# Allocative Efficiency of Capital across Japanese Firms*


## UEDA Kenichi

***Graduate School of Economics and Graduate School of Public Policy, The University of Tokyo***

## Dovchinsuren Khaliun

***Graduate School of Public Policy, The University of Tokyo***



## Abstract

Using the firm-level information of the Financial Statements of Corporations by Industry compiled annually by the Japanese Ministry of Finance, we gauge the allocative efficiency of capital across non-financial firms from 1983 to 2017. We carefully correct the biases stemming from changes in the sampling methodology over the years. We then estimate dispersion in the return on assets (EBIT/total assets) across firms each year, controlling for differences in growth expectations and risks by regressions. Capital allocation rapidly became inefficient around the time when the economic bubbles burst. The degree of inefficiency seems to have stabilized at a high level afterwards, but recently, it appears to be deteriorating again. Moreover, we find that cash and deposit holdings at the firm level have nothing to do with the deteriorating trend of allocative efficiency of capital. Rather, it is estimated to increase the return.



Keywords: capital allocation across firms, allocative efficiency of capital, cash and deposit holdings by firms

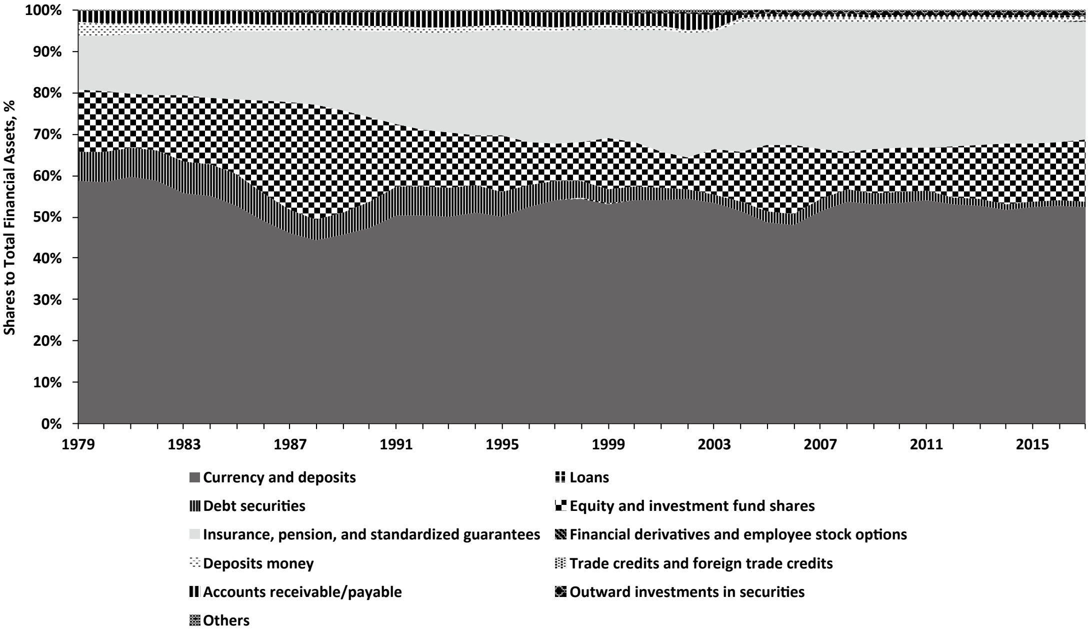
JEL Classification: E2, G3, O4


## I. Introduction

According to the Flow of Funds Accounts issued by the Bank of Japan, the Japanese households shifted their financial assets slightly from bank deposits to direct holdings of securities such as stocks and indirect holdings of securities through pensions and insurance in the 1980s. Yet, the bank deposits still consist of more than half of the households' financial assets in the 1990s even after the economic bubble burst and into the 2000s. The pattern of households' funding to firms has not changed much over the past 30 years (Figure 1).


* This is the English version of Ueda and Dovchinsuren (2020). We are grateful to Hideki Kanda, Shinichi Fukuda, and Hiroshi Fujiki for their useful comments at the conference "Changes in the flow of funds for people to accumulate wealth steadily" of Financial Review. Yoshimi Noda, Takahiro Hattori, and Yosuke Kimura at the Policy Research Institute, Ministry of Finance gave us guidance on the Financial Statements Statistics of Corporations by Industry. We are also thankful for research assistance by Nuobu Renzhi and Kazuatsu Shimizu for their help with other data issues.

Figure 1. Financial Assets Held by Japanese Households



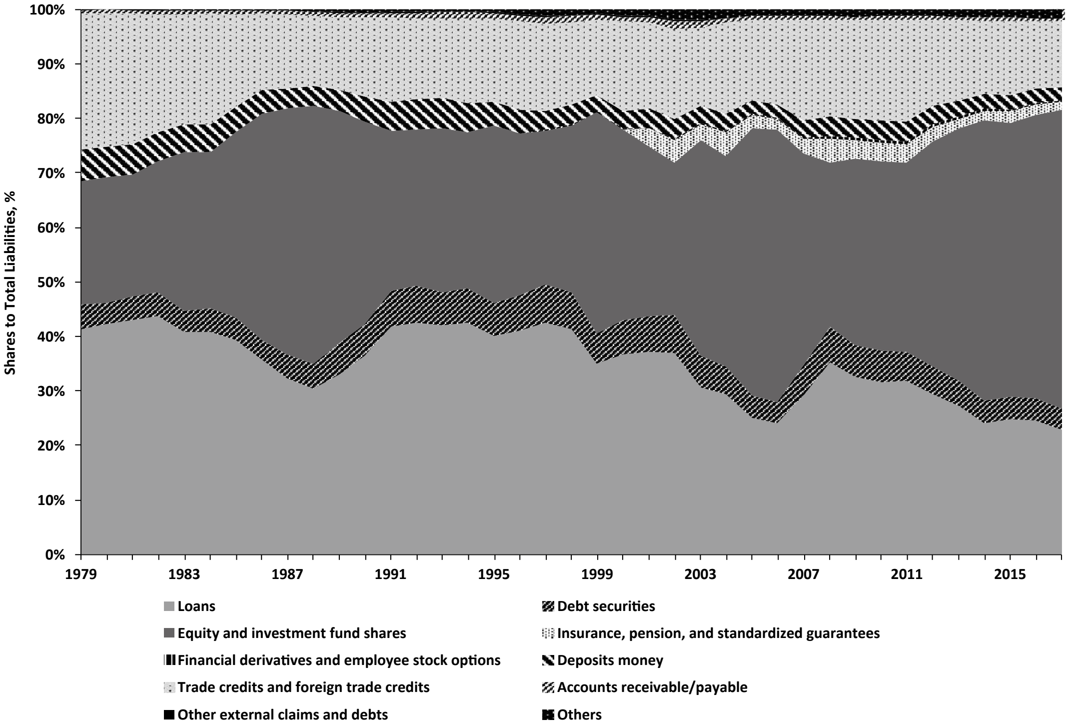

Flow of Funds Accounts, Bank of Japan.
The largest items from the bottom are currency and deposits (dark gray), debt securities (vertical line), equities (squared), and insurance and pension (light gray).

On the firm side, shares of trade credits and bank loans in liability decreased while the share of the equity increased throughout the 1980s. In the 1990s, the share of each item of liability did not change much, and after 2000, the declining bank loans and the rising equity have been observed again (Figure 2A). That is, the debt-to-equity ratio of firms has been declining over the past 20 years.

Figure 2A shows the market value of the firms' liability in the macroeconomy. However, the trend of the firm leverage should be examined using a book value from the perspective of corporate financing. While bank loans do not differ much between the market and book values, equity does. In fact, the share of bank loans in firm liability in a book value has not changed much during the bubble era (1986/87-1990/91) and the years after the 2000s with the rising stock price (Figure 2B). This indicates that the sources of corporate financing have not fluctuated much over time between equity and bank loans.

