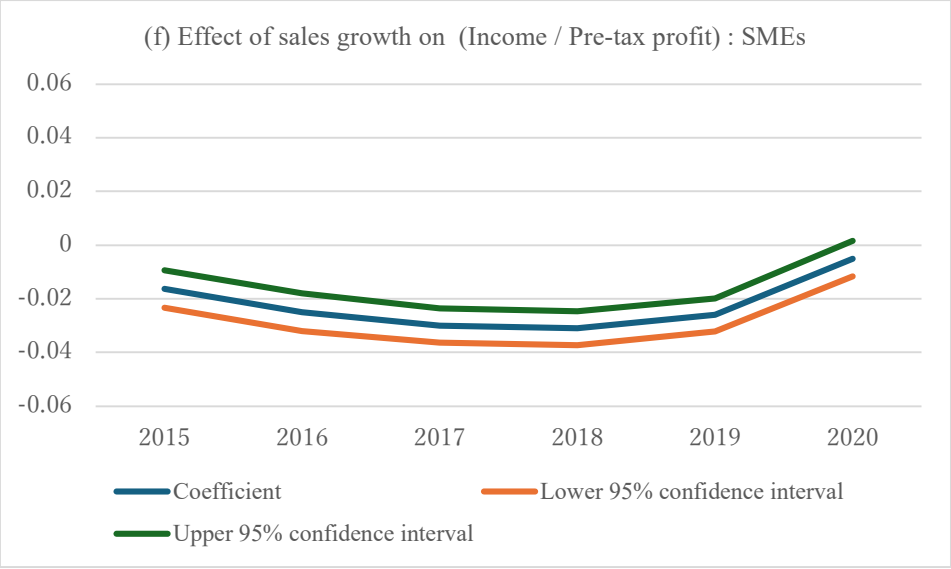



(b) Effect of sales growth on (Corporate tax before special deductions / Income): SMEs
0.01
0.005
0
-0.005
-0.01
2015
2016
2017
2018
2019
2020
Coefficient
Lower 95% confidence interval
Upper 95% confidence interval


(c) Effect of sales growth on (Inhabitant tax on corporate tax / Income): SMEs
0.01
0.005
0
-0.005
-0.01
2015
2016
2017
2018
2019
2020
Coefficient
Lower 95% confidence interval
Upper 95% confidence interval


(d) Effect of sales growth on (Business tax on income / Income): SMEs
0.01
0.005
0
-0.005
-0.01
2015
2016
2017
2018
2019
2020
Coefficient
Lower 95% confidence interval
Upper 95% confidence interval





Large firms

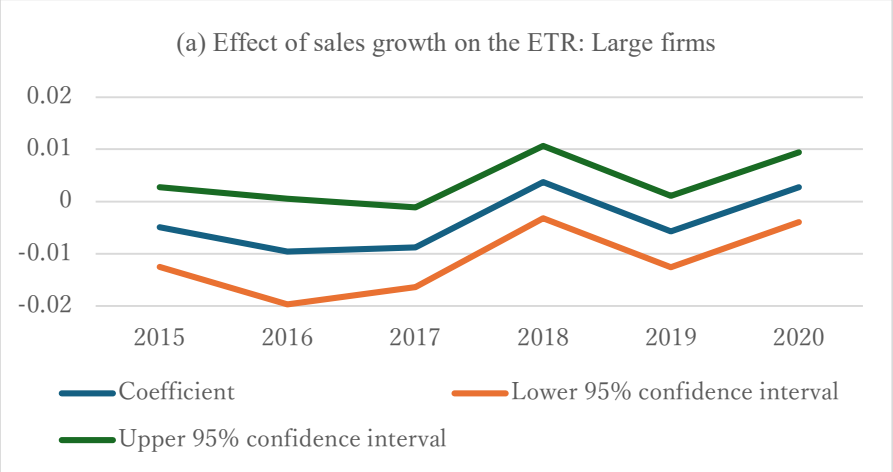
Figure 5(a) shows the results for the effects of sales growth on the ETR for large firms. It indicates that the coefficient on the sales growth rate was negative and significant in FY 2017. Although these results are similar to those for SMEs, the reasons are quite different, as the estimation results for the ETR components reveal.

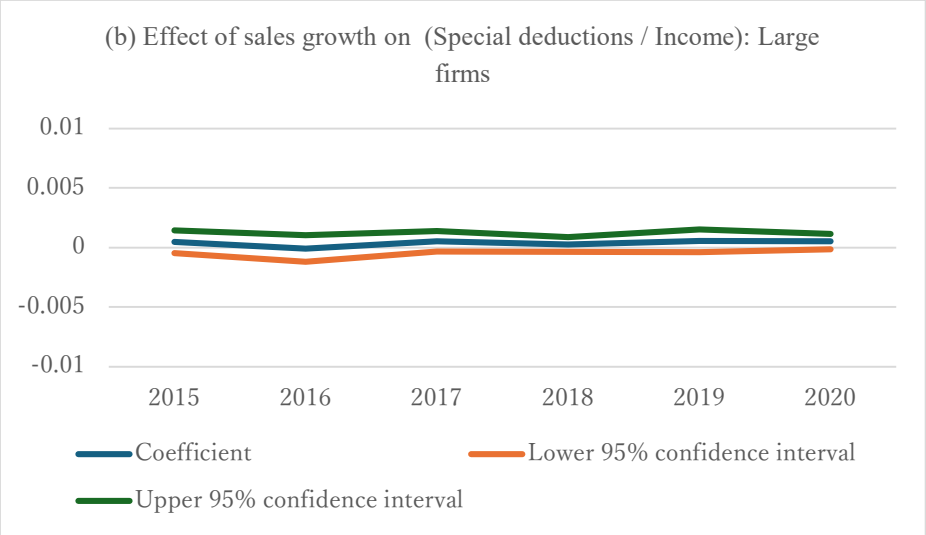
Figures 5(b) to (f) show the results for the effect of the sales growth rate on each ETR component for large firms. Note that we omit the results for (Corporate tax before special deductions / Income), (Inhabitant tax on corporate tax / Income), and (Business tax on income / Income), since unlike SMEs, large firms were subject to uniform corporate tax, inhabitant tax, and business income tax rates irrespective of their sales or sales growth rate.[7] Figure 5(b) shows that the sales growth rate

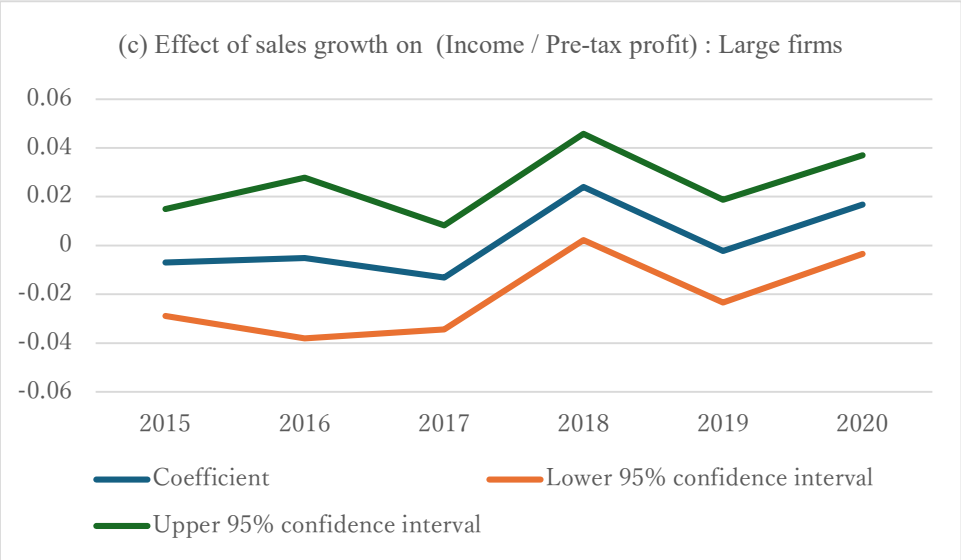
[7] The omitted figures are shown as in Figures A1(a) to (c) in Online Appendix.

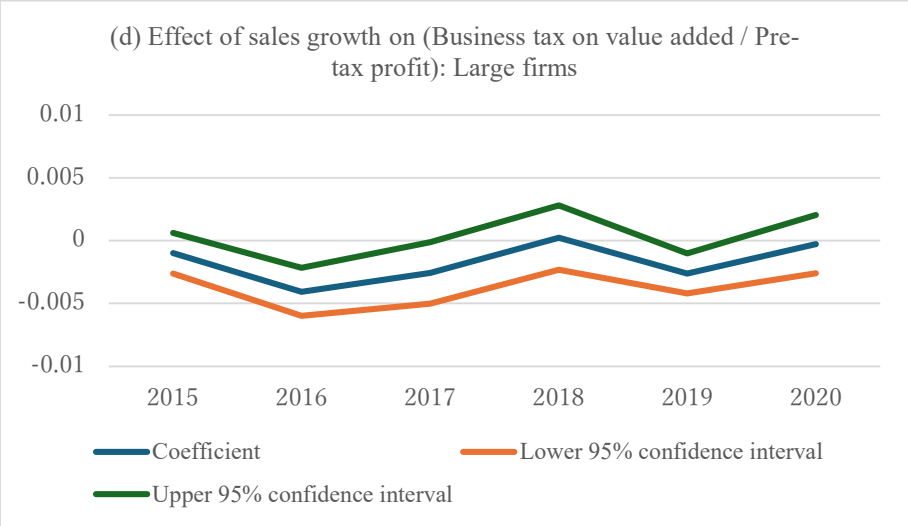
had little effect on (Special deductions / Income), indicating that large firms used tax deductions irrespective of their sales growth rate. Figure 5(c) shows that the sales growth rate also had little effect on (Income / Pre-tax profits), except for FY 2018. Figures 5(d) and (e) indicate that the sales growth rate had significant negative on (Business tax on value added / Pre-tax profits) and (Business tax on capital / Pre-tax profits) in FY 2016-2017 and that these effects disappeared in FY 2018 and FY 2020. The ratios of business taxes on value added and capital to pre-tax profits temporarily declined for firms with higher sales growth since, in the short term, the growth rate of profits before tax likely was higher than the growth rates of value added and capital, the taxable base for pro forma standard taxation. However, as these taxable bases gradually increased to a level closer to firms' pre-tax income, the negative effect of the sales growth on the ratios of business taxes to pre-tax profits became smaller over time. In sum, although the increase in the burden of the pro forma standard taxation due to the tax reforms was smaller for firms with higher sales growth rates pro-growth effects were only temporary. The lower ETR for firms with higher sales growth rates in FY2017 reflects such a temporarily smaller burden of business taxes on value added and capital for firms with higher sales growth rates.

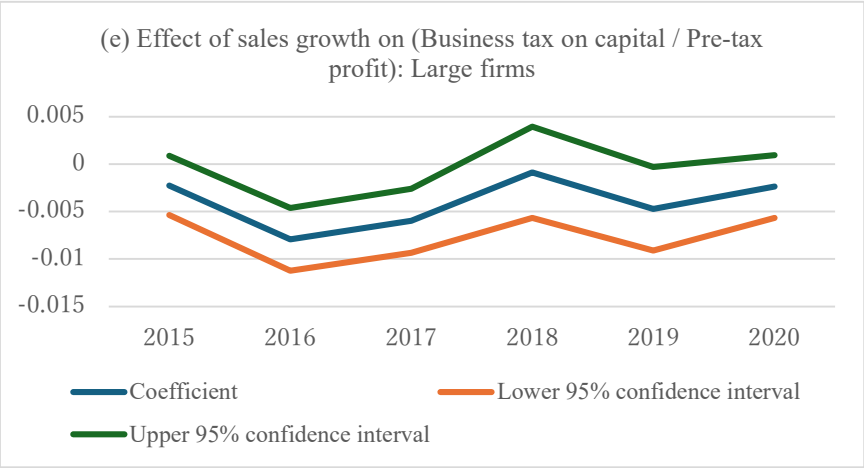
Figure 5. Estimated effect of sales growth on the ETR and its components: Large firms




(b) Effect of sales growth on (Special deductions / Income): Large firms
0.01
0.005
0
-0.005
-0.01
2015
2016
2017
2018
2019
2020
Coefficient
Lower 95% confidence interval
Upper 95% confidence interval


(c) Effect of sales growth on (Income / Pre-tax profit) : Large firms
0.06
0.04
0.02
0
-0.02
-0.04
-0.06
2015
2016
2017
2018
2019
2020
Coefficient
Lower 95% confidence interval
Upper 95% confidence interval


(d) Effect of sales growth on (Business tax on value added / Pre-tax profit): Large firms
0.01
0.005
0
-0.005
-0.01
2015
2016
2017
2018
2019
2020
Coefficient
Lower 95% confidence interval
Upper 95% confidence interval



4.2 Effect of R&D intensity on the ETR

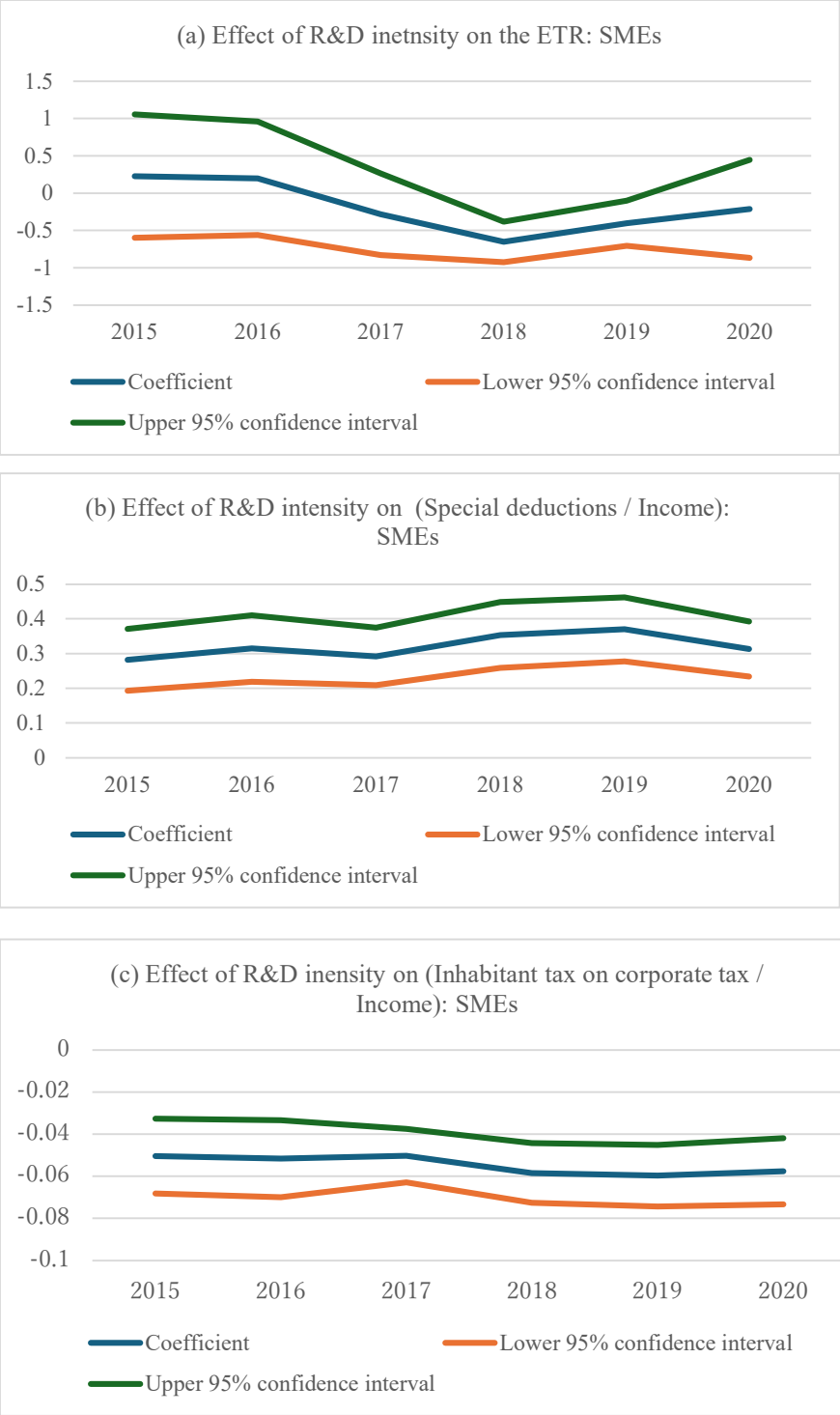
SMEs

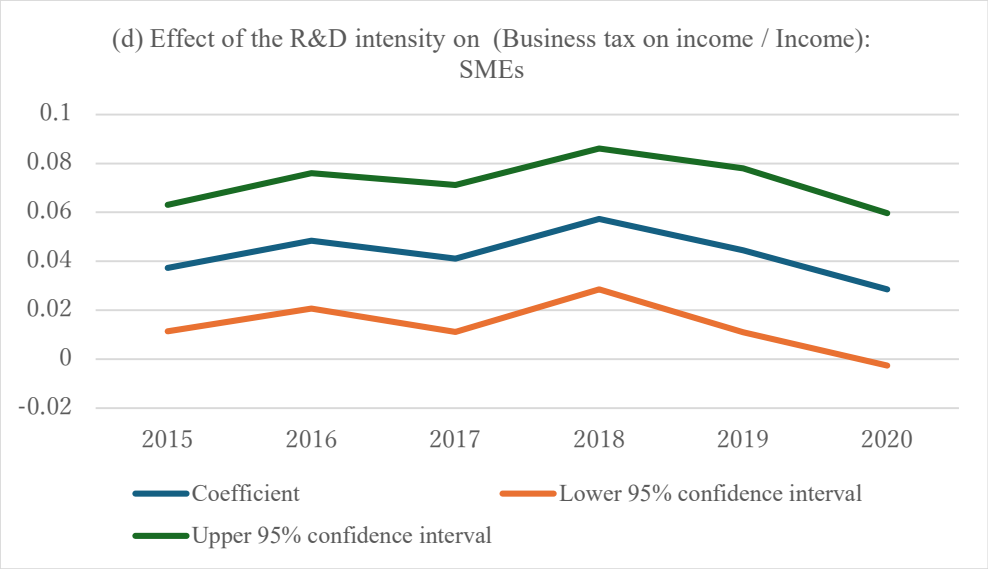
Figure 6(a) shows the results for the effect of firms' R&D intensity – i.e., the ratio of R&D expenditure to sales – on SMEs' ETR. The figure indicates R&D intensity had a significant negative effect on the ETR in FY 2018-2019.

