Microeconometric Analyses on Corporate Public Burdens

by

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Abstract

The purpose of this thesis is revealing corporate response to public burdens such as corporate tax and social security contributions by utilizing microeconometric methods. Japan, which is facing rapid population aging, must balance a sustainable social security system with economic vigor. Since companies are vital bearers of economic growth and vibrancy, it is really important to reveal corporate behavior and find a sure way of not disturbing economy. This thesis empirically estimates the effect of public burdens on corporate behavior, research and development tax credits for small- and medium-sized enterprises, and social security contributions on employment. The structure and contents of the chapters are described below.

Chapter 1 Previous Studies on the Corporate Public Burdens and Overview of the Thesis

Many theoretical and empirical studies have investigated the effect of public burdens on corporate behavior. Chapter 1 summarizes such previous related studies and shows motivations of this thesis. In the end of this chapter, the structure of this thesis is summarized. The contents and aims of the following chapters are briefly introduced.

Chapter 2 Public Burdens and Corporate Behavior: An Empirical Analysis using Survey Data

In Chapter 2, we analyze the various effects of public burdens on corporate behavior with due consideration to the difference between social insurance contributions and corporate taxes, capital stock adjustments, and employment adjustments (regular and non-regular employees). Based on survey data, we estimate corporate response function to

changes in public burdens using Seemingly Unrelated Regression. Empirical results can be summarized as follows: (1) Corporations handle the increase of public burdens in a variety of ways, not only wage reduction. (2) The changes in social insurance contributions have a large influence on the wages and employment of regular workers. On the other hand, corporate taxes have an impact on investment and research & development (R&D). (3) There exist differences in employment adjustment between part-time, regular, and dispatched workers. (4) Corporations tend to deal with the changes in public burdens by reducing their own profits in the short run. In the medium run, however, they tend to cut employment, curb investment, or raise prices.

Chapter 3 Effect of R&D Tax Credits for SMEs in Japan: A Microeconometric Analysis Focused on Liquidity Constraints

Chapter 3 estimates the effect of research and development (R&D) tax credits for small- and medium-sized enterprises (SMEs) by utilizing propensity score matching method to correct any possible selection bias. This study also examines whether the impact of tax credits differs with firms' characteristics such as their industry, size, and liquidity constraints. Empirical results show that R&D tax credits induce an increase in SMEs' R&D expenditures. Moreover, we find that the effect of R&D tax credits on liquidity-constrained firms is much greater than on unconstrained firms.

Chapter 4 Social Security Contributions and Employment Structure: A microeconometric analysis focused on firm characteristics

Chapter 4 empirically estimates the effect of the social security burden on the employment level and structure in Japan, using firm-level microdata matched with social security insurance data. In particular, we use dynamic panel data methods to estimate

labor demand functions and thereby evaluate the degree to which social security contributions influence corporate labor demand. We specifically examine the impact of firm characteristics such as the presence of labor unions and the intensity of competition in the product market. Our empirical results indicate that social security contributions do not have a statistically significant impact on employment. However, companies that face harsh competition in their product and labor markets tend to substitute non-regular workers for regular ones in response to an increase in social security contribution rates.

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Contents

Chapter 1
Previous Studies on the Corporate Public Burdens and Overview of the Thesis

1 Introduction

The purpose of this thesis is revealing corporate response to public burdens such as corporate tax and social security contributions (SSCs hereafter) by utilizing microeconometric methods. Japan, which is facing rapid population aging, must balance a sustainable social security system with economic vigor. Since companies are vital bearers of economic growth and vibrancy, it is really important to reveal corporate behavior and find a sure way of not disturbing economy.

This chapter summarizes such previous related studies and shows motivations of this thesis. In the end of this chapter, the structure of this thesis is summarized.

2 Literature Review

2.1 Government Size, Tax Structures, and Economic Growth

Many theoretical and empirical studies have investigated the effect of public burdens on economy and corporate behavior. Atkinson (1995) summarizes the relationship between government size and economic growth and points out that it is unclear whether larger government disturbs economic growth or not. Bergh and Henrekson (2011), however, reviews recent existing researches utilizing panel data analyses and conclude that 10% increase of government size significantly decreases economic growth rate by 0.5%-1.0%.

Trabandt and Uhlig (2011) estimate the Laffer curves of western countries. According to

their quantitative results, some Nordic countries such Denmark and Sweden are on the wrong side of the Laffer curve for capital income taxation. Nutahara (2015) also calculates the Laffer curves in Japan based on the model proposed by Trabandt and Uhlig (2011). Nutahara (2015) finds that the capital tax rate is either very close to, or larger than, that at the peak of the Laffer curve in Japan. In addition, he points out that the government should increase the labor tax rate but decrease the capital tax rate to maximize government revenue.

Arnold (2008) examines the relationship between tax structures and economic growth by using panel growth regressions for OECD countries and concludes that corporate income taxes appear to have the most negative effect on GDP per capita.

2.2 Social Security Contributions and Corporate Behavior

Since the size of government and tax structures including SSCs are prime determinates of economic growth, it is essential to reveal how companies, the primary drivers of economic growth, are affected by public burdens such as taxes and SSCs, especially for Japan which faces rapid population aging.

A number of empirical researches concerning corporate public burden have been conducted abroad, especially in the U.S. and Europe. Brittain (1971) estimates the labor demand function using cross-country data, while Holmlund (1983), using Swedish time-series data for 1950–1979, shows that half of payroll tax had been shifted back to wages. Gruber and Krueger (1991) also conclude that contributions by employers to Workers' Compensation Insurance had been shifted back to insured (employees) in the form of wage reductions, based on industry-level data in the United States. Baicker and Chandra (2006) empirically analyze the effect of SSCs cost burden on employment levels and non-regular worker employment. They confirm that a 10% increase in health insurance

contributions reduces the aggregate probability of being employed by 1.2% points, reduces hours worked by 2.4% points, and increases the likelihood that a worker is employed only part-time by 1.9% points.

In Japan, on the other hand, there has been little empirical research done on corporate public burden—one reason for which may be data constraints. However, a variety of studies have begun to appear in recent years that concern SSCs shifting and incidence. For example, by using industrial-level data, Tachibanaki and Yokoyama (2008) explore the relationship between SSCs and backward shifting to employees' wages. Similarly, Komamura and Yamada (2004) and Iwamoto and Hamaaki (2006) examine the incidence of employers' contribution rates to social security using panel data on individual health insurance societies throughout Japan.

While these studies aimed to analyze the backward shifting of SSCs by estimating a reduced wage equation, Sakai (2006) investigates the incidence of payroll tax by utilizing the introduction of long-term care insurance in 2000 and that of the total remuneration system in 2003 (*sohoshusei*) as natural experiments and finds that the increase in payroll tax is shifted back to employers. Meanwhile, Miyazato and Ogura (2010) analyze the growth in non-regular workers and confirm that the gap between the wages paid to regular and non-regular workers' contracts. In summary, the consensus that most employers' contributions are shifting back to employees has been gradually building.

2.3 Corporate Tax Burden Shifting and Incidence

Harberger (1962) is a representative study on corporate tax burden shifting and incidence. This study assumes closed and static economy to analyze corporate tax incidence. Although little previous researches have been conducted on corporate tax burden shifting and incidence in Japan, Nishino (1998) shows the theoretical inference.

As an example of an empirical analysis, Gravelle and Smetters (2006) and Randolph (2006) numerically analyze the incidence of corporate tax based on a static general equilibrium model. Doi (2010) builds a simple dynamic general equilibrium model and conclude that corporate income tax burden falls entirely on workers over the long-term.

Other examples exist in the form of Uemura and Maekawa (2000) and Hamaaki (2008). Although they do not directly analyze corporate income tax burden shifting and incidence, they use a tax-adjusted Q model to examine the impact of tax burden on capital investment.

2.4 The Effect of R&D Tax Credits

Another important issue regarding corporate public burdens is tax credit. Since many governments utilize tax credits as instruments to encourage specific economic activities such as research and development (R&D), the effectiveness should be empirically examined. Numerous studies have evaluated the impact of tax credits on R&D. While Hall and van Reenen (2000) comprehensively summarize the related literature and conclude that a $1 tax credit for R&D induces about $1 of additional R&D expenditures, the number of empirical analyses examining the effectiveness of R&D tax credits is quite small in Japan.

Koga (2003), however, examines whether the elasticity of R&D tax credits for Japanese manufacturers from 1989 to 1998 varies with firm size. Onishi and Nagata (2010) apply difference-in-differences-PSM (DID-PSM) to estimate the impact of R&D tax credits on Japanese firms capitalized at ¥1 billion or more. However they find no evidence that R&D tax credits influence R&D expenditures. Kasahara et al. (2011) estimate the tax elasticity of R&D by utilizing the Japanese tax credit reform in 2003. Their empirical result shows that the decrease in the effective rate of R&D tax credits induces an increase in R&D expenditures.

Instead of evaluating the effects of tax credits on R&D expenditures, Czarnitzki et al.

(2011) estimate their effects on innovation in their study of Canadian manufacturers from 1997 to 1999. They find that tax credits encourage firms to conduct R&D and to create and sell new and improved products.

3 Structure of the Thesis

This thesis empirically estimates the effect of public burdens on corporate behavior, research and development tax credits for small- and medium-sized enterprises, SSCs on employment. In Chapter 2, we analyze the various effects of public burdens on corporate behavior with due consideration to the difference between SSCs and corporate taxes, capital stock adjustments, and employment adjustments (regular and non-regular employees).

Chapter 3 estimates the effect of R&D tax credits for small- and medium-sized enterprises by utilizing propensity score matching method to correct any possible selection bias. This chapter also examines whether the impact of tax credits differs with firms' characteristics such as liquidity constraints.

Chapter 4 empirically estimates the effect of the social security burden on the employment level and structure in Japan, using firm-level microdata matched with social security insurance data. In particular, we use dynamic panel data methods to estimate labor demand functions and thereby evaluate the degree to which SSCs influence corporate labor demand. This chapter also examines the impact of firm characteristics such as the presence of labor unions and the intensity of competition in the product market.

This thesis includes materials from two papers that the author co-authored. Chapter 2 and Chapter 4 are based on Kobayashi et al. (2015) and Kobayashi et al. (2013), respectively. These two papers are co-authored with Koichi Kume, Keita Oikawa, and Tetsuro Sone.

Chapter 2
Public Burden and Corporate Behavior: An Empirical Analysis using Survey Data

1 Introduction

As a society experiencing a rapidly declining fertility rate and aging population, Japan stands out among other countries for the urgency with which it must act to reform public finance and social security systems. Accommodating ballooning social security expenditures necessitated by the country's aging population will require people paying more in taxes and for social security contributions (SSCs hereafter). However, given current predictions for a decline in the potential growth rate as a result of Japan's shrinking labor force, it will be important to increase taxes and SSCs to an extent that avoids the stunting of economic growth. It is therefore essential to conduct empirical analyses in order to reveal how companies, the primary drivers of economic growth, are affected by changes to tax rates and SSC rates.

A number of empirical researches concerning corporate public burden such as taxes and SSCs have been conducted abroad, especially in the U.S. and Europe. However, a variety of studies have begun to appear in recent years that concern SSCs shifting and incidence. These studies utilize macroeconomic wage data, industry-specific data, health insurance society-specific data, or companies' financial data. Although there have been very few empirical analyses focusing on corporate tax burden shifting and incidence, some simulation studies are coming out.

Even though some research results concerning the effects of corporate public burden in

Japan have appeared, some remaining issues should be addressed. The first concerns the analysis of the broad effects of corporate public burden. Much of the existing researches in Japan focus on the shift of SSC cost to wages. But in fact, SSC rate changes can potentially impact not only wages but also employment levels, investment, and R&D. The second issue, which relates to the first, is the impact on output and input prices. If companies' production costs rise, they may respond through means that include passing on the cost to output prices[1] or input price. The third issue relates to adjustment time. If SSC and corporate tax rates change, the adjustment cost involved means that companies do not always necessarily adjust employee numbers or investment. However, much of the current research ignore time lag and adjustment cost. The fourth issue is heterogeneous response depending on company characteristics. For example, although it is possible that companies will adopt different methods of absorbing a corporate public burden based on their size and financial conditions, existing researches only analyze at the average corporate behavior following changes in SSC rates.

This chapter investigates the above-mentioned issues by using firm-level microdata matched with survey. We will examine following hypotheses concerning public burden and corporate behavior. The hypotheses are: 1. changes in corporate public burden are absorbed by direct means; 2. changes in corporate public burden are passed on taking into account adjustment cost; 3. companies facing liquidity constraints weigh heavily cash on hand; 4. companies with strong bargaining power shift public cost burden to third parties; 5. companies operating overseas tend not to change profit levels; 6. companies with high foreign capital ratios value profits; 7. companies with high non-regular employment rates prioritize adjustment by way of non-regular employment; and 8. companies with high

[1] Adding the social insurance premium burden imposed on the company to the price of its goods and services and thereby passing the cost on to general consumers is known as forward shifting. Passing this cost on to workers is known as backward shifting.

average wages tend not to adjust worker numbers or wages.

Structure of this chapter is as follows. The next section provides an overview of empirical analyses involving corporate public burden in Japan. Section 3 elaborates on the framework for analysis used in this chapter and explains the eight hypotheses examined herein. Section 4 presents estimation results, and concluding remarks are provided in Section 5.

2 Literature Review

This section reviews previous empirical researches concerning corporate public burden in Japan, with a focus on analyses pertaining to SSCs burden shifting and incidence that have been conducted as part of research in recent years.

Komamura and Yamada (2004) established panel data at the health insurance society level and estimated reduced-form wage function. The conclusion posited that a premium payed by employers was no totally passed on to the employees. Tachibanaki and Yokoyama (2008) also estimated reduced-form wage function. Estimation results concluded that the portion of insurance premiums paid by employees was absorbed by the employers, an entirely different conclusion than that arrived at in Komamura and Yamada (2004). Iwamoto and Hamaaki (2006) and Hamaaki and Iwamoto (2010) conducted critical re-examinations of the above two analyses. With respect to Komamura and Yamada (2004), these studies pointed out the possibility of reverse causality which wages have an impact on insurance premium rates and empirically confirmed it. With respect to Tachibanaki and Yokoyama (2008), they identify a time trend for real wages and SSC rates and points out the possibility of the spurious correlation. After controlling for trends and re-estimating the wage functions, they find that the coefficient indicating the impact of insurance premium on wages becomes insignificant.

The studies above analyze the incidence of a public cost burden on wages by estimating

the reduced-form wage function in which SSCs are included as an explanatory variable. Sakai (2006) empirically analyzes the impact on wages of increases and decreases in the employer's contribution in real terms through the implementation of the total remuneration system in April, 2003. The estimation results found that an increase in the employer's burden in real terms through the implementation of the total remuneration system had a significant and negative impact on wages[2]. Sakai (2006) also looks at corporate survey to analyze wage and employment adjustment behavior at companies confronting employer's contribution increases. It concluded that (1) when the employer's contribution increases, it is difficult for companies to both reduce base salary and adjust employment levels, and (2) the methods for managing corporate burden depend on industry characteristics and the company's business conditions. Miyazato and Ogura (2010) focus their attention on the wages of non-regular employees. In Japan, almost non-regular employees such as part time workers are not required to enroll in the social insurance program, and SSC rate increases raise the unit labor cost for regular employees. But because such increases do not impact on non-regular employees, companies may hire more non-regular employees due to their relatively cheaper cost. The study concludes that increase of SSC burden shrink the wage gap between regular employees and non-regular employees. Kim (2008) uses employee benefit cost data of listed companies as a proxy variable for SSCs[3] to examine whether or not increase of employee benefit cost decrease employment, and the conclusion finds that it does. Kobayashi et al. (2013) analyzes the impact of SSCs on employment levels. It finds that certain companies, among them those facing stiff competition in the business market

[2] However, judgment concerning the results must be reserved as it is likely that bonuses will be determined based on corporate performance or other factors unrelated to increases or decreases in the employer's contribution.

[3] As companies may respond to social insurance premium increases by cutting nonstatutory fringe benefit costs, we will need to reconsider whether or not it is a good thing to use fringe benefit costs as a proxy variable for social insurance premiums.

and those with no labor union, employ fewer regular employees and employ more part-time workers in response to SSC burden increases.

Although little previous researches have been conducted on corporate tax burden shifting and incidence in Japan, Nishino (1998) shows the theoretical inference. As an example of an empirical analysis, Doi (2010) built a simple dynamic general equilibrium model and conducted a simulation analysis of corporate tax burden shifting and incidence. These results led Doi (2010) to conclude that corporate income tax burden falls entirely on workers over the long-term. Other examples exist in the form of Uemura and Maekawa (2000) and Hamaaki (2008). Although they do not directly analyze corporate income tax burden shifting and incidence, they use a tax-adjusted Q model to examine the impact of tax burden on capital investment.

As the above shows, for analyses concerning corporate behavior and public burden, more are focusing on the issue of passing on costs to the worker in the form of lowering wages and are looking at aspects such as the potential for companies' various adjustment methods in dealing with rising public cost burden, alternate modes of regular and non-regular employment, employment level adjustment, and capital investment. This chapter sheds light the characteristics of and various measures taken by companies towards fulfilling their public burden by using survey.

3 Empirical Strategy and Data

3.1 Data

Our Data are that match those from a companies' survey (hereinafter "The Survey") conducted by the Ministry of Economy, Trade and Industry, as well as the Basic Survey of Japanese Business Structure and Activities (hereinafter BSJBSA), conducted by the Ministry

of Economy, Trade, and Industry. The Survey was a questionnaire mailed out to all companies responded to the fiscal 2008 BSJBSA of Japanese Business Structure and Activities. The Survey ran from January 18 to February 22, 2010. Of the 29,080 companies that received questionnaires, valid responses were received from 3,986, for a 13.7% response rate.

This study quantitatively analyzed how companies responded to increase if SSCs over the previous five years and how they plan to absorb the burden and share profit if SSC burden increased in the future or if effective corporate tax rates went up or down. Specifically, it asked the companies to indicate the percentages (and ensure that they total 100%) of burden absorption for each of the following response measures: "increase the cost of products and services," "reduce raw material cost and cost price," "reduce worker wages," "cut capital investment and R&D investment," "employ fewer workers," and "reduce profits (capital share)"[4].

To gain details about what cuts companies made, the Survey asked about the percentage split between "regular employees" and "non-regular employees" when respondents chose "reduce worker wages" and "employ fewer workers." This allows for ascertaining the impact on not only employment levels and wages when public costs being borne by companies change, but also on the effects on regular/non-regular employment alternatives, capital investment and R&D investment, and forward shifting (shifting costs to output prices). Moreover, when faced with public cost burden increases, companies only readjust variable costs in the short term but may touch fixed costs over the medium- to long-term. The Survey also asks separate questions for short-term response and medium- to long-term responses, and examines the differences. Regarding cost burden and profit sharing

[4] For effective corporate tax rates decreases, choices were contrasting phrasing, e.g. "reduce the cost of products and services."

methods for public cost burden, this chapter examines average responses and quantitatively analyzes the kinds of differences that exist concerning company characteristics, i.e. company size, type of employment, profitability, and industry.

3.2 Estimation Model and Method

The Survey establishes several scenarios regarding changes in public costs borne by companies. This chapter discusses three such scenarios: (1) increases in the burden for SSCs (pensions and healthcare) over the previous five years, (2) increases in future SSC burden (a single year increase of 0.5% and a five-year increase of 5%), and (3) change in future effective corporate tax rates. A question example of (2) is shown in Appendix. Based on these scenarios, this chapter empirically analyzes corporate behavior by changes in public burdens such as SSC rates (pensions and healthcare) and corporate tax rate. We also investigate whether the corporate characteristics and market environments are determining factors in companies choosing between forward shifting (shifting costs to output prices) and backward shifting (shifting costs to workers). Specifically, we conduct regression analyses using companies' cost burden absorption or profit sharing ratio as the explained variables and corporate characteristics as the explanatory variable. We utilize Seemingly Unrelated Regression (SUR) estimations in order to take into account the possible existence of complementary and substitutive relationships in cost burden and profit sharing methods.

We assume that companies take following eight responses in response to changes in public burdens: 1) increase the output price, 2) decrease the input price, 3) reduce regular employee wages, 4) cut non-regular employee wages, 5) cut capital investment and R&D investment, 6) employ fewer regular employees, 7) employ fewer non-regular employees, and 8) reduce profits. Conversely, it expresses profit sharing ratio when public cost burden

decreases. In fact, we estimate eight functions simultaneously by using SUR.

The functions we estimate are as follow.

$$\boldsymbol{Response_{ij}} = \boldsymbol{X_i\beta_{1\ldots3}} + \boldsymbol{PS_i\beta_4} + \boldsymbol{dMF_i\beta_5} + \boldsymbol{EX_i\beta_6} + \boldsymbol{dAF_i\beta_7} + \boldsymbol{dAFA_i\beta_8} + \boldsymbol{FDI_i\beta_9}$$
$$+ \boldsymbol{FI_i\beta_{10}} + \boldsymbol{DT_i\beta_{11}} + \boldsymbol{EMP_i\beta_{12\ldots14}} + \boldsymbol{dLC_i\beta_{15}} + \boldsymbol{IR_i\beta_{16}} + \boldsymbol{\varepsilon_{ij}}$$

Where i is a subscript indicating companies, $\boldsymbol{\varepsilon_{ij}}$ is an error term vector, and $\boldsymbol{Response_{ij}}$ are eight responses of companies as noted above, in which the subscript corresponds to eight responses. Since $\boldsymbol{Response_{ij}}$ are the cost burden absorptions and profit sharing ratios for public cost burden changes, we get $\sum_{j=1}^{8} \boldsymbol{Response_{ij}} = 100\%$.

$\boldsymbol{X_i}$ is a corporate characteristics matrix that, as a variable which expresses company size, capital amount (millions of yen), number of employees, and company age, which expresses company growth and maturity. Next is the profit margin on sales ($\boldsymbol{PS}$), a variable that expresses company profitability. $\boldsymbol{dMF}$ is a dummy variable for the manufacturing industry; $\boldsymbol{EX}$ is the export ratio (= exports divided by sales); $\boldsymbol{dAF}$ is a dummy variable that equals 1 for companies having subsidiaries or affiliated companies overseas; $\boldsymbol{dAFA}$ is a dummy[5] that equals 1 for companies that have subsidiaries or affiliated companies in Asia; $\boldsymbol{FDI}$ is stock of foreign direct investment; and $\boldsymbol{FI}$ is the foreign capital ratio. $\boldsymbol{DT}$ is debt ratio which indicate companies financial soundness. $\boldsymbol{EMP}$ is a vectorindicating employment structure. These use the part-time worker ratio (= number of part-time employees divided by the total number of employees), the temporary worker ratio (= number of temporary workers divided by the total number of employees), and the average wage (= total wages divided by the total number of employees). As $\boldsymbol{EMP}$ might endogenous, our interpretation of the results will need to be taken with a grain of salt. The top market dummy variable, signified by $\boldsymbol{dLC}$ (companies that describe themselves as

[5] $\boldsymbol{dAFA}$ is a subset of $\boldsymbol{dAF}$.

"leading companies that lead their markets in both price and quality" on the Survey), is used as a variable for the market environment that companies face. $\boldsymbol{IR}$ is a variable that only takes into account an analysis of companies' responses to past SSC increases, and uses health insurance premium changes (the fluctuation range, as a percent, of the insurance premium rates that companies pay) in the most recent year within the last several years (5 years). Using a SUR estimation here, we perform an estimation that allows for correlations between the different elements in $\boldsymbol{\varepsilon_{ij}}$[6].

3.3 Hypotheses to Be Tested

The following eight hypotheses will be tested in our analyses.

The first hypothesis is that "changes in corporate public burden are absorbed by direct means". Changes to the burden of SSCs effectively change the labor costs of primarily regular employees, and changes to the corporate income tax burden effectively change the return on capital. Consequently, while the former has a considerable impact on regular employee numbers and wages, it does not appear to have much impact on non-regular employment levels or wages, or on investment. The latter appears to have a significant impact on capital investment and R&D investment.

The second hypothesis is that "changes in corporate public burden are passed on taking into account adjustment cost." It appears to be difficult to change employment levels, wages, and investment over the short term because of adjustment costs. For this reason, in response to public cost burden changes, companies appear to adjust profits in the short term and then adjust things such as employment levels, wages, and investment over the

[6] As all explained variables total 100%, with respect individual variables, efficient estimations are possible by applying restrictions so that the total of coefficients between the equations equals zero. However, results changed little when restrictions were applied.

medium- to long-term.

The third hypothesis is that "companies facing liquidity constraints weigh heavily cash on hand." Due to the difficulty of procuring funds externally, companies facing liquidity constraints appear to value cash on hand in business management. If this hypothesis is true, because companies with high debt ratios and companies with low profit ratios value having cash on hand, the trend towards responding to public cost burden changes via measures other than adjusting profit should strengthen.

The fourth hypothesis is that "companies with strong bargaining power shift public cost burden to third parties." For large companies, because it appears that they are highly capable when negotiating with external parties, it appears that many pass on costs to these parties by changing product/service prices and cost price in response to public cost burden changes.

The fifth hypothesis is that "companies operating overseas tend not to change profit levels." Companies doing business overseas are able to accommodate public cost burden changes by shifting operations to other production facilities. As such, they do not appear to change profit levels in order to maintain or increase employment or investment levels.

The sixth hypothesis is that "companies with high foreign capital ratios value profits." Companies with a high foreign capital ratio as a percentage of their equity appear to largely be exposed to pressure in the capital market. As a result, they by and large appear to change profits little when their public cost burden increases and, conversely, increase corporate profits when public cost burden decreases.

The seventh hypothesis is that "companies with high non-regular employment rates prioritize adjustment by way of non-regular employment." Just as companies raise their non-regular employment ratio as a response to uncertainty, it would seem they prioritize adjustment by non-regular employment as a means to accommodate changes in public cost

burden.

The eighth hypothesis is that "companies with high average wages tend not to adjust worker numbers or wages." If the efficient wage hypothesis is true, it would mean that companies offer higher wages to get high-quality workers. Consequently, it is likely that the higher the average wage paid by a company, the more likely they will leave wages and employment levels untouched.