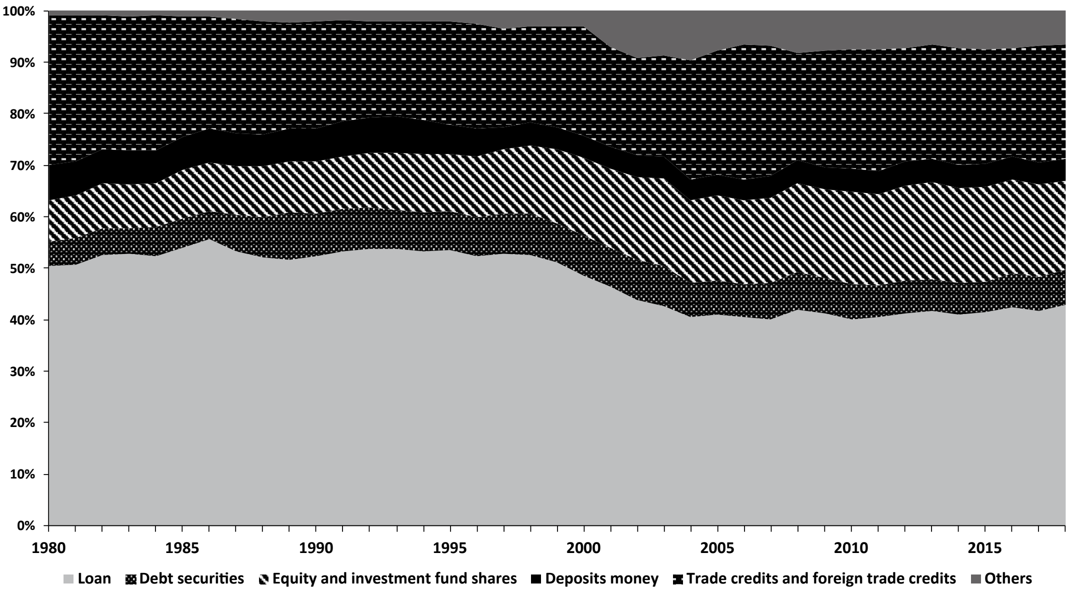
However, as mentioned above, there has not been an increasing share of equity particularly since 2000 in the household assets (in market value). The ratio of deposits has remained similar to that of equity. That means there is an increase in bank deposits to the extent of the increase in assets due to the rising stock price. Since the firms' liability in market value has not increased so much, firms should have had adequate funding from households

Figure 2A. Liabilities of Japanese Firms (Market Value)



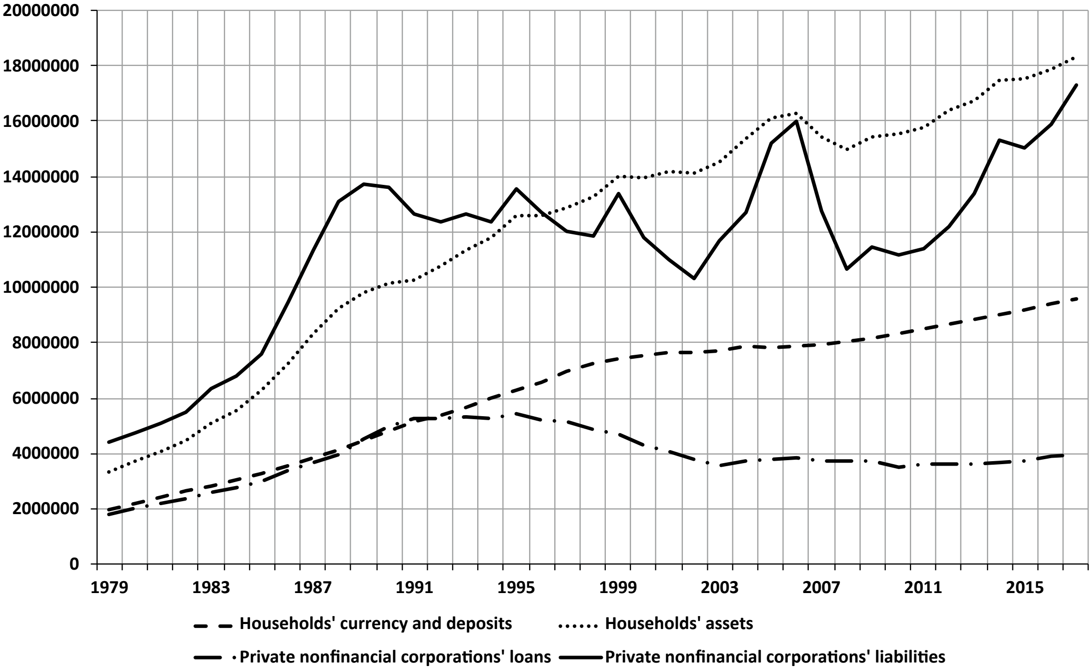

Flow of Funds Accounts, Bank of Japan.
The largest items from the bottom are (bank) loans (light gray), debt securities (diagonal right line), and equities (dark gray).

Figure 2B. Liabilities of Japanese Firms (Book Value) (Flow of Funds Accounts, Bank of Japan)



(Figure 3). This is one of the reasons that real interest rates remain low. In this environment, firms in need of funds can borrow relatively easily.

Figure 3. Households' Financial Assets with the Share of Currency and Deposits and Firms' Liabilities with the Share of Bank Loans in Market Value (Flow of Funds Accounts, Bank of Japan)




Even if the borrowing rate from banks and the cost of financing from equity and bond issuance are low in macrostatistics, individual firms may still have problems in raising funds. In such a case, a firm has to utilize internal funds such as retained earnings. However, it will face financing constraints if there are not sufficient internal funds, and it will be forced to under-invest or operate the business with limited working capital. Anticipating such constraints, a firm may prepare for an unexpected event by saving funds as bank deposits when it earns profits.

It is difficult to say that the share of cash and deposits in firms' financial assets has been increasing since 1980 (Figure 4). Cash and deposits are often a part of a firm's retained earnings, and new flows to retained earnings represents firms' financial surpluses (savings) in the macroeconomy. Although firms' financial surpluses have been positive since 2000, they have no particular trend except for large fluctuations (see Private nonfinancial corporations in Figure 5).

Cases vary across firms. A firm is facing financial constraints if it cannot raise funds at the market interest rate with which it could make sufficient profit. Theoretically, for such a

Figure 4. Firms' Financial Assets in Market Value (Flow of Funds Accounts, Bank of Japan)

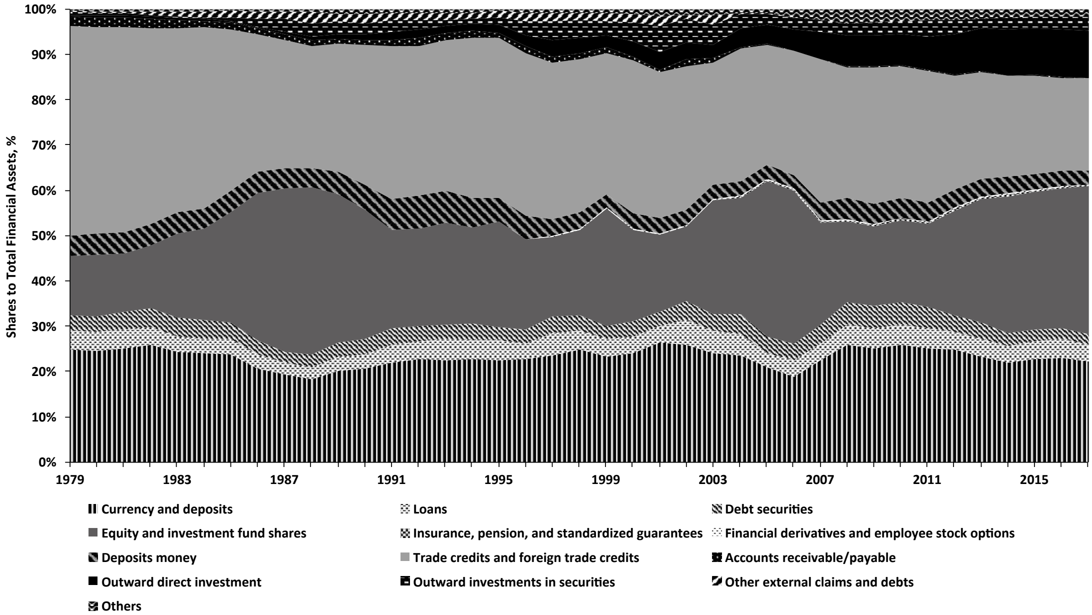
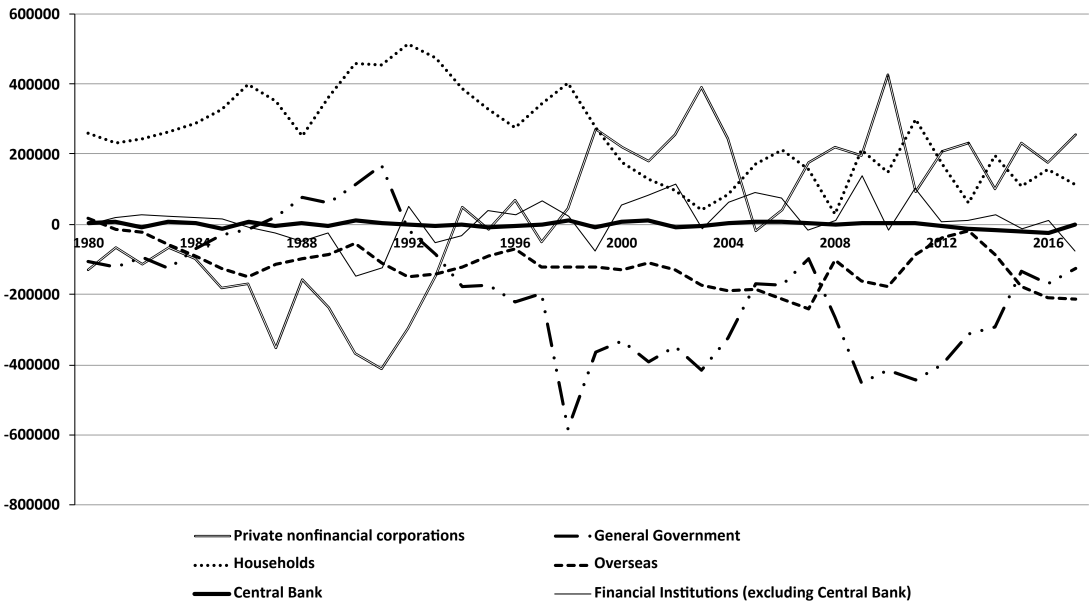



Figure 5. Financial Surpluses and Deficits (Flow of Funds Accounts, Bank of Japan)




firm, the return on assets (marginal product of capital) should be higher than the market interest rate. Such a firm has to make investments from last year's earnings, especially retained earnings. As a result, firms have various return on assets. This indicates that the capital markets, including bank lending in a broad sense, are not functioning efficiently.