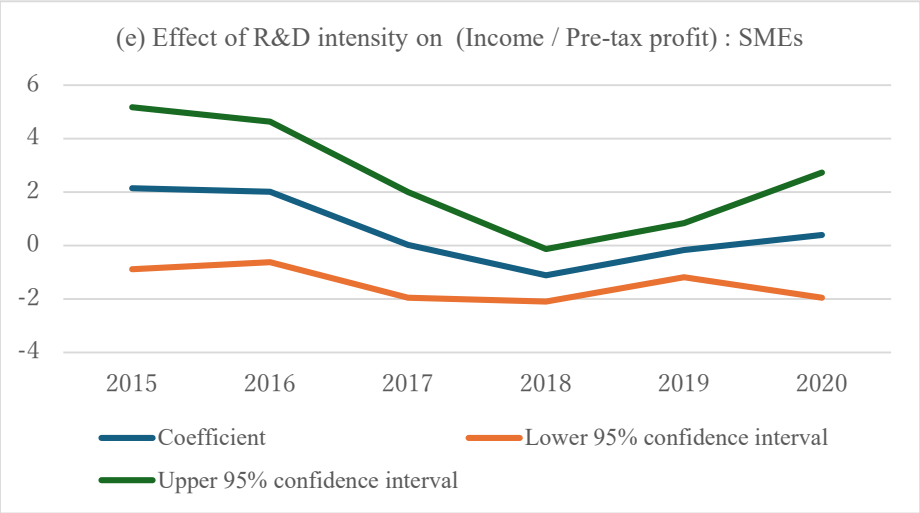
Figures 6(b) to (e) show the results for the effect of R&D intensity on each ETR component for SMEs. We omit the result for (Corporate tax before special deductions / Income), since R&D intensity had no significant effect on it (as shown in Figure A2(a) in Online Appendix). Figure 6(b) shows that R&D intensity had a significant positive effect on (Special deductions / Income) throughout the period and that the effect increased slightly after FY 2018. The change in R&D tax code in FY 2017 brought about an increase in R&D tax credits for SMEs, which reduced the tax base. Figure 6(c) indicates that R&D intensity had a significant negative effect on (Inhabitant tax on corporate tax / Income) throughout the period. Given that inhabitant income tax is the multiple of corporate tax, which is equal to income before special deductions minus special deductions plus other items and the relevant tax rate and that R&D intensity is not likely to immediately affect income before special deductions and other items, it affects (Inhabitant tax on corporate tax / Income) mainly through its impact on (Special deductions / Income). Next, Figure 6(d) shows that R&D intensity had a significant positive effect on (Business tax on income / Income) throughout the period. This result indicates that firms with a higher R&D intensity were likely to earn a higher income and face a higher rate of business tax on income. Meanwhile, Figure 6(e) shows that the coefficients for R&D intensity are positive for (Income / Pre-tax profits), but not significant. This may be due to differences in how R&D is treated in accounting standards and the tax code: while R&D expenditures are typically expensed immediately in financial accounting, tax regulations often require some R&D costs to be capitalized and amortized over time. The size of the coefficients indicates that such discrepancies may have been large in FY 2015–2016 and FY 2020. In sum, R&D intensity had a negative effect on the ETR in FY 2018-2019,

primarily due to its positive impact on (Special deductions / Income) as a result of the reform of R&D tax code for SMEs. However, in other years this negative effect was offset by discrepancies in the treatment of R&D in accounting standards and the tax code.

Figure 6. Estimated effect of R&D intensity on the ETR and its components: SMEs







Large firms

Figure 7(a) shows the results for the effects of R&D intensity on the ETR of large firms. It indicates that the effect of R&D intensity on the ETR was insignificant in FY 2016 and FY 2017 and turned negative and significant in FY 2018–2020.

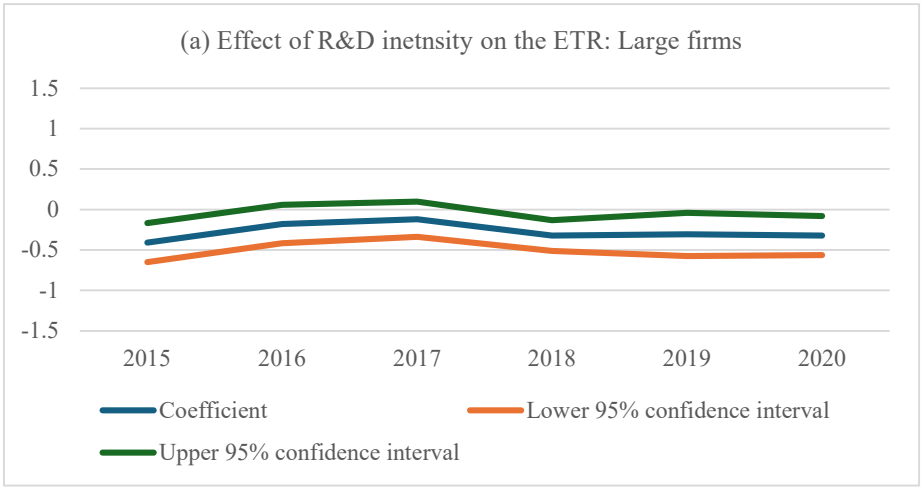
Figures 7(b) to (e) present the results for the effects of R&D intensity on each ETR component for large firms. We omit the figures for (Corporate tax before special deductions / Income), (Business tax on income / Income), (Income / Pre-tax profits), and (Business tax on value added / Pre-tax profits), since R&D intensity had no significant effect on them.[8] Figure 6(b) shows that R&D intensity had a significant positive effect on (Special deductions/ Income) throughout the period. However, the magnitude of the effect gradually declined after the R&D tax code was revised in FY

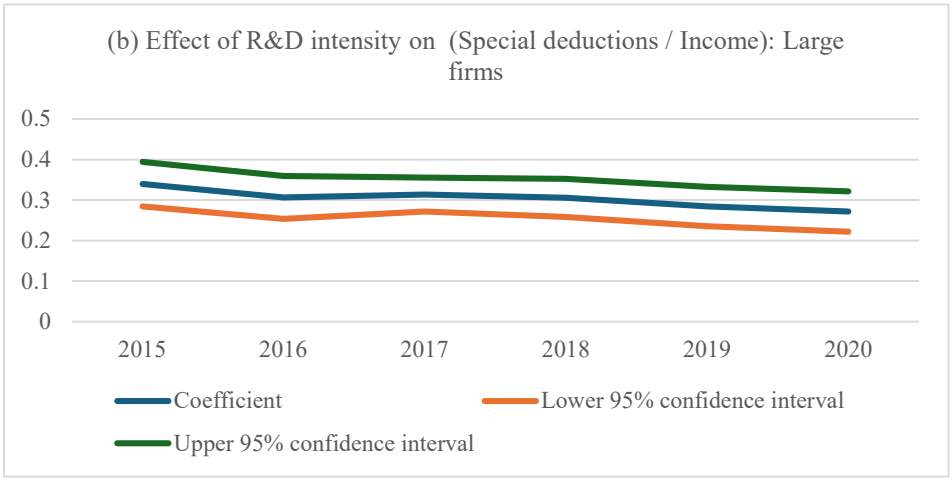
[8] The omitted figures are shown as Figures A2(b) to (e) in Online Appendix.

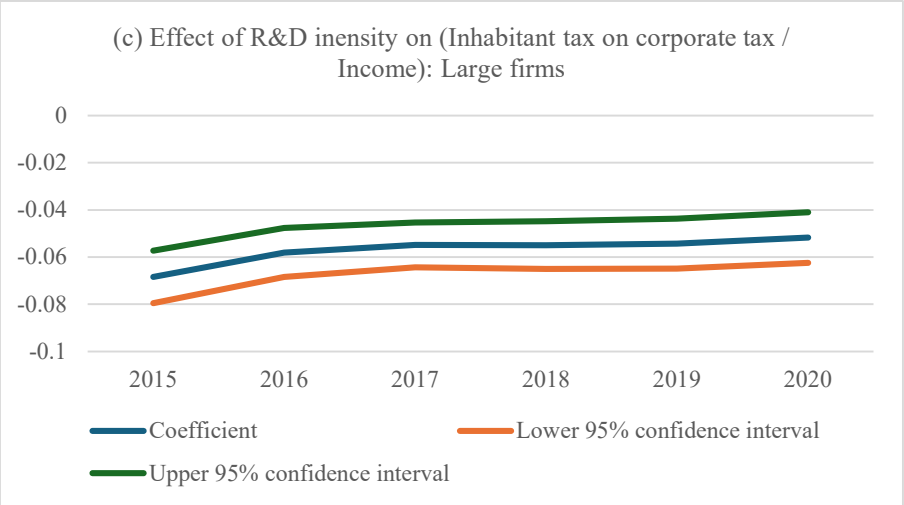
2015 and FY 2017, which decreased R&D tax credits and thereby increased the tax base. Figure 7(c) shows that R&D intensity had a significant negative effect on (Inhabitant tax on corporate tax / Income). In contrast, as shown in Figure 7(d), R&D intensity had a significant positive effect on (Business tax on capital / Pre-tax profits) except for FY 2018 and FY 2020. Although firms with higher R&D intensity were subject to a higher business tax on capital and pre-tax profits, the former tended to increase more with the R&D intensity, since R&D was likely financed by equity capital. This was especially the case in FY 2016 and FY 2017, when the pro forma standard tax rate on capital increased.

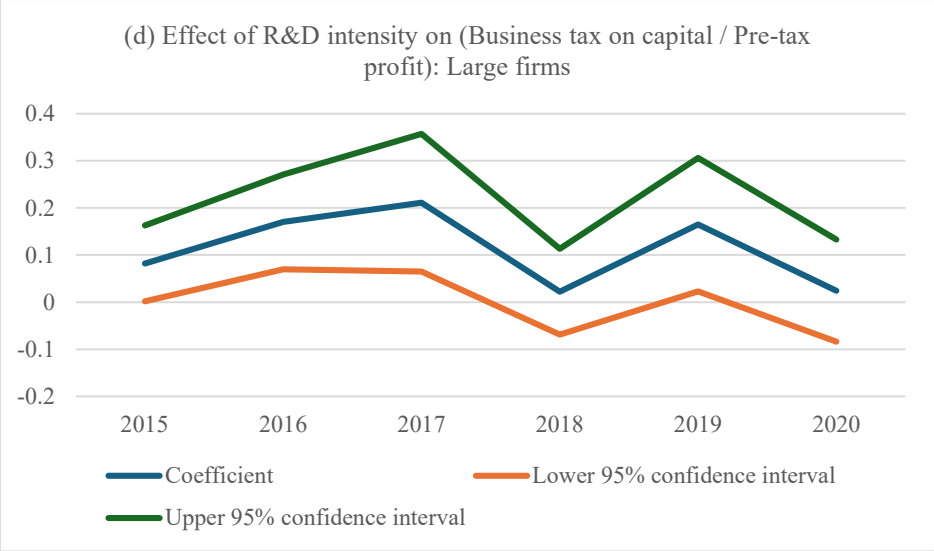
These results indicate that the effects of R&D intensity on the ETR were insignificant in FY 2016 and FY 2017 despite the presence of R&D tax credits, for two reasons. One is the reform of the R&D tax code, which led to smaller special deductions, while the other is the increase in the pro forma standard tax rate on capital. In FY 2018–2020, the effect of R&D intensity on the ETR turned significantly negative, as R&D-intensive firms restrained increases in equity to minimize business tax on capital, thus attenuating the previously positive effect of R&D on capital taxation.

Figure 7. Estimated effect of R&D intensity on the ETR and its components: Large firms







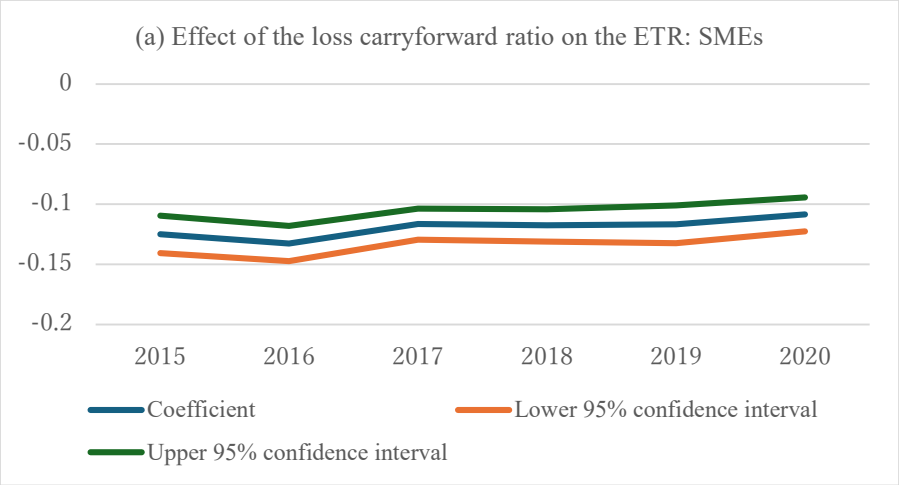


4.3 Effect of loss carryforward on the ETR

SMEs

Figure 8 shows the effect of the ratio of operating loss carryforward to sales on the ETR of SMEs. It indicates that the ratio had a significant negative effect on the ETR throughout the period and that the size of the effect was stable. SMEs with accumulated net operating loss carryforward had a lower ETR than SMEs without such carryforward. This result is expected, considering that the ratio of loss carryforward to income remained at 100% throughout the observation period. Figures A3(a) to (e) in Online Appendix show the estimated effects of the loss carryforward ratio on the ETR components for SMEs.

Figure 8. Estimated effect of the loss carryforward ratio on the ETR: SMEs



Large firms

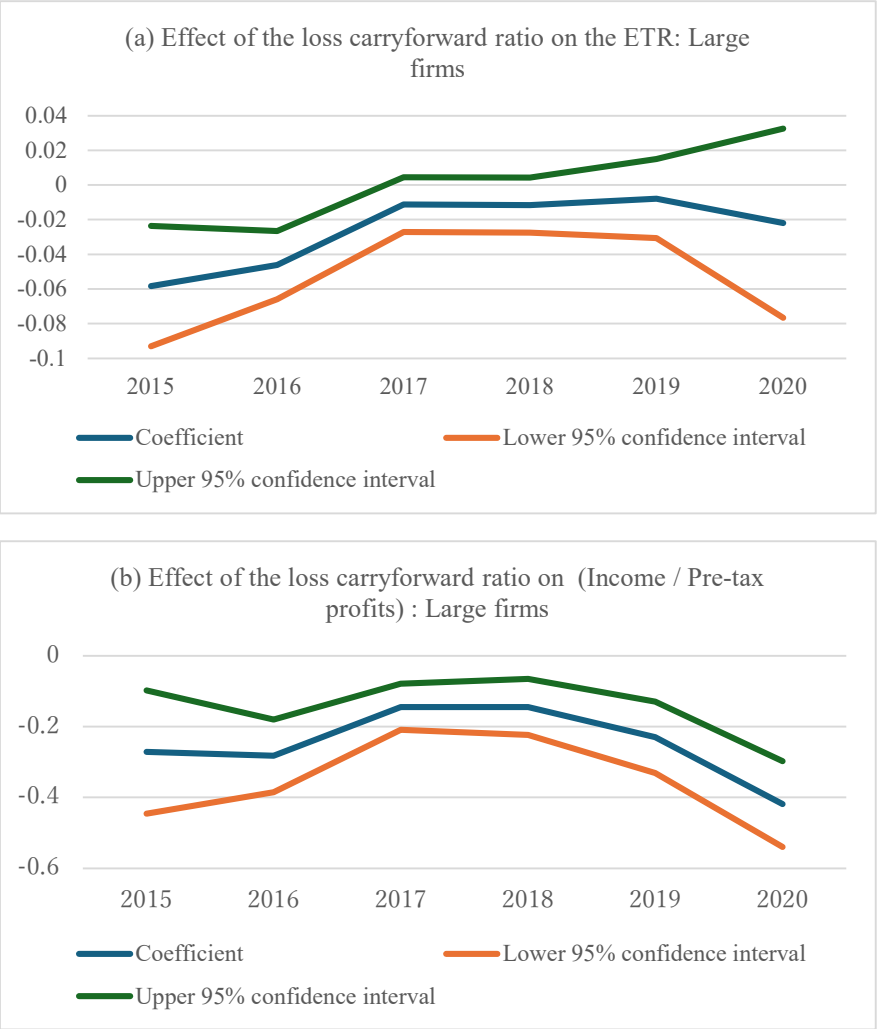
Figure 9(a) shows the effect of the ratio of loss carryforward on the ETR of large firms. The figure indicates that the ratio had a significant negative effect on the ETR in FY 2015 and FY 2016, became insignificant in FY 2017, and remained so afterwards.