The first, third, seventh, and eighth hypotheses are derived from academic interests. For example, some studies such as Baicker and Chandra (2006) reveal that increase in health insurance contributions reduces total employment, and increases part-time employment. In other words, public burdens might distort corporate behavior, the first hypothesis concerns it. The third hypothesis re-examines the role of liquidity constraints on corporate behavior, since some existing researches such as Stiglitz and Weiss (1981) point out that uncertain investments are susceptible to amount of cash on hand. Asano et al. (2011) and Morikawa (2010) reveal that a rise in demand fluctuation in the product market induce an increase in non-regular workers. The seventh hypothesis examines this issue. The eighth hypothesis is derived from “Efficiency Wage Hypothesis”

On the other hand, the second, fourth, fifth, and sixth hypotheses are derived from not so much academic interests as practical ones. Since some arguments claim that companies conducting overseas operations are inclined to hollow out if public burdens in Japan rise, the fifth and sixth hypotheses concern it.

3.4 Descriptive Statistics for Explanatory Variables and Sample Selection

As discussed above, the analysis in this chapter uses data from a survey administered to companies that answered questions about their activities. The survey response rate was less

than 15%, and if there was some sort of systemic bias to the responses, it might distort estimation results. For sample selection biases, estimation results could be corrected using Heckman's two-step estimator. Heckman's two-step estimator requires specifying the mechanism for responding to surveys, but that mechanism in this case has not been explained. This section therefore discusses the possibility of selection bias by way of comparing samples used in the analysis with descriptive statistics for companies that responded to the survey concerning their activities[7].

For the explanatory variable, Table 2-1 indicates descriptive statistics of our sample and BSJBSA. A look at the average values for capital and employee numbers finds that, for companies for which samples were derived by analyzing in comparison with corporate activities, many are relatively smaller. Foreign capital ratios are also small when average values for our sample is compared to a population. The disparity among these variables appears to have occurred due to the large standard deviations in the BSJBSA of Japanese Business Structure and Activities. However, for other variables, values are very close with respect to both averages and standard deviations. Of course, it cannot be denied that there is a possibility of systemic bias being introduced due to factors not measured. However, because no large bias can be found in the samples based on the descriptive statistics, the following analyses will be conducted on the assumption that analysis samples are representative.

[7] Companies that responded to the "Basic Survey of Japanese Business Structure and Activities" are companies that have business locations in industries such as manufacturing, electricity/gas/heat/water supply, information and communications, wholesale trade, and resale trade, that have 50 or more employees, and that have at least ¥30 million in capital.

4 Results

4.1 Tabulation Results

Table 2-2 shows burden absorption ratio for past increases in SSC burden, future increases in SSC burden, and increases in effective corporate tax rates, while Table 2-3 expresses profit-sharing ratios for decreases in effective corporate tax rates.

Looking at percentages of burden absorption, we find that around 50% of all companies respond by "reducing profits," making it the highest scoring response. Concerning the impact on employment levels finds that percentages for absorption by "reducing wages for regular employees" and "employing fewer regular employees," each are at around 10%. This contrasts with the roughly 2% for "reducing wages for non-regular employees" and the roughly 3% for "employing fewer non-regular employees." This strongly suggests the increases in public costs borne by companies are absorbed by employing fewer regular employees and paying them less. These results are attributable to the fact that non-regular employees are not often impacted by their employers' SSC burden, which is in line with the findings of Miyazato and Ogura (2010) and Kobayashi et al (2013). Moreover, rises in SSC rates appear to more significantly impact employment levels than do effective corporate tax rate hikes.

Compared to health insurance premium increases, pension insurance premium increases have a higher burden absorption ratio via employment level and wage adjustment. If workers consider pensions and savings as alternatives to each other, and if they view these as highly compensatory in comparison to health insurance, it may be that pension insurance premium increases will have little effect in changing the labor supply. This suggests that companies are adjusting employment levels and wages accordingly. One reason for these results is that, while pension insurance premium rates had gone up over

the five years preceding the survey period, health insurance premium rates rose very little during this time.

Regarding "reducing investment in capital assets and R&D," absorption percentages were higher when effective corporate tax rates increased than when SSC rates increased. Effective corporate tax rate increases appear to have a more significant impact on investment than employment levels.

Conversely, when effective corporate tax rates decrease, a large percentage of companies (17.3%) share profits by raising regular employees' wages. And the small employment level increases for regular and non-regular employees (6.3% and 1.5%, respectively) suggest that effective corporate tax rate decreases play a part in increasing the wages of primarily existing regular employees. Furthermore, when effective corporate tax rates increase, a large percentage (13.5%) reduce raw material costs and cost price. Yet, when tax rates drop, few companies (3.3%) raise raw material costs and cost price. With respect to the asymmetry in companies' responses to effective corporate tax rate increases and decreases, it would appear that adjustment costs are lower in internal labor market than in the external product market. Moreover, the percentage of companies that increase investment in capital assets and R&D when effective corporate tax rates decrease is greater than those who reduce investment in capital assets and R&D when effective corporate tax rates increase. This suggests that effective corporate tax rate decreases more strongly encourage investment.

4.2 Econometric analysis (1): Responses to past increases in social security contributions

We now conduct an analysis using an SUR estimation to determine how the methods of burden absorption and profit sharing prompted by public costs borne by companies differ

based on company characteristics. Table 2-4 shows estimation results using an explained variable to express responses to past increases in SSCs (pension and healthcare). The sample size in the analysis of past health insurance premium increases is small because the only companies analyzed were those that had experienced a premium increase within the previous five years.

The estimation results for responses to past health insurance premium increases show that company size (capital, number of employees), company age, and foreign capital ratio have little impact. Although it is said that companies with high foreign capital ratios face considerable pressure from the capital market and are prone to pursuing short-term profits, that assertion is not confirmed by these estimation results. Estimated coefficient for the profit margin on sales is positive and significant for "reduced profits," and other coefficients are generally negative. This shows that companies with high profit ratios tend to absorb the burden of SSCs by reducing profits. With respect to the Asia subsidiary dummy variable, coefficient are positive for "reducing the cost of raw materials or cost price" and companies having subsidiaries in Asia trend towards reducing costs when faced with higher SSCs. For debt ratio, the "reduce profits" coefficient is negative and significant, whereas the "increase the price of goods and services" and "employ fewer non-regular employees" coefficients are positive and significant. Companies with high debt ratios and an inability to easily procure funding from external sources do not have the leeway to reduce profits due to the need to retain cash reserves. They therefore tend to absorb burden by forward shifting and cost cutting (as consistent with Sakai 2006). Both coefficients of the part-time worker ratio and temporary worker ratio for "employ fewer non-regular employees" are positive and significant. Companies with high part-time worker and temporary worker ratios appear to employ a large number of non-regular workers in advance in order to prepare for "outside shocks" (e.g., increases in the costs of employing

regular workers, the result of increases in pension insurance premiums)[8]. Regarding "reducing wages for regular employees," coefficient of part-time worker ratio is negative and that of temporary worker ratio is positive. From the perspective of wage cost, regular employees and part-time workers complement each other, while regular employees and temporary workers are alternatives to each other. The part-time worker ratio coefficient for "employing fewer regular employees" is significant and negative, suggesting that regular employees and part-time workers are in a complementary relationship even from the perspective of factors of production. Companies that pay high average wages tend to respond by adjusting employment levels and wages for regular employees. Ariga and Kambayashi (2010) finds that companies often do not adjust wages when doing so would risk making workers harder to acquire. This suggests the possibility that, when wages are a proxy variable for labor productivity, companies that need highly-productive workers will not adjust employment levels or wages much for regular employees. This is so that they can acquire more highly-productive workers. As the efficiency wage hypothesis indicates, it may be that companies offer good wages to get high quality workers. However, when interpreting the results of variables that express these kinds of employment structures, it is worth keeping in mind that they might be endogenous variables, as discussed above.

Company age has a significant and positive effect on "reducing profits" as a way to accommodate past health insurance premium increases. In contrast to pension insurance premiums, which are paid in anticipation of future benefits, health insurance premiums are paid for the sake of receiving benefits at any moment. If company age represents employee age, it may be inferred that older companies tend to respond to health insurance premium rises by reducing profits. Looking at debt rate coefficients, we get the reverse of the forward shifting scenario for the above-mentioned pension insurance premium increases:

[8] See Morikawa (2010) and Asano et al. (2011).

"reduce profits" is significant and positive, and both "increase the price of goods and services" and "reduce the cost of raw materials and cost price" are negative. In all likelihood, companies are responding to premium rate hikes for the sake of the here and now and are engaging in shortsighted profit reductions and applying it to health insurance without increasing product prices. For the export ratio, "employ fewer regular employees" is significant and positive. This suggests that, although it is often thought that companies with high export ratios run businesses that are highly international, these results suggest that previous health insurance premium increases affected a reduced number of regular employees at these companies. As it is highly likely that companies exporting products are companies with strong productivity, it is also likely that medium-term health insurance premium increases make companies with high export ratios and productivity reduce regular employee numbers. There were no differences observed in burden absorption methods caused by different levels of SSC increases. Companies with high percentages of capital in foreign subsidiaries are more likely to "employ fewer non-regular employees." The more a company engages in production overseas, the more it will probably tend to relocate its production processes overseas in the face of rising labor costs.

4.3 Econometric analysis (2): Responses to future increases in social security contributions

Table 2-5 shows the results of estimations concerning companies' responses to future increases in SSCs.

Looking at the distinctive estimation results for the case where SSCs increased 0.5% in a single year shows that the older companies often chose to "reduce profits" in response to the increase. Regarding manufacturing industry, only a small proportion of companies respond by adjusting regular employee numbers, with most of them either choosing to

"reduce profits" or "reduce the cost of raw materials or cost price." Companies with high export ratios responded by choosing to "reduce the cost of raw materials or cost price." These results represent almost no difference compared to the way companies responded to past SSC increases in the previous section.

A largely similar tendency can be seen in the case of a 5% increase over five years. However, compared to the case where rates increased 0.5% in a single year, companies that have foreign subsidiaries show a low tendency for "reducing wages for non-regular employees." The higher a company's foreign capital ratio is, the more often they choose to "employ fewer regular employees," and "employing fewer non-regular employees" becomes a more significant choice the higher a company's debt ratio is. When faced with gradual increases in SSCs over the medium- to long-term, these companies appear to begin spending time reducing employment levels.

Both estimations show that companies that pay high average wages and companies that are at the top of their industries respond by reducing profits, and have a strong tendency to not adjust employment levels and wages for regular employees. These results are similar to the estimation results noted above. Companies with many employees tend to respond by "increasing the price of goods and services" and "reducing the cost of raw materials and price cost." This appears to be because companies that reach a certain size have a measure of power when it comes to negotiating with other companies.

As with how companies responded to past SSC increases, the part-time worker ratio coefficient was negative and temporary worker ratio coefficient was positive for "reducing wages for regular employees." The part-time worker ratio coefficient was also negative and significant for "employing fewer regular employees." Some have pointed out that, as a result of part-time workers becoming the labor force core, they are coming to be seen as an alternative to regular employees. However, to the extent that the estimation results in this

chapter demonstrate, regular employees and part-time workers continue to be in a complementary relationship from the perspective of wage costs and factors of production. From the perspective of wage costs, regular employees and temporary workers are alternatives to each other.

4.4 Econometric analysis (3) Response when effective corporate tax rates increase or decrease

In the analyses of SSCs conducted up to the previous section, we looked at how pension insurance premiums are paid towards a future benefit (in a pay-as-you-go system) while health insurance premiums are a burden paid for health services in the here and now, and at the differences among companies in how they respond to these burdens based on factors such as their ratios of regular employees to non-regular employees and on company age. This section analyzes effective corporate tax rates and requires keeping in mind that companies are impacted differently depending on primarily their business performance and size.

Table 2-6 and Table 2-7 show the results of estimations in cases where effective corporate tax rates increase or decrease. The first point to note is that there is no clear difference between how companies respond when effective corporate tax rates are expected to increase in the future and how they responded to situations such as increases in past SSC rates (Table 2-4).

Looking at differences with respect to increases and decreases in effective corporate tax rates (Table 2-6 and Table 2-7), manufacturing companies reduce the cost of raw materials and cost price when these rates increase but do not raise these costs when the same rates decrease. In the case of manufacturing companies, although they do not reduce investment

in capital assets or R&D when effective corporate tax rates increase, they do significantly increase such investment when rates decrease, and the effects are considerable for the long-term.

For the foreign subsidiary dummy variable, companies tend not to "reduce regular employees' wages" over the short term when effective corporate tax rates increase. Moreover, companies with high percentages of capital in foreign subsidiaries are more likely to "employ fewer non-regular employees" over the medium-term. Analysis results suggest that companies doing business in other countries gradually build systems for optimally dividing operations among these countries as a means to accommodate public cost burden increases in Japan. Conversely, when effective corporate tax rates drop, companies with high export ratios tend to "employ more regular employees" immediately and then "increase profits" over both the short term and medium term. Examining foreign capital ratios finds that, although companies employ fewer regular employees over the short term and medium term when effective corporate tax rates increase, they actively employ more regular employees when rates decrease. In other words, companies with high foreign capital ratios respond by flexibly adjusting regular employee numbers.

With regard to companies' medium-term response when effective corporate tax rates decrease, we see positive signs for "reducing the price of goods and services" and "increasing the cost of raw materials and cost price," and companies tend to "employ more non-regular employees" the higher their part-time worker ratio is. Companies' short-term response to effective corporate tax rate decreases is to step up investment in capital assets and R&D, but the effects of their actions—which might be to reduce the prices of goods and services and employ more non-regular employees—takes time to be seen. However, "employing more regular employees" remains—with the exception of "foreign capital ratio"—not significant or positive, which suggests that companies take a careful approach

to increasing regular employee numbers.

Furthermore, when effective corporate tax rates increase, companies with high debt ratios do not actively reduce profits in the short term. Yet, in the medium term, the debt ratio coefficient is not significant. Their behavior is reversed when effective corporate tax rates decrease; while companies with high debt ratios increase profits in the short term, they "reduce the prices of goods and services" and "increase the cost of raw materials and cost price" in the medium term, tending to keep cash on hand in the near term.

4.5 Summary and Hypothesis Testing

Table 2-8 provides an overview of results for the analyses discussed above. The left side of the table shows public cost burden changes, while burden absorption and profit sharing methods are indicated at the top. The main points are as follows. The first point is companies' diverse behavior in absorbing burden and sharing profits. Companies respond to public cost burden increases and decreases not only by adjusting regular employee numbers and wages, but by making changes to a wide range of things that include the price of goods and services, the cost of raw materials, cost price, investment in capital assets and R&D, and profits. The second point is the differences between SSCs and effective corporate tax rates. There are strong tendencies for SSC changes dramatically affecting regular employee numbers and wages, and for effective corporate tax rate changes strongly impacting investment in capital assets and R&D. Furthermore, the effects of these things on non-regular employee numbers and wages is small on average. Thus, increases in public costs borne by companies is highly likely to drive down regular employee hiring and investment in capital assets and R&D, and to encourage employment of non-regular employees as an alternative. The third point is the differences between short-term response strategies and medium-term response strategies. A look at average values for burden

absorption ratios and profit sharing ratios finds a strong tendency for companies reducing profits in the short term but making adjustments to employment levels, wages, investment, and other areas in the medium term.

Table 2-9 summarizes the results of testing the hypotheses presented in Section 3 based on the above analysis results. Hypotheses 1 and 2 are supported overall by the results of simple tabulation for cost burden absorption and profit sharing ratios. Hypothesis 3 testing also finds that higher debt ratios and lower profit ratios correlate with a tendency to not reduce profits. This is supported overall. Hypothesis 4 is supported and testing results find that, the more employees companies have, the more they shift costs to product and service prices and the more often they adjust cost price. However, there were no significant results with respect to capital. This may be the result of capital not being a proxy variable that expresses company size. Hypothesis 7 testing finds that companies make bigger adjustments in terms of non-regular employee employment levels and wages the higher their temporary worker and part-time worker ratios are. Testing for hypothesis 8 also confirms a tendency for companies to not adjust employment levels or wages the higher the average wages they pay. Both hypotheses are strongly supported.

On the other hand, hypotheses 5 and 6, that "companies with high foreign capital ratios value profits," were not supported by empirical analysis. There were no significant results for variables that express companies' overseas business operations such as the export ratio, foreign subsidiary dummy variable, Asian subsidiary dummy variable, and foreign subsidiary capital ratio. No clear relationship was found between companies' overseas business activity and their response to changes in public cost burden. Almost no significant results were obtained regarding foreign capital ratio.

5 Conclusion

This chapter has examined the impact that changes in public costs borne by companies have on corporate activities. It established several scenarios that elucidated the differences between the nature of SSCs and effective corporate tax rates as factors that impact corporate behavior. It also focuses on possibilities concerning differences among companies in terms of how they decide whether to forward shift (shift costs to prices) or backwards shift (shift costs to workers) and the responses they take over different timelines (short term and medium term), and quantitatively analyzes the company characteristics and market conditions that may be determining factors in these decisions.

As described in detail in preceding sections, the summary of analysis results and the results of hypothesis testing describe companies as being prepared to employ various means of burden absorption and profit sharing. It is now clear that changes in SSCs significantly affect regular employee numbers and wages and that corporate income tax rates strongly tend to impact investment in capital assets and R&D. We also learned that companies strongly tend to respond by adjusting profits in the short term, but that the medium-term finds companies increasingly making changes to employment levels, wages, and investment. Of the hypotheses presented in this chapter, hypotheses 1 through 4 and hypotheses 7 and 8 ended up being mostly supported through empirical analysis. Hypotheses 5 and 6 were not supported. There is a propensity for discussions concerning public cost burden and corporate behavior to become single-track discussions that posit positions such as "employment levels drop when SSC burden rises" and "investment increases when corporate income tax burden decreases." But, as the results of analyses in this chapter show, companies employ a vast range of measures to accommodate the public costs they must bear, and the measures they tend to use differ greatly depending on the

nature of the costs borne, the timeline involved, and company characteristics. Policy discussions concerning public costs borne by companies should focus on these broad-ranging elements.

Naturally, there are several caveats with the results of this chapter. This chapter uses data from a company survey to analyze actions taken by companies to accommodate their public cost burden. It strictly attempts to identify the temporary responses taken by companies imagining that public cost burden will change, and does not take into account the general equilibrium effect throughout the market. Furthermore, because it is a set of hypothetical inquiries and the organizations responding to it are corporate planning departments, the survey may not reflect companies' true managerial decision-making. In addition, the endogeneity of such variables as those that express employment characteristics is questionable. Though we quantitatively analyze corporate behavior by using the cost burden absorptions and profit sharing ratios for public cost burden changes, we might be able to reveal mechanism of corporate behavior by using qualitative analysis of discrete variables. Future studies will need to conduct more detailed and in-depth empirical analyses that take into account a wide range of factors.

Table 2-1 Descriptive statistics for explanatory variables

	Our Smple			Basic Survey of Japanese Business Structure and Activities		
	sample size	mean	Standard Deviation	sample size	mean	Standard Deviation
Capital (¥million)	2915	1190.5	15574.7	29075	1505.1	12998.6
Company age (years)	2915	41.1	18.6	29075	40.2	19.6
No. of Employees	2915	311.7	895.7	29075	432.3	1477.7
Profit margin on sales	2915	0.044	0.071	29027	0.044	0.095
Manufacturing industry dummy	2915	0.461	0.499	29080	0.459	0.498
Export ratio	2915	0.024	0.093	29080	0.027	0.098
Foreign subsidiary dummy	2915	0.145	0.353	29080	0.165	0.371
Asian subsidiary dummy	2915	0.129	0.335	29080	0.145	0.353
Foreign subsidiary capital ratio	2915	0.352	2.132	29080	0.395	3.294
Foreign capital ratio (%)	2915	0.674	5.718	29075	2.044	11.887
Debt ratio	2915	0.667	0.254	28361	0.671	0.331
Part-time worker ratio	2915	0.147	0.218	29080	0.159	0.228
Temporary worker ratio	2915	0.064	0.225	29080	0.068	0.204
Average wages (¥million)	2915	4.386	1.741	29075	4.438	1.907
Market top dummy	2915	0.100	0.300	-	-	-
Social insurance premium increase (%pt)	780	1.124	2.332	-	-	-

Table 2-2 Descriptive statistics for burden absorption ratio

		Increase the cost of goods and services	Reduce the cost of raw materials or cost price	Reduce wages for regular employees	Reduce wages for non-regular employees	Reduce investment in capital assets and R&D	Employ fewer regular employees	Employ fewer non-regular employees	Reduce profits
Responses to past pension insurance premium increases	Mean	6.1	10.7	11.2	1.4	5.2	10.4	3.3	51.7
	SD	17.5	22.0	21.9	5.7	15.3	20.9	11.4	44.2
	sample size	2753							
Responses to past health insurance premium increases	Mean	5.1	9.4	10.0	1.4	4.6	9.3	2.8	57.4
	SD	15.8	21.2	20.9	6.7	13.8	20.1	10.2	43.6
	sample size	827							
Responses to social insurance premiums increase of 0.5% in a single year	Mean	7.6	13.0	13.0	2.0	5.7	12.7	3.9	42.0
	SD	19.4	23.2	22.2	6.3	15.7	21.9	12.0	42.3
	sample size	2822							
Responses to social insurance premiums increase of 5% over five years	Mean	10.6	12.0	16.0	2.8	6.1	14.8	4.3	33.4
	SD	21.1	19.6	21.5	7.0	14.8	20.9	11.3	37.2
	sample size	2888							
Short-term responses to effective corporate tax rate increase	Mean	7.1	13.5	11.0	1.8	7.9	8.4	3.0	47.2
	SD	18.9	23.2	19.8	5.9	18.9	16.2	10.2	42.8
	sample size	2915							
Medium-term responses to effective corporate tax rate increase	Mean	10.8	13.5	12.0	1.9	8.7	9.8	3.2	40.1
	SD	22.3	21.6	19.5	5.9	19.0	16.8	9.9	40.8
	sample size	2908							

Table 2-3 Descriptive statistics for r profit sharing ratio

		Reduce the price of goods and services	Increase the cost of raw materials and price cost	Increase wages for regular employees	Increase wages for non-regular employees	Increase investment in capital assets and R&D	Employ more regular employees	Employ more non-regular employees	Increase profits
Short-term responses to effective corporate tax rate decreases	Mean	5.5	3.3	17.3	2.0	11.2	6.3	1.5	52.9
	SD	18.5	12.5	27.0	6.5	23.5	15.0	6.3	42.7
	sample size	2547							
Medium-term responses to effective corporate tax rate decreases	Mean	6.8	3.7	15.0	2.3	13.9	7.8	1.9	48.6
	SD	19.5	12.6	23.3	7.2	25.1	15.5	7.4	41.7
	sample size	2326							