By looking at the dispersion in firms' return on assets in the entire economy, it is possible to judge the extent of efficient allocation of capital in the macroeconomy as a whole. The purpose of this paper is to understand the current situation and changes over time. Our conclusion is the following: the degree of inefficiency in capital allocation increased sharply in the first half of the 1990s, then remained almost constant until 2003; It increased sharply again from 2004 and has been stable or slightly increasing since 2009.

## II. Theoretical Framework

The optimal level of investment can be obtained by solving a firm's profit maximization problem if the markets function well. The firm's production function is expressed by $f(k,l)$ in general, where $k$ is the capital input and $l$ is the labor input. The production function is usually homogeneous of degree one and exhibits diminishing marginal products of capital and labor.[1] Denoting market interest rate and wage by $r$ and $w$, respectively, we can write the firm's profit maximization problem as

$$\max_{k,l} f(k,l) - rk - wl.$$

The capital is determined at the level where its marginal product of capital becomes equal to the interest rate,

$$f_k = \frac{\partial f}{\partial k} = r.$$

This applies to every firm in a country. Therefore, the dispersion of marginal product of capital across firms is theoretically predicted to be very small if the capital markets function well.[2]

Suppose that the capital markets do not work well, making a firm face a higher interest rate $r+\lambda$ than the other firms. Now, the optimal condition for the capital input becomes as follows,

$$f_k = r + \lambda.$$

The higher interest rate limits the firm's borrowing. The firm would employ less capital since the marginal product of capital is diminishing. Similarly, suppose that there is a firm

[1] The homogeneous of degree one production function means that if factor inputs such as capital and labor are increased by x times, the outputs are also increased by x times. This indicates constant-returns-to-scale so that the production increases linearly as the factor inputs increase. However, the outputs will not be increased by x times if the labor input is left unchanged and the capital input alone is increased by x times. If an additional unit of capital is given to the fixed number of employees, the increase in production becomes less and less. This is called "diminishing marginal product of capital." A similar feature applies to the marginal product of labor as well.

[2] The explanation here and below follows Abiad, Oomes, and Ueda (2008). Perfect competition is also assumed in the goods market, but the same argument goes through even if this is not the case (i.e., in the case of monopoly or oligopoly). Such a case is discussed later.

whose borrowing is restricted compared to other firms even though they face the same interest rate. That firm can only borrow up to $K$ (i.e., credit quota), which is less than the optimal amount of capital input. In this case, the following constraint appears on the firm's profit maximization problem,

$$k \leq K.$$

Setting the Lagrange multiplier of this constraint as μ, then the optimal condition for capital input can be written as follows,

$$f_k = r + \mu.$$

This indicates that the firm is discriminated in the same way when facing a high-interest rate. On the other hand, if a firm receives privileges such as facing a lower interest rate than the other firms or receiving more loans, the opposite math formula holds.

In summary, the dispersion of marginal product of capital across firms appears when there are privileges or discrimination, which are inconsistent with the optimal condition, due to the inefficient capital markets. The homogeneous of degree one production function is considered to fit well for nonfinancial firms such as in manufacturing industries. In this case, the marginal product of capital is proportional to the return on assets (ROA). Hsieh and Klenow (2009) show that the dispersion of the rates of return of those firms is considerably high in China and India than in the United States.

Production is usually associated with productivity shocks. In other words, one does not necessarily obtain the same level of outputs from the same amounts of capital and labor inputs. Therefore, production function is written as follows with a disturbance term ($\epsilon$) in productivity,

$$F(A+\epsilon, k, l) = (A+\epsilon) f(k, l).$$

Because capital input is determined in advance of the productivity shock, the optimal level is decided to equate the expected marginal product of capital to the interest rate,[3]

$$E[F_k] = r.$$

This matters. For example, Obstfeld (1994) shows that with well-functioning capital markets, firms can hedge risks, and thus optimally select projects with high risk and high returns. In other words, the firm itself selects the projects that have high variances in productivity shocks. Therefore, it is fine to find any dispersion in ROA based on the financial

[3] Suppose that productivity shock follows the AR(1) process so that productivity shock in the previous year affects the current year. In this case, some firms are still in the middle of adjusting their capital stocks due to adjustment costs for investment. Here, the optimal condition $E[F_k]=r$ does not always hold. However, suppose that the adjustment process is denoted by $a(\epsilon)$, normalized by the productivity shock of the previous year, then the optimal condition $E[F_k+a(\epsilon)]=r$ holds. This is because similar numbers of firms are always adjusting their capital stocks both from above and below. Please refer to Claessens, Ueda, and Yafeh (2014) for detailed econometric analysis that incorporates the adjustment costs.

statements at the end of the year, as long as there is little dispersion in the expected marginal returns across firms.

The sum of the market values of equities and debts is used to calculate the expected marginal returns of capital. A typical manufacturing firm can be considered to have a homogeneous of degree one production function. In this case, Tobin's Q, the market capitalization divided by total assets, is known to be proportional to the expected marginal returns (Hayashi 1982). The market capitalization is the expected present value of the sum of discounted future profits. Using this relation, at least for listed manufacturing companies, it is possible to examine whether capital is efficiently allocated by looking at the dispersion of Tobin's Q. Abiad, Oomes, and Ueda (2008) find that the dispersion of Tobin's Q across firms, measured by the Gini coefficient, decreased after financial liberalization, that is, the financial and capital market became efficient. Their analysis is based on the major emerging markets where data can be obtained (India, Jordan, Malaysia, South Korea, and Thailand) before and after the financial liberalization that occurred in the 1980s and the early 1990s.[4]

However, this method is applicable only for listed companies whose market values of equities are available, and cannot be extended to the case with many unlisted companies. Moreover, unlisted companies face tighter financial constraints in Japan (Ueda, Ishide, and Goto 2019) and in the world (Ueda and Sharma 2020). Hence, we would like to evaluate the dispersion including unlisted companies. Then, our analysis needs to rely heavily on the financial statements.

Yet, the ROA dispersion based on the financial statements should reflect the variation in the firm's expected marginal returns if the dispersion in the productivity shocks does not change significantly over the sample period. In this sense, the ROA dispersion can be used as an assessment of the functioning of the capital markets.

## III. Data

The Economic Census might be the most preferable to evaluate the changes of dispersion in marginal returns of firms' capital in Japan over time. However, other data is also good enough if randomly sampled. We use the firm-level data from the Financial Statements Statistics of Corporations by Industry compiled by the Ministry of Finance of Japan for our analysis. It is not a simple random sampling but can be treated as random, as we describe below.

The Economic Census compiled by the Statistics Bureau, the Ministry of Internal Affairs

[4] Gini coefficient is used as the dispersion of the expected marginal returns indicates the degree of discrimination in accessing finance or the degree of inequality.

and Communications comprehensively covers all enterprises and establishments in Japan, but it lacks major financial statements, particularly debt information. Basic Survey of Japanese Business Structure and Activities issued by the Ministry of Economy, Trade and Industry contains sufficient financial statements and it is compiled as panel data. However, the survey excludes small enterprises of a certain size or less and covers only from 1992. In addition, unlike the Economic Census and the Financial Statements Statistics of Corporations by Industry, the firms selected in the sample are not obligated to respond, likely creating a statistical bias.

In the Financial Statements Statistics of Corporations by Industry, sample-to-population numbers vary with firms' net worth. Moreover, thresholds changed several times in the past. We use the data from 1983 onwards, and there are two major changes. We employ the method called bootstrap (resampling) so that the changes in the sampling do not affect the estimation of dispersion (such as the Gini coefficient) in the return on assets of firms. Since the dispersion is directly related to the functioning of the capital markets, only non-financial corporations ("Ippan Jigyou Kaisha" in the Financial Statements Statistics of Corporations by Industry) are included in the analysis.