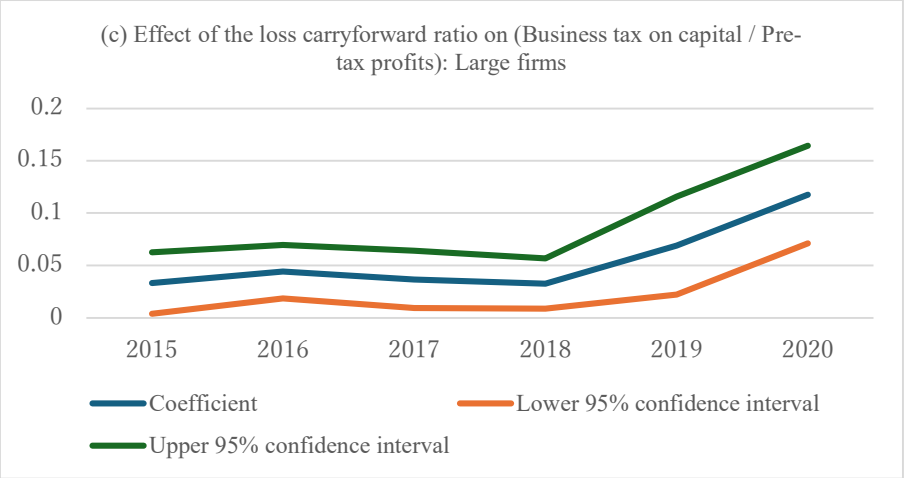
Examining the components of the ETR, we find that the loss carryforward ratio had little effect on (Corporate tax before special deductions / Income), (Inhabitant tax on corporate tax / Income), (Business tax on income / Income), or (Business tax on value added / Pre-tax profits), so we omit the figures for these results. We also find that the loss carryforward ratio had a significant negative effect on (Special deductions / Income) in FY 2015 and FY 2017-2018. However, since the size of this effect was small, we omit the figure for it as well.[9] Figures 9(b) and (c) show the results for the effect of the loss carryforward ratio on the other ETR components. Figure 9(b) indicates that the loss carryforward ratio had a significant negative effect on (Income / Pre-tax profits) throughout the period. The negative effect of the loss carryforward ratio on (Income / Pre-tax profits) is a major factor in the negative impact of this ratio on the ETR overall. However, the size of the effect varies over time. After the effect gradually decreased from FY 2015 to FY 2018, it then started to increase in FY 2019 and continued to do so in FY 2020. The decrease in the negative effect observed until FY 2018 reflects the tax reforms, which saw a reduction in the loss deduction rate. However, large firms with a larger loss carryforward ratio were more likely to see a larger decline in pre-tax income after FY 2018 and hence more likely to see negative income. Next, Figure 9(c) shows that the loss carryforward ratio had a significant positive on (Business tax on capital / Pre-tax profits) throughout the period, with the effect increasing after FY 2018. While the business tax rate on capital was independent of loss carryforward, it increased as a part of the reforms. Because pre-tax profits were smaller for firms that accumulated

[9] The omitted figures are shown as Figures A3 (f) to (j) in Online Appendix.

loss carryforward, such firms were subject to a higher (Business tax on capital / Pre-tax profits) than firms with no loss carryforward and even more so after the rate hike. In sum, the gradually declining negative effect of the loss carryforward ratio on the ETR for large firms can be explained by reduction of the loss deduction rate and the increase in the rate of business tax on capital as part of the reforms.

Figure 9. Estimated effect of the loss carryforward ratio on the ETR and its components: Large firms



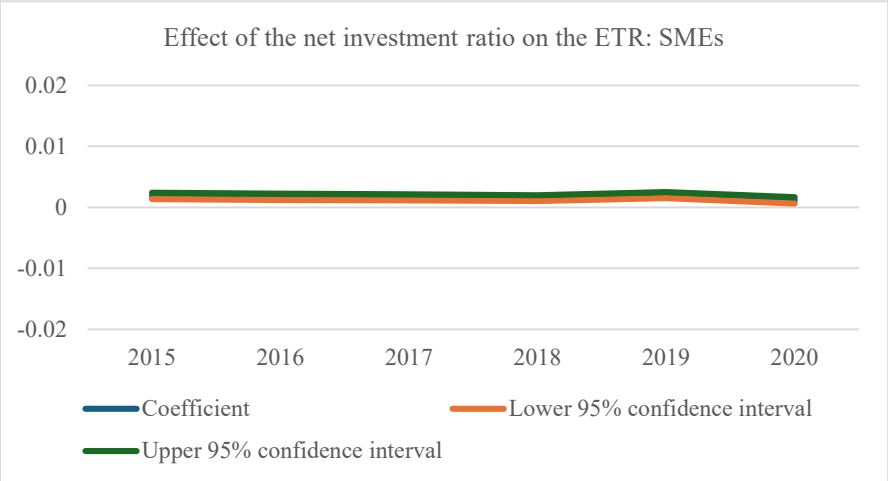


4.4 Effect of the net investment ratio on the ETR

SMEs

Figure 10 shows the effect of the net investment ratio – i.e., the increase in tangible fixed assets divided by the previous year's fixed assets– on the ETR for SMEs. It indicates that the net investment ratio had a significant positive effect throughout the period. Moreover, the size of the effect was stable, albeit quite small at about 0.2 percentage. This result seems surprising given the investment tax incentives for SMEs. However, there is a significant discrepancy between the type of investment that the tax incentives target and the type of investment in firms' balance sheets, which may responsible for the observed positive effect. Figures A4 (a) to (e) in Online Appendix show the estimated effects of the net investment ratio on the components of ETR for SMEs.

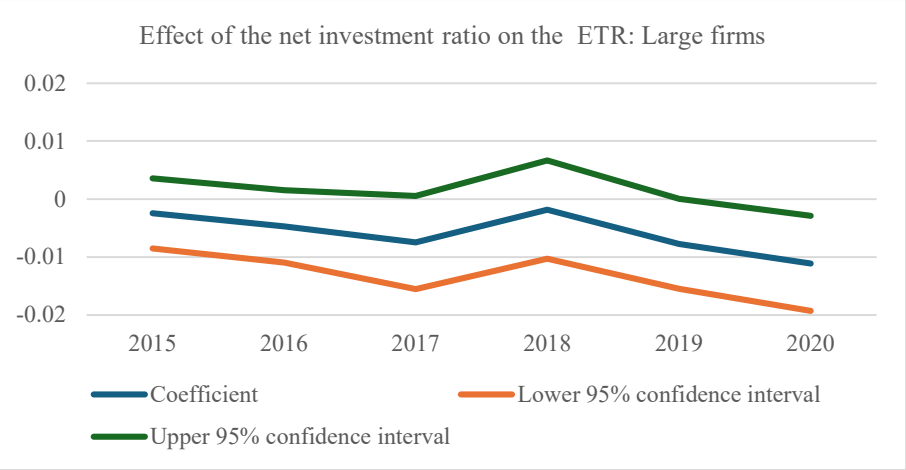
Figure 10. Effect of the net investment ratio on the ETR: SMEs



Large firms

Figure 11 shows the effect of the net investment ratio on the ETR for large firms. The figure indicates that the net investment ratio had a significant negative effect only in FY 2020. This likely reflects that the tax incentives for promoting investment were reduced in FY 2016 and abolished in FY 2017. Considering the discrepancy between investment qualifying for tax incentives and investment recorded in firms' financial statements, a possible explanation is that the reduction in and abolishment of investment tax incentives is responsible for the fact that the investment rate had no significant effect on the ETR except for FY 2020. Figures A4 (f) to (l) in Online Appendix show the estimated effects of the investment rate on the components of ETR for large firms.

Figure 11. Effect of the net investment ratio on the ETR: Large firms

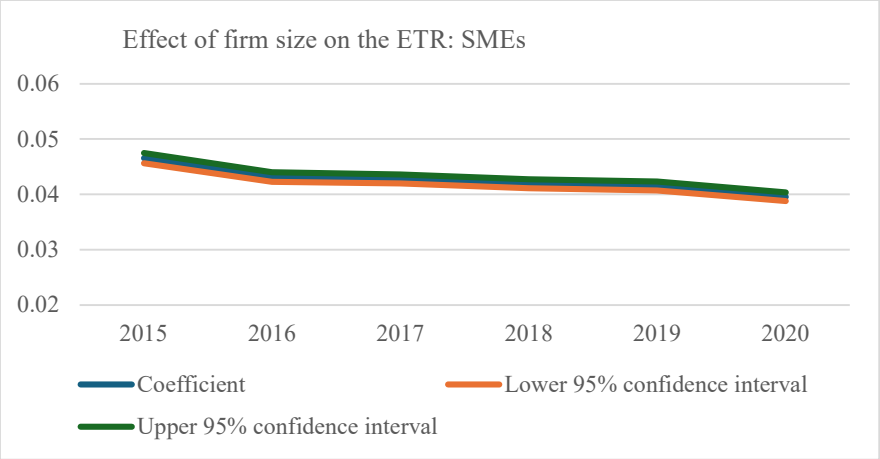


4.5 Effect of firm size on the ETR

SMEs

Figure 12 shows the effect of firm size – as measured by the logarithm of total assets - on the ETR of SMEs. It suggests that the effect of firm size was positive and significant throughout the period. That is, the larger a firms' assets, the more likely it is to achieve taxable income in excess of 8 million yen, the threshold for a higher tax rate. However, the magnitude of the effect of firm size on the ETR gradually declined over time, even though the tax code remained unchanged with respect to SMEs' size during the period. A possible explanation is that firms increasingly restrained their taxable income below the threshold. In fact, we find that while firm size had a significant positive effect on (Corporate tax before special deductions / Income) and (Income / Pre-tax profits) throughout the period, the magnitudes of this effect gradually declined over time. Figures A5(a) to (e)in Online Appendix show the estimated effects of the logarithm of total assets on the components of ETR for SMEs.

Figure 12. Estimated effect of firm size on the ETR and its components: SMEs



Large firms

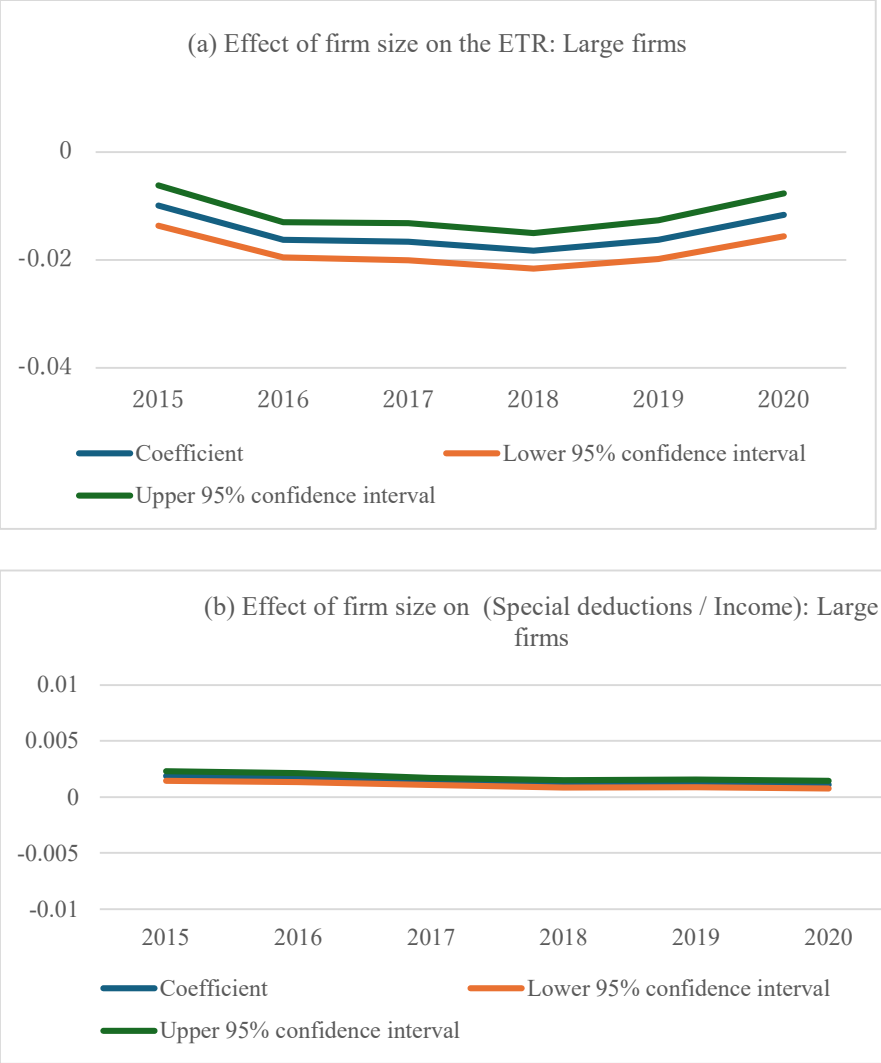
Figure 13(a) shows the effects of firm size (again measured in terms of the logarithm of total assets) on the ETR of large firms. The figure indicates that, unlike for SMEs, the effect of firm size for large firms was negative and significant throughout the period, with the negative effect gradually increasing until FY 2018 and then decreasing thereafter.

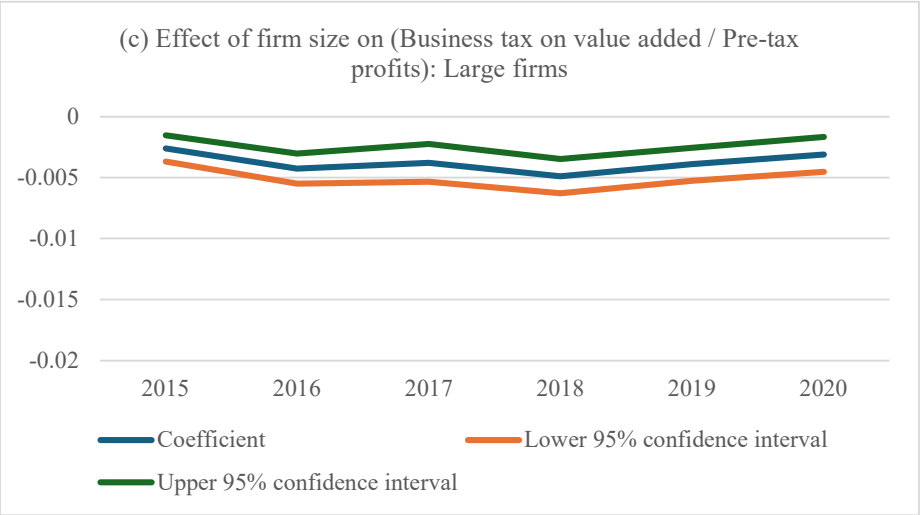
Examining the components of the ETR, we find that the effect of firm size on (Corporate tax before special deductions / Income), (Inhabitant tax on corporate tax / Income), and (Business tax on income / Income) was positive and significant throughout the period. However, the size of the effect was quite small in all cases, so that we omit the figures here. We further find that the effect of firm size on (Income / Pre-tax profit) is insignificant, so we also omit the figure here.[10] Next, Figure 13(b) presents the effect of firm size on (Special deductions / Income). The figure shows that the effect was positive and significant throughout the period, with the magnitude remaining more or less unchanged, indicating that larger firms were more likely to use special deductions, resulting in a lower ETR. Figures 13(c) and (d) show the effect of firm size on (Business tax on value added / Pre-tax profits) and (Business tax on capital / Pre-tax profits). The figures indicate that in both cases the effect was negative and significant. The former effect was stable throughout the period, while the latter gradually increased. While larger firms faced higher business taxes on value added and capital, these factors typically increased at a slower rate than pre-tax profits. This explains why firm size had a negative and significant effect on (Business tax on value added / Pre-tax profits) and (Business tax on capital / Pre-tax profits). Moreover, while the reform of pro forma taxation raise the rates for business taxes on both value added and capital, only the negative effect of firm size on (Business tax on capital / Pre-tax profits) increased over the period. We further examined the effect of firm size on business tax on value

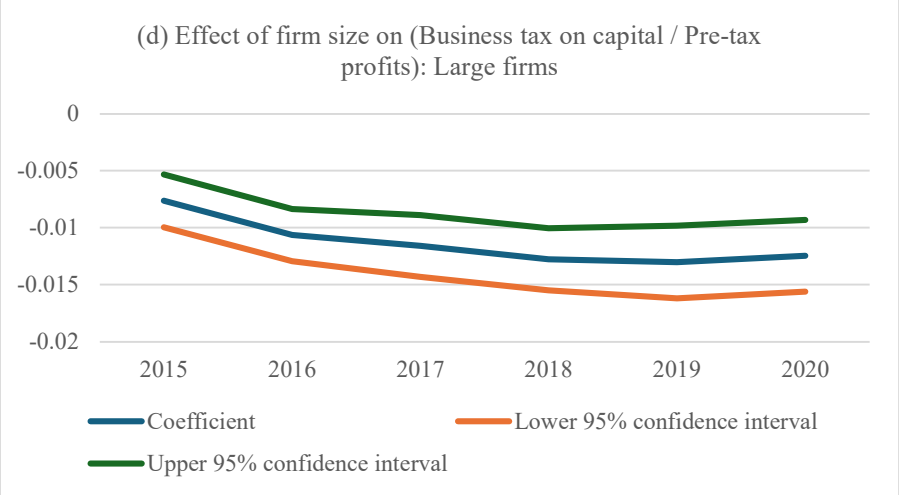
[10] The omitted figures are shown as Figures A5(f) to (i) of Figure E in Online Appendix.

added, business tax on capital, and pre-tax profits separately and find that while the effect of firm size on business tax on value added and on pre-tax profits tended to increase over time, the effect on business tax on capital tended to decrease despite the increase in the rate of business tax on capital. The latter result suggests that as firms became larger over time in terms of their total assets, they were more likely to refrain from increasing capital to mitigate their business tax on capital. In sum, the gradually increasing negative effect of firm size on ETR until FY 2018 was mainly due to large firms' response to the increase in the rate of business tax on capital in the form refraining from increasing their capital, which appeared as a larger negative effect of firm size on (Business tax on capital / Pre-tax profits) over the period.