Table 2-4 SUR estimation for response to past SSC increases

	Responses to past pension insurance premium increases								Responses to past health insurance premium increases							
	Increase the cost of goods and services	Reduce the cost of raw materials or cost price	Reduce wages for regular employees	Reduce wages for non-regular employees	Reduce investment in capital assets and R&D	Employ fewer regular employees	Employ fewer non-regular employees	Reduce profits	Increase the cost of goods and services	Reduce the cost of raw materials or cost price	Reduce wages for regular employees	Reduce wages for non-regular employees	Reduce investment in capital assets and R&D	Employ fewer regular employees	Employ fewer non-regular employees	Reduce profits
Capital	2.55e-05	1.23e-05	1.80e-06	-6.03e-06	-7.23e-06	-1.25e-05	-2.58e-06	-1.12e-05	2.37e-05	4.08e-05	-7.59e-07	2.97e-06	3.25e-06	-1.11e-05	1.93e-05	-7.80e-05
	(2.73e-05)	(3.42e-05)	(3.39e-05)	(8.92e-06)	(2.38e-05)	(3.25e-05)	(1.75e-05)	(6.81e-05)	(2.79e-05)	(3.74e-05)	(3.65e-05)	(1.19e-05)	(2.44e-05)	(3.55e-05)	(1.76e-05)	(7.59e-05)
Company age	0.00487	0.0178	0.00371	-0.00338	-0.0315*	0.0116	-0.00879	0.00572	-0.0464	-0.0859**	-0.0124	-0.0228*	-0.0627**	-0.0544	0.0155	0.269***
	(0.0186)	(0.0233)	(0.0231)	(0.00608)	(0.0163)	(0.0222)	(0.0119)	(0.0465)	(0.0305)	(0.0405)	(0.0396)	(0.0131)	(0.0268)	(0.0384)	(0.0194)	(0.0758)
Number of employees	0.000711	0.00103*	-0.000627	0.000271*	-0.000192	-0.000316	-0.000152	-0.000720	0.00162***	0.000786	-0.000827	-6.18e-05	-0.000174	-0.000665	-0.000657*	-2.32e-05
	(0.000437)	(0.000548)	(0.000543)	(0.000143)	(0.000381)	(0.000520)	(0.000280)	(0.00109)	(0.000558)	(0.000748)	(0.000731)	(0.000238)	(0.000489)	(0.000710)	(0.000352)	(0.00152)
Profit margin on sales	4.017	8.197	-24.76***	-3.584**	-9.784**	-25.33***	-3.941	55.18***	-5.633	-15.29	-23.58**	-9.723***	-4.062	-31.40***	-7.781	97.46***
	(5.171)	(6.482)	(6.429)	(1.690)	(4.515)	(6.155)	(3.320)	(12.91)	(8.503)	(11.35)	(11.09)	(3.638)	(7.455)	(10.77)	(5.381)	(22.20)
Manufacturing industry dummy	0.595	0.932	-2.872***	0.0310	0.814	-2.553***	0.403	2.650	1.250	3.241**	-5.330***	-0.0410	1.479	-3.112**	-1.200	3.713
	(0.700)	(0.877)	(0.870)	(0.229)	(0.611)	(0.833)	(0.449)	(1.747)	(1.198)	(1.604)	(1.567)	(0.512)	(1.050)	(1.521)	(0.757)	(3.203)
Export ratio	-2.019	5.294	-1.583	0.994	-4.182	5.328	-1.460	-2.369	-5.344	-2.327	11.02	-1.088	-9.427	24.12***	-3.610	-13.34
	(3.949)	(4.951)	(4.910)	(1.290)	(3.448)	(4.701)	(2.535)	(9.858)	(6.830)	(9.161)	(8.951)	(2.912)	(5.984)	(8.691)	(4.311)	(18.59)
Foreign subsidiary dummy	1.696	-3.809	0.557	-0.277	3.104	-0.868	0.477	-0.881	4.730	-4.148	4.798	-0.888	-3.304	-7.536	-1.707	8.055
	(2.609)	(3.271)	(3.244)	(0.853)	(2.278)	(3.105)	(1.675)	(6.512)	(4.811)	(6.452)	(6.304)	(2.051)	(4.215)	(6.120)	(3.036)	(13.08)
Asian subsidiary dummy	-3.655	7.002**	0.402	0.379	-1.135	1.497	0.769	-5.257	-6.448	8.951	-0.998	1.175	4.199	7.446	2.081	-16.40
	(2.719)	(3.408)	(3.380)	(0.888)	(2.374)	(3.236)	(1.745)	(6.786)	(5.023)	(6.738)	(6.583)	(2.141)	(4.401)	(6.391)	(3.170)	(13.68)
Foreign subsidiary capital ratio	0.0837	-0.267	-0.0656	0.00173	-0.116	0.0630	0.0758	0.224	0.476	-0.400	-0.479	0.0967	0.324	0.677	0.448**	-1.143
	(0.178)	(0.223)	(0.221)	(0.0582)	(0.155)	(0.212)	(0.114)	(0.444)	(0.351)	(0.471)	(0.460)	(0.150)	(0.308)	(0.447)	(0.222)	(0.956)
Foreign capital ratio	-0.0580	-0.0899	0.0780	-0.00884	-0.0750	-0.0517	-0.0204	0.226	0.0120	-0.139	-0.160	-0.0273	-0.0732	0.0614	0.00863	0.317
	(0.0585)	(0.0733)	(0.0727)	(0.0191)	(0.0511)	(0.0696)	(0.0375)	(0.146)	(0.107)	(0.144)	(0.141)	(0.0458)	(0.0941)	(0.137)	(0.0678)	(0.293)
Debt ratio	2.793**	1.454	1.679	0.0565	0.344	1.190	1.837**	-9.353***	-4.229**	-7.828***	-3.030	0.572	-2.085	-3.963	0.649	19.91***
	(1.406)	(1.763)	(1.749)	(0.460)	(1.228)	(1.674)	(0.903)	(3.510)	(2.148)	(2.828)	(2.760)	(0.928)	(1.887)	(2.680)	(1.371)	(4.837)
Part-time worker ratio	0.274	4.809**	-5.517**	1.455**	0.926	-1.909	7.025***	-7.064	-1.084	-1.905	-4.344	0.605	-0.913	-6.295	7.801***	6.135
	(1.801)	(2.257)	(2.239)	(0.588)	(1.572)	(2.143)	(1.156)	(4.495)	(3.060)	(4.063)	(3.967)	(1.314)	(2.685)	(3.852)	(1.943)	(7.575)
Temporary worker ratio	-0.112	0.130	3.951**	0.335	-0.0342	0.221	4.183***	-8.672**	-1.039	-1.237	8.530***	0.574	-0.114	-1.886	2.021*	-6.848
	(1.515)	(1.900)	(1.884)	(0.495)	(1.323)	(1.804)	(0.973)	(3.783)	(1.834)	(2.460)	(2.403)	(0.782)	(1.607)	(2.333)	(1.157)	(4.993)
Average wages	0.0984	-0.439	-1.052***	-0.0948	0.284	-0.453*	-0.112	1.769***	-0.609	-1.562***	-1.358***	-0.0606	-0.324	-1.560***	-0.326	5.800***
	(0.230)	(0.289)	(0.286)	(0.0752)	(0.201)	(0.274)	(0.148)	(0.575)	(0.379)	(0.497)	(0.485)	(0.164)	(0.333)	(0.471)	(0.242)	(0.832)
Market top dummy	1.478	1.415	-3.618***	-0.132	-1.240	-1.316	-0.329	3.742	0.545	-0.0277	-6.938***	-0.288	-3.343**	-0.696	0.00903	10.74**
	(1.122)	(1.406)	(1.394)	(0.366)	(0.979)	(1.335)	(0.720)	(2.800)	(1.861)	(2.495)	(2.438)	(0.793)	(1.630)	(2.367)	(1.174)	(5.062)
Social insurance premium rate increases									0.0241	0.0168	-0.0472	-0.0226	0.360*	-0.0934	0.0299	-0.267
									(0.240)	(0.322)	(0.314)	(0.102)	(0.210)	(0.305)	(0.152)	(0.651)
Sample size	2753								780							

Figures in parentheses indicate robust standard errors for heteroscedasticity

***, **, and * indicate significant estimates for the 1%, 5%, and 10% levels, respectively.

Table 2-5 SUR estimation for response to future SSC increases

	Responses to social insurance premiums increase of 0.5% in a single year								Responses to social insurance premiums increase of 5% over five years							
	Increase the cost of goods and services	Reduce the cost of raw materials or cost price	Reduce wages for regular employees	Reduce wages for non-regular employees	Reduce investment in capital assets and R&D	Employ fewer regular employees	Employ fewer non-regular employees	Reduce profits	Increase the cost of goods and services	Reduce the cost of raw materials or cost price	Reduce wages for regular employees	Reduce wages for non-regular employees	Reduce investment in capital assets and R&D	Employ fewer regular employees	Employ fewer non-regular employees	Reduce profits
Capital	-5.43e-06	-1.02e-05	1.85e-05	5.66e-06	-1.70e-05	-2.42e-05	-2.32e-05	5.58e-05	-1.02e-05	3.27e-06	-1.30e-05	4.64e-06	-3.40e-06	-3.31e-05	-2.59e-05	7.76e-05
	(2.88e-05)	(3.41e-05)	(3.26e-05)	(9.27e-06)	(2.32e-05)	(3.23e-05)	(1.74e-05)	(6.13e-05)	(3.11e-05)	(2.88e-05)	(3.14e-05)	(1.02e-05)	(2.18e-05)	(3.07e-05)	(1.63e-05)	(5.41e-05)
Company age	-0.0353*	-0.0726***	-0.0306	-0.0138**	-0.0300*	-0.0434*	-0.0125	0.238***	0.00142	-0.0121	0.0255	-0.00904	-0.0184	-0.00805	0.00316	0.0176
	(0.0203)	(0.0239)	(0.0229)	(0.00657)	(0.0164)	(0.0226)	(0.0123)	(0.0397)	(0.0220)	(0.0204)	(0.0222)	(0.00720)	(0.0155)	(0.0217)	(0.0116)	(0.0383)
Number of employees	0.00128**	0.000771	-0.000912	-8.11e-05	0.000137	0.000116	0.000566*	-0.00187*	0.00128**	0.000307	-0.000809	-0.000324*	4.58e-05	-9.01e-05	0.000543*	-0.000953
	(0.000500)	(0.000594)	(0.000568)	(0.000161)	(0.000404)	(0.000562)	(0.000303)	(0.00107)	(0.000541)	(0.000500)	(0.000546)	(0.000177)	(0.000379)	(0.000533)	(0.000284)	(0.000939)
Profit margin on sales	-6.409	-13.81**	-29.24***	-4.176**	-12.34***	-29.69***	-7.640**	103.3***	-8.824	-3.543	-14.91**	-2.289	-7.340*	-22.10***	-2.483	61.49***
	(5.569)	(6.587)	(6.305)	(1.799)	(4.497)	(6.230)	(3.379)	(11.47)	(6.034)	(5.586)	(6.092)	(1.974)	(4.235)	(5.953)	(3.168)	(10.49)
Manufacturing industry dummy	-0.642	2.730***	-3.822***	-0.0689	0.138	-2.197**	-0.200	4.062**	0.525	2.642***	-3.141***	-0.00371	0.690	-1.568*	0.0343	0.821
	(0.772)	(0.914)	(0.874)	(0.249)	(0.623)	(0.864)	(0.468)	(1.611)	(0.830)	(0.769)	(0.838)	(0.272)	(0.583)	(0.819)	(0.436)	(1.443)
Foreign subsidiary dummy	0.774	-0.186	-1.438	-0.819	3.044	-1.591	-0.496	0.711	-1.878	1.343	-2.010	-1.677*	3.283	0.335	-0.980	1.584
	(2.956)	(3.506)	(3.354)	(0.953)	(2.384)	(3.317)	(1.790)	(6.304)	(3.082)	(2.853)	(3.112)	(1.008)	(2.163)	(3.041)	(1.618)	(5.356)
Asian subsidiary dummy	-0.984	3.439	2.085	1.035	-3.207	3.008	1.509	-6.883	1.212	1.362	1.678	1.640	-3.587	0.344	1.464	-4.112
	(3.084)	(3.659)	(3.500)	(0.994)	(2.487)	(3.461)	(1.868)	(6.581)	(3.226)	(2.987)	(3.257)	(1.055)	(2.264)	(3.183)	(1.694)	(5.606)
Foreign subsidiary capital ratio	-0.130	-0.259	0.000133	0.00895	-0.0760	-0.0538	0.0337	0.476	-0.115	-0.273	-0.170	0.000361	-0.0245	-0.0266	0.100	0.509
	(0.182)	(0.216)	(0.206)	(0.0586)	(0.147)	(0.204)	(0.110)	(0.388)	(0.198)	(0.184)	(0.200)	(0.0649)	(0.139)	(0.196)	(0.104)	(0.345)
Foreign capital ratio	-0.0367	0.0291	-0.0463	-0.0161	-0.0586	0.0838	0.0669*	-0.0222	-0.0395	0.0481	-0.0170	-0.0248	-0.0664	0.145**	0.0422	-0.0876
	(0.0610)	(0.0724)	(0.0692)	(0.0197)	(0.0492)	(0.0685)	(0.0370)	(0.130)	(0.0666)	(0.0617)	(0.0672)	(0.0218)	(0.0467)	(0.0657)	(0.0350)	(0.116)
Debt ratio	-0.689	-0.330	-2.952*	-0.649	-1.075	-3.168*	1.280	7.584***	-0.396	2.911*	1.017	0.152	0.359	1.231	2.329***	-7.602***
	(1.500)	(1.749)	(1.680)	(0.489)	(1.216)	(1.654)	(0.917)	(2.514)	(1.642)	(1.520)	(1.658)	(0.537)	(1.152)	(1.620)	(0.862)	(2.853)
Part-time worker ratio	-5.693***	1.184	-9.092***	3.253***	-1.201	-4.157*	6.238***	9.469**	-1.047	5.165***	-5.671***	5.886***	0.183	-3.538*	7.622***	-8.599**
	(1.985)	(2.335)	(2.238)	(0.644)	(1.606)	(2.208)	(1.208)	(3.803)	(2.150)	(1.990)	(2.171)	(0.703)	(1.509)	(2.121)	(1.129)	(3.736)
Temporary worker ratio	0.355	-0.524	4.800**	0.470	-0.118	-0.853	2.684***	-6.814*	-0.481	-1.066	3.034*	0.463	-0.169	-0.916	2.890***	-3.755
	(1.670)	(1.981)	(1.895)	(0.538)	(1.347)	(1.874)	(1.011)	(3.564)	(1.810)	(1.676)	(1.828)	(0.592)	(1.271)	(1.786)	(0.950)	(3.146)
Average wages	-0.618**	-0.361	-1.314***	-0.215**	2.03e-05	-1.289***	-0.619***	4.415***	0.326	0.153	-0.648**	-0.0451	0.240	-0.528*	-0.275*	0.777
	(0.260)	(0.303)	(0.291)	(0.0847)	(0.211)	(0.287)	(0.159)	(0.436)	(0.281)	(0.261)	(0.284)	(0.0920)	(0.198)	(0.278)	(0.148)	(0.489)
Market top dummy	-0.763	-1.986	-2.484*	0.214	-1.021	-2.340*	0.374	8.007***	-2.233*	0.269	-2.216*	0.412	-0.306	-0.882	1.058	3.898*
	(1.243)	(1.475)	(1.411)	(0.401)	(1.003)	(1.395)	(0.753)	(2.647)	(1.320)	(1.222)	(1.333)	(0.432)	(0.926)	(1.302)	(0.693)	(2.294)
Sample size	2822								2888							

Figures in parentheses indicate robust standard errors for heteroscedasticity

***, **, and * indicate significant estimates for the 1%, 5%, and 10% levels, respectively.

Table 2-6 SUR estimation for response to future effective corporate tax rate increases

	Short-term responses to effective corporate tax rate increase								Medium-term responses to effective corporate tax rate increase							
	Increase the cost of goods and services	Reduce the cost of raw materials or cost price	Reduce wages for regular employees	Reduce wages for non-regular employees	Reduce investment in capital assets and R&D	Employ fewer regular employees	Employ fewer non-regular employees	Reduce profits	Increase the cost of goods and services	Reduce the cost of raw materials or cost price	Reduce wages for regular employees	Reduce wages for non-regular employees	Reduce investment in capital assets and R&D	Employ fewer regular employees	Employ fewer non-regular employees	Reduce profits
Capital	-1.88e-05	2.54e-05	1.47e-05	3.81e-06	-5.67e-05**	-1.39e-05	-1.84e-05	6.37e-05	4.09e-05	2.94e-05	7.40e-07	-9.25e-08	-3.51e-05	-2.06e-05	-1.78e-05	2.69e-06
	(2.80e-05)	(3.43e-05)	(2.93e-05)	(8.76e-06)	(2.80e-05)	(2.39e-05)	(1.49e-05)	(6.28e-05)	(3.30e-05)	(3.18e-05)	(2.88e-05)	(8.74e-06)	(2.81e-05)	(2.48e-05)	(1.46e-05)	(5.97e-05)
Company age	0.0166	-0.0118	-0.000463	-0.000479	-0.00263	-0.0228	-0.0188*	0.0405	0.0129	-0.00920	-0.0261	0.000181	-0.00539	0.00573	-0.00716	0.0291
	(0.0197)	(0.0242)	(0.0206)	(0.00616)	(0.0197)	(0.0168)	(0.0105)	(0.0442)	(0.0233)	(0.0224)	(0.0203)	(0.00617)	(0.0198)	(0.0175)	(0.0103)	(0.0422)
Number of employees	0.00156***	-0.000739	-0.000780	-0.000152	0.00135***	-9.31e-05	0.000460*	-0.00161	0.00172***	-0.000527	-0.000507	-3.83e-05	0.000908*	-0.000184	0.000405	-0.00178*
	(0.000501)	(0.000613)	(0.000524)	(0.000156)	(0.000500)	(0.000427)	(0.000267)	(0.00112)	(0.000590)	(0.000568)	(0.000515)	(0.000156)	(0.000502)	(0.000443)	(0.000261)	(0.00107)
Profit margin on sales	-11.00**	-8.546	-17.44***	-1.619	-7.224	-17.87***	-4.691	68.39***	-9.675	-8.556	-16.40***	-1.252	-7.258	-16.69***	-2.723	62.55***
	(5.375)	(6.579)	(5.622)	(1.678)	(5.367)	(4.585)	(2.862)	(12.04)	(6.314)	(6.085)	(5.513)	(1.675)	(5.379)	(4.742)	(2.798)	(11.44)
Manufacturing industry dummy	-0.0747	3.034***	-1.178	-0.0185	0.695	-1.052*	0.143	-1.547	-0.127	3.864***	-0.869	0.118	0.205	-1.061	-0.0304	-2.099
	(0.740)	(0.906)	(0.774)	(0.231)	(0.739)	(0.631)	(0.394)	(1.659)	(0.873)	(0.841)	(0.762)	(0.232)	(0.744)	(0.656)	(0.387)	(1.582)
Export ratio	4.025	8.033	-1.983	1.249	2.556	-1.875	0.789	-12.79	1.361	3.537	-1.771	1.862	0.863	4.253	1.594	-11.70
	(4.081)	(4.996)	(4.269)	(1.274)	(4.075)	(3.481)	(2.173)	(9.145)	(4.735)	(4.563)	(4.134)	(1.256)	(4.034)	(3.556)	(2.098)	(8.578)
Foreign subsidiary dummy	2.454	2.123	-5.791**	-0.496	-1.088	-2.804	-0.513	6.115	0.170	5.030	-2.329	-1.157	-1.614	-1.308	-1.423	2.629
	(2.758)	(3.376)	(2.885)	(0.861)	(2.754)	(2.353)	(1.469)	(6.180)	(3.279)	(3.160)	(2.863)	(0.870)	(2.793)	(2.462)	(1.453)	(5.941)
Asian subsidiary dummy	-3.582	1.901	4.037	0.637	1.329	4.024	1.393	-9.740	0.0783	-1.300	1.612	1.266	2.097	1.967	2.185	-7.904
	(2.873)	(3.517)	(3.005)	(0.897)	(2.869)	(2.451)	(1.530)	(6.438)	(3.416)	(3.292)	(2.983)	(0.906)	(2.910)	(2.565)	(1.514)	(6.189)
Foreign subsidiary capital ratio	-0.0252	-0.341	-0.0951	0.0203	0.0317	-0.0587	0.0740	0.394	-0.192	-0.238	-0.196	0.00190	0.160	-0.141	0.177*	0.429
	(0.179)	(0.219)	(0.187)	(0.0559)	(0.179)	(0.153)	(0.0954)	(0.401)	(0.211)	(0.204)	(0.185)	(0.0561)	(0.180)	(0.159)	(0.0937)	(0.383)
Foreign capital ratio	-0.0402	0.0759	-0.0464	0.000294	-0.0436	0.118**	0.00209	-0.0662	-0.0564	0.112	-0.0393	0.00163	-0.0994	0.106*	0.00965	-0.0343
	(0.0622)	(0.0762)	(0.0651)	(0.0194)	(0.0621)	(0.0531)	(0.0331)	(0.139)	(0.0734)	(0.0707)	(0.0641)	(0.0195)	(0.0625)	(0.0551)	(0.0325)	(0.133)
Debt ratio	1.199	2.390	-1.145	0.510	2.171	1.753	0.634	-7.511**	0.233	1.779	-1.936	0.205	1.885	2.887**	-0.112	-4.941
	(1.475)	(1.806)	(1.543)	(0.461)	(1.473)	(1.259)	(0.786)	(3.306)	(1.742)	(1.679)	(1.521)	(0.462)	(1.484)	(1.308)	(0.772)	(3.156)
Part-time worker ratio	-3.185*	6.030**	-2.629	2.162***	3.663*	-3.700**	4.453***	-6.796	-0.995	5.710***	-2.870	3.091***	2.408	-4.423***	4.089***	-7.010*
	(1.928)	(2.360)	(2.017)	(0.602)	(1.925)	(1.645)	(1.027)	(4.320)	(2.258)	(2.176)	(1.972)	(0.599)	(1.924)	(1.696)	(1.001)	(4.091)
Temporary worker ratio	-2.894*	-1.888	-0.825	0.281	1.383	0.413	1.028	2.500	-3.474*	-1.914	-0.803	-0.0628	2.374	0.265	0.373	3.241
	(1.576)	(1.929)	(1.648)	(0.492)	(1.573)	(1.344)	(0.839)	(3.530)	(1.836)	(1.770)	(1.604)	(0.487)	(1.565)	(1.379)	(0.814)	(3.327)
Average wages	-0.0356	0.0777	-0.473*	-0.165**	0.0829	-0.438**	-0.341***	1.291**	0.0685	0.0531	-0.347	-0.154**	0.174	-0.428**	-0.353***	0.986*
	(0.244)	(0.298)	(0.255)	(0.0761)	(0.243)	(0.208)	(0.130)	(0.546)	(0.287)	(0.277)	(0.251)	(0.0762)	(0.245)	(0.216)	(0.127)	(0.521)
Market top dummy	0.545	-0.250	-1.422	-0.155	-1.849	-0.243	0.445	2.930	1.301	0.0226	-1.422	-0.0581	-1.888	-1.823*	-0.186	4.054
	(1.183)	(1.448)	(1.238)	(0.369)	(1.181)	(1.009)	(0.630)	(2.651)	(1.391)	(1.341)	(1.215)	(0.369)	(1.185)	(1.045)	(0.617)	(2.521)
Sample size	2915								2908							

Figures in parentheses indicate robust standard errors for heteroscedasticity

***, **, and * indicate significant estimates for the 1%, 5%, and 10% levels, respectively.

Table 2-7 SUR estimation for response to future effective corporate tax rate decreases

	Short-term responses to effective corporate tax rate decreases								Medium-term responses to effective corporate tax rate decreases							
	Reduce the price of goods and services	Increase the cost of raw materials and price cost	Increase wages for regular employees	Increase wages for non-regular employees	Increase investment in capital assets and R&D	Employ more regular employees	Employ more non-regular employees	Increase profits	Reduce the price of goods and services	Increase the cost of raw materials and price cost	Increase wages for regular employees	Increase wages for non-regular employees	Increase investment in capital assets and R&D	Employ more regular employees	Employ more non-regular employees	Increase profits
Capital	-4.67e-06	6.01e-06	-5.84e-07	3.48e-06	-5.89e-05*	-1.22e-05	-5.64e-06	7.24e-05	0.000161***	6.25e-06	5.43e-06	3.73e-06	-9.10e-05	-3.43e-05	-1.48e-05	-3.64e-05
	(2.76e-05)	(1.86e-05)	(4.01e-05)	(9.66e-06)	(3.49e-05)	(2.23e-05)	(9.37e-06)	(6.32e-05)	(4.80e-05)	(3.10e-05)	(5.70e-05)	(1.76e-05)	(6.16e-05)	(3.80e-05)	(1.81e-05)	(0.000102)
Company age	-0.0633***	-0.00545	-0.0356	-0.00109	-0.0765***	-0.0713***	-0.0117*	0.265***	-0.0221	0.0127	0.0413	-0.00275	-0.0323	-0.0280	0.00500	0.0261
	(0.0204)	(0.0137)	(0.0290)	(0.00715)	(0.0256)	(0.0164)	(0.00694)	(0.0429)	(0.0225)	(0.0145)	(0.0267)	(0.00825)	(0.0289)	(0.0178)	(0.00848)	(0.0479)
Number of employees	-7.51e-05	-0.000342	-0.000808	-0.000107	0.00152**	-0.000405	0.000115	0.000102	-0.000245	-0.000465	-0.00112*	-0.000203	0.00163**	-0.000345	4.48e-05	0.000703
	(0.000500)	(0.000336)	(0.000726)	(0.000175)	(0.000631)	(0.000404)	(0.000170)	(0.00115)	(0.000565)	(0.000365)	(0.000672)	(0.000208)	(0.000726)	(0.000447)	(0.000213)	(0.00121)
Profit margin on sales	-14.56***	-5.037	-31.10***	-0.893	-15.43**	-17.97***	-2.617	87.60***	-6.618	-4.488	-19.88***	1.047	-3.559	-10.18**	-1.178	44.85***
	(5.602)	(3.775)	(8.059)	(1.963)	(7.051)	(4.516)	(1.905)	(12.32)	(6.123)	(3.953)	(7.282)	(2.251)	(7.867)	(4.848)	(2.311)	(13.06)
Manufacturing industry dummy	-0.262	-0.458	-2.103*	0.112	3.565***	-1.564**	-0.0643	0.775	-0.0539	0.309	-0.727	0.278	5.238***	-1.284*	-0.218	-3.542**
	(0.772)	(0.520)	(1.116)	(0.270)	(0.974)	(0.624)	(0.262)	(1.735)	(0.847)	(0.547)	(1.007)	(0.311)	(1.088)	(0.671)	(0.320)	(1.807)
Export ratio	1.529	3.178	6.539	-0.972	1.650	5.764*	-0.882	-16.81*	5.614	3.559	3.660	0.628	4.637	5.119	-1.519	-21.70**
	(4.323)	(2.910)	(6.276)	(1.513)	(5.460)	(3.496)	(1.467)	(9.901)	(4.775)	(3.083)	(5.679)	(1.755)	(6.135)	(3.781)	(1.802)	(10.19)
Foreign subsidiary dummy	0.609	-1.377	-7.209*	-0.489	4.109	-2.399	-0.676	7.432	-2.257	-1.296	-5.548	-1.655	-2.887	-3.788	-0.352	17.78**
	(2.821)	(1.899)	(4.095)	(0.987)	(3.563)	(2.281)	(0.957)	(6.458)	(3.259)	(2.104)	(3.875)	(1.198)	(4.187)	(2.580)	(1.230)	(6.951)
Asian subsidiary dummy	-0.298	0.423	4.782	0.675	0.551	3.398	0.869	-10.40	1.758	0.159	2.424	1.971	7.054	4.354	0.767	-18.49**
	(2.940)	(1.979)	(4.268)	(1.029)	(3.713)	(2.378)	(0.998)	(6.734)	(3.393)	(2.191)	(4.035)	(1.247)	(4.360)	(2.686)	(1.281)	(7.238)
Foreign subsidiary capital ratio	0.0339	0.0775	-0.0337	-0.0302	-0.537**	-0.0496	-0.0566	0.596	-0.00940	0.0355	0.0356	0.0466	-0.449*	-0.0817	0.0616	0.360
	(0.190)	(0.128)	(0.275)	(0.0664)	(0.240)	(0.153)	(0.0644)	(0.434)	(0.201)	(0.130)	(0.239)	(0.0738)	(0.258)	(0.159)	(0.0758)	(0.428)
Foreign capital ratio	-0.00462	0.0888**	-0.0580	0.00288	-0.137*	0.153***	0.0220	-0.0672	-0.0196	0.0910**	-0.0241	0.000930	-0.186**	0.144***	0.0229	-0.0283
	(0.0620)	(0.0417)	(0.0900)	(0.0217)	(0.0783)	(0.0501)	(0.0210)	(0.142)	(0.0668)	(0.0431)	(0.0795)	(0.0246)	(0.0858)	(0.0529)	(0.0252)	(0.143)
Debt ratio	-0.658	0.706	-6.691***	-1.265**	-5.713***	-1.748	-0.460	15.83***	3.417**	2.198**	-1.882	0.745	-1.172	1.267	0.644	-5.219
	(1.521)	(1.030)	(2.104)	(0.536)	(1.887)	(1.210)	(0.521)	(2.696)	(1.691)	(1.091)	(2.010)	(0.621)	(2.172)	(1.338)	(0.638)	(3.606)
Part-time worker ratio	1.105	-1.307	-14.10***	2.475***	-1.236	-6.624***	0.658	19.03***	5.073**	0.398	-7.561***	3.486***	4.479	-4.820***	2.800***	-3.856
	(2.001)	(1.350)	(2.841)	(0.702)	(2.506)	(1.605)	(0.682)	(4.129)	(2.215)	(1.430)	(2.634)	(0.814)	(2.846)	(1.754)	(0.836)	(4.725)
Temporary worker ratio	-1.985	-0.882	-1.503	-0.133	-0.0264	-1.821	0.116	6.235*	-1.266	-1.335	-1.782	-0.199	-0.531	0.0799	0.00432	5.029
	(1.579)	(1.063)	(2.292)	(0.553)	(1.994)	(1.277)	(0.536)	(3.616)	(1.688)	(1.090)	(2.008)	(0.621)	(2.169)	(1.337)	(0.637)	(3.601)
Average wages	-0.332	-0.480***	-2.774***	-0.389***	-0.237	-0.604***	-0.300***	5.115***	0.644**	-0.283	-1.259***	-0.168*	0.631*	-0.290	-0.116	0.842
	(0.250)	(0.169)	(0.347)	(0.0879)	(0.310)	(0.199)	(0.0855)	(0.456)	(0.275)	(0.177)	(0.326)	(0.101)	(0.353)	(0.217)	(0.104)	(0.586)
Market top dummy	2.337*	-1.303	-1.738	0.0161	-2.570	-1.328	0.353	4.233	1.968	-0.130	-2.381	0.0589	-0.793	-1.806*	0.457	2.628
	(1.241)	(0.835)	(1.801)	(0.434)	(1.567)	(1.004)	(0.421)	(2.836)	(1.359)	(0.878)	(1.616)	(0.500)	(1.746)	(1.076)	(0.513)	(2.899)
Sample size	2547								2326							

Figures in parentheses indicate robust standard errors for heteroscedasticity

***, **, and * indicate significant estimates for the 1%, 5%, and 10% levels, respectively.

Table 2-8 Summary of estimation results

Public Cost Burden Changes	Impact (Results)		Production Factor Input			Production Factor Price		Outside Factors		Profits	
			Regular Employment	Non-Regular Employment	Investment in Capital Assets and R&D	Regular Employee Wages	Non-Regular Employee Wages	Price of Goods and Services	Cost of Raw Materials and Price Cost		
Social Insurance Premiums	Increases	Short Term	- Major impact from social insurance premium increases. - However, the impact is smaller among companies paying high wages.	- The overall impact on non-regular employment is small. - However, companies with high non-regular employee ratios strongly tend to accommodate public cost burden changes by adjusting non-regular employee numbers.	The impact on investment is small.	- Social insurance premium increases are strongly correlated with reducing regular employee wages.	- The overall impact on non-regular employee wages is small. - However, companies with high non-regular employee ratios strongly tend to accommodate public cost burden changes by adjusting non-regular employee wages.	- The impact on production costs and investment costs is small. - However, large companies tend to make adjustments to production and investment costs.		- The impact is large.	- companies with high rates of return strongly tend to accommodate public cost burden changes by increasing or decreasing profits. - companies with high debt ratios strongly tend to avoid increasing/decreasing profits.
		Medium Term								- The impact lessens over the medium term.	
Effective corporate tax rates	Increases	Short Term	- The overall impact on regular employment is small. - However, the impact is even smaller among companies paying high wages.		- There is a strongly negative impact on investment.	- Effective corporate tax rate increases and decreases have little impact on regular employee wages. - The impact is even smaller among companies paying high wages.				- The impact is large.	
		Medium Term			- The negative impact grows over the medium term.					- The impact lessens over the medium term.	
	Decreases	Short Term			- There is a strongly positive impact on investment. - This impact is particularly big at manufacturing companies.					- The impact is large.	
		Medium Term								- The impact lessens over the medium term.	