Tables 1a-1c show the sample sizes and population numbers categorized by years with the same capital-based classifications (1983-1995, 1996-2008, 2009-2017) relying on the information from the Policy Research Institute and e-Stat (the portal site of the official statistics of Japan). In order to unify the classifications over time, we create 5 categories based on firm's net worth: 1 billion yen or more, 100 million yen or more and less than 1 billion yen, 50 million yen or more and less than 100 million yen, 10 million yen or more and less than 50 million yen, and less than 10 million yen. Specifically, from 1983 to 2009, the categories

Table 1a. Sample and Population Size by Capital-based Category (Years 1983-1995)

| Capital category | Sample size (corporations) | Population number (corporations) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (note2) | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 |
| 1 bil.yen or more | All | 2,298 | 2,458 | 2,598 | 2,691 | 2,846 | 3,088 | 3,414 | 3,805 | 4,065 | 4,245 | 4,485 | 4,718 | 4,897 |
| 100 mil.yen or more-less than 1 bil.yen | Sampling with probability proportional to size (note3) | 14,222 | 14,680 | 15,119 | 15,675 | 16,733 | 17,442 | 18,916 | 19,997 | 21,474 | 22,718 | 23,494 | 23,734 | 23,994 |
| 50 mil.yen or more-less than 100 mil.yen (note 1) | 2,000 | 22,799 | 24,074 | 25,136 | 26,890 | 28,578 | 30,330 | 29,335 | 31,600 | 34,063 | 36,618 | 38,871 | 40,509 | 41,701 |
| 20 mil.yen or more-less than 50 mil.yen (note1) | 4,000 | 271,354 | 282,006 | 291,697 | 306,529 | 324,523 | 345,875 | 348,416 | 375,018 | 404,984 | 449,066 | 512,212 | 577,197 | 639,899 |
| 10 mil.yen or more-less than 20 mil.yen (note1) | 3,000 | | | | | | | | | | | | | |
| 5 mil.yen or more-less than 10 mil.yen (note1) | 2,000 | 302,389 | 315,681 | 326,159 | 342,674 | 361,759 | 385,476 | 397,117 | 435,947 | 472,627 | 503,635 | 519,447 | 510,939 | 494,690 |
| 2 mil.yen or more-less than 5 mil.yen (note1) | 2,000 | 547,030 | 556,476 | 560,818 | 574,991 | 592,180 | 603,755 | 583,188 | 600,041 | 621,544 | 687,995 | 726,912 | 767,406 | 801,917 |
| Less than 2 mil.yen (note1) | 2,000 | 634,958 | 623,734 | 609,041 | 604,671 | 603,140 | 594,574 | 556,936 | 554,047 | 547,827 | 533,289 | 509,934 | 482,775 | 442,150 |
| Total | — | 1,795,050 | 1,819,109 | 1,830,568 | 1,874,121 | 1,929,759 | 1,980,540 | 1,937,322 | 2,020,455 | 2,106,584 | 2,237,566 | 2,335,355 | 2,407,278 | 2,449,248 |

Note 1: The sampling differs between metropolitan areas and other areas.
Note 2: There is a slight deviation from the actual number of firms sampled each year.
Note 3: First, sort firms in ascending order of capital and sum the capital in sequence. Second, pick sample firms each time the total amount reaches a multiple of 500 million yen. All the firms with net worth of more than 500 million yen are included in the sample.

## Table 1b. Sample and Population Size by Capital-based Category (Years 1996-2008)

| Capital category | Sample size (corporations) | Population number (corporations) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (note2) | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 |
| 1 bil.yen or more | All | 5,114 | 5,237 | 5,310 | 5,386 | 5,472 | 5,559 | 5,671 | 5,686 | 5,620 | 5,616 | 5,612 | 5,547 | 5,497 |
| 100 mil.yen or more-less than 1 bil.yen | Sampling with probability proportional to size (note3) | 24,317 | 24,883 | 25,726 | 26,089 | 26,414 | 27,301 | 27,960 | 28,220 | 28,213 | 27,645 | 27,745 | 27,820 | 28,742 |
| 50 mil.yen or more-less than 100 mil.yen (note 1) | 2,000 | 43,051 | 44,328 | 45,810 | 46,988 | 47,995 | 50,254 | 50,896 | 49,977 | 51,087 | 52,636 | 54,769 | 56,652 | 58,113 |
| 20 mil.yen or more-less than 50 mil.yen (note1) | 4,000 | 178,570 | 187,238 | 194,917 | 199,756 | 204,059 | 211,628 | 213,486 | 209,262 | 211,109 | 212,049 | 212,323 | 212,516 | 211,888 |
| 10 mil.yen or more-less than 20 mil.yen (note1) | 4,000 | 587,969 | 848,525 | 894,130 | 903,047 | 904,098 | 913,258 | 908,721 | 882,997 | 886,946 | 879,680 | 870,593 | 857,508 | 841,670 |
| 5 mil.yen or more-less than 10 mil.yen (note1) | 2,000 | 453,841 | 332,512 | 313,829 | 311,559 | 311,771 | 314,602 | 313,734 | 312,338 | 316,613 | 315,023 | 313,907 | 319,049 | 331,349 |
| 3 mil.yen or more-less than 5 mil.yen (note1) | 2,000 | 703,423 | 910,189 | 951,872 | 983,284 | 1,016,265 | 1,052,770 | 1,074,585 | 1,117,716 | 1,164,230 | 1,178,715 | 1,193,814 | 1,198,070 | 1,173,128 |
| 2 mil.yen or more-less than 3 mil.yen (note1) | 1,000 | 138,193 | 22,011 | 7,722 | 6,043 | 5,383 | 5,162 | 4,639 | 4,232 | 4,313 | 4,931 | 5,496 | 8,422 | 14,254 |
| Less than 2 mil.yen (note1) | 2,000 | 333,368 | 59,028 | 31,154 | 27,760 | 26,942 | 27,389 | 27,262 | 28,370 | 33,442 | 42,482 | 51,370 | 73,691 | 109,793 |
| Total | — | 2,467,846 | 2,433,951 | 2,470,470 | 2,509,912 | 2,548,399 | 2,607,923 | 2,626,954 | 2,638,798 | 2,701,573 | 2,718,777 | 2,735,630 | 2,759,279 | 2,774,434 |

Note 1-3 are same as Table 1a.

## Table 1c. Sample and Population Size by Capital-based Category (Years 2009-2017)

| Capital category | Sample size (corporations) | Population number (corporations) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | (note2), (note3) | 2,009 | 2,010 | 2,011 | 2,012 | 2,013 | 2,014 | 2,015 | 2,016 | 2,017 |
| 1 bil.yen or more | All | 5,456 | 5,345 | 5,274 | 5,205 | 5,156 | 5,132 | 5,074 | 5,098 | 5,067 |
| 500 mil.yen or more-less than 1 bil.yen | All | 27,899 | 27,041 | 26,644 | 26,059 | 25,480 | 25,235 | 24,862 | 24,912 | 24,891 |
| 100 mil.yen or more-less than 500 mil.yen | 10,000 | | | | | | | | | |
| 50 mil.yen or more-less than 100 mil.yen (note1) | 2,000 | 58,995 | 59,440 | 59,881 | 60,216 | 60,587 | 61,093 | 61,663 | 62,038 | 62,638 |
| 20 mil.yen or more-less than 50 mil.yen (note1) | 4,000 | 210,311 | 207,633 | 205,546 | 203,313 | 201,465 | 200,080 | 198,995 | 197,720 | 19 6,377 |
| 10 mil.yen or more-less than 20 mil.yen (note1) | 4,000 | 823,205 | 803,460 | 784,109 | 763,703 | 746,468 | 731,543 | 717,457 | 697,438 | 68 3,098 |
| Less than 10 mil.yen (note1) | 4,000 | 1,646,046 | 1,658,225 | 1,670,397 | 1,681,314 | 1,702,125 | 1,726,536 | 1,757,917 | 1,788,778 | 1,821,736 |
| Total | — | 2,771,912 | 2,761,144 | 2,751,851 | 2,739,810 | 2,741,281 | 2,749,619 | 2,765,968 | 2,775,984 | 2,793,807 |

Note 1-3 are same as Table 1a.