Figure 13. Estimated effect of firm size on the ETR and its components: Large firms





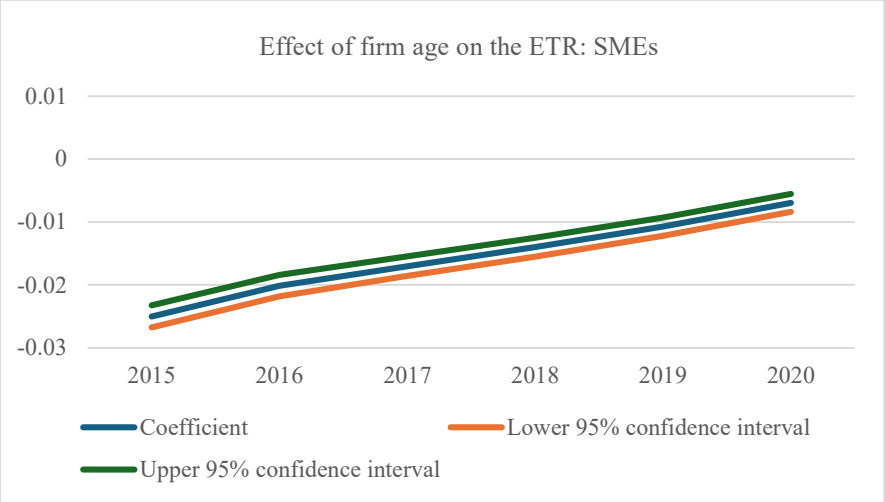


4.6 Effect of firm age on the ETR

SMEs

Figure 14 presents the effects of firm age (measured in terms of the logarithm of firm age) on SMEs' ETR. The figure indicates that the effect was negative and significant throughout the period and that the negative effect gradually decreased over the period. Examining the components of the ETR, we find that older SMEs were more likely to see lower (Corporate tax before special deductions / Income) and (Income / Pre-tax profits). These results suggest that older firms were more likely to keep their taxable income below the threshold of 8 million yen, although this age effect decreased over time. We omit the figures here to save space. Figures A6 (a) to (e) in Online Appendix show the estimated effects of the logarithm of firm age on the components of ETR for SMEs.

Figure 14. Estimated effect of firm age on the ETR and its components: SMEs



Large firms

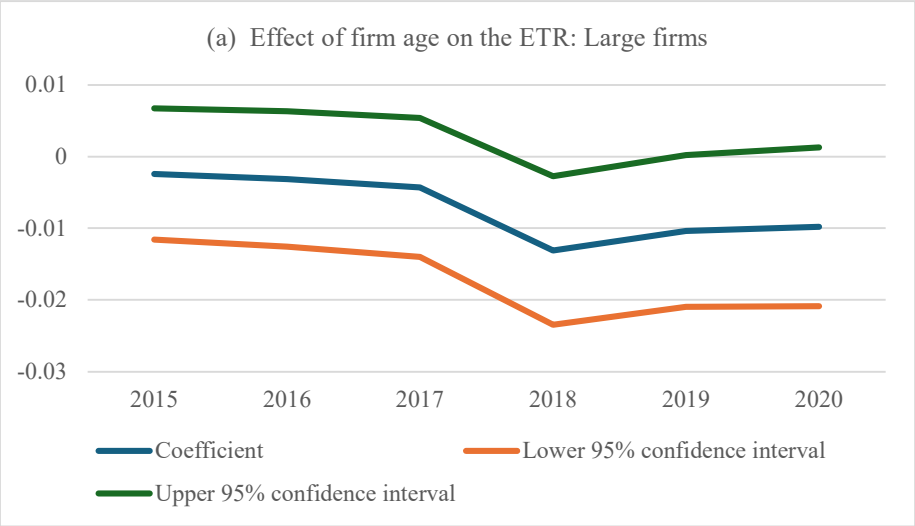
Figure 15(a) shows the effect of firm age on large firms' ETR. The figure indicates that the effect was not significant except for FY 2018, when it was negative and significant.

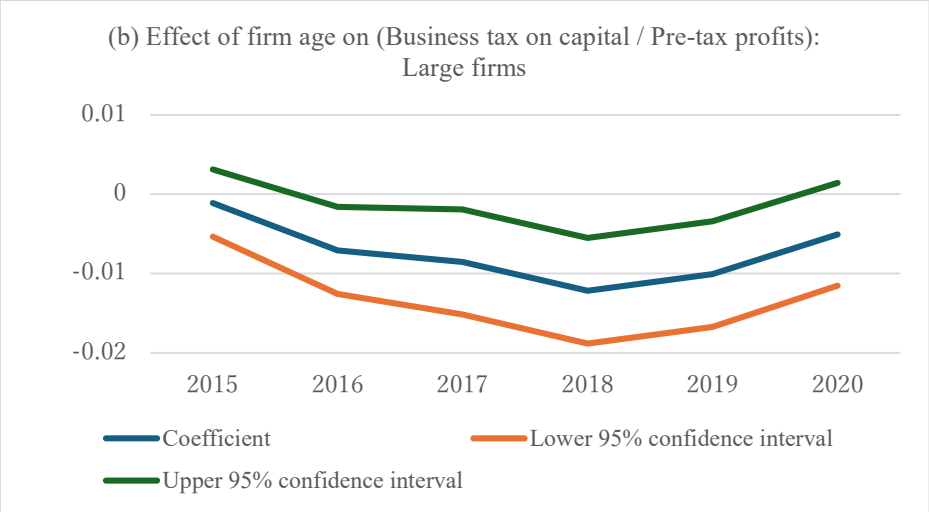
Examining the ETR components, we find that the effect of firm age on (Corporate tax before special deductions / Income) and (Inhabitant tax on corporate tax / Income) were positive and significant; however, since they were quite small, we omit the figures here. We further find that the effect of firm age on (Special deductions / Income), (Income / Pre-tax profits), and (Business tax on value added / Pre-tax profits) was insignificant, so we also omit the corresponding figures.[11] Next, Figure 15(b) presents the effect of firm age on (Business tax on capital / Pre-tax profits). The figure shows that the effect was negative and significant in FY 2016–2019. The negative effect increased until FY 2018 and then slightly decreased again. While older firms are likely to have more capital and therefore are likely to be subject to more business tax on capital, they are also more likely to earn more pre-tax profits. However, pre-tax profit increased more with age than capital, leading to lower (Business tax on capital / Pre-tax profits) for older firms. This negative effect became larger as the rate of business tax on capital increased as a result of the tax reform. Moreover, older firms refrained from increasing their capital more than before as they faced a higher tax rate on capital than before. In fact, while the sensitivity of pre-tax profits to age tended to increase over the period, the sensitivity of business tax on capital to age decreased "The latter result suggests that, in response to the increase in the rate of business tax on capital, the older firms were, the more likely they were to mitigate their business tax on capital by refraining from increasing their capital. In sum, firm age had a significant negative effect on the ETR in FY 2018, since older firms tended to refrain from increasing their capital

[11] The omitted figures are shown as Figures A6 (f) to (k)in Online Appendix.

to mitigate business tax liabilities on capital.

Figure 15. Estimated effect of firm age on the ETR and its components: Large firms





Conclusion

In the present paper, we used tax filing data of Japanese business enterprises from 2014 to 2020 to empirically examine how the 2015-2018 tax reforms in Japan aimed at encouraging firm growth affects the average corporate tax burden and whether the tax base reforms in these reforms benefited growing firms or not. The descriptive statistics show that the annual average ETR of all firms increased a little after the tax reform. The estimated sensitivities of backward-looking ETRs and their individual components with respect to various concurrent firm characteristics suggest that the sensitivities of ETRs with respect to these characteristics only temporarily evolved in favor of growing and R&D intensive firms. While the narrower loss deductions and the heavier pro forma standard tax on capital

resulted in a larger tax burden for loss-making firms, such results consistent with the aim of the tax reforms were only temporarily observed due to firms' responses to the tax base reforms, the abolition of tax incentives for investment, the restriction on the use of R&D tax credits, and the increase in the pro forma standard tax rate on capital. Therefore, we find no evidence that the 2015-2018 tax reforms in Japan benefited growing firms in the long run.

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Online Appendix: Effects of firms' characteristics on the components of ETR

Figure A1 Estimated effect of sales growth on the components of ETR

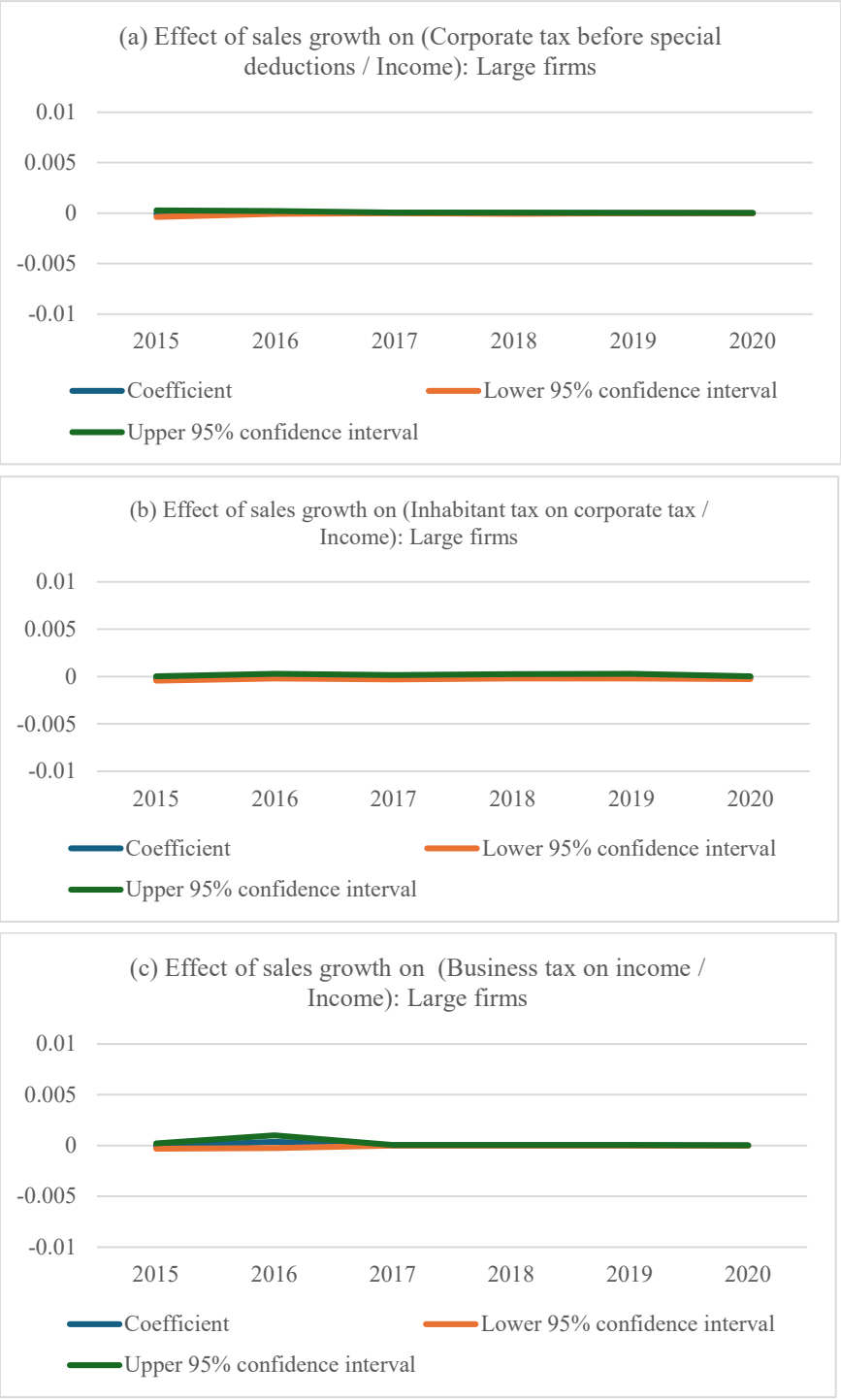
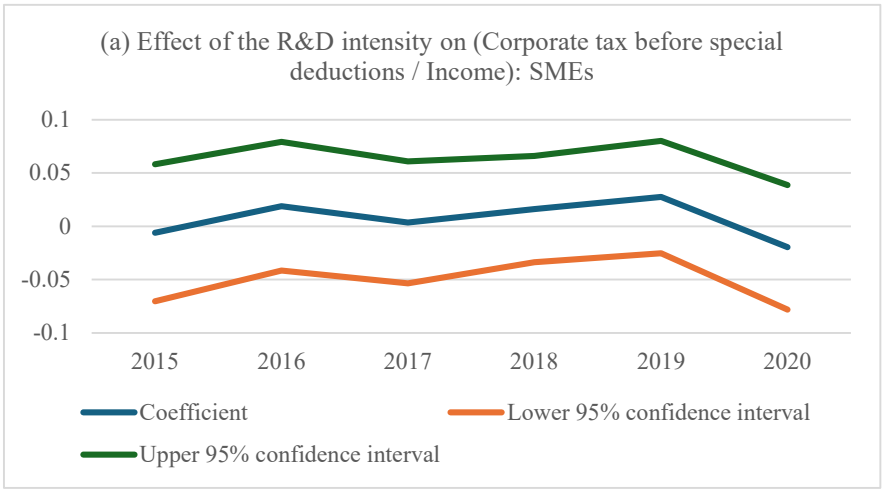
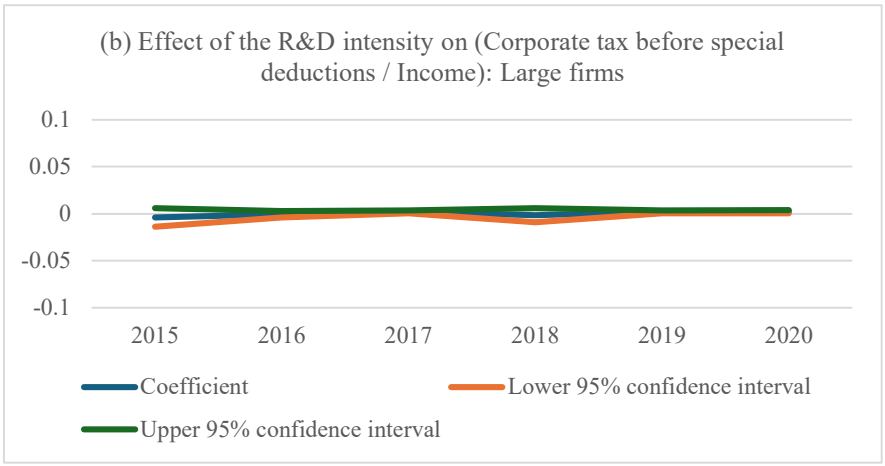
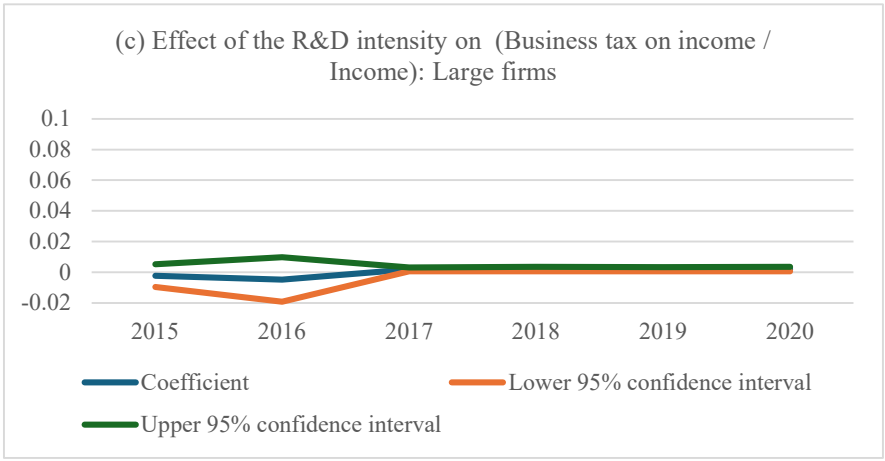
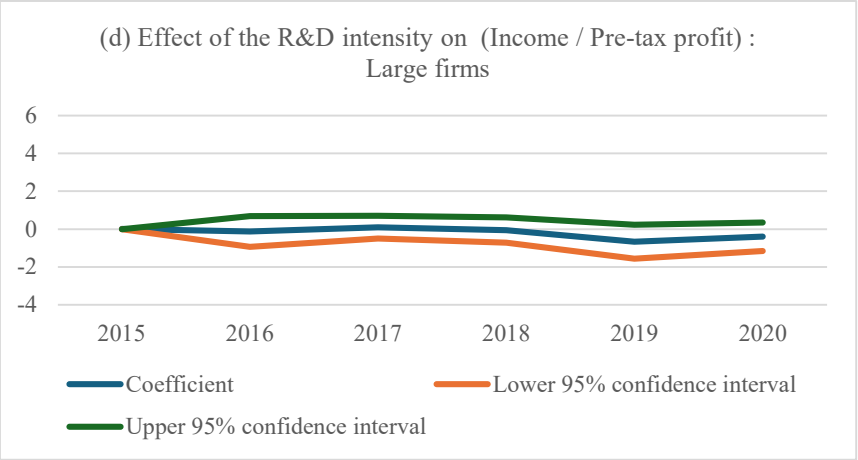