Table 2-9 Hypothesis testing results

Hypothesis	Details of Hypothesis	Testing Method and Relevant Explanatory Variables	Testing Results
(1) Changes in corporate public burden are absorbed by direct means	・As examples of public cost burden, insurance premium burden affects the employment of regular employees and corporate income tax burden affects investment. ・Insurance premium increases may create the need to reduce the wage gap between regular and non-regular employees and employ more non-regular employees.	Tested via simple tabulation of explained variables.	・The hypothesis is supported overall.
(2) Changes in corporate public burden are passed on taking into account adjustment cost	・When public cost burden changes occur, companies adjust easily-adjustable costs in the short term and pass costs on to areas that may incur adjustment costs in the medium- to long-term. ・That is, companies reduce profits in the short term and reduce things such as employment, wages, and investment in the medium- to long-term.	Tested via simple tabulation of explained variables.	・The hypothesis is supported overall.
(3) Companies facing liquidity constraints weigh heavily cash on hand	・As companies facing liquidity constraints have difficulty procuring funds externally, they appear to value having cash on hand. ・Companies with little cash on hand, high debt ratios, or low profit ratios strongly tend to take measures other than reducing profits.	・Profit margin on sales ・Debt ratio	・The hypothesis is supported overall.
(4) Companies with strong negotiating power shift public cost to third parties	・Certain companies, including large companies, have strong bargaining power with third parties and strongly tend to shift costs to product and service prices and reduce cost price, among other actions.	・Capital ・Number of employees	・The hypothesis is supported for number of employees. ・No significant results were obtained for capital.
(5) Companies operating overseas do not change profit levels	・Companies with a significant share of overseas operations respond to public cost burden increases do not often reduce profits because they are more likely to shift operations to overseas production facilities.	・Export ratio ・Foreign subsidiary dummy ・Asian subsidiary dummy ・Foreign subsidiary capital ratio	・The hypothesis is not supported in almost every case.
(6) Companies with high foreign capital ratios value profits	・Companies with high foreign capital ratios are exposed to pressure in the capital market. Thus, they do not significantly adjust profits when cost burden increases but do increase profits when cost burden decreases.	・Foreign capital ratio	・Results obtained do not support the hypothesis.
(7) Companies with high non-regular employment rates prioritize adjustment by way of non-regular employment	・Because companies use non-regular employment as a means of cost adjustment, companies with high non-regular employee ratios accommodate public cost burden changes by adjusting non-regular employee numbers.	・Temporary worker ratio ・Part-time worker ratio	・The hypothesis is supported overall.
(8) Companies with high average wages do not adjust worker numbers or wages	・Companies paying high average wages do not change wages or employee levels if they usually offer workers higher wages than the market average based on the efficiency wage hypothesis.	・Average wages	・The hypothesis is supported overall.

Appendix: An Example of Questions

As a social insurance premium burden, we take pension premium and the sum of medical and long-term insurance premium into account. The current plan aims to increase pension premium 0.354% annually and the total rate of these three insurance premiums will account for 28% by 2017. In accordance to the statement mentioned above, we would like to hear how your company would respond to this expected increase in social insurance premium. (See Table)

Table

	Current plan	<1>	<2>
2010	25.05%	25.55%	26.05%
2014	26.47%	26.97%	31.47%

<1> Consider the case where the sum of three social insurance premium rates would increase by 0.5% more in 2010 fiscal year. How would your company deal with this burden increase?

<2> Consider the case where the sum of three social insurance premium rates would increase by 5% in the following 5 years (2010-2015 fiscal years) and by 1% in each year constantly. How would your company deal with this burden increase between 2010 fiscal year and 2014 fiscal year (5years)?

Please answer the following questions regarding the cases <1>-<2>. Please also be aware that this story is about the hypothetic future and your answers can only be based on your prediction.

Question: How would your company deal with future increase in social insurance

premium? Please answer the percentages of following items.

	<1> the sum of three social insurance premium rates would increase by 0.5% more in 2010 fiscal year	<2> the sum of three social insurance premium rates would increase by 5.0% in the following 5 years
Increase the output price	%	%
Decrease the input price	%	%
Reduce regular employee wages	%	%
Cut non-regular employee wages	%	%
Cut capital investment and R&D investment	%	%
Employ fewer regular employees	%	%
Employ fewer non-regular employees	%	%
Reduce profits	%	%
Total	100 %	100 %

Chapter 3
Effect of R&D Tax Credits for SMEs in Japan: A Microeconometric Analysis Focused on Liquidity Constraints

1 Introduction

According to modern theories of economic growth, research and development (R&D) plays a major role in sustainable growth. Technological progress is particularly important in Japan as the country is facing a rapidly decreasing population. However, R&D has spillover effects on other firms, and its social return is higher than its private return. In other words, since R&D has characteristics of a public good, R&D expenditures tend to be below desirable levels. Many governments offer tax credits or direct grants to foster private sector R&D. Tax credits are often favored because they are neutral with respect to industry and the nature of firm. Compared to direct grants, they have the advantage of potentially minimizing discretionary decisions by government.

Numerous studies have evaluated the impact of tax credits on R&D. Hall and van Reenen (2000) comprehensively summarize the related literature and conclude that a $1 tax credit for R&D induces about $1 of additional R&D expenditures. Many studies, however, disregard the problem of selection bias. Recipients of tax credits might systematically differ from non-recipients. For instance, recipients might aspire to technological innovation and be more inclined than non-recipients to consolidate R&D systems. For this reason, recent studies such as Huang and Yang (2009) and Onishi and Nagata (2010) begin to estimate the effect of R&D tax credit after carefully correcting possible selection bias. While some

above-mentioned studies estimate the effects of R&D tax credits on the basis of a careful correction of the selection bias, several issues are remaining especially in small- and medium-sized enterprises (SMEs).

First, existing researches which correct possible selection bias does not focus on SMEs. Many studies point out that innovation by SMEs is essential for economic growth. Acs and Audretsch (1990) and Audretsch (2006) find that SMEs' contribution to technological progress through R&D and innovation has a crucial impact on economic growth. As R&D of SMEs plays a major role in innovation and technological progress, evaluating the impact of R&D tax credits on SMEs remains an important research issue.

Second, as SMEs tend to face liquidity constraints, their level of R&D expenditures may be less than that of larger firms. R&D expenditures are characterized by high cost and, usually, firm-specific investment. And they have little collateral value because labor cost comprises a large portion of these expenditures[1]. Whether tax credits alleviate SMEs' liquidity constraints is a significant research subject. If tax credits mitigate liquidity constraints, they may be an effective tool to induce SMEs' R&D.

This chapter contributes empirical literature by estimating the effect of R&D tax credits on Japanese SMEs. To avoid selection bias as mentioned above, we employ the matching method introduced by Rubin (1974) to match tax credit recipients with non-recipients possessing the most similar characteristics. As we note lately, the matching method need not assume specific functional forms and can address the systematic selection bias arising from the application of R&D tax credits. By subdividing our samples by industry, firm size, and liquidity constraint, we also examine the different effect of R&D tax credits according to firm characteristics.

Our empirical results show that offering R&D tax credits for Japanese SMEs more than

[1] Hall (2002) surveys the relationship between R&D and financing constraints.

doubled their R&D expenditures, and the effect is considerably large for SMEs facing liquidity constraints. Our findings thus indicate that R&D tax credits are effective policy instruments for inducing private R&D expenditures.

The chapter is organized as follows. Section 2 discuses research background, Section 3 introduces preliminarily examines our data and describes our empirical strategy. Section 4 presents estimation results and a discussion. Section 5 concludes and proposes subjects for future study.

2 Research Background

2.1 Literature Review on the Effect of R&D tax credits and the Selection Bias

As we introduced in Section 1, numerous studies have evaluated the impact of tax credits on R&D. Although effects of R&D tax credits are rarely estimated by utilizing micro data because of data availability, analyses using micro data are emerging. Koga (2003), for instance, examines whether the elasticity of R&D tax credits for Japanese manufacturers from 1989 to 1998 varies with firm size. He finds that tax credits primarily stimulate R&D in large rather than medium-size firms. Baghana and Mohnen (2009) examine tax price elasticity for Canadian manufacturers from 1997 to 2003. In contrast to Koga (2003), they find that estimated elasticity is significantly negative for small firms and insignificant for large firms.

Many studies, however, disregard the problem of selection bias. Recipients of tax credits might systematically differ from non-recipients. For instance, recipients might aspire to technological innovation and be more inclined than non-recipients to consolidate R&D systems. For this reason, merely estimating the difference in R&D between recipients and

non-recipients may produce a biased estimate. Correcting any possible selection bias in the empirical analysis is important for assessing the effect of R&D tax credits.

Instead of evaluating the effects of tax credits on R&D expenditures, Czarnitzki et al. (2011) estimate their effects on innovation in their study of Canadian manufacturers from 1997 to 1999. To correct the selection bias, they use propensity score matching (PSM)[2] and find that tax credits encourage firms to conduct R&D and to create and sell new and improved products. Huang and Yang (2009) investigate the effect of tax incentives on R&D among Taiwanese manufacturers. As a result of estimation employing PSM, they show that recipients of R&D tax credits appear on average to spend 93.53% more on R&D and have a 14.47% higher growth rate of R&D expenditures compared to non-recipients with similar characteristics.[3] Onishi and Nagata (2010) apply difference-in-differences-PSM (DID-PSM) to estimate the impact of R&D tax credits on Japanese firms capitalized at ¥1 billion or more. However they find no evidence that R&D tax credits influence R&D expenditures[4].

While some existing researches reveal the effect of R&D tax credits after carefully considering possible selection bias, these do not focus on SMEs. Since innovation by SMEs is key factor for economic growth as we explain in next subsection, estimating the effect of tax credits on R&D of SMEs are important remaining research issues.

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[2] Several studies estimate the effects of R&D subsides using PSM. Duguet (2005), Heshmati and Lööf (2007), González and Pazó (2008), and Ito and Nakano (2009) find that R&D subsidies increase private R&D expenditures.

[3] Huang and Yang (2009) employ Generalized Method of Moment (GMM) for panel data to correct endogeneity bias. They find results similar to those obtained by PSM analyses.

[4] Kasahara et al. (2011), while not applying PSM, estimate the tax elasticity of R&D by utilizing the Japanese tax credit reform in 2003. Using the variation across firms in the changes in the effective rate of tax credits between 2002 and 2003, they attempt to correct for the selection bias. Their empirical result shows that the decrease in the effective rate of R&D tax credits induces an increase in R&D expenditures.

2.2 The Importance of SMEs' R&D

R&D of small- and medium-sized enterprises (SMEs) in particular has two important aspects. First, innovation by SMEs is essential for economic growth. Acs and Audretsch (1990) and Audretsch (2006) find that SMEs' contribution to technological progress through R&D and innovation has a crucial impact on economic growth. Kim et al. (2010) attribute stagnation in Japan's total factor productivity (TFP) growth during the "Two Lost Decades" to small firms' low R&D expenditures. We confirm these observations statistically. Figure 3-1 shows long-term changes in the ratio of R&D expenditures to sales of large enterprises and SMEs in manufacturing. Although ratios for both have been increasing gradually, SMEs' expenditures have grown a mere 1.7 times since 1970 versus three-fold for large enterprises. Figure 3-2 shows the ratio of R&D expenditures to sales with respect to the number of employees in Japan and the United States. In the United States, the ratio of R&D has no relation to the number of employees. In Japan, however, the smaller is the workforce, the lower is the ratio of sales to R&D expenditures.

Second, as SMEs tend to face liquidity constraints, their level of R&D expenditures may be less than that of larger firms. R&D expenditures are characterized by high cost and, usually, firm-specific investment. At the same time, they have little collateral value because labor cost comprises a large portion of these expenditures.[5] Stiglitz and Weiss (1981) also note the importance of internal funding for uncertain investments such as R&D because of asymmetric information. Although R&D requires abundant external funding, recent studies find that many SMEs face financial constraints (Petersen and Rajan 1994; Berger and Udell 2002; Carpenter and Petersen 2002; Czarnitzki 2006). A pioneering study by Czarnitzki and Hottenrott (2011) reveals that smaller firms have limited access to external

[5] Hall (2002) surveys the relationship between R&D and financing constraints.

funding, which impedes R&D of SMEs.

2.3 Japan's System of R&D Tax Credits for SMEs

This subsection briefly introduces Japan's system of R&D tax credits for SMEs. Japan introduced R&D tax credits in 1967. Initially, tax credits were applied only to incremental R&D expenditures from the previous year and no preferences were included for SMEs. Since then, R&D tax credits have been expanded and preferences for SMEs introduced.

Table 1 summarizes Japan's present system of R&D tax credits for SMEs. As the table shows, there are three types of credits: basic, incremental, and high-level. SMEs can receive a credit equaling 12% of their total R&D expenditures and not exceeding an amount equal to 30% of their corporate taxes. In addition, SMEs are eligible for an incremental credit if their R&D expenditures exceed "comparative R&D expenditures," that is, average R&D expenditures over the past three years. The amount equals 5% of the difference between R&D expenditures and "comparative R&D expenditures" and not exceeding an amount equal to 10% of the company's corporate taxes. The high-level credit permits companies to deduct an amount equal to 10% of the firm's corporate taxes if R&D expenditures surpass "average sales" for the past three years. Companies may not claim the incremental and high-level credits simultaneously.

Since our dataset, described in detail in the next subsection, can identify firms receiving tax credits, we can estimate the effect of tax credits by employing it. Unfortunately, however, we can evaluate only the overall impact of whole R&D tax credits because of the inability to distinguish each types of tax credit.

3 Empirical Strategy

3.1 Selection Bias

When assessing the effect of R&D tax credits, it is important to correct for any possible selection bias in the empirical analysis. However, most studies that estimate elasticity of R&D tax credits regard them as an exogenous variable even though characteristics of recipients could differ from non-recipients. For example, a high level of R&D expenditures might reflect the firm's characteristics and not the effect of tax credits. As a result, most research might be unable to identify the causal effects of the R&D credit.

Econometric evaluation techniques provide several estimation methods to correct for the selection bias, including DID estimation, selection model, instrumental variables estimation (IV), Regression Discontinuity Design (RDD), and the matching method. Because our dataset is cross-sectional, we cannot utilize DID estimation that requires panel data. Selection model and IV estimation need instrumental variables that correlate treatment variables and not output variables. Since Japan's system of R&D tax credits gives preferential treatment to SMEs, we might utilize discontinuity between SMEs and large firms in order to estimate the effect of tax credits. However, it is difficult to exploit RDD because the size of companies is classified on a scale of capital fund in the Japan's system of taxation, and companies have some room to maneuver their volume of capital fund. Therefore, we apply the matching method introduced by Rubin (1974) and developed by Rosenbaum and Rubin (1983) and Heckman et al. (1997, 1998). Besides addressing endogeneity, the matching method has the advantage of not needing to assume a specific functional form.

3.2 Matching Method

The matching method is summarized as follows.[6] Let a binary treatment indicator D_i equal 1 if firm i receive R&D tax credits and 0 otherwise, where $i = 1, \ldots, N$ and N denotes the total number of firms. The potential outcomes for each firm i are defined as $Y_i(D_i)$, where Y_i denotes R&D expenditures. The treatment effect for firm i is expressed as

$$\tau_i = Y_i(1) - Y_i(0), \tag{1}$$

where τ_i indicates the treatment effect.

However, we cannot observe $Y_i(0)$, the counterfactual outcome. Hence, estimating the individual treatment effect τ_i is impossible, and we must estimate the average treatment effect (ATE). ATE is the difference in the expected outcomes between recipients and non-recipients.

$$\tau_{ATE} = E[\tau_i] = E[Y_i(1) - Y_i(0)]. \tag{2}$$

ATT indicates the expected effect on the outcome if firms in "the population" were randomly assigned for treatment. Nevertheless, as Heckman (1997) notes, ATE might lack relevance because it includes the effects on firms for which the program was never intended. Therefore, we estimate the average treatment effect on the treated (ATT), the effect on those for which the program is actually intended. ATT is expressed as

[6] This discussion primarily depends on Caliendo and Kopeinig (2008). For a more detailed discussion, see also Cameron and Trivedi (2005), Guo and Fraser (2010), and Wooldridge (2010).

$$\tau_{ATT} = E[Y_i(1)|D_i = 1\,] - E[Y_i(0)|D_i = 1]. \tag{3}$$

Because $E[Y_i(0)|D_i = 1]$ is the counterfactual mean, we cannot observe it. However, using the mean outcome of untreated firms $E[Y_i(0)|D_i = 0]$ instead can generate a selection bias.

$$\begin{aligned} E\,[Y_i(1)|D_i = 1\,] - E[Y_i(0)|D_i = 0] &= \tau_{ATT} \\ &+E\,[Y_i(0)|D_i = 1\,] - E[Y_i(0)|D_i = 0]. \end{aligned} \tag{4}$$

The final two terms of Equation (4) are the selection bias. τ_{ATT} is precisely estimated in so far as $E\,[Y_i(0)|D_{\mathrm{i}} = 1\,] - E[Y_i(0)|D_i = 0] = 0$. This condition satisfies in experiments of random assignment but not in non-experimental studies. Rubin (1977) introduced the conditional independence assumption (CIA) to cope with the selection problem. CIA assumes that recipients and potential outcomes are independent for firms with identical exogenous covariates X_i. Covariates X_i consist of the set of characteristics that potentially affect receiving the R&D tax credit. If CIA is satisfied, we have the following equality.

$$E[Y_i(0)|D_i = 1, X_i] = E[Y_i(0)|D_i = 0, X_i] \tag{5}$$

This equality implies that the counterfactual outcome can be substituted for the outcomes of non-recipients, provided there are no systematic differences between the recipient and non-recipient groups. Therefore, Equation (3) can be rewritten as

$$\tau_{ATT} = E[Y_i(1)|D_i = 1\,,\ X_i = x] - E[Y_i(0)|D_i = 0, X_i = x]. \tag{6}$$

To estimate the difference in the outcomes between recipients and non-recipients, we use the matching method introduced by Rubin (1974). Traditional matching estimators pair each recipient with an observable similar non-recipient and interpret the difference in outcomes as the effect of treatment. However, if we use many variables, matching recipients and similar non-recipients becomes difficult. To construct a valid control group, Rosenbaum and Rubin (1983) suggest matching on the basis of the propensity score ($\mathrm{P}(D_i = 1|X_i = x)$), with the probability of receiving a treatment conditional on the covariates. In effect, we use probit estimation that regresses D_i on covariates X_i. Using the estimated propensity score of firms choosing to receive R&D tax credits, we can execute the matching algorithm to find the proper counterfactual. The matching procedure is successful if the means of covariates X_i among the two groups do not differ significantly (balancing property).

3.3 Several Matching Approaches

We use kernel matching, k-nearest-neighbor matching, and caliper matching. Kernel matching is a nonparametric method that uses the weighted average of non-recipients to construct the counterfactual outcome. We must choose the kernel function and the bandwidth in applying kernel matching. Econometricians acknowledge that the choice of kernel function is of slight importance but that of bandwidth is crucial because of the trade-off between bias and variance of estimates: high bandwidth induces large bias and small variance. We use Epanechnikov's kernel function and 0.05 as a bandwidth. K-nearest-neighbor matching matches k-closest firms in terms of propensity score. Choice of k also imposes a trade-off between bias and variance: large k leads to large bias and small variance. On the basis of earlier studies, we use 5 as k. Caliper matching can avoid bad matches by imposing a tolerance level on the maximum propensity score distance

(caliper). We use 0.05 as the tolerance level. While caliper matching has the advantage of small bias, variance of estimates increases when fewer matches are performed. Since there is no best matching approach, we use three alternative methods to compare estimation results.

3.4 Data and Variables

We utilize cross-sectional firm-level data from *The 2009 Basic Survey of Small and Medium Enterprises* conducted by the Small and Medium Enterprise Agency of the Ministry of Economy, Trade and Industry. This survey collects information about SMEs[7] and covers construction, manufacturing, information and communications, wholesale and retail trade, and other industries. Sampling in this survey is based on the results of *The 2006 Establishment and Enterprise Census* from the Ministry of Internal Affairs and Communications. The valid response rate for this survey is 49.2% based on 55,636 completed questionnaires.

Table 3-2 shows descriptive statistics for recipients and non-recipients[8]. ln(R&D expenditure), which is log of R&D expenditure (thousands of yen), is our outcome variable. Since we utilize log of R&D expenditures as an outcome variable, companies that do not conduct R&D are excluded from our analysis. Therefore, we explore the effect of tax credits on companies' decisions to change the volume of R&D (intensive margin), not on whether they begin to conduct R&D (extensive margin). We realize that the average ln(R&D expenditure) among recipients is higher than among non-recipients. As discussed, however,

[7] For example, SMEs in manufacturing are companies capitalized at ¥300 million or less or employ 300 or fewer persons. For a detailed definition of SMEs, consult the "Outline of the 2009 Basic Survey on Small and Medium Enterprises" on the web page of the Small and Medium Enterprise Agency.

[8] We do not analyze individual proprietorships because few apply for R&D tax credits.

this difference may result from the selection bias, which we must correct when evaluating the effects of R&D tax credits.

Other variables in Table 3-2 are exogenous covariates X. To satisfy CIA, covariate X must consist of variables that potentially affect receiving the credits. However, the determining factors of receiving R&D tax credits are not adequately revealed. We use the following variables that may affect application of tax credits as covariates: ln(total workers), patent dummy, recurring profit margin, and dependence on debt.

Because larger firms are thought to afford conducting R&D, we use ln(total workers) as a covariate, which indicates firm size. Patent dummy is a variable that has unit value if a firm has patents and zero otherwise. Because a firm with patents is thought to undertake innovation, we utilize the patent dummy as the proxy variable for innovation. Unprofitable firms have little incentive to apply tax credits because they might not pay substantial corporate tax. Therefore, we use recurring profit margin as a proxy variable for profitability. When firms do not hold sufficient internal funds, R&D investment may be restricted owing to financial constraints. We also exploit dependence on debt as a covariate.

Caliendo and Copeinig (2008) recommend including as covariates only those variables that are unaffected by receiving the credits, such as fixed over time or measured before receiving. Unfortunately, we cannot utilize lagged variables as covariates because our dataset is cross-sectional. Therefore, we use the following variables that are fixed over time as X: ln(capital fund), a dummy for the company's founding year, a dummy for main financing bank, an industry dummy, and a region dummy.