## Table 2. Population Size after Unifying the Capital-based Categories (Years 1983-2017)

| Capital category | Year | | | | | | |
|---|---|---|---|---|---|---|---|
| | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 |
| 1 bil.yen or more | 2297 | 2457 | 2598 | 2691 | 2845 | 3087 | 3413 |
| 100 mil.yen or more-less than 1 bil.yen | 5670 | 5801 | 5908 | 6169 | 6512 | 6659 | 6995 |
| 50 mil.yen or more-less than 100 mil.yen | 1682 | 1700 | 1685 | 1766 | 1790 | 1804 | 1923 |
| 10 mil.yen or more-less than 50 mil.yen | 4430 | 5307 | 5127 | 5889 | 5989 | 5875 | 6276 |
| Less than 10 mil.yen | 3807 | 4133 | 4114 | 4746 | 4796 | 4760 | 5028 |
| Total | 17886 | 19398 | 19432 | 21261 | 21932 | 22185 | 23635 |

| Capital category | Year | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 |
| 1 bil.yen or more | 3805 | 4065 | 4245 | 4484 | 4712 | 4890 | 5077 | 5166 | 5211 | 5236 |
| 100 mil.yen or more-less than 1 bil.yen | 7358 | 7765 | 8214 | 8514 | 8685 | 8781 | 7537 | 7546 | 7573 | 7486 |
| 50 mil.yen or more-less than 100 mil.yen | 1903 | 1825 | 1869 | 1855 | 1831 | 1860 | 2022 | 1946 | 1975 | 1809 |
| 10 mil.yen or more-less than 50 mil.yen | 6466 | 6330 | 6276 | 6387 | 6362 | 6765 | 6992 | 6355 | 5899 | 5528 |
| Less than 10 mil.yen | 5227 | 5010 | 4853 | 4800 | 4628 | 4298 | 4063 | 4381 | 4847 | 4495 |
| Total | 24759 | 24995 | 25457 | 26040 | 26218 | 26594 | 25691 | 25394 | 25505 | 24554 |

| Capital category | Year | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 |
| 1 bil.yen or more | 5255 | 5257 | 5344 | 5363 | 5275 | 5267 | 5204 | 5155 | 5033 | 4939 |
| 100 mil.yen or more-less than 1 bil.yen | 7578 | 7699 | 7851 | 8205 | 8229 | 7956 | 7884 | 7535 | 7726 | 7626 |
| 50 mil.yen or more-less than 100 mil.yen | 1799 | 1715 | 1740 | 1985 | 2411 | 2528 | 2531 | 2475 | 2249 | 2375 |
| 10 mil.yen or more-less than 50 mil.yen | 5259 | 5125 | 5039 | 5301 | 5656 | 5672 | 5773 | 5627 | 5578 | 5535 |
| Less than 10 mil.yen | 4447 | 4047 | 3866 | 4031 | 4245 | 4315 | 4228 | 4247 | 4242 | 2282 |
| Total | 24338 | 23843 | 23840 | 24885 | 25816 | 25738 | 25620 | 25039 | 24828 | 22757 |

| Capital category | Year | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
| 1 bil.yen or more | 4819 | 4758 | 4705 | 4682 | 4674 | 4648 | 4729 | 4756 |
| 100 mil.yen or more-less than 1 bil.yen | 7955 | 8151 | 7934 | 7859 | 8179 | 8380 | 8420 | 8250 |
| 50 mil.yen or more-less than 100 mil.yen | 2334 | 2376 | 2388 | 2466 | 2526 | 2482 | 2429 | 2412 |
| 10 mil.yen or more-less than 50 mil.yen | 5643 | 5761 | 5850 | 5978 | 6045 | 6057 | 5957 | 5861 |
| Less than 10 mil.yen | 2275 | 2422 | 2394 | 2324 | 2323 | 2344 | 2266 | 2210 |
| Total | 23026 | 23468 | 23271 | 23309 | 23747 | 23911 | 23801 | 23489 |

of less than 10 million yen are merged and, from 1996 to 2017, the categories of 10 million to 50 million yen are merged. Table 2 shows the sample size for each capital-based classification for each year used in this study.

As it is clear from Table 2, the sampling probabilities vary as a fixed number of samples for each category is taken from the corresponding population for each year. The sampling probabilities also fluctuate year by year due to the changes in the sampling method and the changes in the population numbers. If one looks at the dispersion in ROA using the original sample directly, the result might be attributed to changes in the sampling probability. In order to correct this, we resample the data so that the sample-to-population ratios become the same for all years and all capital-based categories.

Specifically, for each year, we calculate the relative weight of each category in the total population by dividing the number of the category population by the number of the total population. Using this weight, the number of resamples for each category is calculated each year so that the total number of resamples for each year becomes 3,300 firms. Then, we pick resamples randomly for each category and for each year from the original samples.[5] There may be errors from the ideal resampling due to the procedure itself in a one-time resampling, and hence we conduct the resampling 30 times. That is, resamples of 3,300 firms are created 30 times from the original data.

## IV. Methods to Estimate Dispersion in Marginal Product of Capital

As mentioned above, the dispersion in the marginal product of capital is proportional to ROA. Note that the term "profits" in economics and accounting do not correspond to each other perfectly. It is necessary to pay attention to which accounting item should be used. We use the operating income for our analysis. The operating income here is often referred to as EBIT, which is the firm's net income before tax and interest expenses are deducted. Without the corporate tax, this is the sum of interest payments on debt, dividends to shareholders, and retained earnings, which should be returned to shareholders by raising stock prices. Therefore, it is collectively referred to as allocation to "capitalists." All of them must be included in the measurement of the marginal product of capital. We exclude, for example, capital gains and losses from asset sales (non-operating income) to measure the marginal returns of the core business. Also, we exclude extraordinary gains and losses.

Our regression analysis follows Abiad, Oomes, and Ueda (2008). However, we use the ratio of operating income to total assets (ROA) for the dependent variable, instead of Tobin's Q. The dispersion is estimated each year, but the dispersion should be estimated con-

[5] We use the Stata command "bsample." The number of resamples of 3,300 is obtained in order to have as many resamples as possible but not to exceed the original number of samples in each category.

sidering the differences in risk management and growth opportunities, assessed by the capital markets, including bank loans in a broad sense.

Tobin's Q is often used as a proxy for growth opportunities for each firm in studies on listed companies, but Tobin's Q is not observable for unlisted firms. Some papers use the growth opportunities of the industry instead, and we follow them. Specifically, we use the fixed effects of about 40 industries for non-financial firms in the Financial Statements Statistics of Corporations by Industry.[6]

A high-risk firm is required to pay a corresponding risk premium at the time of lending, and accordingly, its ROA must be high. Although the industry specific risk is absorbed by the industry fixed effects, it is also necessary to consider the risk of each firm such as the probability of bankruptcy. It is controlled by the firm size (total assets, *TA*) and the ratio of debt to total assets (*Debt*). The squared term of the debt ratio is included as it is well known as debt overhang that firms with high leverage face a non-linear increase in risk and decline in profits (Hennessy 2004).

Moreover, it is often said to be useless for firms to hold cash and deposits. If so, the ratio of cash and deposits to total assets (*Cash*) would reduce ROA. On the other hand, if a firm knows that it is difficult to raise funds in an emergency, it should keep a certain amount of cash and deposits in hand. If this is the case, the firm does not miss any profit opportunities, and therefore, the ratio of cash and deposits to total assets (*Cash*) would have a positive effect on ROA. Note that, in aggregate, the ratio of cash and deposits to total assets has remained almost constant over the sample period in the Financial Statements Statistics of Corporations by Industry, as in the Flow of Funds from the Bank of Japan (Figure 6).[7]

In summary, we conduct the following fixed effect regressions and obtain error terms. We then investigate the dispersion of the error terms across firms, which are the residual components of ROA other than those explained by the growth opportunities and risks.

$$ROA_{i,j}=\alpha_j+\beta TA_{i,j}+\gamma Cash_{i,j}+\delta Debt_{i,j}+\kappa Debt_{i,j}^2+\eta_{i,j}$$

The subscript *i* indicates a firm, and *j* indicates the industry. The first term on the right-hand side is the industry fixed effects. We run the regression for each year from 1983 to 2017. Table 3a shows the descriptive statistics and Table 3b is the correlation table.[8]

---

6 Regarding the number of industries, it is about the same as US SIC 2-digit level that is often used in the US-focused studies. Although the classification has gone through some revisions in accordance with changes in sampling, the number of industries is almost the same. The number of industries has changed from 37 (1983-2003) to 43 (2004-2008) and 45 (2009-2017) in our sample period.

7 The same can be said for the facts that trade credits (notes/accounts receivable) have declined throughout the 1980s, and that the ratio of security holdings and fixed assets to total assets have been about the same since the 1990s.

8 The samples with zero or negative total assets, negative cash and deposits, and negative liabilities, are removed as they are probably typos. Then, we also take out outliers regarding ROA based on three standard deviations.

Figure 6. Changes in the Breakdown of Total Assets, the Financial Statements Statistics of Corporations by Industry, Based on 3,300 Firms whose Gini Coefficient is the Median of 30 Resamples Each Year
(The white portion consists mostly of securities.)