Figure A2 Estimated effect of the R&D intensity on the components of ETR








(d) Effect of the R&D intensity on (Income / Pre-tax profit) : Large firms
6
4
2
0
-2
-4
2015
2016
2017
2018
2019
2020
Coefficient
Lower 95% confidence interval
Upper 95% confidence interval

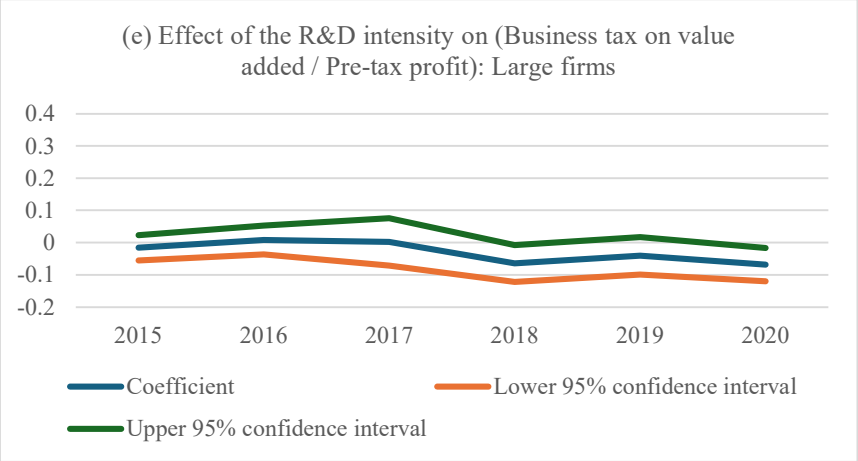
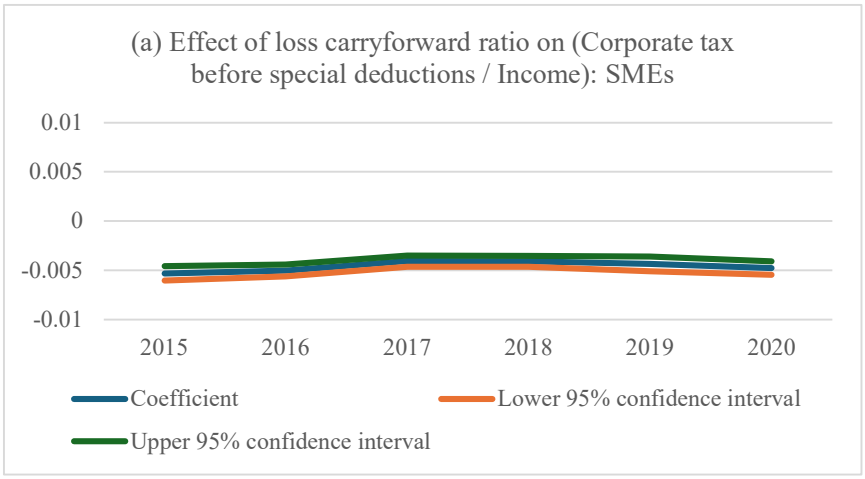
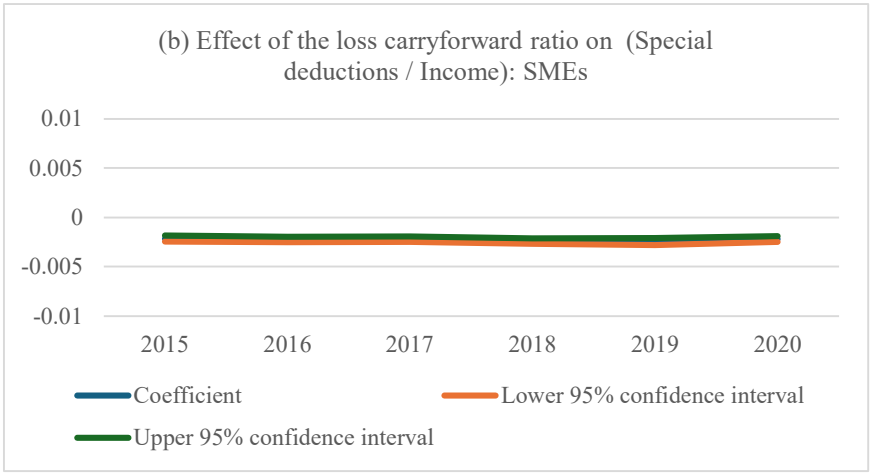
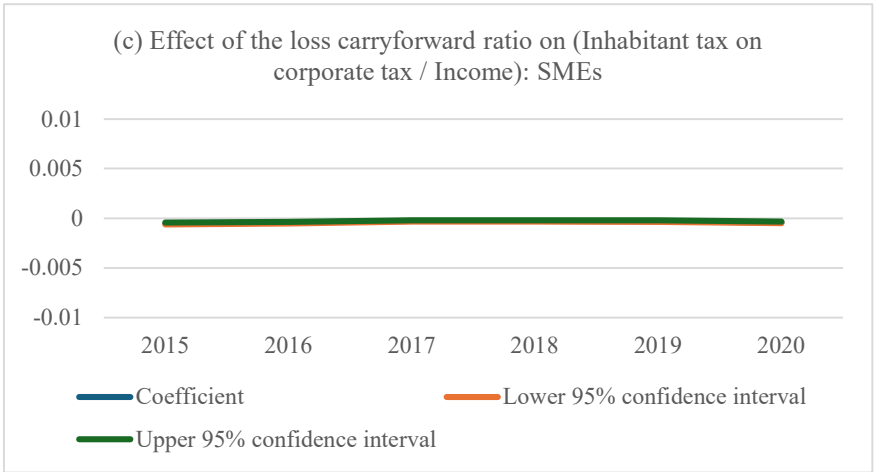
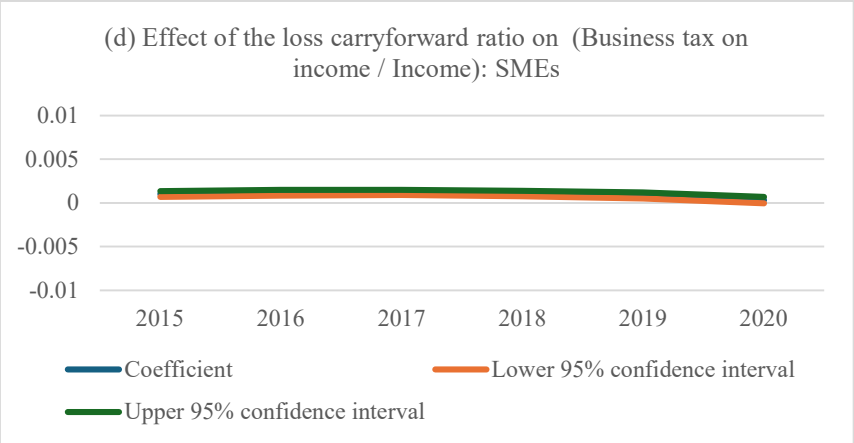

(e) Effect of the R&D intensity on (Business tax on value added / Pre-tax profit): Large firms
0.4
0.3
0.2
0.1
0
-0.1
-0.2
2015
2016
2017
2018
2019
2020
Coefficient
Lower 95% confidence interval
Upper 95% confidence interval

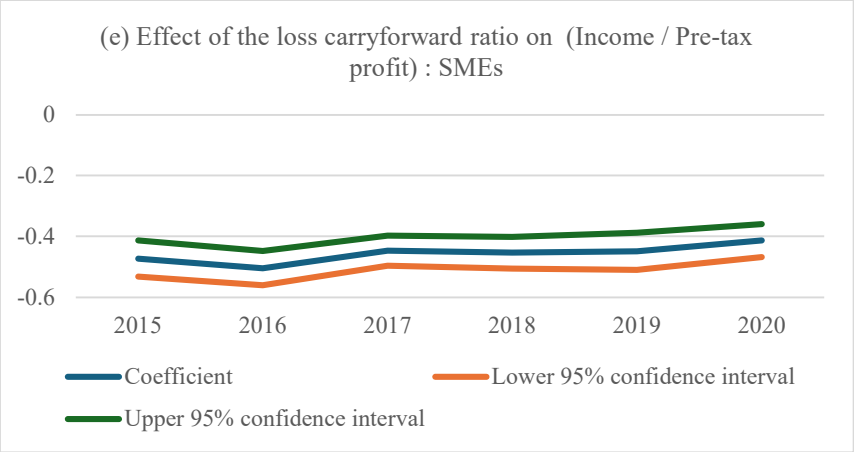
Figure A3 Estimated effect of the loss carryforward ratio on the components of ETR

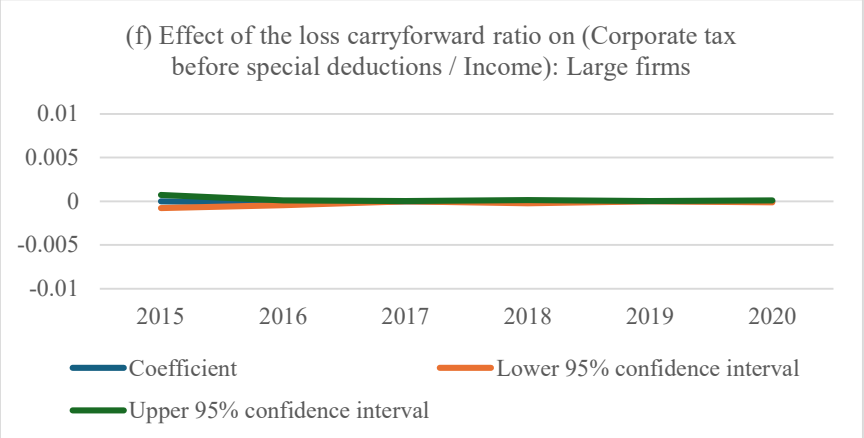


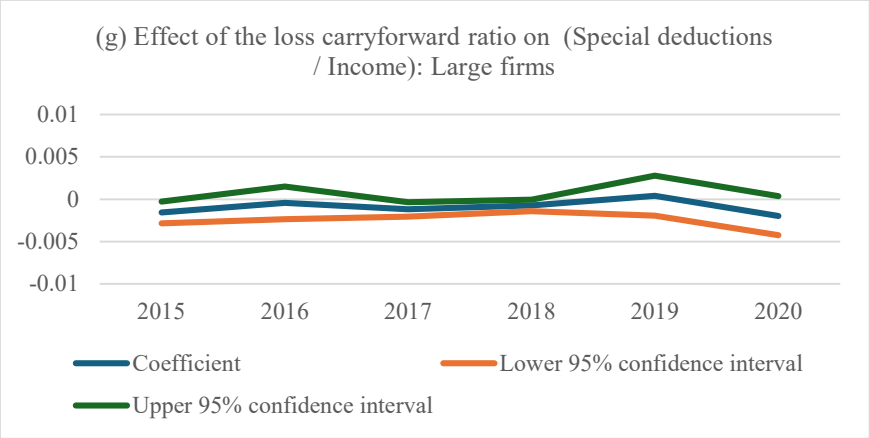


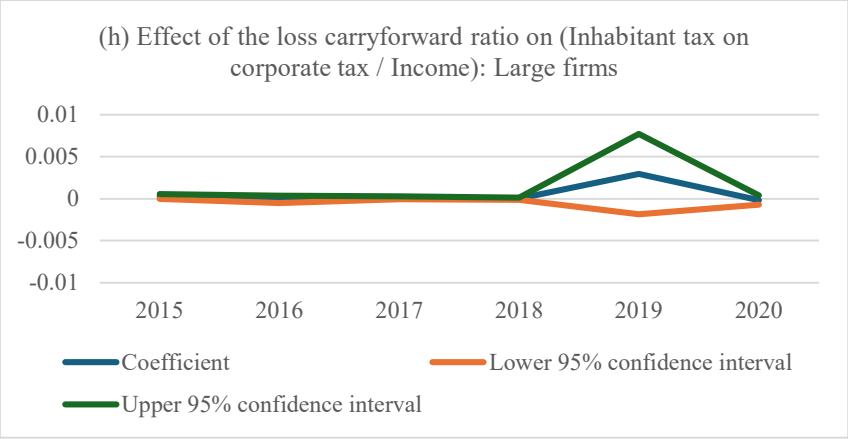


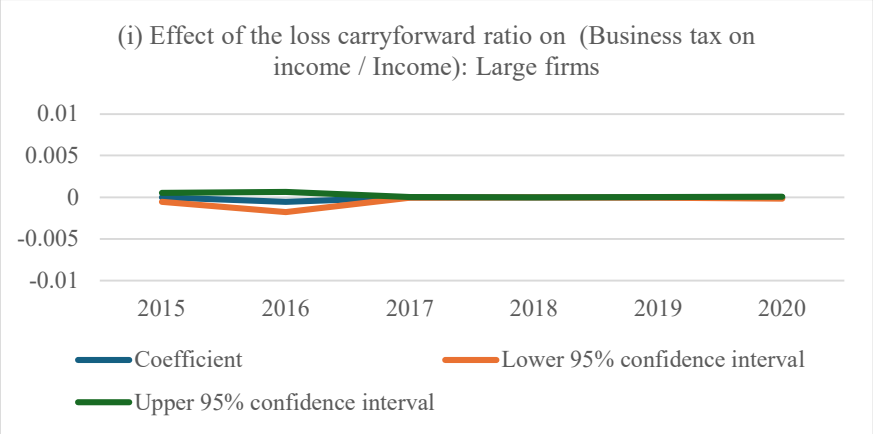

(d) Effect of the loss carryforward ratio on (Business tax on income / Income): SMEs
0.01
0.005
0
-0.005
-0.01
2015
2016
2017
2018
2019
2020
Coefficient
Lower 95% confidence interval
Upper 95% confidence interval


(e) Effect of the loss carryforward ratio on (Income / Pre-tax profit) : SMEs
0
-0.2
-0.4
-0.6
2015
2016
2017
2018
2019
2020
Coefficient
Lower 95% confidence interval
Upper 95% confidence interval


(f) Effect of the loss carryforward ratio on (Corporate tax before special deductions / Income): Large firms
0.01
0.005
0
-0.005
-0.01
2015
2016
2017
2018
2019
2020
Coefficient
Lower 95% confidence interval
Upper 95% confidence interval


(g) Effect of the loss carryforward ratio on (Special deductions / Income): Large firms
0.01
0.005
0
-0.005
-0.01
2015
2016
2017
2018
2019
2020
Coefficient
Lower 95% confidence interval
Upper 95% confidence interval


(h) Effect of the loss carryforward ratio on (Inhabitant tax on corporate tax / Income): Large firms
0.01
0.005
0
-0.005
-0.01
2015
2016
2017
2018
2019
2020
Coefficient
Lower 95% confidence interval
Upper 95% confidence interval


(i) Effect of the loss carryforward ratio on (Business tax on income / Income): Large firms
0.01
0.005
0
-0.005
-0.01
2015
2016
2017
2018
2019
2020
Coefficient
Lower 95% confidence interval
Upper 95% confidence interval