Descriptive statistics of exogenous covariates as well are shown in Table 3-2. The average ln(total workers) among recipients is higher than among non-recipients, implying that recipients are relatively larger than non-recipients. Variables from $D_{1999\text{-}2003}$ and $D_{after2004}$ are dummies that show the year in which the firm was founded, whose base category is

founded before 1999[9]. Recipients firms are somewhat older than non-recipient firms. Variables ranging from the construction to other service dummies show the firm's industry, and those from the Hokkaido-Tohoku to the Kyushu-Okinawa dummy indicate regions where a firm is located. The base category of region dummies is the Kanto District, which includes metropolitan Tokyo.

3.5 Sample Separation

In addition to analyzing the whole sample, we subdivide it to examine the efficiency of R&D tax credits according to firm characteristics. Especially, we focus on liquidity constraint because it dampens R&D of SMEs, as noted earlier.

First, we separate our sample by industry. Descriptive statistics of our sample shown in Table 3-2 confirm that manufacturers are more R&D intensive and more likely to apply R&D tax credits than are non-manufacturers. For this reason, examining the efficacy of R&D tax credits for manufacturers is highly significant for policy. For example, Huang and Yang (2009) ascertain whether the effect of R&D tax credits varies among hi-tech and non-high-tech Taiwanese manufacturers and find no significant difference.

Second, we focus on the effect of R&D tax credits by firm size. As mentioned, Koga (2003) finds that R&D tax credits have a greater effect on large than on small firms, whereas the elasticity estimated by Baghana and Mohnen (2009) is significantly negative for small firms, unlike for large firms. By dividing firms into subgroups with 51 or more employees and 50 or fewer, we reexamine the effectiveness of R&D tax credits by firm size. Table 3-3

[9] While it is preferable to use firm age as substitute for a dummy for the foundation year, firm age is not available in our dataset. However, our survey asks firms about the foundation year from choices: 2007, 2006, 2005, 2004, 2003, 2002, between 1999 and 2001, and before or on 1998. We utilize these as proxy variables for firm age. Since some dummy variables perfectly predict the application of tax credits in the estimations using subsamples, we combine these dummy variables into two categories.

presents summary statistics by firm size.

Finally, we split the sample according to whether firms face liquidity constraints. As noted, previous studies such as Czarnitzki and Hottenrott (2011) reveal that smaller firms suffer more from external constraints on R&D expenditures than do larger firms. Stiglitz and Weiss (1981) also note the importance of internal funding for uncertain investments such as R&D because of asymmetric information. This problem might be more serious for small firms that cannot access financial markets directly. As a result, R&D tax credits might be effective for liquidity-constrained firms.

Since Fazzari et al. (1988), empirical studies have sought to reveal financial constraints through two different approaches. The first approach uses cash flow indicators. As unconstrained firms were not expected to be sensitive to availability of internal financial resources, we can identify constrained firms by examining the sensitivity of R&D investment to internal funds. The second approach is to classify firms by size, financial marketing regimes, and governance structures. However, the literature has strongly criticized the relationship between cash flow and investment as a sufficient indication of overall financial constraints (see Kaplan and Zingales 1997, 2000 and the response by Fazzari et al., 2000).[10] Hence, we utilize the financial environment, which is faced by all firms, as a direct measure to group firms with respect to liquidity constraint. *The 2009 Basic Survey of Small and Medium Enterprises,* on which our dataset is based, asked firms whether their main financial bank imposed conditions such as seeking guarantees from business managers or third parties, requiring property as collateral, or insisting on public credit guarantees. If so, we define them as liquidity constrained. Descriptive statistics by liquidity constraint appear in Table 3-3.

[10] Czarnitzki and Hottenrott (2011) employ a credit-rating index to reflect financing opportunities.

4 Estimation Results

4.1 Probit Estimation

4.1.1 Whole sample

We first estimate the probit model to obtain the propensity score. Table 3-4 presents the estimation results. The following covariates are found to have significant influence on a firm's decision to apply for R&D tax credits.

Firms' propensity to apply for R&D tax credits is positively associated with ln(total workers). This result indicates that large firms tend to use R&D tax credits. The patent dummy is also associated with applications for tax credits. Because firms holding patents are thought to pursue innovation actively, they are also deemed to utilize tax credits to cover some of the cost associated with R&D expenditures.

Recurring profit margin has a positive influence on applications for credit and dependence on debt has a negative influence. These findings imply that firms applying for R&D tax credits are good standing because loss-making enterprises cannot claim them.

Firms established as a limited company (*yugen gaisha*) tend not to use R&D tax credits. Compared with *kabushiki gaisha* (the base category), most *yugen gaisha* are small companies. For this reason, we expect the coefficient of the *yugen gaisha* dummy to be negative.

In contrast, dummies for the firm's year of founding, the main bank dummies, industry dummies (excluding personal service dummy), and regional dummies (excluding the Hokkaido-Tohoku dummy) show no significant effects on applying for R&D tax credits. Covariates related to firm size, innovation, and finance are dominant in firms' decisions to apply for R&D tax credits.

4.1.2 Subsamples

Estimation results of the probit model using subsamples are also shown in Table 3-4. Coefficients of some variables such as $D_{1999\text{-}2003}$ and Hokkaido-Tohoku dummy are eliminated in Table 3-4. Some dummy variables perfectly predict the application of tax credits or take the same value in the estimations. However, eliminating these variables from estimation means that firm would be regarded as the reference (base category). Therefore we exclude such firms from the estimation.

Coefficients obtained by using different subsamples are similar. However, differences between subsamples are as follows. Among non-manufacturers, patent dummy and recurring profit margin show no positive influence on applying for R&D tax credits. Coefficients for other variables do not differ between manufacturers and non-manufacturers. This result might imply that patents are R&D's important outcomes for manufacturing, but these are not for services.

Although a 1% increase in the number of workers increases the probability of a large firm applying for the credit, this effect is lesser for small firms. In contrast, although the coefficient of dependence on debt is significantly negative for small firms, it is smaller for large firms. This result might imply that financial constraint prevent small firms from conducting R&D.

Similarly, while the coefficient of dependence on debt for firms without liquidity constraints is statistically insignificant, the coefficient for firm with liquidity constraints is significantly negative. This result might imply that R&D of firms with liquidity constraints is susceptible to scarcity of internal fund.

4.2 Effect of R&D Tax Credits

4.2.1 Whole sample

Table 3-5 shows the estimation results from matching estimators using propensity score retrieved from the probit model. The upper section of the table displays the result from unmatched estimates, which shows the difference in ln(R&D expenditure) between recipients and non-recipients before matching. The lower section of the table displays the result from matching estimator. "ATT" exhibits the average treatment effect on the treated, which is estimated by using propensity score matching.

The first column of Table 3-5 presents the average ln(R&D expenditure) of the treated group (recipients), and the second column presents that of the control group (non-recipients). The third column shows the difference between the first and second columns. The fourth column provides the standard error of the differences, and the fifth column gives the t-value for the equivalence of difference in means between the two groups.

In each matching method, all ATTs are smaller than the unmatched difference: the unmatched difference is 2.222, whereas ATTs are 1.251 (kernel), 1.268 (k-nearest-neighbor), and 0.996 (caliper). This implies that the unmatched difference, which disregards the selection bias, is overestimated.

However, after correcting the selection bias by using propensity score matching, estimated ATTs from all matching methods remain positive and statistically significant. Because the outcome variable is a natural logarithm of R&D expenditures, the estimated ATTs of 0.996–1.268 indicate that the application of R&D tax credits nearly doubles R&D expenditures. These estimates resemble those of Huang and Yang (2009), which are 0.898–0.960[11]. These imply that R&D tax credits are important for inducing R&D

[11] Taiwan's system of R&D tax credits is also similar to Japan's one. Under the industrial

expenditures among Japanese SMEs.

4.2.2 Subsamples

Turning to the estimates for subsamples, Table 3-6 lists treatment effects by industry. Estimated ATT for non-manufacturers is slightly smaller than that for manufacturers in each matching method. Average of three methods is 1.239 in manufacturers and 0.971 in non-manufacturers, respectively. Since manufacturers are more R&D intensive and tend to claim R&D tax credits, this finding means that R&D tax credits are more effective for manufacturers. This result might reflect a difference of characteristics between manufacturers and non-manufacturers. For instance, if non-manufacturers require more intangible assets to conduct R&D than manufacturers, R&D stock of non-manufacturers might have little collateral value. As a result, non-manufacturers might be reluctant to conduct R&D even if they could utilize tax credits.

Estimated results by firm size are shown in Table 3-7, and estimated ATT for small firms is somewhat larger than that for large firms. Average of three methods is 1.059 in large firms and 1.362 in small firms, respectively. Existing studies focused on firm size, such as Koga (2003), Baghana and Mohnen (2009), and Kasahara et al. (2011), reveal that elasticity of R&D tax credits vary with firm size. Our empirical results also confirm that the effect of tax credits differ with firm size.

Table 3-8 shows that estimates of ATT for firms with liquidity constraints are much larger than for firms without them. Average of three methods is 1.591 in liquidity constraint and 0.887 in non-liquidity constraint, respectively. Table 3-9, which shows the results of tests regarding ATT differences, indicates that one of differences in mean by liquidity constraint

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technology policy, Taiwanese companies are entitled to tax credits up to 15% of qualified R&D expenses, with the maximum amount of tax credit capped at 30% of the income tax payable for the year.

is statistically significant. These results imply that internal funding is important for making investments in activities with uncertain outcomes, such as R&D. Existing research reveals that smaller firms suffer more from external constraints on R&D expenditures than do larger firms, and such constraints prevent SMEs from R&D spending. These consequences are also supported by the estimation results above. Our results imply that tax credits for SMEs facing external funding constraints are considerably effective in stimulating their R&D expenditures.

4.3 Tests of Balancing Property

As discussed in Subsection 3.2, we must confirm that the means of covariates between the recipient and the non-recipient groups do not differ significantly from zero. If so, our matching results can be regarded as reliable.

Table 3-10 shows the average covariates of each group and the standard t-test for the equity of mean sample values along with its p-value before and after matching. Before matching, the means of many covariates among recipients differ statistically from non-recipients. This finding indicates that the treated and control groups generally do not exhibit similar characteristics prior to matching. After matching, however, we cannot reject the null hypothesis of the t-test that the mean differences between recipients and non-recipients are equal for almost all covariates in every matching method.

Table 3-11 lists the joint significance tests and pseudo-R^2. In Table 3-11, "|%bias|" stands for the absolute percentage of the mean difference between recipients and non-recipients. Means of |%bias| decrease considerably after matching. The pseudo R^2 approaches zero if matching is successful. As the table shows, the pseudo R^2 and p-value of the LR-test approach zero.

In short, these statistical tests strongly support the legitimacy of our propensity matching

estimates.[12]

4.4 Discussions

This subsection discusses empirical results from two different viewpoints.

First is the difference of results between this chapter and previous studies, especially Onishi and Nagata (2010). While both our study and Onishi and Nagata (2010) estimate the effect of Japanese tax credits, these results are quite different. Onishi and Nagata (2010) estimate the impact of R&D tax credits on Japanese firms capitalized at ¥1 billion or more. They find no evidence that R&D tax credits influence R&D expenditures. On the contrary, our results show that tax credits significantly increase R&D expenditures of SMEs. The possible reasons why each study leads to different results are as follows. First is the firm size. Onishi and Nagata (2010) focus on large firms, but our study analyzes SMEs. As Baghana and Mohnen (2009) and Kasahara et al. (2011) reveal, small firms are likely to be more reactive to R&D tax credits since they have limited access to external funding. They have little collateral and they may be young firms with little relationship to financial institutions. Second is the difference of analyzing tax system. Onishi and Nagata (2010) estimate the change of effect from basic type tax credits to incremental type. On the other hand, this study estimates the effect of whole tax credits. Even though the change of the effect from basic type to incremental type does not differ significantly from zero, it does not mean that R&D tax credits as a whole have no influence on R&D expenditures. Third is the difference of analytical method. Onishi and Nagata (2010) use propensity score matching in

[12] Balancing properties of subsamples are also satisfied in almost all estimations. We have abbreviated their statistical tests because of space constraints. However, the means of main financing bank dummy between the recipient and the non-recipient groups in non-manufactures and those of Kyushu-Okinawa dummy in small firms differ significantly from zero in Caliper matching. Therefore, the ATT derived by these matching might be unreliable.

a manner similar to our estimates. However several differences exist between this chapter and theirs. They utilize DID-PSM, whereas we use ordinary PSM. Heckman et al. (1997) show that DID-PSM often performs the best among the class of estimators they examine, especially when omitted time-invariant characteristics are important sources of bias. Regarding this point, estimates by Onishi and Nagata (2010) are more robust than ours. However, sample selection problems might arise in their analyses because their dataset shrinks in the process of matching three different datasets.

The second viewpoint is the relationship between R&D tax credits and liquidity constraints. Though our empirical results show that estimates of ATT for firms with liquidity constraints are much larger than for firms without them, the theoretical background is not necessarily clear. Kasahara et al. (2011) construct a simple two-period model of R&D expenditure with financial constraint to reveal how tax credits alleviate financial constraint. Their theory implies that the effect of tax credits on R&D expenditure would be increasing in liquidity constraint. The theoretical expectation is also empirically confirmed. However, their theoretical model does not explain why tax credits enlarge R&D expenditure more than increase of cash flow by tax credits. Another possible explanation is a financial accelerator proposed by Bernanke et al. (1999). They point out that shocks to the economy are amplified by their effects on borrowers' cash flows. In our case, R&D tax credits reduce not only the user cost of R&D but also the external finance premium through increased internal fund. These channels might amplify the effect of tax credits. In either case, constructing theoretical framework is important future subject.

5 Conclusion

Dormant R&D by SMEs contributed to the slowdown in Japan's TFP growth and its

"Two Lost Decades." Thus, it is especially important to induce an increase in R&D expenditures among SMEs. In many countries, R&D tax credits are a major policy tool to stimulate R&D. This chapter analyzed the effect of R&D tax credits on Japanese SMEs. We estimated ATT of R&D tax credits by propensity score matching to correct for the selection bias. Our empirical results revealed that tax credits positively influence SMEs' decisions to conduct R&D, and application of tax credits more than doubles the R&D expenditures on average. Therefore, tax credits are an effective instrument to foster R&D among SMEs. Moreover, by estimating ATT using several subsamples, we found that ATT for firms with liquidity constraints is much larger than for those not facing liquidity constraints. This result might imply that providing R&D tax credits to liquidity-constrained firms is a more efficient policy because tax credits reinforce internal funds.

Our analyses have several limitations. First, even if R&D tax credits are effective policy instruments, their usefulness is limited if few firms apply them. In effect, SMEs' ratio of application of R&D tax credits is a mere 0.26%,[13] and SMEs' R&D rate is 2.35%. It is necessary to study further the reasons behind this situation. By doing so, we could also make matching estimates more accurate. In this paper, since we exclude companies that do not conduct R&D from the analysis, the effect of tax credits on extensive margin is still up in the air. It is also necessary to reveal whether R&D tax credits have a significant impact on extensive margin.

Second, in Subsection 4.4, we discussed possible reasons why our empirical results differ from previous studies. To clarify these reasons, mindful of these differences, research into the effect of R&D tax credits must be advanced. For example, if we utilize panel data, we obtain robust and detailed estimates. By using panel data, we can take advantage of DID-PSM as noted above. Furthermore, while we have no choice but to employ covariates

[13] *The 2009 Basic Survey on Small and Medium Enterprises*

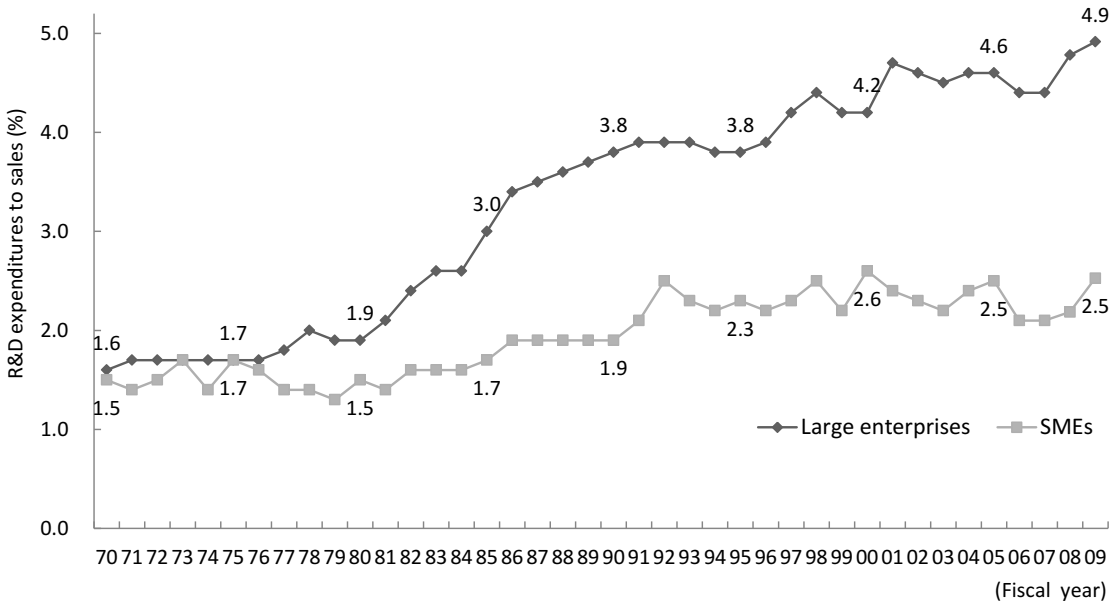
of same-year R&D expenditures, using lags of covariates is preferable.

Third, we cannot determine the optimal level of R&D tax credits from our empirical results because our PSM analyses do not identify their general equilibrium effects and cost-benefit analysis. Further scholarship would benefit from general equilibrium analyses to determine socially optimum tax credits.

Forth, *The 2009 Basic Survey of Small and Medium Enterprises* which we utilize in this chapter collects information about SME as of 2008. Since not only foreign countries but also Japan were hit hard by the global financial, economic climate in 2008 was awfully harsh. Therefore we must confirm the robustness of our results by utilizing data of other years.

Finally, many existing researches confirmed the relationship between R&D and liquidity constraints. However, as discussed in Subsection 4.4, the theoretical relationship between R&D tax credits and liquidity constraints has not been clear yet. We need to construct a theoretical model explaining that relationship.

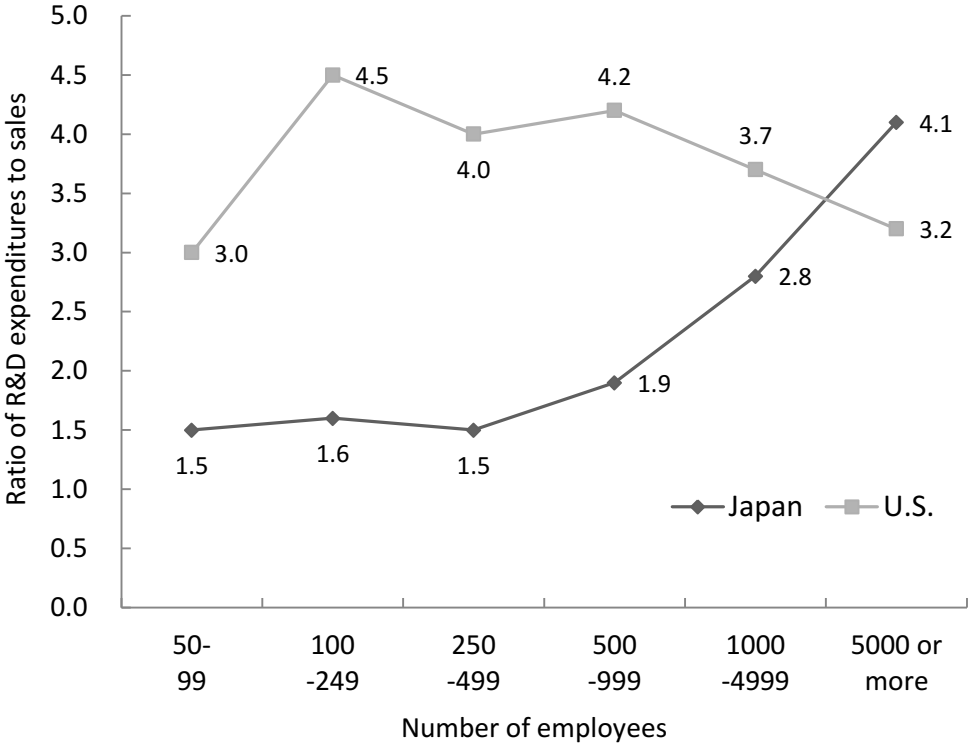
Figure 3-1 Changes in R&D expenditures of SMEs and large enterprises (manufacturing)



Source: Ministry of Internal Affairs and Communications, *Survey of Research and Development*

Notes: Enterprises with workforces of 1 to 299 employees are considered SMEs, and those employing 300 or more are considered large enterprises. R&D expenditures include both internal and external expenditures. Data are for enterprises engaging in R&D.

Figure 3-2 Ratio of R&D expenditures to sales by number of employees in Japan and the U.S. (manufacturing)



Source: Small and Medium Enterprise Agency of Japan, *2009 White Paper on Small and Medium Enterprise in Japan*

Notes: Data for enterprises that responded about R&D in Japan and the U.S. federal subsidies are not included for the U.S. To match the value definition of the U.S., R&D expenditures for outsourced work were excluded from R&D expenditures and R&D expenditures for commissioned work were included in Japanese values.

Table 3-1 Summary of Japanese system of R&D tax credits for SMEs

Types	Basic type	Incremental type	High-level type
Subject of tax credits	Total amount of R&D expenditures	R&D expenditures above "comparative R&D expenditures"	R&D expenditures above 10% of "average sales"
Tax credit rate	12%	5%	(R&D/Sales − 10%) × 0.2
Upper limit of tax credits	30% of the company's corporation tax	10% of the company's corporation tax	10% of the company's corporation tax

Source: Small and Medium Enterprise Agency of Japan

Notes: As of 2009. "Comparative R&D expenditures" is defined as average R&D expenditures for the past three years. "Average sales" is defined as average sales for the past three years.

Table 3-2 Descriptive statistics: all firms, by industry

	All firms		recipients		non-recipients		By industry							
							Manufacturing				Non-manufacturing			
							recipients		non-recipients		recipients		non-recipients	
	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
ln(R&D expenditure)	7.9	2.2	9.8	1.7	7.6	2.1	10.0	1.7	8.2	2.0	8.8	1.7	7.1	2.0
ln(total workers)	3.5	1.4	4.3	1.1	3.3	1.4	4.4	1.0	3.8	1.2	4.0	1.4	3.0	1.5
Patent dummy	0.325	0.469	0.535	0.500	0.294	0.456	0.566	0.497	0.430	0.495	0.400	0.497	0.160	0.367
Recurring profit margin	-1.1	36.4	4.5	8.1	-1.9	38.8	4.4	7.6	-3.3	52.8	4.7	10.4	0.0	14.7
Dependence on debt	63.6	403.5	29.0	23.8	68.7	432.0	30.3	23.5	48.4	48.6	23.7	24.7	86.5	642.9
ln(capital fund)	10.0	1.2	10.5	1.1	9.9	1.2	10.6	1.1	10.3	1.0	10.0	0.8	9.6	1.2
$D_{1999\text{-}2003}$=1{founded between 1999 and 2003}	0.075	0.264	0.021	0.145	0.083	0.276	0.013	0.114	0.041	0.199	0.057	0.236	0.122	0.328
$D_{after2004}$=1{founded after or on 2004}	0.038	0.191	0.032	0.177	0.039	0.193	0.020	0.140	0.018	0.131	0.086	0.284	0.059	0.235
D_{city}=1{main financing bank is the city bank}	0.398	0.490	0.545	0.499	0.376	0.485	0.553	0.499	0.401	0.491	0.514	0.507	0.379	0.486
D_{yugen}=1{set up as a limited company(yugen gaisha)}	0.151	0.358	0.011	0.103	0.172	0.377	0.000	0.000	0.000	0.000	0.057	0.236	0.255	0.436
Construction dummy	0.024	0.153	0.021	0.145	0.025	0.155	0.000	0.000	0.000	0.000	0.114	0.323	0.055	0.228
Manufacturing dummy	0.587	0.492	0.813	0.391	0.554	0.497	1.000	0.000	1.000	0.000	0.000	0.000	0.000	0.000
Information, communications, and transport dummy	0.076	0.266	0.016	0.126	0.085	0.280	0.000	0.000	0.000	0.000	0.086	0.284	0.191	0.394
Wholesale dummy	0.090	0.287	0.064	0.246	0.094	0.292	0.000	0.000	0.000	0.000	0.343	0.482	0.211	0.408
Personal service dummy	0.098	0.297	0.011	0.103	0.111	0.314	0.000	0.000	0.000	0.000	0.057	0.236	0.248	0.432
Other service dummy	0.093	0.343	0.080	0.309	0.095	0.347	0.000	0.000	0.000	0.000	0.429	0.608	0.213	0.496
Hokkaido-Tohoku dummy	0.079	0.270	0.021	0.145	0.088	0.283	0.013	0.114	0.072	0.258	0.057	0.236	0.099	0.299
Chubu dymmy	0.111	0.314	0.102	0.303	0.112	0.316	0.105	0.308	0.132	0.339	0.086	0.284	0.085	0.279
Kinki dummy	0.201	0.401	0.267	0.444	0.191	0.393	0.263	0.442	0.228	0.420	0.286	0.458	0.152	0.360
Chugoku-Shikoku dummy	0.072	0.258	0.080	0.272	0.070	0.256	0.072	0.260	0.054	0.226	0.114	0.323	0.085	0.279
Kyushu-Okinawa dummy	0.058	0.234	0.059	0.236	0.058	0.233	0.046	0.210	0.040	0.196	0.114	0.323	0.074	0.263
sample size	1452		187		1265		152		628		35		564	