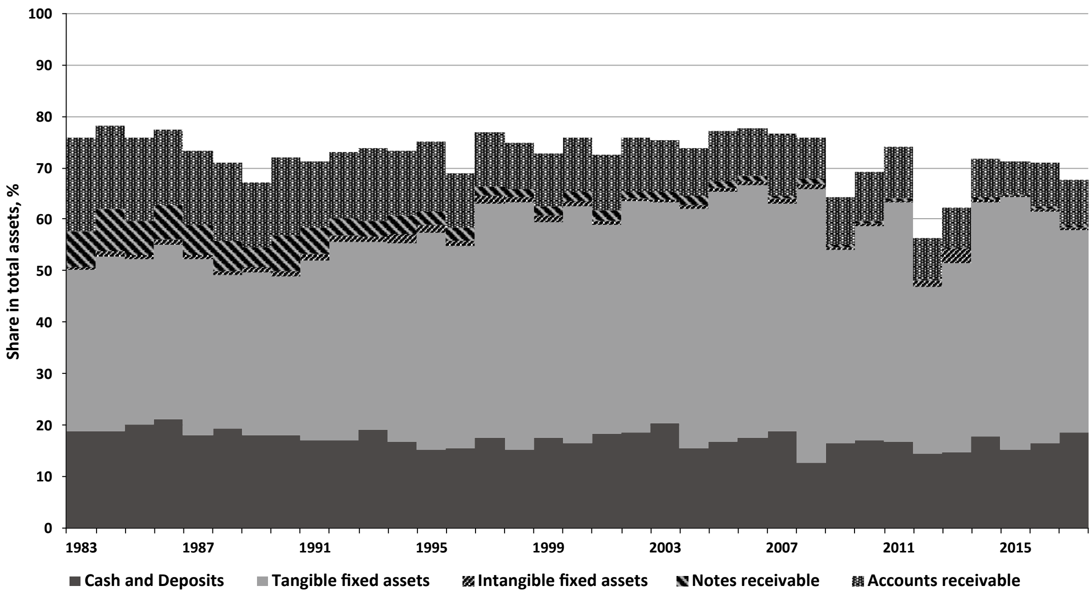



Table 3a. Descriptive Statistics

| | Mean | SD | Min. | Max. | Count |
|---|---|---|---|---|---|
| Operating revenue/TA | 0.013 | 0.220 | -64.545 | 29.614 | 823,437 |
| log TA | 20.803 | 2.733 | 6.908 | 30.494 | 823,437 |
| Cash/TA | 0.172 | 0.175 | 0.000 | 1.000 | 814,494 |
| Debt/TA | 1.159 | 256.955 | 0.000 | 232,998.781 | 823,437 |

Table 3b. Correlation Matrix of Variables (***Significant at 1%)

| | Operating revenue/TA | log TA | Cash/TA | Debt/TA |
|---|---|---|---|---|
| Operating revenue/TA | 1.000 | | | |
| log TA | 0.157*** | 1.000 | | |
| Cash/TA | -0.007*** | -0.314*** | 1.000 | |
| Debt/TA | 0.004*** | -0.005*** | 0.004*** | 1.000 |

In some industries, monopolistic competition or oligopoly may prevail. In these cases, ROA in those industries could be higher than the market interest rate. However, the addition of such monopoly rents for an industry should be absorbed by the industry fixed effects. The error term $\eta$ in the above equation represents the variations from the industry specific average of ROA. Thus, theoretically, even without perfect competition in a goods market, our method can successfully measure the efficiency of the capital markets.

If the dispersion of ROA is very different across the industries, and if the share of a particular industry is increasing, then the overall dispersion will depend on the share of that industry in terms of the numbers of firms. Figure 7 shows the changes in the share of the industries based on the numbers of firms over time in the Financial Statements Statistics of Corporations by Industry. In fact, the share of the manufacturing industry shows a declining trend, and that of the service industry (in a narrow sense excluding retail, transportation, and telecommunications) is increasing. However, the shares of both industries are moving slowly. It would warrant caution if there is any deviation from this tendency.

Table 4 shows the regression result of each year using all the samples. The firm size has a significantly positive coefficient for all years, raising the ROA. As for the debt ratio, a non-linear relation is found due to the effect of debt overhang as in the literature. The linear term is negative and the quadratic term is positive, and both are significant for most years to explain the ROA differences. This means that the borrowing itself is not regarded as a risk but that, with larger leverage, the higher risk premium becomes demanded.

Regarding the ratio of cash and deposit holdings to total assets, there is no significant year before the bubble era (1986/87-1990/91), but after that era, significantly positive coeffi-

Figure 7. Changes in the Share of Industries in Terms of the Numbers of Firms in the Financial Statements Statistics of Corporations by Industry

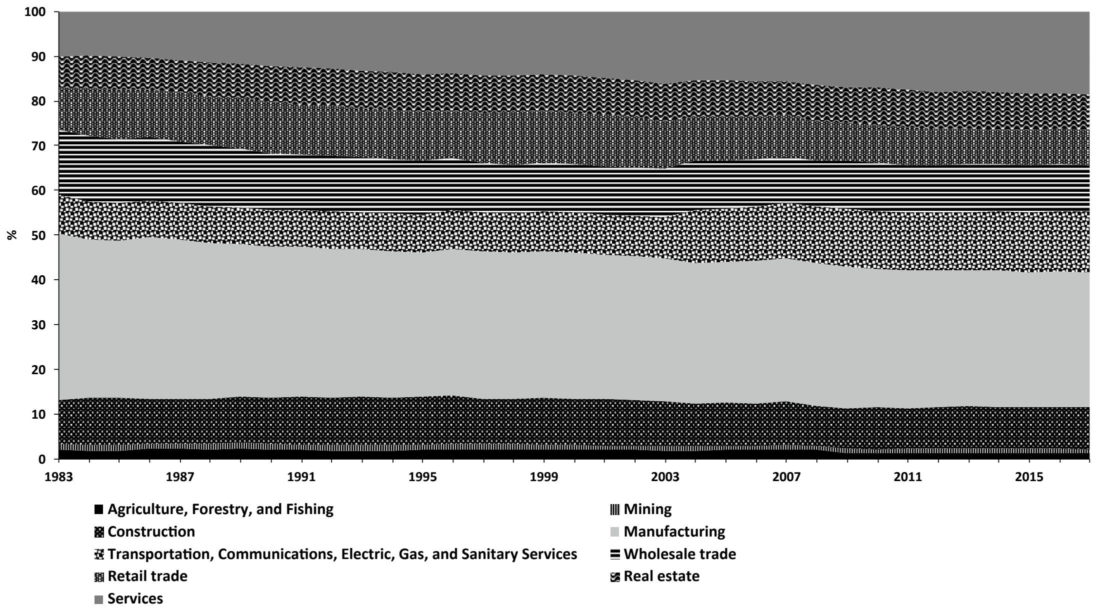


Table 4. Regression Results for Each Year Based on Fixed Effects Model
(The dependent variable is ROA.)

| | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| log TA | 0.006$^{***}$ | 0.005$^{***}$ | 0.005$^{***}$ | 0.004$^{***}$ | 0.010$^{***}$ | 0.004$^{***}$ | 0.003$^{***}$ | 0.004$^{***}$ | 0.010$^{***}$ | 0.007$^{***}$ | 0.010$^{***}$ | 0.009$^{***}$ | 0.011$^{***}$ |
| | (16.49) | (12.91) | (11.93) | (13.49) | (9.06) | (11.50) | (8.48) | (11.25) | (10.16) | (17.50) | (22.56) | (18.53) | (14.81) |
| Cash/TA | 0.032$^{***}$ | 0.009 | 0.013 | 0.009 | 0.007 | 0.041$^{***}$ | 0.032$^{***}$ | 0.026$^{***}$ | 0.096$^{***}$ | 0.011 | 0.028$^{***}$ | 0.011 | 0.047$^{***}$ |
| | (3.33) | (0.92) | (1.29) | (1.18) | (0.34) | (5.32) | (3.82) | (2.77) | (6.65) | (1.33) | (3.16) | (1.04) | (3.60) |
| Debt/TA | -0.085$^{***}$ | -0.099$^{***}$ | -0.051$^{***}$ | -0.068$^{***}$ | -0.023 | -0.048$^{***}$ | -0.063$^{***}$ | -0.059$^{***}$ | -0.017 | -0.089$^{***}$ | -0.079$^{***}$ | -0.085$^{***}$ | -0.032$^{***}$ |
| | (-14.72) | (-15.71) | (-6.49) | (-13.42) | (-1.13) | (-9.34) | (-11.05) | (-8.49) | (-1.53) | (-15.11) | (-11.19) | (-12.16) | (-3.60) |
| (Debt/TA)^2 | 0.003$^{***}$ | 0.007$^{***}$ | 0.001$^{***}$ | 0.003$^{***}$ | 0.000 | 0.002$^{***}$ | 0.003$^{***}$ | 0.001$^{***}$ | 0.000 | 0.004$^{***}$ | 0.002$^{***}$ | 0.003$^{***}$ | 0.000$^{*}$ |
| | (9.54) | (4.23) | (5.97) | (7.50) | (1.39) | (4.30) | (6.13) | (4.17) | (1.39) | (9.44) | (3.63) | (3.63) | (1.94) |
| Constant | -0.033$^{***}$ | 0.006 | -0.029$^{**}$ | -0.010 | -0.150$^{***}$ | -0.009 | 0.024$^{***}$ | -0.014 | -0.185$^{***}$ | -0.056$^{***}$ | -0.146$^{***}$ | -0.126$^{***}$ | -0.199$^{***}$ |
| | (-3.62) | (0.71) | (-2.54) | (-1.20) | (-4.27) | (-1.05) | (2.77) | (-1.22) | (-7.01) | (-5.44) | (-11.56) | (-9.15) | (-9.33) |
| Observations | 17,368 | 18,823 | 18,895 | 20,564 | 21,345 | 21,522 | 22,994 | 24,056 | 24,376 | 24,702 | 25,202 | 25,300 | 25,689 |
| Adjusted $R^2$ | 0.132 | 0.129 | 0.075 | 0.100 | 0.074 | 0.068 | 0.074 | 0.075 | 0.063 | 0.109 | 0.131 | 0.128 | 0.079 |