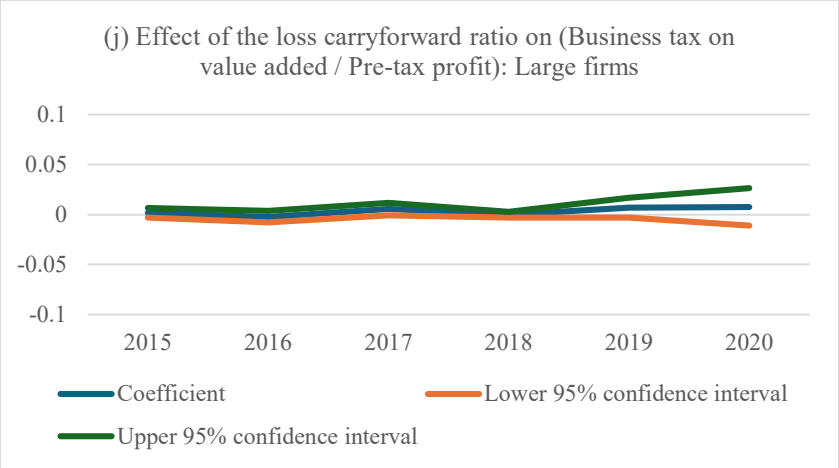
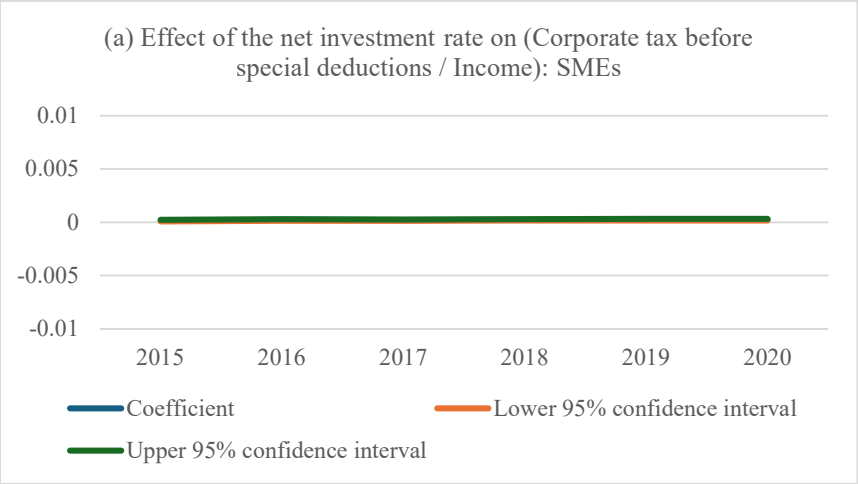
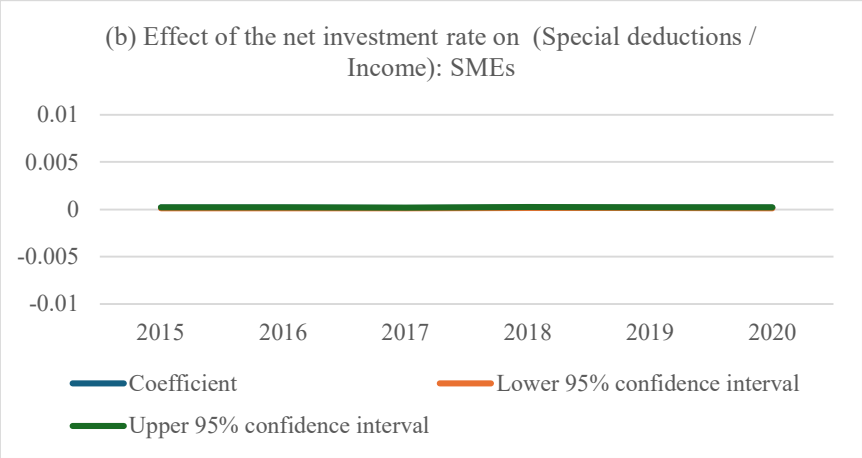
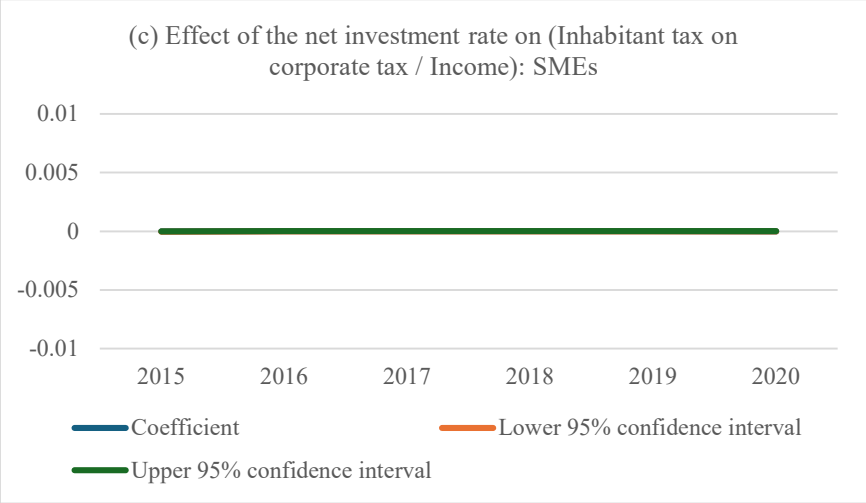
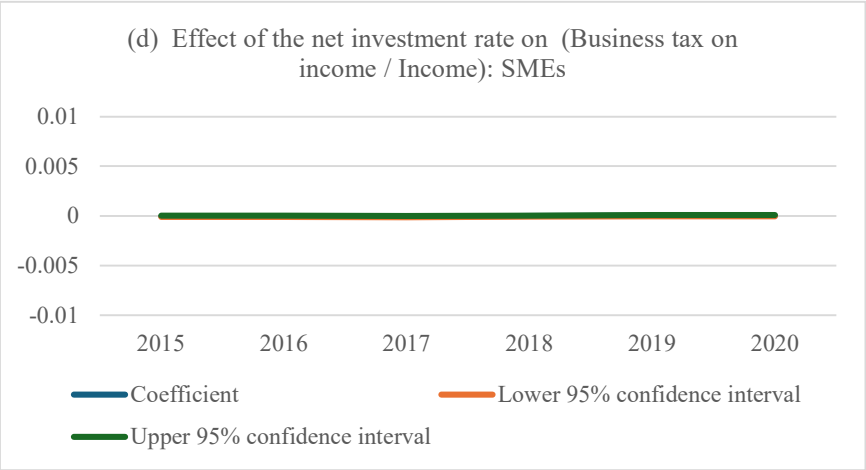

(j) Effect of the loss carryforward ratio on (Business tax on value added / Pre-tax profit): Large firms
0.1
0.05
0
-0.05
-0.1
2015
2016
2017
2018
2019
2020
Coefficient
Lower 95% confidence interval
Upper 95% confidence interval

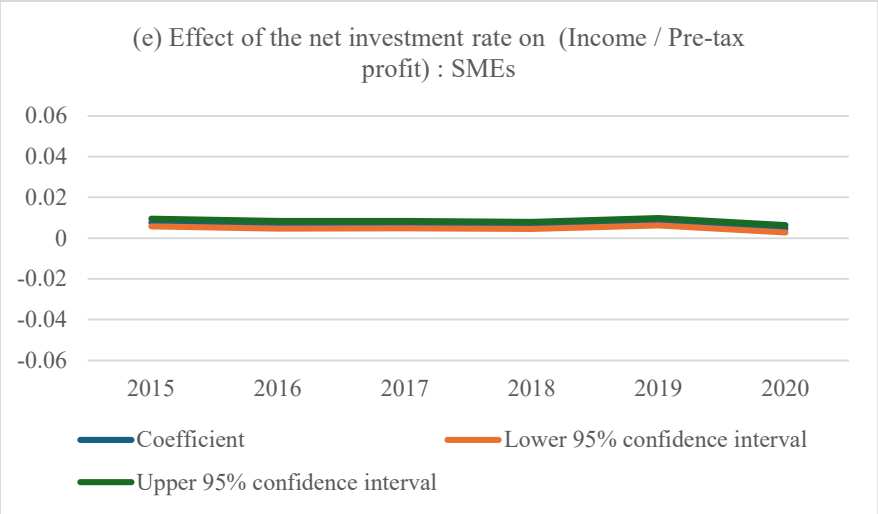
Figure A4 Estimated effect of the net investment rate on the components of ETR

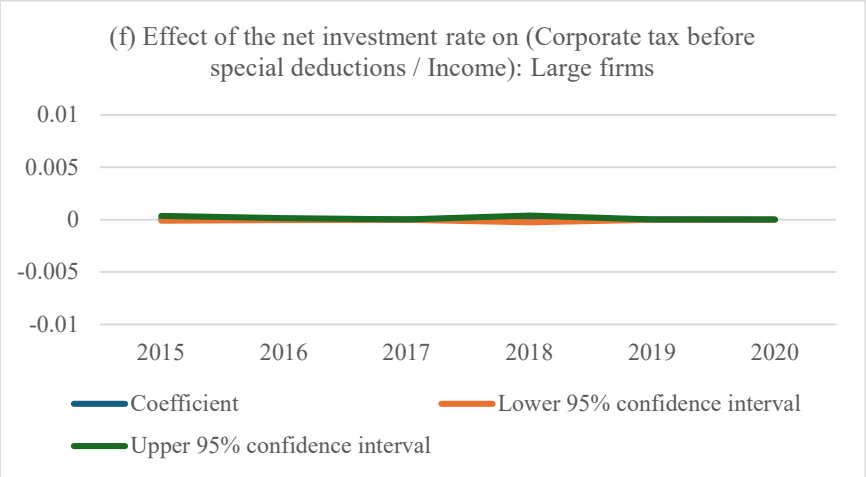


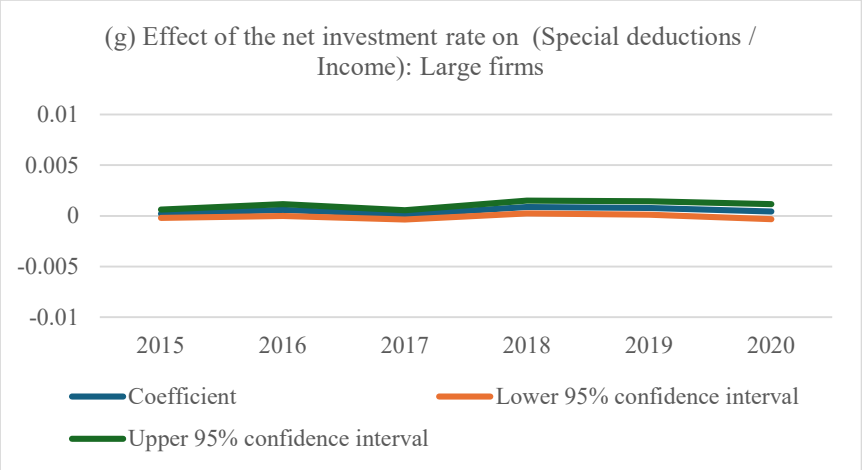


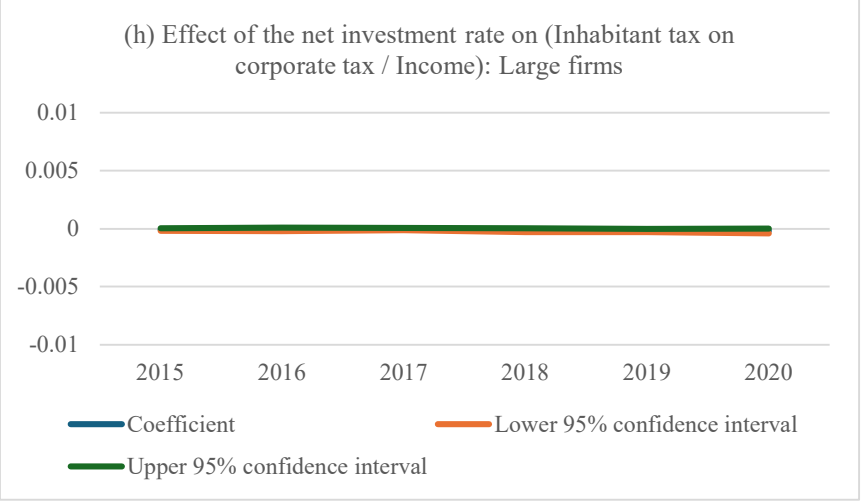


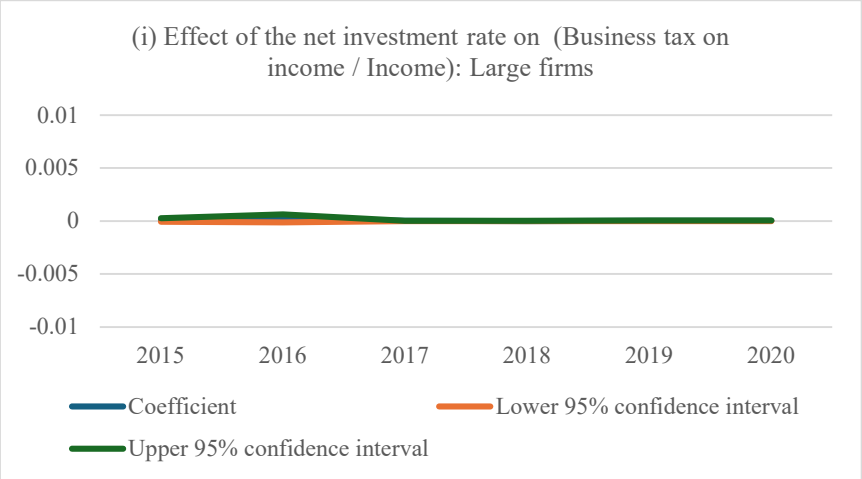

(d) Effect of the net investment rate on (Business tax on income / Income): SMEs
0.01
0.005
0
-0.005
-0.01
2015
2016
2017
2018
2019
2020
Coefficient
Lower 95% confidence interval
Upper 95% confidence interval

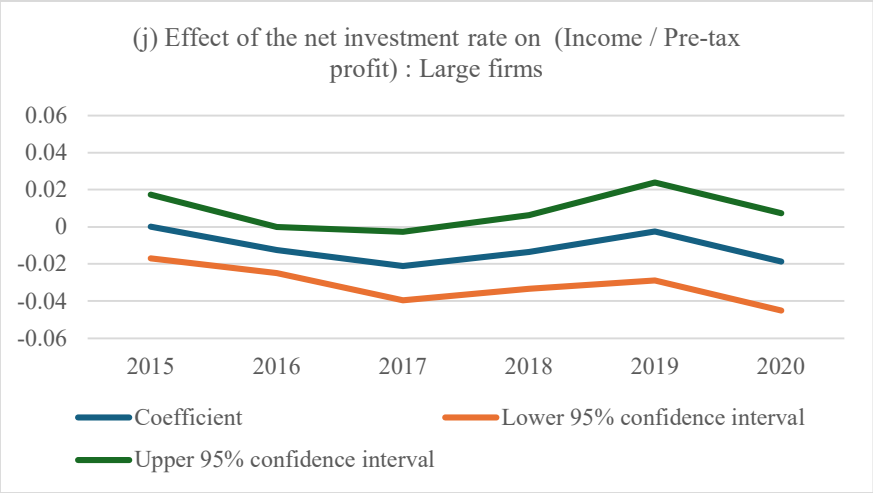

(e) Effect of the net investment rate on (Income / Pre-tax profit) : SMEs
0.06
0.04
0.02
0
-0.02
-0.04
-0.06
2015
2016
2017
2018
2019
2020
Coefficient
Lower 95% confidence interval
Upper 95% confidence interval

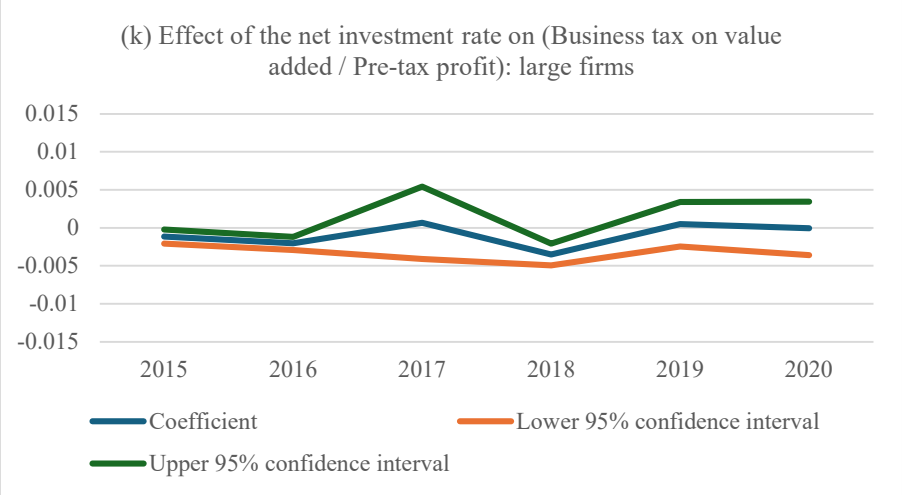

(f) Effect of the net investment rate on (Corporate tax before special deductions / Income): Large firms
0.01
0.005
0
-0.005
-0.01
2015
2016
2017
2018
2019
2020
Coefficient
Lower 95% confidence interval
Upper 95% confidence interval