Table 3-3 Descriptive statistics: by firm size, by liquidity constraint

	By firm size								By liquidity constraint							
	51 or more employees				50 or fewer employees				Liquidity constraint				Non-liquidity constraint			
	recipients		non-recipients		recipients		non-recipients		recipients		non-recipients		recipients		non-recipients	
	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
ln(R&D expenditure)	10.3	1.4	8.7	2.0	8.8	1.8	7.0	1.9	9.9	1.6	7.7	2.0	9.6	2.0	7.8	2.4
ln(total workers)	4.9	0.6	4.8	0.6	3.2	0.8	2.6	1.0	4.3	1.0	3.3	1.3	4.3	1.3	3.3	1.6
Patent dummy	0.617	0.488	0.408	0.492	0.388	0.491	0.279	0.449	0.552	0.499	0.315	0.465	0.491	0.505	0.337	0.473
Recurring profit margin	4.3	7.0	1.3	7.8	4.7	9.9	-2.3	30.2	3.8	7.6	-2.6	45.6	6.2	9.2	-0.7	18.3
Dependence on debt	30.2	22.7	40.7	28.9	26.9	25.7	85.7	588.1	35.3	22.3	76.1	518.3	13.1	19.8	45.1	103.2
ln(capital fund)	10.8	1.1	10.7	1.0	10.0	0.9	9.5	1.0	10.5	1.1	9.9	1.1	10.5	1.1	10.0	1.4
$D_{1999\text{-}2003}$=1{founded between 1999 and 2003}	0.000	0.000	0.000	0.000	0.060	0.239	0.071	0.257	0.015	0.122	0.072	0.258	0.038	0.192	0.101	0.301
$D_{after2004}$=1{founded after or on 2004}	0.025	0.157	0.028	0.165	0.045	0.208	0.038	0.192	0.022	0.148	0.030	0.171	0.057	0.233	0.066	0.249
D_{city}=1{main financing bank is the city bank}	0.575	0.496	0.458	0.499	0.493	0.504	0.347	0.476	0.478	0.501	0.330	0.471	0.717	0.455	0.590	0.493
D_{yugen}=1{set up as a limited company(yugen gaisha)}	0.000	0.000	0.000	0.000	0.030	0.171	0.239	0.427	0.007	0.086	0.140	0.347	0.019	0.137	0.160	0.367
Construction dummy	0.017	0.129	0.030	0.172	0.030	0.171	0.018	0.132	0.022	0.148	0.028	0.164	0.019	0.137	0.024	0.154
Manufacturing dummy	0.867	0.341	0.684	0.466	0.716	0.454	0.581	0.494	0.828	0.378	0.634	0.482	0.774	0.423	0.528	0.500
Information, communications, and transport dummy	0.025	0.157	0.043	0.203	0.000	0.000	0.000	0.000	0.015	0.122	0.091	0.288	0.019	0.137	0.101	0.301
Wholesale dummy	0.033	0.180	0.071	0.257	0.119	0.327	0.122	0.328	0.067	0.251	0.104	0.305	0.057	0.233	0.101	0.301
Personal service dummy	0.008	0.091	0.094	0.292	0.015	0.122	0.102	0.303	0.000	0.000	0.000	0.000	0.038	0.192	0.101	0.301
Other service dummy	0.058	0.269	0.053	0.236	0.119	0.370	0.133	0.418	0.075	0.291	0.109	0.378	0.094	0.354	0.090	0.310
Hokkaido-Tohoku dummy	0.033	0.180	0.096	0.295	0.000	0.000	0.000	0.000	0.007	0.086	0.082	0.275	0.057	0.233	0.087	0.282
Chubu dymmy	0.142	0.350	0.127	0.333	0.030	0.171	0.125	0.331	0.112	0.316	0.117	0.321	0.075	0.267	0.115	0.319
Kinki dummy	0.308	0.464	0.213	0.410	0.194	0.398	0.206	0.405	0.254	0.437	0.177	0.382	0.302	0.463	0.260	0.440
Chugoku-Shikoku dummy	0.050	0.219	0.076	0.265	0.134	0.344	0.068	0.252	0.082	0.276	0.068	0.252	0.075	0.267	0.059	0.236
Kyushu-Okinawa dummy	0.050	0.219	0.043	0.203	0.075	0.265	0.062	0.241	0.052	0.223	0.051	0.220	0.075	0.267	0.052	0.223
sample size	120		395		67		678		134		866		53		268	

Table 3-4 Determinants of R&D tax credits using probit model

	All Firms		By industry				By firm size				By liquidity constraint			
			Manufacturing		Non-manufacturing		51 or more employees		50 or fewer employees		Liquidity constraint		Non-liquidity constraint	
	Coef	SE	Coef	SE	Coef	SE	Coef	SE	Coef	SE	Coef	SE	Coef	SE
ln(total workers)	0.238 ***	0.050	0.261 ***	0.064	0.200 **	0.082	0.300 **	0.127	0.169 *	0.098	0.254 ***	0.064	0.260 ***	0.089
Patent dummy	0.258 ***	0.100	0.221 *	0.114	0.291	0.226	0.374 ***	0.139	0.086	0.158	0.364 ***	0.118	0.018	0.208
Recurring profit margin	0.018 ***	0.005	0.023 ***	0.007	0.011	0.009	0.022 **	0.009	0.017 **	0.007	0.016 **	0.007	0.020 **	0.008
Dependence on debt	-0.008 ***	0.002	-0.007 ***	0.002	-0.011 ***	0.004	-0.005 *	0.003	-0.011 ***	0.003	-0.011 ***	0.002	-0.005	0.004
ln(capital fund)	-0.043	0.055	-0.020	0.064	-0.119	0.120	-0.124 *	0.072	0.078	0.096	0.011	0.065	-0.188 *	0.110
$D_{1999\text{-}2003}$=1{founded between 1999 and 2003}	-0.099	0.264	-0.053	0.376	-0.062	0.399			0.432	0.318	-0.253	0.367	0.105	0.458
$D_{after2004}$=1{founded after or on 2004}	0.309	0.283	0.223	0.430	0.474	0.382	0.275	0.474	0.443	0.382	0.401	0.399	0.171	0.445
D_{city}=1{main financing bank is the city bank}	0.154	0.104	0.179	0.120	0.064	0.224	0.090	0.146	0.166	0.157	0.110	0.122	0.424 *	0.229
D_{yugen}=1{set up as a limited company(yugen gaisha)}	-0.715 **	0.354			-0.551	0.471			-0.724 *	0.406	-0.786	0.507	-0.839	0.633
Construction dummy	0.125	0.441			0.247	0.463	1.134	1.142	0.327	0.597	0.389	0.553	-0.085	0.869
Manufacturing dummy	0.433	0.317					1.773 *	1.050	0.112	0.402	0.582	0.409	0.554	0.601
Information, communications, and transport dummy	-0.411	0.411			-0.246	0.429	1.518	1.096			-0.150	0.525	-0.569	0.767
Wholesale dummy	0.099	0.355			0.200	0.375	1.080	1.086	0.038	0.442	0.325	0.451	-0.049	0.677
Personal service dummy	-0.755 *	0.459			-0.690	0.477	0.161	1.188	-0.654	0.611			-0.379	0.711
Other service dummy	0.194	0.267			0.296	0.276	1.571	1.008	-0.079	0.327	0.321	0.329	0.132	0.540
Hokkaido-Tohoku dummy	-0.613 **	0.271	-0.953 **	0.374	-0.047	0.430	-0.474	0.314			-1.095 **	0.449	0.138	0.416
Chubu dymmy	-0.192	0.161	-0.297	0.182	0.198	0.352	0.012	0.202	-0.711 **	0.335	-0.143	0.185	-0.449	0.350
Kinki dummy	0.058	0.119	-0.041	0.137	0.361	0.254	0.200	0.163	-0.170	0.192	0.086	0.144	0.019	0.228
Chugoku-Shikoku dummy	0.237	0.193	0.143	0.233	0.509	0.363	-0.072	0.304	0.481 *	0.263	0.283	0.227	0.368	0.397
Kyushu-Okinawa dummy	0.344	0.221	0.066	0.278	0.807 **	0.392	0.289	0.324	0.405	0.327	0.203	0.267	0.853 *	0.469
Constant	-1.743 ***	0.576	-1.641 ***	0.588	-1.023	1.132	-2.640 **	1.285	-2.294 **	0.940	-2.382 ***	0.705	-0.641	1.098
Log likelihood	-448.475		-338.384		-103.240		-245.291		-183.178		-315.583		-120.485	
Pseudo R-squared	0.196		0.120		0.226		0.123		0.187		0.199		0.182	
sample size	1452		780		599		515		745		1000		341	

Note: Asterisks ***, **, and * indicate statistical significance at the .01, .05, and .10 levels, respectively.

Table 3-5 Treatment effects of R&D tax credits on R&D expenditures: all firms

		Effective sample size		Estimates				
		Treated	Controls	Treated	Controls	Difference	SE	t-value
Ummatched		187	1,265	9.803	7.581	2.222	0.162	13.74
ATT	Kernel	186	1,264	9.778	8.527	1.251	0.158	7.91
	K-nearest-neighbor	187	465	9.803	8.535	1.268	0.173	7.34
	Caliper	186	144	9.778	8.781	0.996	0.222	4.49

Table 3-6 Treatment effects of R&D tax credits on R&D expenditures: by industry

			Effective sample size		Estimates				
			Treated	Controls	Treated	Controls	Difference	SE	t-value
Manufacturing	Unmatched		152	628	10.025	8.166	1.859	0.178	10.46
	ATT	Kernel	151	627	10.008	8.728	1.280	0.174	7.37
		K-nearest-neighbor	152	347	10.025	8.814	1.212	0.186	6.53
		Caliper	151	121	10.008	8.783	1.225	0.236	5.19
Non-manufacturing	Unmatched		35	564	8.838	7.086	1.752	0.353	4.96
	ATT	Kernel	33	564	8.789	7.722	1.067	0.336	3.17
		K-nearest-neighbor	34	109	8.789	7.745	1.044	0.363	2.88
		Caliper	33	30	8.789	7.987	0.802	0.471	1.70

Table 3-7 Treatment effects of R&D tax credits on R&D expenditures: by firm size

			Effective sample size		Estimates				
			Treated	Controls	Treated	Controls	Difference	SE	t-value
51 or more employees	Unmatched		120	395	10.342	8.737	1.605	0.200	8.03
	ATT	Kernel	114	341	10.298	9.140	1.158	0.185	6.27
		K-nearest-neighbor	120	238	10.331	9.222	1.108	0.195	5.69
		Caliper	114	83	10.298	9.388	0.910	0.271	3.36
50 or fewer employees	Unmatched		67	678	8.838	6.968	1.870	0.248	7.55
	ATT	Kernel	64	678	8.794	7.519	1.275	0.249	5.11
		K-nearest-neighbor	64	208	8.794	7.412	1.382	0.263	5.25
		Caliper	64	55	8.794	7.364	1.430	0.333	4.29

Table 3-8 Treatment effects of R&D tax credits on R&D expenditures: by liquidity constraints

			Effective sample size		Estimates				
			Treated	Controls	Treated	Controls	Difference	SE	t-value
Liquidity constraint	Unmatched		134	866	9.885	7.656	2.229	0.182	12.28
	ATT	Kernel	134	864	9.885	8.353	1.532	0.181	8.45
		K-nearest-neighbor	134	321	9.885	8.384	1.501	0.198	7.57
		Caliper	134	105	9.885	8.145	1.740	0.270	6.45
Non-liquidity constraint	Unmatched		53	288	9.597	7.845	1.751	0.347	5.04
	ATT	Kernel	53	288	9.597	8.684	0.913	0.369	2.48
		K-nearest-neighbor	53	135	9.597	8.705	0.891	0.369	2.42
		Caliper	53	42	9.597	8.740	0.857	0.433	1.98

Table 3-9 Test of ATT difference by subgroups

		z-value	p-value
By industry	Kernel	0.563	0.573
	K-nearest-neighbor	0.411	0.681
	Caliper	0.803	0.422
By firm size	Kernel	-0.377	0.706
	K-nearest-neighbor	-0.837	0.402
	Caliper	-1.211	0.226
By liquidity constraint	Kernel	1.507	0.132
	K-nearest-neighbor	1.457	0.145
	Caliper	1.729	0.084

Table 3-10 Tests of matching covariates by balancing property: test statistics

	Unmatched				Matched											
					Kernel				K-Nearest Neighbor				Caliper			
	Mean		t-test		Mean		t-test		Mean		t-test		Mean		t-test	
	Treated	Control	t-value	p-value	Treated	Control	t-value	p-value	Treated	Control	t-value	p-value	Treated	Control	t-value	p-value
ln(total workers)	4.269	2.044	22.030	0.000	4.274	4.196	0.700	0.487	4.292	4.234	0.530	0.597	4.274	4.242	0.300	0.766
Patent dummy	0.532	0.018	51.230	0.000	0.530	0.527	0.040	0.965	0.535	0.542	-0.140	0.885	0.530	0.551	-0.420	0.677
Recurring profit margin	4.518	-0.018	0.450	0.651	4.267	3.570	0.580	0.561	4.467	3.945	0.600	0.547	4.267	3.975	0.350	0.724
Dependence on debt	29.035	91.902	-0.600	0.547	29.349	30.110	-0.080	0.935	29.035	27.332	0.680	0.499	29.349	27.795	0.610	0.543
ln(capital fund)	10.521	9.029	19.140	0.000	10.519	10.505	0.130	0.898	10.521	10.539	-0.160	0.875	10.519	10.654	-1.210	0.228
$D_{1999\text{-}2003}$=1{founded between 1999 and 2003}	0.021	0.078	-2.910	0.004	0.022	0.029	-0.460	0.647	0.021	0.025	-0.210	0.837	0.022	0.022	0.000	1.000
$D_{after2004}$=1{founded after or on 2004}	0.032	0.045	-0.860	0.390	0.032	0.030	0.160	0.873	0.032	0.032	0.000	1.000	0.032	0.022	0.640	0.523
D_{city}=1{main financing bank is the city bank}	0.543	0.243	9.560	0.000	0.541	0.535	0.110	0.913	0.545	0.535	0.210	0.836	0.541	0.562	-0.420	0.677
D_{yugen}=1{set up as a limited company(yugen gaisha)}	0.011	0.393	-10.730	0.000	0.011	0.018	-0.600	0.550	0.011	0.009	0.210	0.833	0.011	0.005	0.580	0.563
Construction dummy	0.021	0.047	-1.660	0.098	0.022	0.024	-0.130	0.899	0.021	0.028	-0.400	0.690	0.022	0.043	-1.170	0.242
Manufacturing dummy	0.809	0.168	23.470	0.000	0.816	0.796	0.490	0.623	0.813	0.818	-0.130	0.894	0.816	0.816	0.000	1.000
Information, communications, and transport dummy	0.016	0.141	-4.930	0.000	0.016	0.020	-0.260	0.793	0.016	0.018	-0.160	0.874	0.016	0.016	0.000	1.000
Wholesale dummy	0.064	0.088	-1.170	0.243	0.065	0.066	-0.030	0.974	0.064	0.055	0.390	0.695	0.065	0.049	0.670	0.502
Personal service dummy	0.011	0.199	-6.470	0.000	0.011	0.016	-0.460	0.644	0.011	0.004	0.720	0.473	0.011	0.000	1.420	0.157
Other service dummy	0.085	0.273	-4.170	0.000	0.070	0.081	-0.350	0.728	0.080	0.090	-0.280	0.782	0.070	0.092	-0.650	0.515
Hokkaido-Tohoku dummy	0.021	0.112	-3.940	0.000	0.022	0.025	-0.200	0.838	0.021	0.032	-0.640	0.523	0.022	0.054	-1.640	0.103
Chubu dymmy	0.106	0.112	-0.250	0.805	0.103	0.106	-0.100	0.922	0.102	0.112	-0.330	0.739	0.103	0.076	0.910	0.363
Kinki dummy	0.266	0.158	4.070	0.000	0.265	0.245	0.430	0.669	0.267	0.236	0.690	0.491	0.265	0.232	0.720	0.472
Chugoku-Shikoku dummy	0.080	0.090	-0.470	0.639	0.081	0.086	-0.170	0.866	0.080	0.092	-0.400	0.686	0.081	0.086	-0.190	0.852
Kyushu-Okinawa dummy	0.059	0.095	-1.690	0.091	0.059	0.064	-0.160	0.871	0.059	0.070	-0.420	0.674	0.059	0.054	0.220	0.823

Table 3-11 Tests of matching covariates by balancing property: joint significance tests

	Before	After		
		kernel	K-Nearest Neighbor	Caliper
Mean of |%bias|	54.86	1.99	2.53	4.67
SD of |%bias|	58.62	1.66	1.90	4.33
Maximum of |%bias|	176.66	6.16	7.65	13.22
Minimum of |%bias|	1.82	0.08	0.00	0.00
Pseudo R^2	0.400	0.004	0.008	0.020
LR test p-value	0.000	1.000	1.000	0.941

Chapter 4
Social Security Contributions and Employment Structure: A Microeconometric Analysis Focused on Firm Characteristics

1 Introduction

For Japan, which is facing rapid population aging, carrying out structural reforms to public finances and social security is an urgent issue. As in other OECD countries, social expenditure has been rapidly increasing in Japan as its population ages. Inevitably, to cover these costs, social security contributions (SSCs hereafter) have been increased. However, Japan, which faces a fall in its population growth rate owing to a decrease in the productive-age population, must balance a sustainable social security system with economic vigor. Figure 4-1 shows the long-term trend in the ratio of SSCs to total labor cost. From approximately 12% in 1980, the ratio rose to 18% in 1990 and peaked at 23% in 2011. Hence, examining how SSCs influence economic activity is an important research topic.

Many theoretical and empirical studies have investigated the shift of SSCs to wage reductions, especially abroad. For example, Brittain (1971) estimates the labor demand function using cross-country data, while Holmlund (1983), using Swedish time-series data for 1950–1979, shows that half of payroll tax had been shifted back to wages. Gruber and Krueger (1991) also conclude that contributions by employers to Workers' Compensation Insurance had been shifted back to insured (employees) in the form of wage reductions,

based on industry-level data in the United States.

Although many studies analyze the relationship between SSCs and wages, few have examined the incidence of SSCs in Japan. However, a growing number of recent studies have empirically analyzed whether SSCs affect wages. For example, by using industrial-level data, Tachibanaki and Yokoyama (2008) explore the relationship between SSCs and backward shifting to employees' wages. Similarly, Komamura and Yamada (2004) and Iwamoto and Hamaaki (2006) examine the incidence of employers' contribution rates to social security using panel data on individual health insurance societies throughout Japan. Ito (2009) further analyzes this incidence using firm-level panel data on listed companies.

However, some crucial issues concerning the relationship between SSCs and wages remain. The first of four main issues is overcoming the effect of SSCs on employment. Compared with the amount of research on the SSC–wages relation, few studies have analyzed how SSCs affect employment. Of this scarce literature, Kobayashi et al. (2015) show that companies deal with changes in the public burden such as SSCs and corporate income taxes through various adjustments. In particular, they find that companies tend to adjust employment levels to cope with changes in SSCs. Similarly, Kim's (2008) pioneering research analyzes the relationship between changes in SSCs and employment using panel data on Japanese listed companies. While he finds that an increase in SSCs decreases employment, this conclusion is somewhat limited given that he utilizes companies' welfare expenses as a proxy variable for SSCs because of data unavailability.

The second issue is the influence on employment structure (i.e., the balance between regular and non-regular workers). In Japan, companies have to bear SSCs when they hire

regular workers, but not when they employ non-regular workers[22]. As a result, the influence of SSCs may differ by type of worker[23]. Indeed, the ratio of non-regular workers to total workers has kept pace with the growth in the social security burden. While the ratio was approximately 20% in 1990, it has risen towards 35% recently (Figure 4-2). As Figure 4-3 indicates, this increasing ratio of part-time workers and decreasing per-capita income have dragged down SSC revenue. For that reason, some authors point out that the increase of SSCs has a huge impact on employment structure.

The third issue is the consideration of a time adjustment. As Kobayashi et al. (2015) point out, companies may not immediately react to changes in SSC rates, because of the adjustment cost incurred. However, existing studies do not take into account such factors. Further, since adjusting employment is time consuming, analyses that overlook such an adjustment time might be biased[24].

The final issue is the consideration of different responses to SSCs. Companies' responses might vary with their size, employment structure, product market competition, and other characteristics. Ariga and Kambayashi (2010), for instance, show that companies' measures depend on the need to negotiate with labor unions or the intensity of competition in their product markets. In contrast to previous researchers, who have only aimed to grasp the average effect of SSCs on corporate behavior, we also determine the effects on whether firms employ part-timers (extensive margin) and/or on how they

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[22] Welfare pension payments, health insurance, and long-term care insurance are provided to employees who work 30 hours or more per week. However, employees whose spouses enter social insurance and whose annual incomes do not exceed 1.3 million yen are not covered by social insurance. From October 2016, however, coverage will be extended to employees (1) working between 20 and 30 hours a week, (2) earning 1,060 thousand yen or more a year, and (3) working for companies that employ 501 workers or more.

[23] Miyazato and Ogura (2010) analyze the empirical incidence of employers' healthcare contributions using micro wage data and find that SSCs narrow the gap between the wage rates of regular workers and those of non-regular workers.

[24] There are many previous studies of employment adjustments. For example, Abe and Noda (2009) estimate the employment adjustment function using firm-level microdata.

change the number of part-timers employed (intensive margin).

Based on the foregoing, this chapter empirically estimates how the social security burden influences employment level and structure using firm-level microdata matched with social security insurance data. Since the rates of social health insurance vary among health insurance societies in Japan, we can identify this effect based on these variations. In particular, we use dynamic panel data methods to estimate the labor demand function and thereby evaluate how SSCs influence corporate labor demand. We also examine the impacts of companies' characteristics such as firm size, the presence of labor unions, and the intensity of competition in the product market.

The remainder of this Chapter is organized as follows. Section 2 introduces the theoretical background. Section 3 summarizes the empirical literature on the link between SSCs and corporate behavior. Section 4 describes our estimation strategy and explains the data matching method. Section 5 presents and discusses the estimation results. Section 6 concludes and proposes subjects for future study.

2 Theoretical Background

Since Summers (1989) constructed the basic partial equilibrium model about the incidence of SSCs, numerous theoretical models have been suggested. In this section, we explain the theoretical model used herein based on the previous approaches of Gruber and Krueger (1991) and Baicker and Chandra (2006).

2.1 Theoretical Model

Suppose that labor demand (L_d) is given by

$$L_d = L_d(w + t), \tag{7}$$

and further suppose that labor supply (L_s) can be expressed by

$$L_s = L_s(w + at), \tag{8}$$

where w is the after-SSCs wage rate, t represents the SSCs provided by the employer, and $a(0 < a < 1)$ represents employees' monetary valuation of that insurance. If employees regard the contributions as income tax, a takes the value of 0. Conversely, if they regard the contributions as a counter value of the benefits to them, it takes 1[25].

By differentiating the supply–demand equilibrium equation, we obtain the following identities:

$$\frac{dw}{dt} = -\frac{\eta^d - a\eta^s}{\eta^d - \eta^s} \tag{9}$$

$$\frac{dL}{dt} = \frac{(a-1)\eta^d\eta^s}{\eta^d - \eta^s} \tag{10}$$

where η^d and η^s are the labor demand and supply elasticity with respect to wages, respectively. Specifically, (3) demonstrates the effect of rising SSCs on wages, while (4) shows that on employment.

When $a = 1$ (i.e., employees regard the contributions as a counter value of the benefits to them), $dw/dt = -1$, and SSCs entirely shift back to employees. In that case, since

[25] This model assumes that SSCs are specific and provided only by employers. Gruber (1997) and Iwamoto and Hamaaki (2006) introduce employees' burden and proportional contributions to their theoretical models.

$dL/dt = 0$, the employment level remains constant. Conversely, if $a = 0$, then the results are identical to those obtained for the incidence of income tax, and the burden ratio between employers and employees varies depending on η^d and η^s.

If labor supply is inelastic ($\eta^s = 0$) or labor demand is completely elastic ($\eta^d = \infty$), (3) is $dw/dt = -1$. Therefore, contributions wholly shift back to employees and employment remains unchanged.

2.2 Graphical Interpretation

Figure 4-4 depicts the incidence of employers' SSCs. $L_d(w)$ and $L_s(w)$ represent the labor demand and supply curves before the introduction of social insurance, respectively. In this case, equilibrium wages and employment are w_0 and L_0, respectively. Consider the case where SSCs are now introduced and where the statutory contribution is set at t to employers by legislation. In this case, after-SSCs wage received by employees decline to w_1 and labor cost paid by employers rise to $w_1 + t$. If employees disvalue these contributions (i.e., they do not feel worthy of the social insurance benefit in return for the contributions), the results are identical to those obtained for the incidence of income tax. In this situation, the after-SSCs wage received by employees and labor cost paid by employers are given by w_1 and $w_1 + t$, respectively. Employment thus decreases to L_1. Although SSCs are statutorily imposed on employees, they only incur a proportion of the burden $(w_0 - w_1)$, and employers bear the rest $(w_1 + t - w_o)$. Thus, employees and employers share the burden of SSCs even though they are statutorily imposed on the former.

When employees partly feel worthy of the social insurance benefit in return for the contributions, the labor supply curve shifts downward to $L_s(w + at)$. In this case, the after-SSCs wage received by employees and labor cost paid by employers are given by w_2

and $w_2 + t$, respectively. Consequently, the proportion of the burden borne by employees increases. As shown in Figure 4-4, employees thus cover the majority of the contributions. However, employment increases from L_1 to L_2. Finally, when employees regard the contributions as a counter value of the benefits to them ($a = 1$), the labor supply curve shifts downward to the point where employment returns to the original level (L_0). Employees now absorb the total cost.

2.3 Relationship between the Labor and Product Markets

In this subsection, we present a simple theoretical model of the relationship between the product market and the elasticity of labor demand, as presented by Hamermesh (1993). First, we assume that a firm maximizes profits as follows:

$$\pi = p\big(F(L_d)\big) \cdot F(L_d) - wL_d \tag{11}$$

Here, p is the product price, which is a decreasing function of output because of the incompleteness of the product market. $F(L_d)$ is a production function that transforms labor services into output and $F(L_d)' > 0,\ F(L_d)'' < 0$. By solving the profit-maximizing problem in (5), we ascertain the following first-order condition:

$$F'(L_d)\left(1 + \frac{\partial p\big(F(L_d)\big)/\partial L_d}{F'(L_d)} \cdot \frac{F(L_d)}{p}\right) = \frac{w}{p} \tag{12}$$

$$F'(L_d)\left(1 - \frac{1}{\eta}\right) = \frac{w}{p} \tag{13}$$

where $\eta(\geq 0)$ is the absolute value of the elasticity of product demand. Moreover, the left-hand side of (7) indicates the marginal product revenue and the right-hand side

represents real wages. (7) implies that the elasticity of labor demand rises when the elasticity of product demand increases. Therefore, firms that face imperfect product markets because of their high shares of the product market or their provision of differentiated goods and services tend not to adjust their employment levels in response to changes in real wages. This theory is known as the second of Marshall's four laws of derived demand. By contrast, if a firm faces a perfectly competitive product market, $\eta \to \infty$ and (7) becomes $F'(L_d) = w/p$. This condition indicates that a firm that faces a competitive product market tends to adjust employment compared with other firms.