| 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 |
|---|---|---|---|---|---|---|---|---|---|---|
| 0.008$^{***}$ | 0.006$^{***}$ | 0.012$^{***}$ | 0.012$^{***}$ | 0.011$^{***}$ | 0.010$^{***}$ | 0.011$^{***}$ | 0.007 | 0.011$^{***}$ | 0.021$^{***}$ | 0.017$^{***}$ |
| (10.68) | (17.27) | (15.36) | (24.07) | (17.77) | (17.89) | (10.51) | (0.80) | (19.20) | (11.74) | (16.42) |
| -0.003 | 0.052$^{***}$ | 0.026$^{*}$ | 0.034$^{***}$ | 0.033$^{***}$ | 0.029$^{***}$ | 0.018 | 0.026 | 0.052$^{***}$ | -0.004 | 0.049$^{***}$ |
| (-0.21) | (6.98) | (1.84) | (3.71) | (3.23) | (2.90) | (0.86) | (0.34) | (5.83) | (-0.11) | (3.40) |
| -0.060$^{***}$ | -0.038$^{***}$ | -0.050$^{***}$ | -0.035$^{***}$ | -0.031$^{***}$ | -0.030$^{***}$ | -0.064$^{***}$ | -0.066 | -0.010$^{***}$ | -0.011$^{*}$ | -0.012$^{**}$ |
| (-5.82) | (-9.66) | (-6.07) | (-8.10) | (-6.29) | (-5.94) | (-7.07) | (-0.81) | (-3.00) | (-1.90) | (-2.52) |
| 0.001$^{***}$ | 0.001$^{***}$ | 0.000$^{***}$ | 0.000$^{***}$ | 0.000$^{***}$ | 0.000$^{***}$ | 0.000$^{***}$ | 0.000 | 0.000$^{***}$ | 0.000$^{*}$ | 0.000$^{**}$ |
| (6.05) | (4.99) | (3.00) | (5.76) | (5.11) | (4.03) | (7.14) | (0.19) | (2.82) | (1.91) | (2.12) |
| -0.114$^{***}$ | -0.102$^{***}$ | -0.224$^{***}$ | -0.226$^{***}$ | -0.201$^{***}$ | -0.190$^{***}$ | -0.177$^{***}$ | -0.093 | -0.209$^{***}$ | -0.421$^{***}$ | -0.341$^{***}$ |
| (-4.88) | (-10.31) | (-9.90) | (-17.24) | (-12.25) | (-12.37) | (-6.30) | (-0.36) | (-14.70) | (-10.51) | (-13.50) |
| 24,689 | 24,272 | 24,546 | 23,592 | 23,459 | 22,939 | 22,934 | 24,675 | 25,397 | 25,460 | 25,284 |
| 0.087 | 0.092 | 0.121 | 0.133 | 0.107 | 0.089 | 0.130 | 0.103 | 0.067 | 0.057 | 0.065 |

| 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|---|---|---|
| 0.018$^{***}$ | 0.026$^{***}$ | 0.021$^{***}$ | 0.013$^{***}$ | 0.017$^{***}$ | 0.013$^{***}$ | 0.010$^{***}$ | 0.008$^{***}$ | 0.011$^{***}$ | 0.008$^{***}$ | 0.011$^{***}$ |
| (15.97) | (17.12) | (13.49) | (17.57) | (19.93) | (17.43) | (20.01) | (10.08) | (14.82) | (13.90) | (3.37) |
| 0.032$^{**}$ | 0.039$^{*}$ | 0.051$^{***}$ | 0.045$^{***}$ | 0.071$^{***}$ | 0.076$^{***}$ | 0.063$^{***}$ | 0.031$^{***}$ | 0.056$^{***}$ | 0.031$^{***}$ | 0.036 |
| (2.22) | (1.79) | (3.43) | (4.89) | (7.48) | (8.33) | (9.11) | (2.76) | (5.42) | (3.54) | (1.28) |
| -0.013$^{*}$ | -0.009$^{*}$ | -0.016 | -0.016$^{***}$ | 0.000 | -0.003$^{*}$ | -0.002 | -0.029$^{***}$ | -0.006$^{***}$ | -0.026$^{***}$ | -0.012 |
| (-1.78) | (-1.78) | (-1.59) | (-3.19) | (0.05) | (-1.84) | (-1.33) | (-6.50) | (-2.64) | (-6.45) | (-0.55) |
| 0.000$^{*}$ | 0.000$^{*}$ | 0.000 | 0.000$^{***}$ | -0.000 | 0.000$^{*}$ | 0.000 | 0.000$^{***}$ | 0.000$^{**}$ | 0.000$^{***}$ | 0.000 |
| (1.84) | (1.79) | (1.49) | (3.53) | (-0.11) | (1.85) | (1.14) | (5.74) | (2.45) | (5.14) | (0.71) |
| -0.354$^{***}$ | -0.560$^{***}$ | -0.443$^{***}$ | -0.267$^{***}$ | -0.351$^{***}$ | -0.272$^{***}$ | -0.201$^{***}$ | -0.136$^{***}$ | -0.223$^{***}$ | -0.140$^{***}$ | -0.216$^{**}$ |
| (-12.28) | (-15.93) | (-10.81) | (-13.42) | (-17.61) | (-15.58) | (-16.90) | (-6.83) | (-12.45) | (-9.24) | (-2.38) |
| 24,721 | 24,545 | 22,477 | 22,610 | 23,100 | 22,884 | 22,779 | 23,297 | 23,503 | 23,357 | 23,138 |
| 0.076 | 0.066 | 0.092 | 0.089 | 0.062 | 0.058 | 0.051 | 0.074 | 0.041 | 0.064 | 0.022 |

Note that the fixed effects are not reported in the table.
Robust *t*-statistics are in parenthesis. *Significant at 10%; **Significant at 5%; ***Significant at 1%.

cients appear in most years. This indicates the usefulness of cash holdings in Japanese firms during and after the bubble era. This contrasts with a typical argument that highlights the uselessness of cash holdings. In fact, it has been known that firms' cash holdings increased for various reasons in the G7 countries including Japan after 2000 (e.g., Cardarelli and Ueda (2006) as an earliest paper). However, as mentioned above, cash and deposit holdings are not increasing in the macroeconomic perspective in Japan.

We then repeat resampling and run the regressions for each year 30 times. For each time, we obtain the year-specific dispersion of error terms, that is, the components of the ROA unexplained by the regression based on the simple theory. Recall that the dispersion of error terms is considered as (proportional to) the dispersion in marginal product of capital.

We use the Gini coefficient to gauge the dispersion. It shows the degree of inequality in ROA, and in essence shows the degree of inequality in financial constraints. It is unnatural to have a minus value for the Gini coefficient due to its definition, and hence it is calculated based on a gross return (the return that counts principal) by adding one to each error term. Note that ROA can be considered as an "interest rate" of investment and that the error term usually fluctuates around zero. The gross ROA does not fall below minus 1 (loss greater than total assets, i.e., the loss is greater than -100%) unless there is a bankruptcy due to a sudden deterioration in the business condition. In fact, there are no such cases in our sample.