(g) Effect of the net investment rate on (Special deductions / Income): Large firms
0.01
0.005
0
-0.005
-0.01
2015
2016
2017
2018
2019
2020
Coefficient
Lower 95% confidence interval
Upper 95% confidence interval


(h) Effect of the net investment rate on (Inhabitant tax on corporate tax / Income): Large firms
0.01
0.005
0
-0.005
-0.01
2015
2016
2017
2018
2019
2020
Coefficient
Lower 95% confidence interval
Upper 95% confidence interval


(i) Effect of the net investment rate on (Business tax on income / Income): Large firms
0.01
0.005
0
-0.005
-0.01
2015
2016
2017
2018
2019
2020
Coefficient
Lower 95% confidence interval
Upper 95% confidence interval


(j) Effect of the net investment rate on (Income / Pre-tax profit) : Large firms
0.06
0.04
0.02
0
-0.02
-0.04
-0.06
2015
2016
2017
2018
2019
2020
Coefficient
Lower 95% confidence interval
Upper 95% confidence interval


(k) Effect of the net investment rate on (Business tax on value added / Pre-tax profit): large firms
0.015
0.01
0.005
0
-0.005
-0.01
-0.015
2015
2016
2017
2018
2019
2020
Coefficient
Lower 95% confidence interval
Upper 95% confidence interval

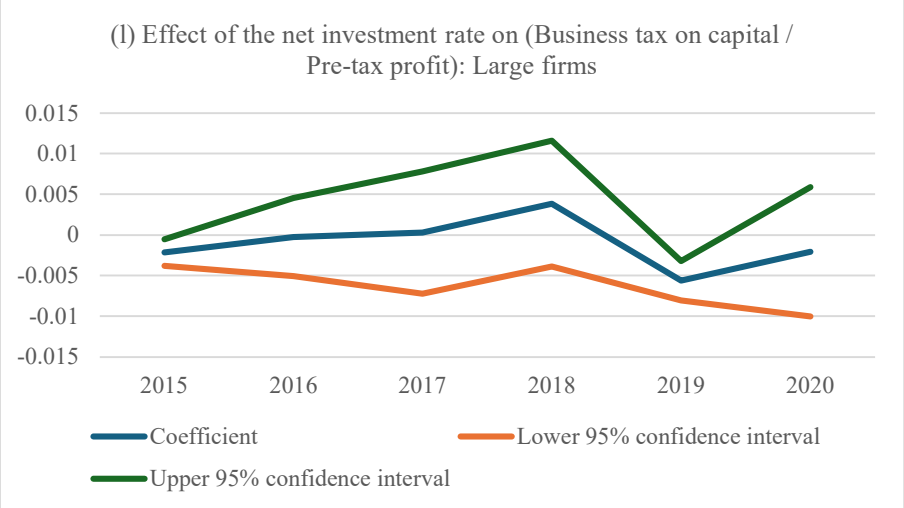
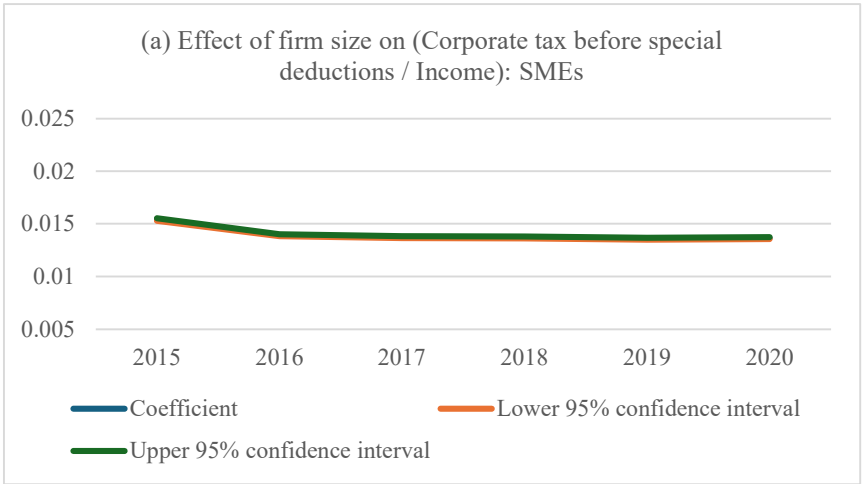
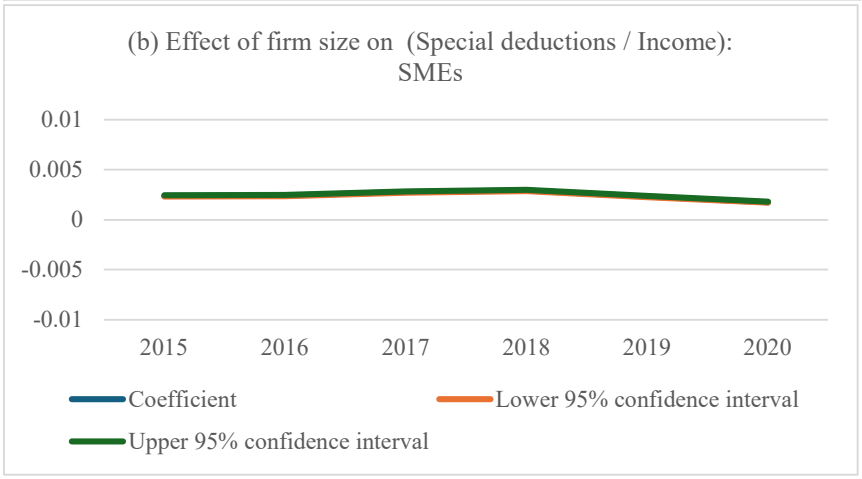
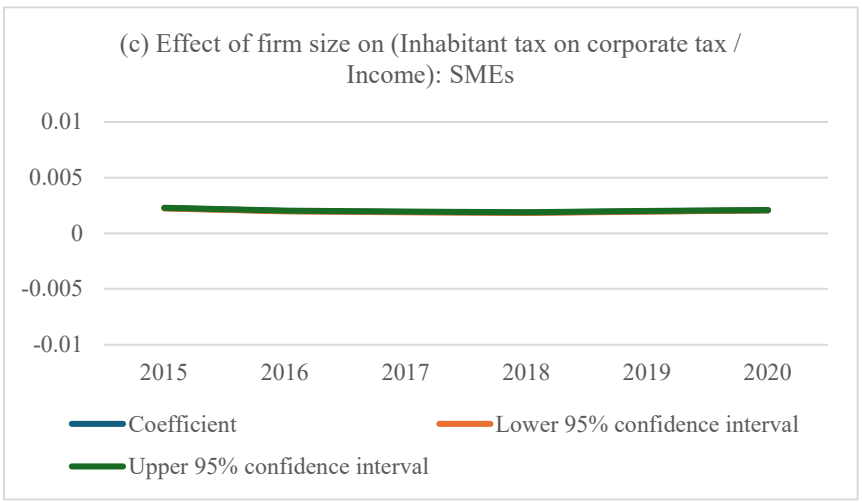
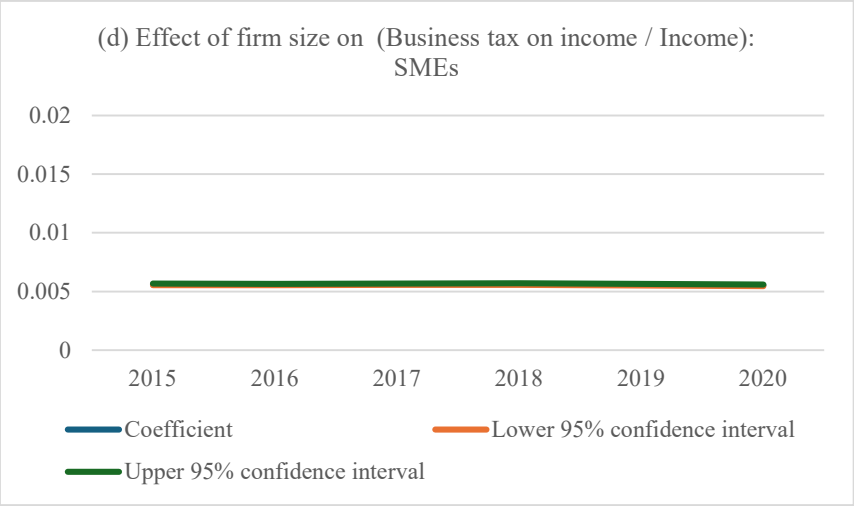

(l) Effect of the net investment rate on (Business tax on capital / Pre-tax profit): Large firms
0.015
0.01
0.005
0
-0.005
-0.01
-0.015
2015
2016
2017
2018
2019
2020
Coefficient
Lower 95% confidence interval
Upper 95% confidence interval

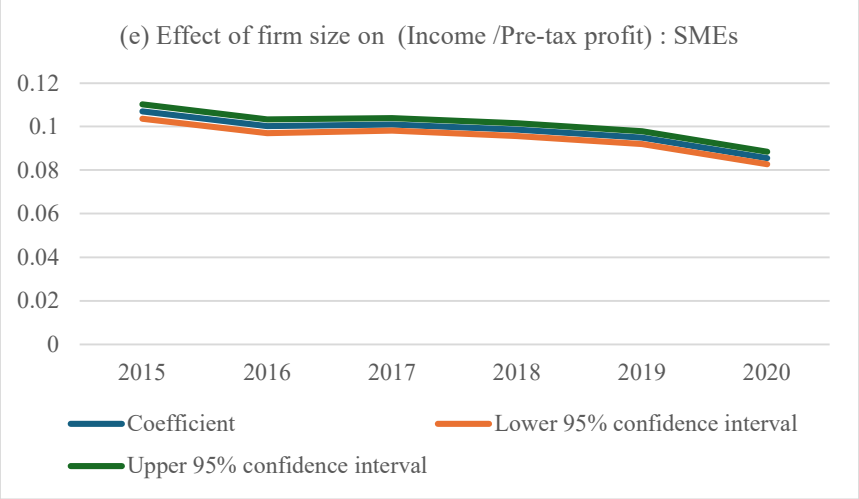
Figure A5 Estimated effect of firm size on the components of ETR

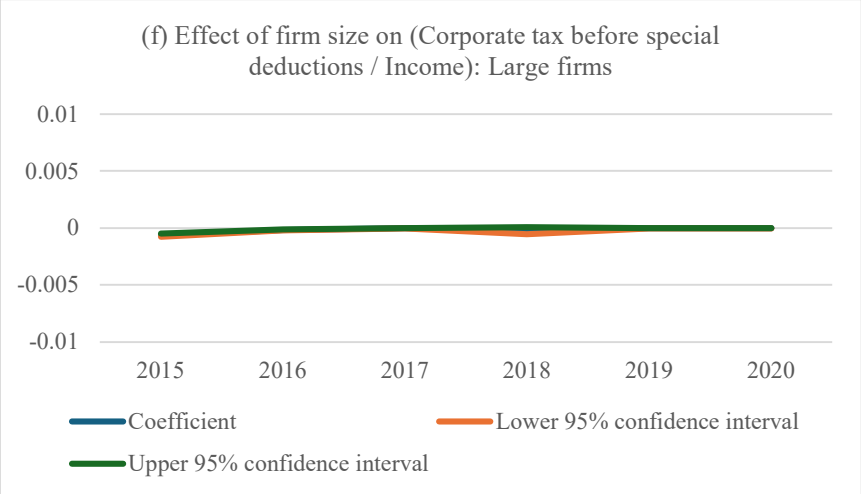


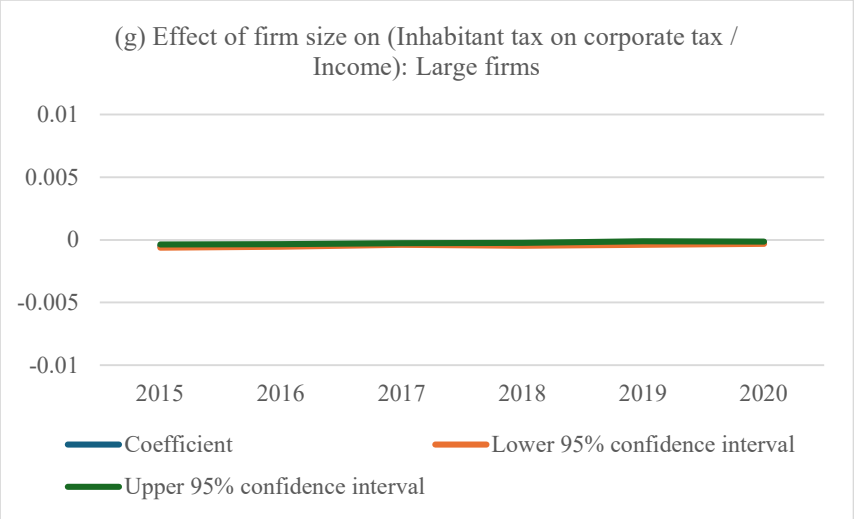


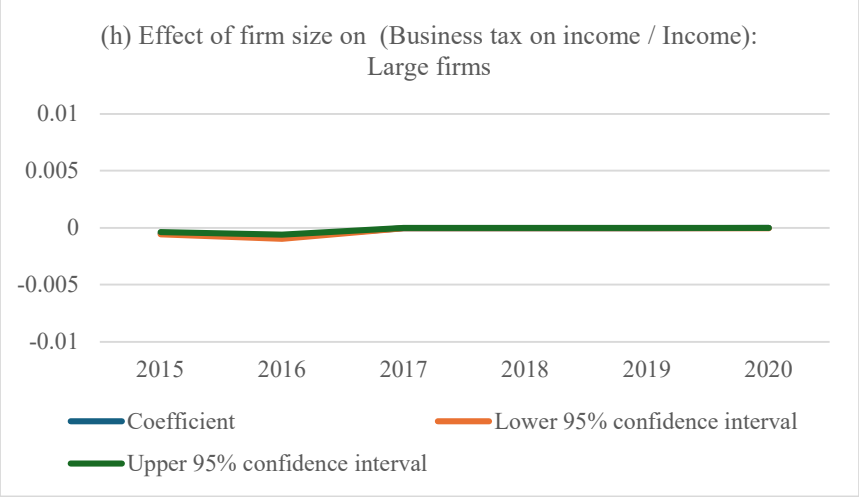



(d) Effect of firm size on (Business tax on income / Income): SMEs
0.02
0.015
0.01
0.005
0
2015
2016
2017
2018
2019
2020
Coefficient
Lower 95% confidence interval
Upper 95% confidence interval


(e) Effect of firm size on (Income /Pre-tax profit) : SMEs
0.12
0.1
0.08
0.06
0.04
0.02
0
2015
2016
2017
2018
2019
2020
Coefficient
Lower 95% confidence interval
Upper 95% confidence interval


(f) Effect of firm size on (Corporate tax before special deductions / Income): Large firms
0.01
0.005
0
-0.005
-0.01
2015
2016
2017
2018
2019
2020
Coefficient
Lower 95% confidence interval
Upper 95% confidence interval


(g) Effect of firm size on (Inhabitant tax on corporate tax / Income): Large firms
0.01
0.005
0
-0.005
-0.01
2015
2016
2017
2018
2019
2020
Coefficient
Lower 95% confidence interval
Upper 95% confidence interval


(h) Effect of firm size on (Business tax on income / Income): Large firms
0.01
0.005
0
-0.005
-0.01
2015
2016
2017
2018
2019
2020
Coefficient
Lower 95% confidence interval
Upper 95% confidence interval