2.4 Possibility of Substitution for Non-regular Workers

Some authors argue that rising SSCs in Japan have stimulated the trend to substitute non-regular workers for regular ones. As noted in footnote 1, welfare pension payments, health insurance, and long-term care insurance are provided to employees who work 30 hours or more per week and those who work three-quarter working days or more per month as regular workers. Otherwise, neither employers nor employees bear SSCs. Since a rise in SSCs does not affect the labor cost of non-regular workers, although it raises that of regular workers, the increase in SSCs is thought to be a possible cause of the growing ratio of non-regular workers[26].

From a theoretical standpoint, if employees regard these contributions as a counter value of the benefits to them, SSCs entirely shift back to them in the form of wage reductions and employment remains unchanged. Therefore, there is no reason for companies to substitute non-regular workers for regular ones. However, since a rise in contributions leads to a decline in employment, this gives rise to the possibility of

[26] Existing studies point out that a change in industrial structure (trend towards a service economy), evolving ICT, and a rise in demand fluctuation in the product market are other factors that can induce an increase in non-regular workers (Asano et al., 2011, Morikawa, 2010).

substituting regular for non-regular workers. If the degree of such substitutability is high, the wage elasticity of labor demand is also thought to be high. Figure 4-5 depicts the case of the high wage elasticity of labor demand and low wage elasticity of labor supply. When employees partially feel worthy of the social insurance benefit in return for the contributions, equilibrium employment decreases from L_1 to L_2. At that time, if regular and non-regular workers are substitutable (complementary), non-regular employment increases (decreases).

Moreover, other factors such as a minimum wage system, negotiation with labor unions, and concerns about demoralization owing to wage cuts also prevent companies from shifting back to workers. In these cases, a significant decrease in regular employment and substituting other production factors such as non-regular workers might arise.

3 Existing Empirical Studies in Japan

3.1 The Incidence of Employers' Contributions

Most existing studies of the relationship between SSCs and workers focus on whether employers' contributions shift back to employees as wage reductions. The pioneering research by Tachibanaki and Yokoyama (2008), for instance, evaluates the incidence of employers' SSCs in Japan by estimating a reduced form of the labor wage function using industrial-level data. Their result shows that SSCs increase wages and the authors conclude that the contributions are borne by employers. Similarly, Komamura and Yamada (2004), who estimate a reduced form of the wage function using individual panel data on health insurance societies, also examine the incidence of employers' contributions[27]. However, in contrast to the findings of Tachibanaki and Yokoyama (2008),

[27] Although the published year of Komamura and Yamada (2004) is earlier than that of Tachibanaki and Yokoyama (2008), a discussion paper version of Tachibanaki and Yokoyama (2008) was released in 2001.

they conclude that the majority of employers' contributions to health insurance shift back to employees in the form of wage reductions.

Iwamoto and Hamaaki (2006) and Hamaaki and Iwamoto (2010) critically reappraise the results of Tachibanaki and Yokoyama (2008) and Komamura and Yamada (2004). Regarding the former paper, they point out a spurious positive correlation between wages and employers' SSC rates by using trend variables. By modifying the estimation, they thus conclude that employers' contributions seem to at least partly shift back to employees. Concerning the latter paper, they find reverse causality from wages to SSCs. Overall, Iwamoto and Hamaaki (2006) conclude that the incidence estimated by Komamura and Yamada (2004) is overvalued and claim that it is valid for employers' contributions to at least partly shift back to employees.

While these studies aimed to analyze the backward shifting of SSCs by estimating a reduced wage equation, Sakai (2006) and Miyazato and Ogura (2010) took different approaches. Sakai (2006) investigates the incidence of payroll tax by utilizing the introduction of long-term care insurance in 2000 and that of the total remuneration system in 2003 (*sohoshusei*) as natural experiments and finds that the increase in payroll tax is shifted back to employers[28]. Meanwhile, Miyazato and Ogura (2010) analyze the growth in non-regular workers. Since a large proportion of non-regular workers are not obliged to join the social insurance system in Japan, the rise in the SSC rate increases the labor cost of regular workers but not that of non-regular workers. As a result, demand for non-regular workers, which are comparatively inexpensive, might expand. Miyazato and Ogura (2010) therefore confirm that the gap between the wages paid to regular and non-regular

The paper by Tachibanaki and Yokoyama (2008) is thus regarded as the pioneering empirical study in Japan.

[28] In this regard, however, Sakai (2006) withholds drawing a conclusion because bonuses are thought to be determined by other factors, such as corporate performance.

workers' contracts[29]. In summary, the consensus that most employers' contributions are shifting back to employees has been gradually building.

3.2 The Effect on Employment

As our theoretical model explained, the effect of SSCs on employment differs depending on the parameters η^d, η^s, and a. For instance, if labor demand is completely elastic to wages, employers' contributions shift back to employees in the form of wage reductions. However, the impact on employment varies according to a. While a rise in SSCs decreases employment when $a < 1$, employment is unchanged when $a = 1$. However, it is unclear whether companies substitute non-regular workers for regular ones in response to a rise in SSCs.

Empirical studies that analyze how SSCs affect employment are relatively scarce compared with those of wages. Gruber (1994) and Gruber (1997) are pioneering and valuable studies in this regard. Gruber (1994) estimates how mandated maternity benefits influence wage and labor supply. Several state and federal mandates stipulate that childbirth be covered comprehensively in health insurance plans, raising the relative cost of insuring women of childbearing age. He utilizes the differences among states as natural experiments in order to estimate the causal effects on wages and labor supply. Although he presents evidence of a substantial shift in the cost of health insurance from employers to employees, he finds little effect on total labor input for that group. Gruber (1997) also evaluates the effects of changes in mandatory pension contributions using the privatization of pensions in Chile as a natural experiment. The results also confirm that changes in SSCs do not affect employment, although the cost borne by employers is

[29] Miyazato and Ogura (2010) conduct an instrumental variables regression using a lagged rate of SSCs and the proportion of the elderly in the enrollment of the insurance association as instruments in order to avoid possible endogenous bias, and they draw a similar conclusion.

passed over to employers in the form wage reductions. In brief, despite the limited number of empirical studies, many researchers now acknowledge that employees incur SSCs in the form of wage reductions.

Kim (2008) also analyzes how SSCs affect employment using individual panel data on Japanese listed companies but with welfare expenses as a proxy of SSCs because of limited data availability[30]. His empirical result suggests that welfare expenses negatively affect employment.

Empirical studies that analyze the substitution of non-regular workers for regular ones are fewer still. Kim (2008) also examines the effect of welfare expenses on regular employment. He simply calculates the number of regular workers by multiplying the total number of workers by the industry-level ratio of regular workers, which is taken from the *Labour Force Survey*, and finds that increasing welfare expenses decreased regular employment until the early 1990s. However, by contrast, his estimation result implies that a rise in contributions has decreased the substitution of non-regular workers for regular ones since the early 1990s.

Baicker and Chandra (2006) also examine the effect of SSCs on employment and the substitution of non-regular workers, using state-level, per-capita medical malpractice payments as an instrument for imputed premiums. Since part-time workers are typically not covered by social insurance, employers tend to replace full-time workers with part-time ones. Indeed, Baicker and Chandra (2006) confirm that a 10% increase in health insurance contributions reduces the aggregate probability of being employed by 1.2% points, reduces hours worked by 2.4% points, and increases the likelihood that a worker is employed only part-time by 1.9% points.

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[30] Since companies vary discretionary welfare expenses in response to changes in SSCs, the estimates presented by Kim (2008) might have possible biases.

Sakai (2009) and Kobayashi et al. (2015) also analyze the substitution of regular for non-regular workers using questionnaires. Sakai (2009) finds that more than half of small and medium-sized enterprises increase non-regular workers in response to an increase in SSCs. By contrast, Kobayashi et al. (2015) show that while some companies reduce the wages of regular workers in response to an increase in SSCs, few reduce those of non-regular workers.

4 Estimation Strategy and Data

4.1 Estimation Model and Method

In this chapter, we use firm-level panel data in order to estimate a labor demand function that includes the SSC rate paid by employers. Based on existing research, we specify the labor demand functions of regular workers, non-regular workers, and dispatched workers as shown below:

$$\begin{aligned}\ln Regular_{it} = \beta_0 \ln Regular_{it-1} + INS_{it}\beta_1 + \ln WAGE_{it}\beta_2 + \ln PWAGE_{it}\beta_3 \\ + \ln VA_{it-1}\beta_4 + \ln K_{it}\beta_5 + \alpha_i + t_i + \varepsilon_{it}\end{aligned} \tag{14}$$

$$\begin{aligned}\ln Part_{it} = \beta_0 \ln Part_{it-1} + INS_{it}\beta_1 + \ln WAGE_{it}\beta_2 + \ln PWAGE_{it}\beta_3 \\ + \ln VA_{it-1}\beta_4 + \ln K_{it}\beta_5 + \alpha_i + t_i + \varepsilon_{it}\end{aligned} \tag{15}$$

$$\begin{aligned}\ln Dispatched_{it} = \beta_0 \ln Dispatched_{it-1} + INS_{it}\beta_1 + \ln WAGE_{it}\beta_2 + \ln PWAGE_{it}\beta_3 \\ + \ln VA_{it-1}\beta_4 + \ln K_{it}\beta_5 + \alpha_i + t_i + \varepsilon_{it}\end{aligned} \tag{16}$$

where the subscript *i* indicates companies and *t* indicates years.

These equations can be interpreted as reduced forms of labor demand functions. $\ln Regular$, $\ln Part$, and $\ln Dispatched$ are the natural logs of the number of regular workers, part-time workers, and dispatched workers, respectively. Since some companies do not employ part-time or dispatched workers, we take the logarithm of the number of workers plus one.

INS represents the SSCs paid by employers. The estimated coefficient, β_1, is the primary concern in this chapter. Although companies must pay contributions towards pension payments, health, long-term care, unemployment, and children allowance, we consider only health insurance herein for the following three main reasons. First, because the SSC rates of pension payments and children allowance are cross-sectionally identical for all companies, we can control for these effects using year dummies. Second, the contribution rate of unemployment varies by industry sector. As we explain later, all companies included in our dataset, however, are classified as "other businesses" according to the Ministry of Economy, Trade and Industry (METI). Hence, we can control for the rate of unemployment in the same manner as we can for pension payments and children allowance. Finally, companies have to bear the SSCs of long-term care when they employ workers aged 40 or over. Unfortunately, since we cannot utilize the age composition of employers, we thus exclude the SSC rate of long-term care[31].

α_i is the individual fixed effect, t_i is the year dummy, and ε_{it} is the error term. We also include the interaction terms between SSCs and the following firm characteristic dummies: superiority in product market, presence of labor unions, and price setting principal of products and services.

[31] If the rate of long-term care is correlated with that of health insurance, endogeneity arises if we exclude the former from the explanatory variables. If the rates of long-term care and health insurance are positively correlated, the estimated coefficient of the latter is positively biased. Indeed, the estimation that included the SSC rate of long-term care as an explanatory variable showed few changes in coefficients.

$WAGE$ and $PWAGE$ are price factors that denote the average annual incomes in yen of all and part-time workers, respectively. Although we should consider the incomes of dispatched workers, we do not have available the appropriate average income for this group. Therefore, we assume that we can control for this variable using the individual fixed effect and year dummy; however, the estimation results for dispatched workers are only used as reference. VA indicates value added (millions of yen) and K is tangible assets (millions of yen). These variables are proxies of companies' size. Since our theoretical model assumes that companies determine optimal level of production in response to wage rate, SSCs, product price, and various elasticities, we use the lag of value added.

Many researchers point out that employment is typically adjusted gradually because of the existence of firing costs, negotiation with labor unions, and concerns over declines in employee morale[32]. Hence, we adopt a dynamic model that includes a lagged dependent variable as an explanatory variable. In an ordinary partial adjustment model, $(1-\beta_0)$ means the adjustment speed of employment.

In dynamic panel data models, it is well known that the fixed effects estimator is biased when the number of periods is fixed. In this chapter, we utilize the first-differenced (FD) Generalized Method of Moments (GMM) estimator proposed by Holtz-Eakin et al. (1988) and Arellano and Bond (1991) and the system GMM estimator suggested by Blundell and Bond (1998). The FD GMM estimation starts by differencing all regressors, using the GMM instrumented by lagged variables. The system GMM estimator combines the differenced equation with the level equation. The instruments for the level equation are the lagged differences of the variables, which are valid when these differences are

[32] For example, Abe and Noda (2009) estimate the adjustment speed of employment using firm-level panel data on listed companies and confirm that the speed has increased recently.

uncorrelated with the individual effects[33].

Both these estimators have advantages and disadvantages. While the consistency of the system GMM estimator is established only when the initial conditions satisfy mean-stationary, the FD GMM estimator does not require such a condition. However, the FD GMM estimator suffers from a weak instrument problem when the dynamic panel autoregressive coefficient (β_0) approaches unity, whereas the system GMM does not lead to have such issues[34]. Additionally, the system GMM is efficient since it utilizes more moment conditions. For these reasons, we comprehensively examine the robustness of the presented estimations using both methods.

The consistencies of the FD GMM and system GMM are eliminated when error terms are serially correlated. Therefore, we examine this assumption using the test proposed by Arellano and Bond (1991). To allow for a consistent estimation, GMM estimators also require instruments to be exogenous. Hence, we test this condition using the Sargan test suggested by Arellano and Bond (1991). Further, we examine whether the system GMM estimator is consistent by testing mean-stationary in the initial conditions. In this chapter, since most statistical tests indicate that the system GMM estimations do not satisfy the exogeneity of instruments, we show the results of the FD GMM.

4.2 Data and Matching Method

The data used in this chapter come from the Basic Survey of Japanese Business Structure and Activities (BSJBSA) published by METI and the Annual Report on Society-Managed Health Insurance (ARSHI) published by the National Federation of

[33] Chigira et al. (2011) explain these estimation methods and tests of dynamic panel data models in detail.

[34] Not only the FD GMM but also the system GMM suffer from a weak instrument problem when the ratio of the fixed effect's (α_i) variance (σ_α^2) to the error's (ε_{it}) variance (σ_v^2) is very large.

Health Insurance Societies. BSJBSA, an annual survey that began in 1991, collects representative statistics on Japanese firms with 50 or more regular employees and more than 30 million yen in capital, including those engaged in the mining, manufacturing, electricity and gas, wholesale, retail, and several services industries. Over 25,000 firms are surveyed every year. ARSHI annually collects information on the SSC rates for employers and employees, the number of insured employees covered by society-managed insurance policies, and average monthly earnings from approximately 1,500 health insurance societies. We match BSJBSA to ARSHI by using the following procedure:

i. We use the company names in BSJBSA and society names in ARSHI.

ii. METI also conducts the "Survey of companies' public burden,"[35] which asks BSJBSA respondent firms about the names of their social insurance societies. We match BSJBSA to ARSHI using these societies' names, too.

iii. Some social insurance societies publish the names of the companies they cover online. We also match the datasets using this information.

After this three-step process, the number of matched companies is approximately 4,600[36]. The final number of companies in the estimation is approximately 3,000 because of missing variables.

All variables except for the SSC rate and wage rate are obtained from BSJBSA. The industry level hourly wage of all workers is obtained from the Japan Industrial Productivity Database (JIP-Database) constructed by Research Institute of Economy, Trade, and Industry. The industry-level hourly wage of part-time workers is obtained from the

[35] The questionnaire was sent to 29,080 firms in January 2010, of which 3,986 firms participated, which corresponded to a 13.7% response rate.

[36] We cannot examine the changes in societies that companies join. We therefore assume that all companies continued to hold the same insurance cover during the analyzed period.

Monthly Labour Survey carried out by the Ministry of Health, Labour and Welfare.

4.3 Descriptive Statistics

The summary statistics are presented in Table 4-1. While average ln$Regular$ declined from 2004 to 2007, ln$Part$ and ln$Dispatched$ monotonically grew. As shown in Figure 4-2, our dataset indicates that regular employment declined, whereas non-regular employment expanded during the mid-2000s. The fact that the standard deviation of ln$Dispatched$ widened also implies that the use of dispatched workers had diversified. Further, average INS declined from 2004 to 2007. Since the Japanese economy was vigorous during this period, many societies could afford to decrease the SSC rate[37][38].

While the annual hourly wage of workers had been almost stable from 2004 to 2007, that of part-time workers was increased. The lag of value added gradually fell, a decrease of about 4% from 2004 to 2007, while tangible assets also showed a similar tendency.

4.4 Possible Sample Selection Bias

A possible drawback of our dataset is potential selection bias owing to the low matching rate. Although BSJBSA surveys over 25,000 firms, our dataset shrinks to approximately 3,500 in the process of matching to ARSHI. As most matched firms are respondents to the Survey of companies' public burden, possible systematic bias in survey responses might thereby lead to some bias in the estimated results.

The most common approach to overcoming sample selection bias is using Heckman's two-step estimation. For this method, we need those exogenous factors that affect the

[37] Macro statistics also indicate a similar situation.

[38] The rise and fall of SSCs might have an asymmetric effect on wages and employment insofar as the downward rigidity of wages. This chapter only analyzes the period in which the average rate of SSCs decreased. Future research should pay attention to these facts.

sample selection mechanism but do not influence labor demand. However, it is usually difficult to find such factors. Therefore, we discuss the possibility of sample selection bias by comparing the descriptive statistics of the estimated sample to that of the population as a whole (i.e., all firms surveyed in BSJBSA).

Table 4-2 compares the descriptive statistics. The mean numbers of regular and dispatched workers, mean annual income of workers, mean value added, and mean tangible assets in the estimated sample are much greater than those in the overall population. While it is unclear whether these differences affect the estimated results, Iwamoto and Hamaaki (2009) point out that the estimated results should be stable when they restrict the sample to larger societies, because these firms can set actuarially reasonable rates using the law of large numbers. If similar situations are realized in our sample, we should be able to obtain stable results because the firms included in our dataset are relatively large.

Additionally, as Cameron and Trivedi (2005, p. 801) point out, if selection is only based on the time-invariant characteristics of individual firms, the fixed effects estimator can control sample selection bias. Therefore, if sample selection arises only at the time the survey was conducted, such bias might be controlled by the individual fixed effects. Either way, we should pay careful attention when generalizing our estimation results[39].

5 Estimation Results

5.1 Basic Estimation

Table 4-3 shows the basic estimation results. Column (1) and (2) shows the estimation

[39] When we calculate the descriptive statistics by limiting the sample to survey respondents, they are approximately the same as for the whole population. Therefore, the gap between the estimated sample and population is attributed to the matching process, which used published information online. When limiting the sample to survey respondents, the estimation results do not really change.

results of the labor demand function for regular workers. The latter includes year dummies, the former does not. The dependent variable of column (3) and (4) is ln$Part$, while that of column (5) and (6) is ln$Dispatched$. The "FD" in the table means the estimation results using the FD GMM method.

According to the Sargan statistics, the null hypotheses regarding overidentifying restrictions are not rejected in most estimation by the FD GMM. Further, the Arellano–Bond statistics indicate that the error terms do not have second-order serial correlations at the 5% significance level.

While the coefficients of the SSC rate paid by employers are negative for regular and dispatched workers, the coefficient is positive for part-time workers. Although these coefficients are not statistically significant as a whole when we control year effects, the increase in the SSC rate might negatively affect regular workers and positively affect part-time workers. These results concur with those presented by Gruber (1994, 1997). From the standpoint of economic theory, these results can thus be attributed to an inelastic labor supply.

As theoretically expected, the coefficient of ln$WAGE$ is negative for regular workers in column (2), while that of ln$PWAGE$ is not significant for part-time and dispatched workers. Since most coefficients of the lagged dependent variables are statistically significant, this finding suggests that adjusting employment takes time.

5.2 Estimation Including Interaction Terms

As shown above, changes in the SSC rates might affect employment, but these are statistically insignificant as a whole. However, as the theoretical model implies, the impact of changes in the SSC rate on employment vary depending on the labor demand and supply elasticity with respect to wages. In this section, therefore, we estimate the

heterogeneous impact of changes in the SSC rate on employment.

Table 4-4 shows the estimation results including the interaction terms with INS. Because the dummy variables for firm characteristics are obtained from the Survey of companies' public burden, the estimated sample is restricted to survey respondents. We use the following three dummy variables: (1) leading company dummy, (2)labor union dummy, and (3) mark-up price dummy. The leading company dummy takes a value of 1 if the company is a leader in its own business sector and 0 otherwise. As theoretically described, companies that have high shares of their product markets tend not to adjust employment levels in response to changes in wages. The labor union dummy characterizes whether the company has a labor union. As pointed out earlier, employment adjustment costs might increase when companies have a labor union, as they tend not to change employment levels. Finally, the mark-up price dummy takes 1 if the company determines its profit margin for itself and 0 otherwise. If product markets are perfectly competitive, companies cannot determine a price in isolation. This dummy therefore indicates that companies have monopolistic power in their product markets.

The estimated coefficients of INS are significant for regular workers (-0.152) in column (2), implying that companies in the base category decrease regular workers. These coefficients mean that companies in the base category decrease regular employment by 15.2% in response to 1% point increase in the SSC rate. Indeed, companies classified in the base category are found to be susceptible to changes in the SSC rate. The coefficient of the interaction term with the leading company dummy is estimated to be 0.0695 for regular workers, indicating that leaders tend not to reduce regular employees in response to an increase in INS. This finding is consistent with the theoretical analysis described above.

The coefficient of the interaction term with the labor union dummy is estimated to be 0.146, suggesting that companies that have labor unions tend not to adjust regular

employment levels with variation in INS. This result might indicate that companies that have labor unions face higher employment adjustment costs[40].

The coefficient of the interaction term with the mark-up price dummy is also positive but insignificant. As companies that can set their own prices based on their mark-up ratios are considered to be competitive, they are also not inclined to alter regular employment even when INS varies. The estimation result might indicate that our theoretical prediction is valid.

Table 4-5 shows the descriptive statistics of the dummy variables in 2007. The number of firms classified into the base category is 773. The number rises to 1359 when we include firms classified into groups whose coefficient of interaction terms are not significant. In other words, approximately 60% of firms are susceptible to a change in the SSC rate.

5.3 Extensive and Intensive Margins

In this step, we explore the effect of SSCs on whether firms begin to employ part-timers (extensive margin) and on their decisions to change the number of part-timers employed (intensive margin). In this regard, we estimate the following equation using the FD GMM:

$$\begin{aligned} PartDum_{it} = \beta_0 PartDum_{it-1} + INS_{it}\beta_1 + \ln WAGE_{it}\beta_2 + \ln PWAGE_{it}\beta_3 \\ + \ln VA_{it-1}\beta_4 + \ln K_{it}\beta_5 + \alpha_i + t_i + \varepsilon_{it} \end{aligned} \tag{17}$$

where $PartDum$ takes 1 if firm i employs part-time workers and 0 otherwise, while all the other variables are as in the previous section.

[40] Generally speaking, however, Japanese companies tend not to adjust employment regardless of the presence or absence of labor unions because of employment legislation and the prevailing lifetime employment system. Hence, this result might indicate other effects of firms' characteristics such as firm size.

Because the dependent variable is a dummy, (17) assumes a linear probabilistic model. Since β_1 in (17) indicates the impact of SSCs on whether firms begin to employ part-time workers, we can interpret β_1 as the extensive margin. In addition, we also estimate (14) and (15) after restricting the analysis to firms that employed part-timers in the previous year. In these estimations, we can interpret β_1 as the intensive margin, because β_1 represents the change in the number of part-timers employed.

Table 4-6 presents the estimation results for the extensive and intensive margins. The first column displays the estimation result of (17), while the second and the third are that with the interaction terms. The coefficients of INS are not significant. These results imply that the extensive margin is relatively small. Columns 4–9 present the estimation results of the intensive margin, in which the sample is restricted to firms that employed part-time workers in the previous year. Although the coefficients of INS in columns 4-6 are almost quite similar to Table 4-3 and Table 4-4, the absolute values of the coefficients in columns 7-9 are much larger and significant. For instance, the coefficients of INS are significant in the ninth column (0.333) compared with 0.0616 in Table 4-3. From these results, we can conclude that the intensive margin is much larger than the extensive margin.

5.4 Discussion

Based on the presented theoretical analyses, existing empirical studies, and our estimation results, in this subsection we discuss the effect of SSCs on wages and employment, the effect of SSCs on employment structure, and the discrepancy between the findings of previous studies and our results.

First, our empirical results indicate that SSCs do not have a statistical significant influence on employment as a whole, allowing us to conclude that these results correspond to the relatively high wage elasticity of labor supply or large employees'

monetary valuation of social insurance (a in the theoretical model). These results are consistent with those of Gruber (1994, 1997)[41]. On the other hand, our results also confirm that companies that face harsh market competition or that do not have labor unions tend to adjust employment in response to changes in SSC rates. These facts imply that the wage elasticity of labor demand and supply differ from one company to another. Our research findings suggest that companies that face low employment adjustment costs or higher competition are inclined to adjust employment following changes in SSC rates. These results thus correspond to those of Ariga and Kambayashi (2010), which show that firms that have little room to adjust wages because of immediate competition in the product or labor market resort to employment adjustments. Kodama and Yokoyama (2018) also reveal that companies reduce the number of employees in response to an exogenous increase in SSCs.

Second, our results demonstrate the complementary relationship between regular and dispatched workers and the substitutable relationship between regular and part-time workers. Hara (2003) confirms the complementary relationship between regular and part-time workers in the whole economy, while Yamaguchi (2011) finds a substitutable relationship by using firm-level microdata on listed companies. Further, Yamaguchi (2011) shows that Allen's partial elasticity of substitution and Morishima's elasticity of substitution indicate a substitutable relationship between regular and non-regular workers despite using the elasticity estimated by Hara (2003). Therefore, in spite of the results presented by Hara (2003), we find that regular and non-regular workers have a substitutable relationship in line with Yamaguchi (2011).