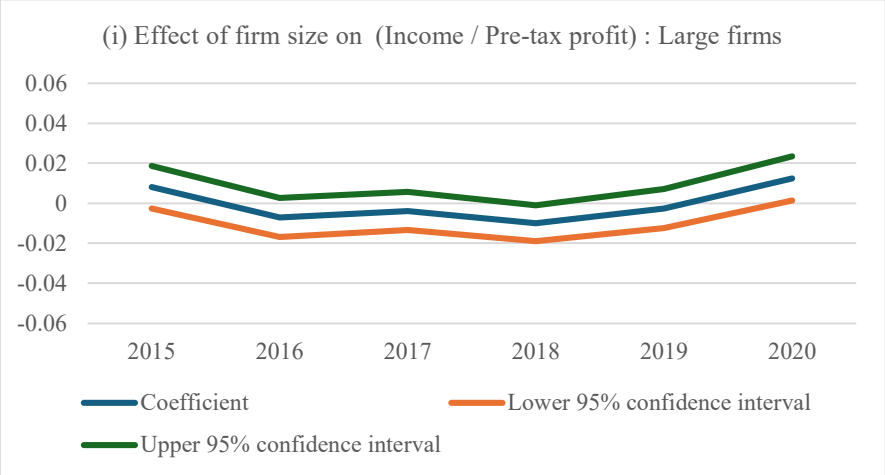
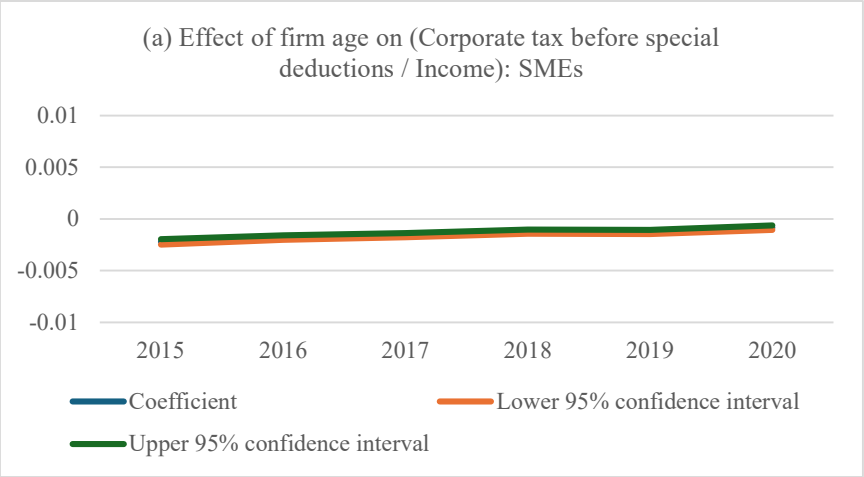
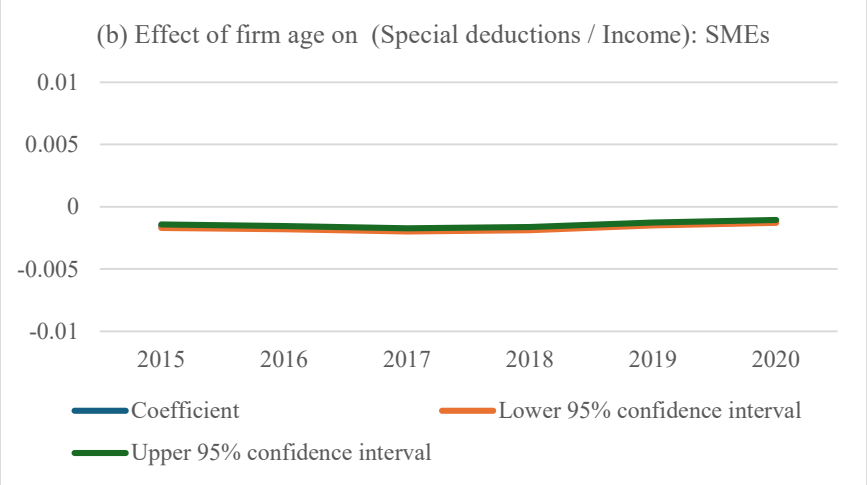
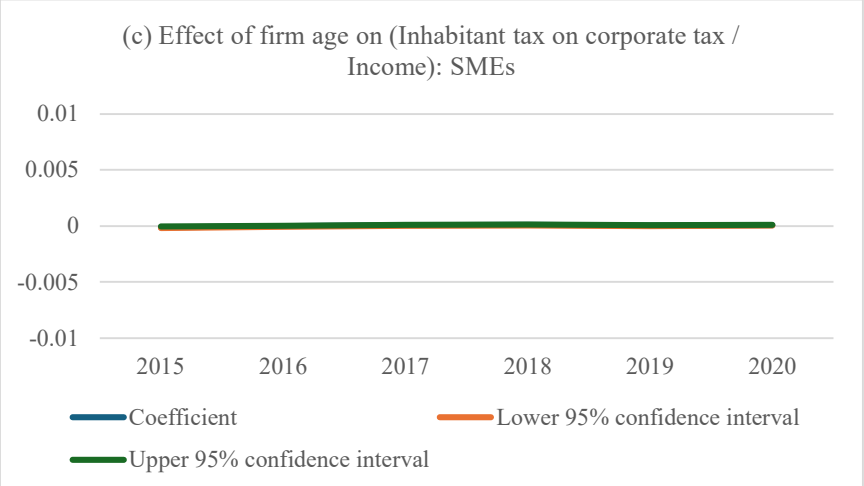
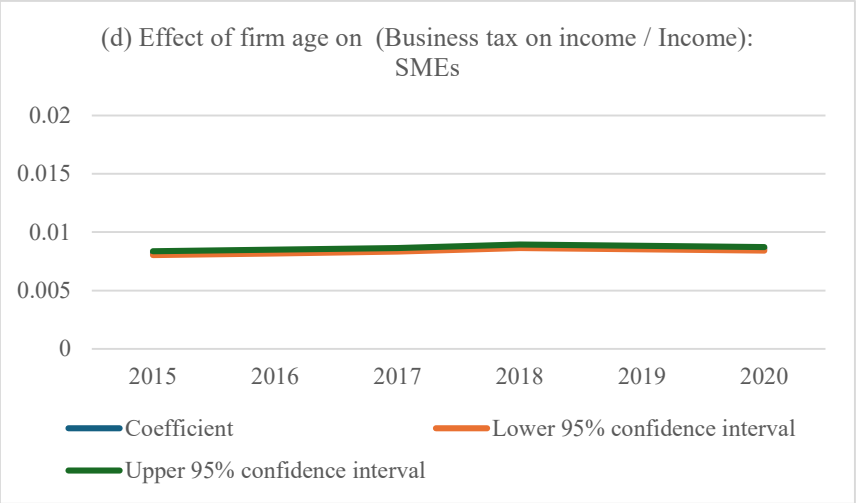

(i) Effect of firm size on (Income / Pre-tax profit) : Large firms
0.06
0.04
0.02
0
-0.02
-0.04
-0.06
2015
2016
2017
2018
2019
2020
Coefficient
Lower 95% confidence interval
Upper 95% confidence interval

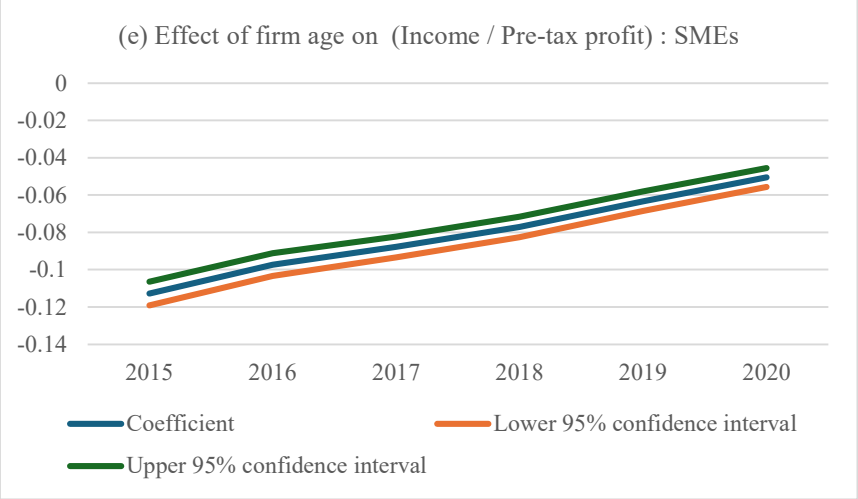
Figure A6 Estimated effect of firm age on the components of ETR

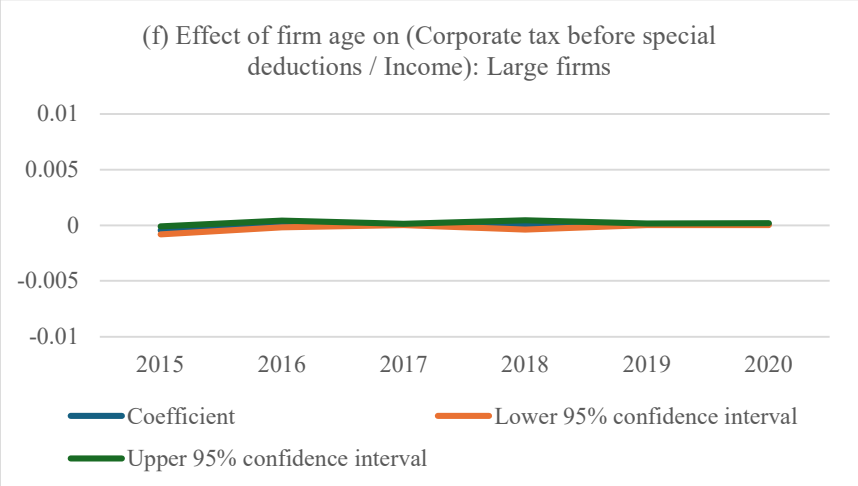


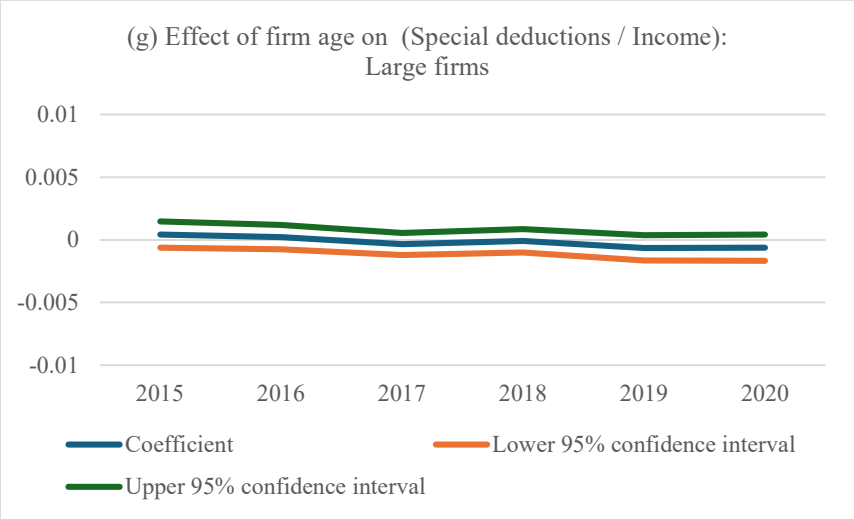


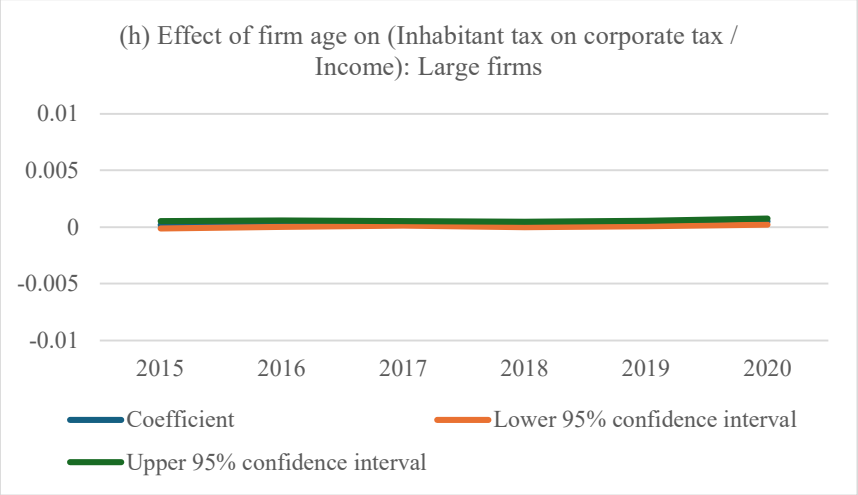


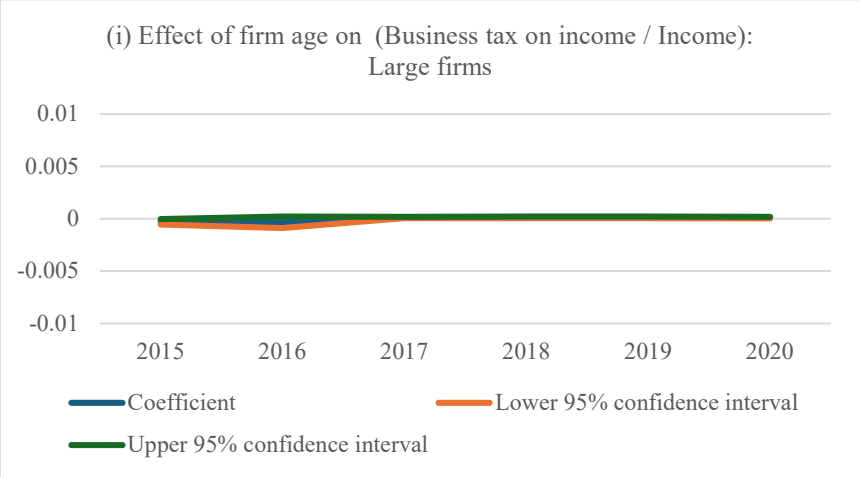

(d) Effect of firm age on (Business tax on income / Income): SMEs
0.02
0.015
0.01
0.005
0
2015
2016
2017
2018
2019
2020
Coefficient
Lower 95% confidence interval
Upper 95% confidence interval

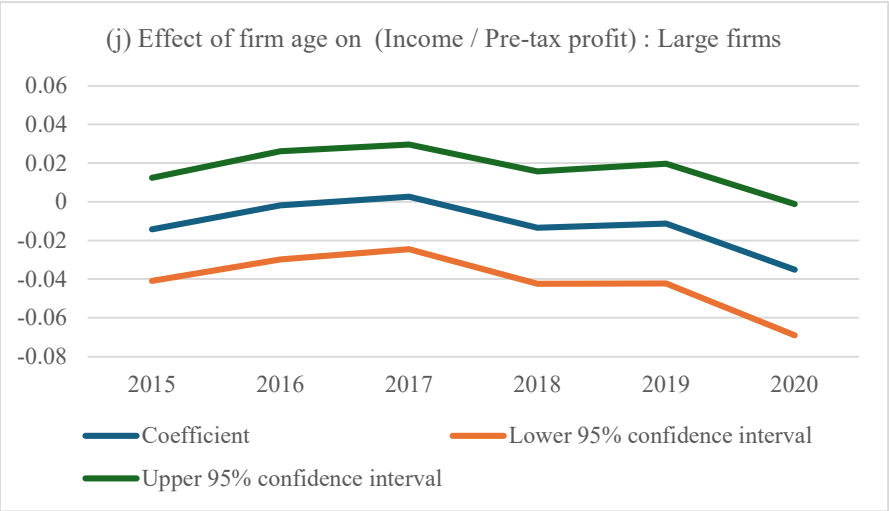

(e) Effect of firm age on (Income / Pre-tax profit) : SMEs
0
-0.02
-0.04
-0.06
-0.08
-0.1
-0.12
-0.14
2015
2016
2017
2018
2019
2020
Coefficient
Lower 95% confidence interval
Upper 95% confidence interval

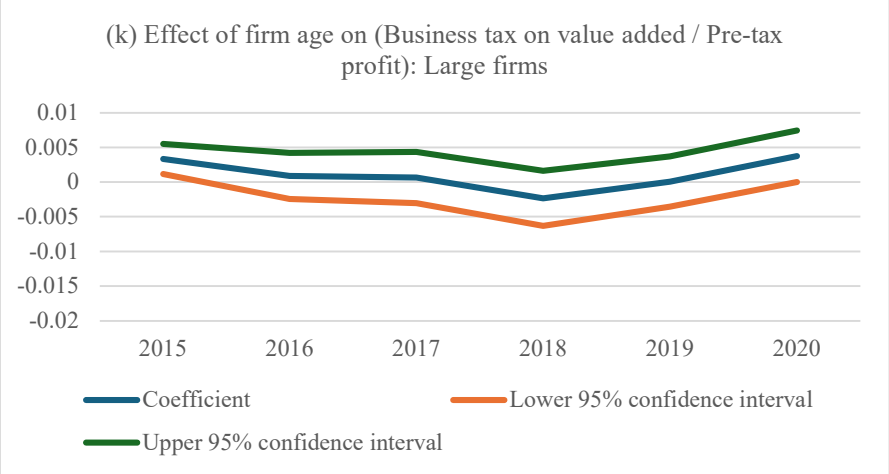

(f) Effect of firm age on (Corporate tax before special deductions / Income): Large firms
0.01
0.005
0
-0.005
-0.01
2015
2016
2017
2018
2019
2020
Coefficient
Lower 95% confidence interval
Upper 95% confidence interval


(g) Effect of firm age on (Special deductions / Income): Large firms
0.01
0.005
0
-0.005
-0.01
2015
2016
2017
2018
2019
2020
Coefficient
Lower 95% confidence interval
Upper 95% confidence interval


(h) Effect of firm age on (Inhabitant tax on corporate tax / Income): Large firms
0.01
0.005
0
-0.005
-0.01
2015
2016
2017
2018
2019
2020
Coefficient
Lower 95% confidence interval
Upper 95% confidence interval


(i) Effect of firm age on (Business tax on income / Income): Large firms
0.01
0.005
0
-0.005
-0.01
2015
2016
2017
2018
2019
2020
Coefficient
Lower 95% confidence interval
Upper 95% confidence interval


(j) Effect of firm age on (Income / Pre-tax profit) : Large firms
0.06
0.04
0.02
0
-0.02
-0.04
-0.06
-0.08
2015
2016
2017
2018
2019
2020
Coefficient
Lower 95% confidence interval
Upper 95% confidence interval


(k) Effect of firm age on (Business tax on value added / Pre-tax profit): Large firms
0.01
0.005
0
-0.005
-0.01
-0.015
-0.02
2015
2016
2017
2018
2019
2020
Coefficient
Lower 95% confidence interval
Upper 95% confidence interval