Finally, we discuss the distinction between previous studies and this chapter in terms of

[41] However, our results do not correspond with the findings of Baicker and Chandra (2006). However, given that Baicker and Chandra (2006) analyze the ramifications of the SSC rate increasing drastically, this discrepancy might be expected.

how SSCs affect employment. As stated earlier, Kim (2008) finds that an increase in companies' welfare expenses decreases employment, whereas our empirical estimations indicate that SSCs have little effect on employment. These contrasting results might have occurred for the following reasons. First, in contrast to Kim (2008), our dataset might have selection bias. Second, Kim (2008) focuses on large firms, whereas our study includes small firms. Third, Kim (2008) utilizes companies' welfare expenses as a proxy variable, whereas we utilize true SSC rates, which can be considered to be more accurate. Fourth, Kim's (2008) dataset ranges from 1984 to 2003, but ours runs from 2004 to 2007. Some scholars argue that the downward rigidity of wages disappeared around 2000 in Japan[42]. If this were true, it might be natural that Kim (2008) and this chapter lea to different outcomes. Future works should be dedicated to exploring these differences further.

5.5 How Much Can SSCs Explain the Rise in Part-time Workers? A Simple Simulation Analysis

To confirm the impact of SSCs on the rise in part-timers, we conduct a simple simulation analysis using the estimation results presented in Table 4-4. The procedures for a simulation analysis are as follows. First, we calculate individual firms' elasticity of the SSC rate for regular and part-time workers using the estimation results in Table 4-4. In the next step, we compute a weighted average elasticity. Second, we calculate the effective SSC rate using macro statistics provided by the System of National Accounts calculated by the Cabinet Office and the Japanese Social Security Statistics compiled by the National Institute of Population and Social Security Research. Specifically, the effective rate is calculated by dividing wages and salaries by compulsory employers' actual SSCs. Third, by multiplying the weighted average elasticity by the effective rate of SSCs, we ascertain a

[42] See Yoshikawa (2013), for example.

simulated ratio of part-timers to regular plus part-time workers[43]. The simulation starts in 1995, after which the ratio of part-timers drastically increased.

Figure 4-6 presents the simulation analysis. The solid line indicates the actual ratio of part-timers, while the dashed line shows the simulated ratio. The actual ratio increased from 13.0% in 1995 to 19.3% in 2007, whereas the simulated ratio increased to 15.3% in 2007. Therefore, approximately one third of the increase can be explained by the rise in SSCs.

6 Conclusion

Given the aging population in Japan, this chapter empirically examined the theoretical effect of the social security burden on wages and employment using firm-level panel data. The presented analysis allowed us to describe four major findings. First, our empirical results indicated that SSCs do not have a statistically significant impact on employment in line with those of Gruber (1994, 1997). In light of previous empirical results on how SSCs influence wages, the burden is considered to be borne by employees in the form of wage reductions rather than job losses. Second, by contrast, non-negligible companies substitute non-regular workers for regular ones in response to an increase in SSC rates. As Sakai (2009) and Kobayashi et al. (2015) point out, companies handle rate variations differently, prompting researchers to consider such diversity in future studies.

Third, we confirmed that the intensive margin, which is the effect of SSCs on how firms that already employ part-time workers change the number of part-timers, is much larger than the extensive margin, which is the effect on whether firms begin to employ part-timers. Finally, our simplified simulation analysis showed that approximately one

[43] This method implicitly assumes that the elasticity of health insurance is applicable to other SSCs such as pension payments and long-term care.

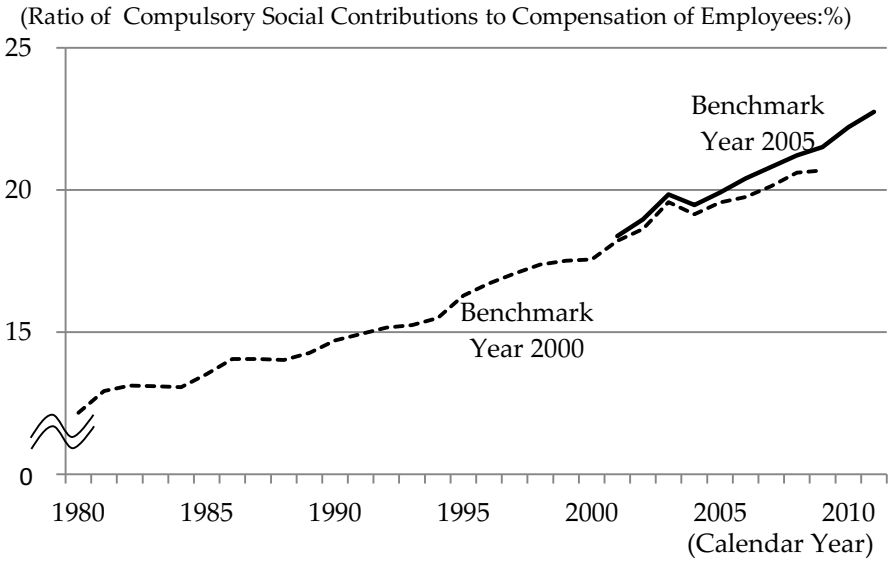
third of the increase in part-time workers could be explained by the rise in SSCs.

Our analyses have several limitations, however. The first limitation concerns sample selection. In this chapter, we had to match two datasets in order to analyze the relationship between SSCs and company behavior, but many companies were eliminated from the dataset because of the matching process. We thus need a dataset without sample selection bias to obtain more robust empirical evidence.

Second, we analyzed a period in which SSC rates were relatively stable, and thus, researchers should generalize our results with caution. Third, companies might control employment in advance if they anticipate a future increase in SSCs. In that case, even though we do not confirm the instantaneous relationship between SSCs and employment, SSCs might affect long-term employment levels. As far as we know, a theoretical model that considers such a long-term effect has not yet been constructed.

Finally, while we conducted a simple simulation analysis in order to assess the impact of SSCs on employment, this simulation was not based on a general equilibrium model. A rise in consumption tax has been discussed in Japan in order to cover the increasing social security burden owing to rapid population aging. To consider the optimal combination of various taxes and SSCs, we must, therefore, construct a general equilibrium model.

Figure 4-1 Changes in SSCs



Source: Cabinet Office "National Accounts"

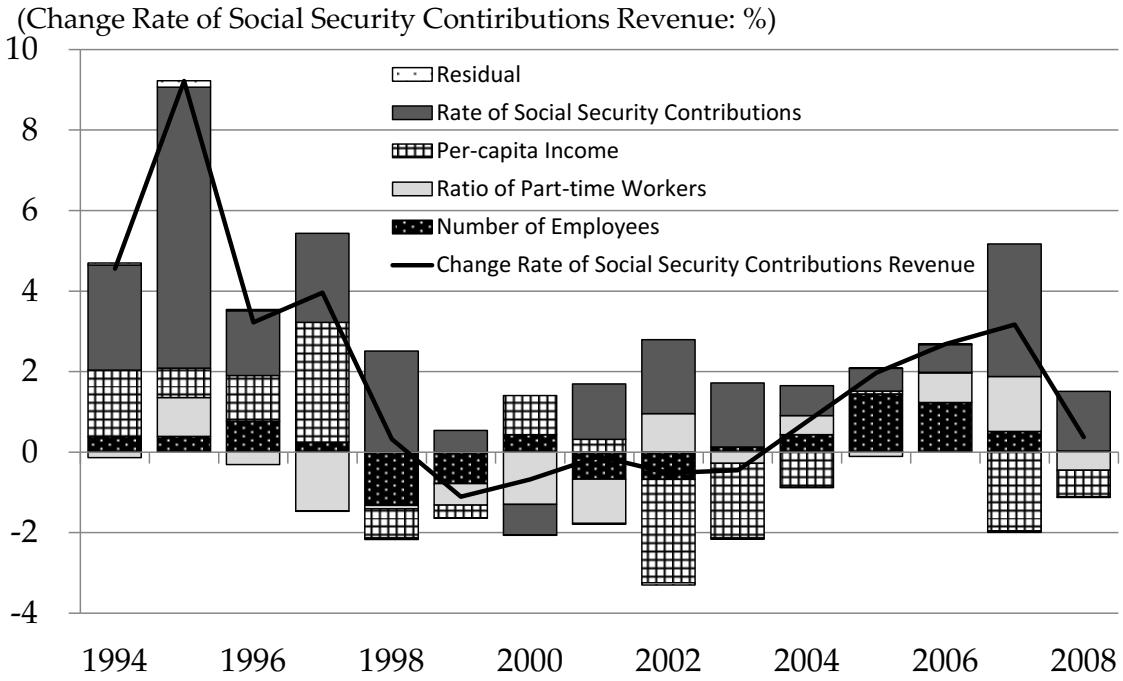
Notes: The benchmark for 2005 is the continuous line, while that for 2000 is the dashed line. These lines are calculated as the ratio of the sum of compulsory employers' actual SSCs and compulsory employees' SSCs to employee compensation.

Figure 4-2 Changes in the Ratio of Non-regular Employment

Source: Ministry of Internal Affairs and Communications "Labour Force Survey"

Notes: The data source until 2001 is "The Special Survey of the Labour Force Survey," while it the "Labour Force Survey (Detailed Tabulation)" thereafter.

Figure 4-3 Factors that Affect SSC Revenue



Sources: Cabinet Office "National Accounts;" National Institute of Population and Social Security Research "Annual Report of Social Security Statistics;" Ministry of Health, Labour and Welfare "Monthly Labour Survey"

Notes: This figure is a simple decomposition of SSC revenue.

Figure 4-4 Incidence of Employers' SSCs

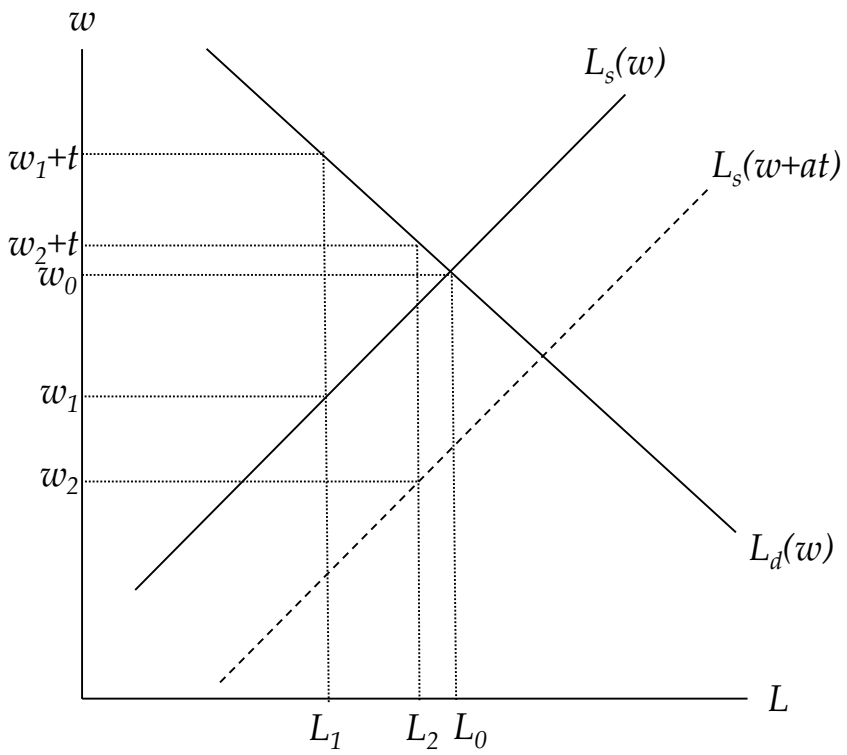


Figure 4-5 The Case of High Demand Elasticity and Low Supply Elasticity

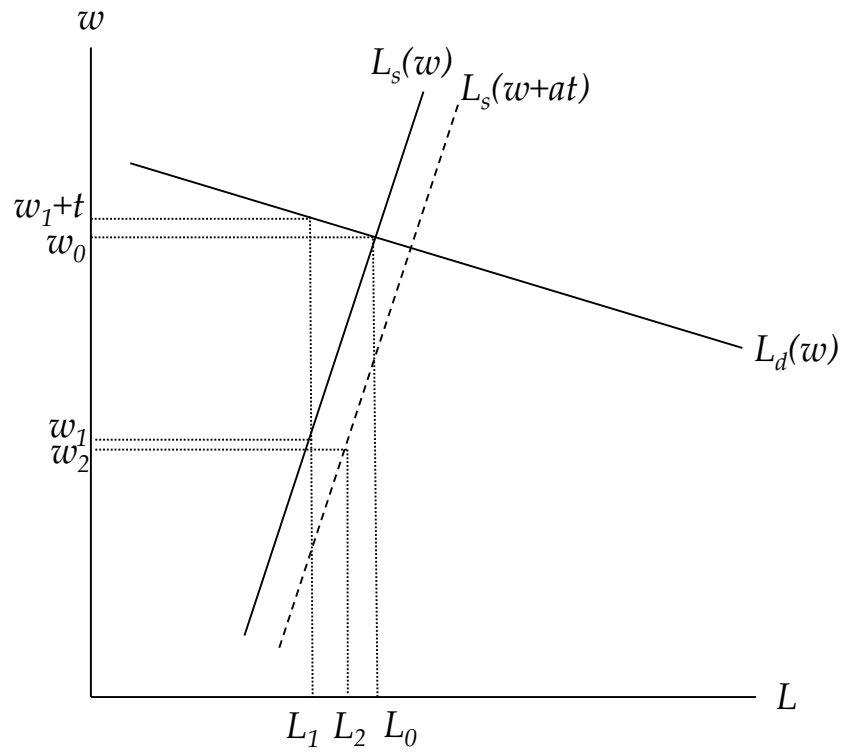
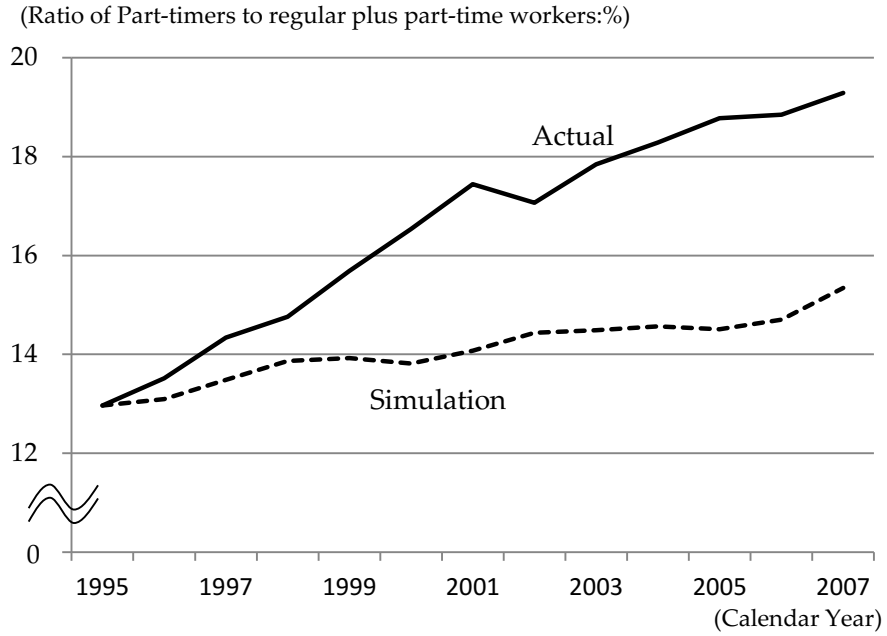


Figure 4-6 A Simulation Analysis of the Ratio of Part-time Workers



Source: Ministry of Internal Affairs and Communications "Labour Force Survey"

Notes: The data source until 2001 is "The Special Survey of the Labour Force Survey," while it is the "Labour Force Survey (Detailed Tabulation)" thereafter.

Table 4-1 Descriptive Statistics

		ln*Regular*	ln*Part*	ln*Dispatched*	*INS*	ln*WAGE*	ln*PWAGE*	ln*VA* (-1)	ln*K*
2004	mean	5.37	2.10	1.42	4.10	7.86	6.89	7.57	7.41
	standard deviation	1.31	2.02	1.85	0.45	0.23	0.10	1.58	2.13
	number of firms	2,947	2,947	2,783	2,947	2,908	2,947	2,947	2,947
2005	mean	5.36	2.09	1.52	4.06	7.88	6.91	7.57	7.36
	standard deviation	1.30	2.00	1.90	0.44	0.23	0.10	1.57	2.15
	number of firms	3,051	3,051	2,887	3,051	3,011	3,051	3,051	3,051
2006	mean	5.33	2.20	1.66	4.03	7.89	6.92	7.56	7.31
	standard deviation	1.30	1.99	1.96	0.43	0.23	0.10	1.57	2.14
	number of firms	3,140	3,140	2,971	3,140	3,100	3,140	3,140	3,140
2007	mean	5.33	2.33	1.70	4.01	7.86	6.92	7.53	7.30
	standard deviation	1.31	2.01	2.01	0.42	0.24	0.11	1.57	2.13
	number of firms	3,472	3,472	3,203	3,472	3,433	3,472	3,472	3,472
total	mean	5.35	2.18	1.58	4.05	7.87	6.91	7.56	7.34
	standard deviation	1.31	2.01	1.94	0.44	0.23	0.10	1.57	2.13
	number of firms	12,610	12,610	11,844	12,610	12,452	12,610	12,610	12,610

Table 4-2 Comparison of the Estimated Sample with the Population

	Estimated Sample			Population		
	mean	standard deviation	number of firms	mean	standard deviation	number of firms
Number of regular workers	756.5	2560.8	12,610	324.9	1210.1	97,154
Number of part-time workers	127.0	948.2	12,610	106.1	781.1	97,154
Number of dispatched workers	59.1	318.9	11,844	27.5	200.0	95,573
Annual income of workers (million yen)	5.048	2.014	12,610	4.649	2.021	101,832
Value Added (million yen)	13382.2	66337.1	12,090	4702.2	28363.4	89,520
Tangible Assets (million yen)	25524.2	244102.4	12,610	6741.2	90058.4	101,224

Table 4-3 Estimation Results: Basic Estimation

	(1)	(2)	(3)	(4)	(5)	(6)
	ln*Regular*	ln*Regular*	ln*Part*	ln*Part*	ln*Dispatched*	ln*Dispatched*
	FD	FD	FD	FD	FD	FD
INS	-0.0537**	-0.00995	0.0771	0.111	-0.598**	-0.0286
	(0.0242)	(0.0189)	(0.0636)	(0.0727)	(0.298)	(0.0666)
ln*WAGE*	0.0597	-0.182	0.461	-0.302	-0.115	-0.259
	(0.130)	(0.143)	(0.358)	(0.670)	(0.829)	(0.582)
ln*PWAGE*	0.00111	0.00923	0.183	-0.330	5.871**	0.494
	(0.116)	(0.0790)	(0.364)	(0.469)	(2.994)	(0.370)
ln*VA* (-1)	-0.0650	-0.0240	0.0169	0.00542	0.104	0.0163
	(0.0487)	(0.0234)	(0.0311)	(0.0354)	(0.0717)	(0.0321)
ln*K*	0.0564***	0.0590***	0.0202	-0.00249	0.131	-0.00621
	(0.0133)	(0.0101)	(0.0364)	(0.0425)	(0.104)	(0.0363)
ln*Regular* (-1)	0.767*	0.325*				
	(0.457)	(0.170)				
ln*Part* (-1)			0.267***	0.492***		
			(0.0889)	(0.0572)		
ln*Dispatched* (-1)					-2.512	0.191**
					(1.560)	(0.0775)
Sample size	8,339	8,339	8,339	8,339	8,181	8,181
Number of firms	3,255	3,255	3,255	3,255	3,235	3,235
Year Dummies	No	Yes	No	Yes	No	Yes
Sargan statistics	8.667	1.067	5.140	2.075	0.243	5.613
(p-value)	(0.013)	(0.587)	(0.077)	(0.354)	(0.886)	(0.060)
Arellano-Bond statistics	0.241	0.502	0.446	1.657	-1.764	0.944
(p-value)	(0.809)	(0.616)	(0.656)	(0.098)	(0.078)	(0.345)

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 4-4 Estimation Results: Including Interaction Terms

	(1)	(2)	(3)	(4)	(5)	(6)
	ln*Regular* FD	ln*Regular* FD	ln*Part* FD	ln*Part* FD	ln*Dispatched* FD	ln*Dispatched* FD
INS	-0.202**	-0.152*	0.0106	0.0616	-0.170	-0.179
	(0.0808)	(0.0835)	(0.130)	(0.139)	(0.178)	(0.183)
×leading company dummy	0.0736*	0.0695*	-0.149	-0.195	-0.212	-0.206
	(0.0418)	(0.0399)	(0.249)	(0.274)	(0.244)	(0.258)
×labor union dummy	0.183***	0.146**	0.137	0.122	0.210	0.285
	(0.0703)	(0.0729)	(0.150)	(0.161)	(0.196)	(0.189)
×mark-up price dummy	0.0943	0.0725	0.00794	0.0212	0.0524	0.126
	(0.0623)	(0.0602)	(0.162)	(0.174)	(0.201)	(0.195)
ln*WAGE*	0.0272	-0.346**	0.794*	-0.444	1.103***	-0.00554
	(0.108)	(0.174)	(0.418)	(0.745)	(0.411)	(0.703)
ln*PWAGE*	0.145	0.134	0.154	-0.413	1.351**	0.825*
	(0.0952)	(0.0934)	(0.389)	(0.502)	(0.567)	(0.429)
ln*VA* (-1)	0.0140	-0.0146	0.0287	0.0188	0.0295	0.0180
	(0.0343)	(0.0237)	(0.0353)	(0.0390)	(0.0349)	(0.0358)
ln*K*	0.0640***	0.0562***	0.0107	-0.00681	-0.0391	-0.0569
	(0.0119)	(0.0108)	(0.0380)	(0.0435)	(0.0474)	(0.0512)
ln*Regular* (-1)	-0.145	0.137				
	(0.334)	(0.187)				
ln*Part* (-1)			0.188*	0.365***		
			(0.102)	(0.0636)		
ln*Dispatched* (-1)					0.0705	0.304***
					(0.268)	(0.0879)
Sample size	5,411	5,411	5,411	5,411	5,395	5,395
Number of firms	2,120	2,120	2,120	2,120	2,139	2,139
Year Dummies	No	Yes	No	Yes	No	Yes
Sargan statistics	9.079	0.233	2.438	1.504	2.507	3.245
(p-value)	(0.011)	(0.890)	(0.296)	(0.471)	(0.286)	(0.197)
Arellano-Bond statistics	0.107	0.421	-0.00526	0.854	-0.0712	1.146
(p-value)	(0.915)	(0.674)	(0.996)	(0.393)	(0.943)	(0.252)

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 4-5 Descriptive Statistics of the Dummy Variables in 2007

	Percent
leading company dummy	10.7%
labor union dummy	31.7%
mark-up price dummy	43.7%
sample size in 2007	2262

Table 4-6 Estimation Results: Extensive and Intensive Margins

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Part Dummy			ln*Regular*			ln*Part*		
INS	0.00111	-0.0473	-0.0200	-0.0159	-0.132**	-0.0824	0.313***	0.528**	0.333*
	(0.0322)	(0.0674)	(0.0702)	(0.0255)	(0.0537)	(0.0611)	(0.118)	(0.237)	(0.173)
×leading company dummy		0.0880	0.0693		-0.00456	0.0210		-0.355	-0.288
		(0.101)	(0.105)		(0.0484)	(0.0332)		(0.339)	(0.284)
×labor union dummy		0.0654	0.0469		0.131**	0.105*		-0.0690	0.0476
		(0.0720)	(0.0750)		(0.0540)	(0.0566)		(0.282)	(0.222)
×mark-up price dummy		0.00234	-0.00669		0.0485	-0.00523		-0.134	-0.0299
		(0.0739)	(0.0766)		(0.0605)	(0.0560)		(0.288)	(0.218)
ln*WAGE*	0.229	0.262	-0.0959	-0.487**	-0.157	-0.556***	-0.366	1.242**	-0.279
	(0.179)	(0.182)	(0.311)	(0.193)	(0.150)	(0.199)	(0.627)	(0.624)	(0.637)
ln*PWAGE*	0.239	0.247	0.183	0.122	0.0975	0.143	-0.551	-3.806***	-0.603
	(0.189)	(0.195)	(0.233)	(0.145)	(0.148)	(0.148)	(0.435)	(0.865)	(0.444)
ln*VA* (-1)	-0.00331	-0.00434	-0.00403	-0.0340	0.114	-0.0339	0.105***	-0.0123	0.111***
	(0.0159)	(0.0164)	(0.0174)	(0.0236)	(0.0758)	(0.0232)	(0.0393)	(0.0635)	(0.0398)
ln*K*	0.0302	0.0157	0.00957	0.0457***	0.0763***	0.0443***	0.0525	-0.0848	0.0365
	(0.0197)	(0.0161)	(0.0171)	(0.0136)	(0.0243)	(0.0140)	(0.0489)	(0.0849)	(0.0483)
Part Dummy (-1)	0.228***	0.239***	0.335***						
	(0.0681)	(0.0705)	(0.0440)						
ln*Regular* (-1)				0.359	-0.954	0.364*			
				(0.222)	(0.692)	(0.212)			
ln*Part* (-1)							-0.0893**	0.828***	-0.0952**
							(0.0432)	(0.268)	(0.0430)
Sample size	5,708	5,411	5,411	4,069	3,867	3,867	4,069	3,867	3,867
Number of firms	2,243	2,120	2,120	1,735	1,642	1,642	1,735	1,642	1,642
Year Dummies	No	No	Yes	No	No	Yes	No	No	Yes
Sargan statistics	2.326	1.920	4.899	0.454	3.952	0.403	2.480	1.433	2.356
(p-value)	(0.313)	(0.383)	(0.086)	(0.797)	(0.139)	(0.817)	(0.289)	(0.488)	0.3079
Arellano-Bond statistics	1.312	1.245	1.856	0.468	-1.118	0.434	-1.488	2.464	-1.337
(p-value)	(0.190)	(0.213)	(0.063)	(0.640)	(0.264)	(0.664)	(0.137)	(0.014)	(0.181)

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

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