Here, let us look at each year's regression result of the specific set of resamples which has the Gini coefficient of ROA to be the median among the 30 Gini coefficients obtained from the 30 sets of resamples and regressions. This is represented in Table 5. The regression

Table 5. Regression Results for Each Year Based on Fixed Effects Model
(The dependent variable is ROA. Regression results based on the set of resamples that has the Gini coefficient of ROA as the median among the 30 sets of the Gini coefficients.)

| | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| log TA | 0.016*** | 0.011*** | 0.015*** | 0.015*** | 0.008*** | 0.011*** | 0.007*** | 0.011*** | 0.011*** | 0.020*** | 0.024*** | 0.016*** | 0.023*** |
| | (8.75) | (5.47) | (6.88) | (9.38) | (3.91) | (6.66) | (3.25) | (5.72) | (5.07) | (10.03) | (11.43) | (6.73) | (9.51) |
| Cash/TA | 0.034 | 0.027 | 0.028 | 0.026 | 0.087*** | 0.080*** | 0.087*** | 0.046** | 0.032 | 0.039* | 0.007 | 0.023 | 0.104*** |
| | (1.64) | (1.47) | (1.26) | (1.53) | (3.70) | (4.77) | (3.68) | (2.35) | (1.34) | (1.65) | (0.36) | (1.06) | (3.54) |
| Debt/TA | -0.098*** | -0.122*** | -0.043*** | -0.099*** | 0.019 | -0.037*** | -0.070*** | -0.038*** | -0.059*** | -0.094*** | -0.111*** | -0.121*** | -0.014 |
| | (-9.12) | (-9.17) | (-3.50) | (-6.04) | (1.11) | (-3.00) | (-4.58) | (-2.73) | (-2.74) | (-10.22) | (-7.84) | (-8.62) | (-1.49) |
| (Debt/TA)^2 | 0.003*** | 0.010*** | 0.002*** | 0.008** | -0.017*** | 0.002** | 0.005** | 0.002*** | -0.000 | 0.004*** | 0.006*** | 0.007*** | -0.000 |
| | (7.98) | (4.93) | (2.98) | (2.46) | (-10.78) | (2.57) | (2.22) | (4.03) | (-0.04) | (10.75) | (4.79) | (10.59) | (-0.25) |
| Constant | -0.190*** | -0.088** | -0.213*** | -0.176*** | -0.134*** | -0.157*** | -0.053 | -0.144*** | -0.120*** | -0.280*** | -0.352*** | -0.202*** | -0.441*** |
| | (-5.54) | (-2.41) | (-5.35) | (-5.93) | (-3.30) | (-4.84) | (-1.34) | (-3.60) | (-2.79) | (-7.28) | (-8.40) | (-4.22) | (-8.85) |
| Observations | 3,274 | 3,282 | 3,277 | 3,278 | 3,255 | 3,273 | 3,279 | 3,272 | 3,259 | 3,277 | 3,251 | 3,246 | 3,236 |
| Adjusted $R^2$ | 0.150 | 0.131 | 0.052 | 0.133 | 0.446 | 0.082 | 0.086 | 0.065 | 0.096 | 0.155 | 0.178 | 0.148 | 0.189 |

| | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0.017*** | 0.012*** | 0.020*** | 0.022*** | 0.014*** | 0.011*** | 0.017*** | 0.010*** | 0.019*** | 0.025*** | 0.012*** |
| | (5.05) | (6.87) | (7.52) | (9.97) | (6.57) | (5.08) | (5.75) | (2.63) | (5.54) | (6.02) | (3.46) |
| | 0.029 | 0.065*** | 0.032 | -0.013 | 0.013 | -0.057*** | 0.073** | 0.061** | 0.073*** | 0.115*** | 0.078*** |
| | (0.77) | (3.12) | (1.17) | (-0.66) | (0.54) | (-2.73) | (2.55) | (2.25) | (3.02) | (3.61) | (2.62) |
| | -0.008 | -0.045*** | -0.048*** | -0.056*** | -0.047*** | -0.096*** | -0.035*** | -0.045*** | -0.006 | 0.038*** | -0.024*** |
| | (-0.29) | (-3.92) | (-3.21) | (-6.82) | (-3.83) | (-10.00) | (-3.06) | (-6.42) | (-0.49) | (2.63) | (-2.99) |
| | 0.000 | 0.003*** | 0.002*** | 0.002*** | 0.001*** | 0.005*** | -0.001 | 0.000*** | 0.000 | -0.002*** | 0.000*** |
| | (1.04) | (4.13) | (4.83) | (7.66) | (3.60) | (8.25) | (-1.31) | (11.92) | (0.30) | (-16.85) | (3.01) |
| | -0.309*** | -0.204*** | -0.345*** | -0.367*** | -0.227*** | -0.122*** | -0.300*** | -0.163** | -0.360*** | -0.518*** | -0.213*** |
| | (-3.66) | (-5.41) | (-6.09) | (-8.39) | (-4.82) | (-2.79) | (-5.08) | (-2.08) | (-4.86) | (-6.06) | (-3.05) |
| | 3,229 | 3,234 | 3,217 | 3,233 | 3,234 | 3,233 | 3,227 | 3,242 | 3,254 | 3,219 | 3,230 |
| | 0.058 | 0.070 | 0.087 | 0.143 | 0.084 | 0.177 | 0.142 | 0.233 | 0.083 | 0.779 | 0.052 |

| | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0.014*** | 0.024*** | 0.024*** | 0.011*** | 0.008*** | 0.010*** | 0.012*** | 0.004 | 0.011*** | 0.008*** | 0.007 |
| | (5.22) | (7.67) | (8.21) | (4.82) | (3.19) | (3.64) | (4.74) | (0.95) | (2.77) | (3.43) | (1.64) |
| | 0.063*** | 0.099*** | 0.078*** | -0.004 | 0.010 | 0.130*** | 0.090*** | 0.111*** | 0.122*** | 0.131*** | 0.118*** |
| | (2.76) | (3.09) | (3.40) | (-0.18) | (0.51) | (5.88) | (4.93) | (5.22) | (3.93) | (7.16) | (5.34) |
| | -0.010 | -0.020** | -0.029*** | -0.086*** | -0.053*** | -0.014*** | -0.013*** | -0.035*** | 0.009 | -0.007 | 0.005 |
| | (-0.85) | (-2.29) | (-5.08) | (-10.46) | (-5.82) | (-3.16) | (-2.79) | (-6.81) | (0.95) | (-1.54) | (1.22) |
| | -0.001 | 0.000*** | 0.000*** | 0.004*** | 0.001*** | 0.000 | 0.000*** | 0.000*** | -0.000 | 0.000 | -0.000 |
| | (-1.12) | (5.03) | (8.13) | (12.58) | (4.24) | (0.84) | (3.03) | (6.86) | (-1.25) | (0.95) | (-1.24) |
| | -0.260*** | -0.459*** | -0.462*** | -0.142*** | -0.114** | -0.200*** | -0.223*** | -0.053 | -0.219*** | -0.163*** | -0.133* |
| | (-4.67) | (-7.33) | (-7.97) | (-3.04) | (-2.07) | (-3.65) | (-4.52) | (-0.67) | (-2.70) | (-3.35) | (-1.70) |
| | 3,227 | 3,216 | 3,215 | 3,247 | 3,243 | 3,253 | 3,262 | 3,245 | 3,236 | 3,258 | 3,244 |
| | 0.067 | 0.115 | 0.215 | 0.160 | 0.109 | 0.120 | 0.067 | 0.141 | 0.045 | 0.059 | 0.023 |

Note that the fixed effects are not reported in the table.
Robust *t*-statistics are in parenthesis. *Significant at 10%; **Significant at 5%; ***Significant at 1%.

results are almost the same as those in Table 4, which is based on all the original samples. More coefficients are significant in more years. Put differently, we confirm the robustness of the original regression results as the results appear more strongly in the median set of resamples.

## V. Changes in the Dispersion of Marginal Returns on Capital

Figure 8 shows the changes in the Gini coefficients of error terms obtained each year. The box plots of the Gini coefficients are shown as there are 30 resampled sets of data. The solid line in the middle of the box indicates the median value of the 30 Gini coefficients, the top of the box is the 3rd quartile, and the bottom is the 1st quartile. The upper and lower tip values of the whiskers indicate the upper and lower adjacent values, respectively. We pay attention to the median to avoid resampling bias.

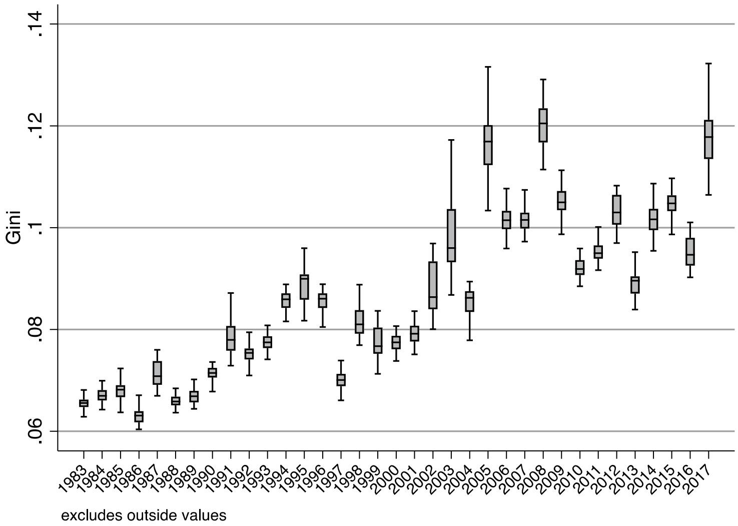
As already explained, the sampling method of the Financial Statements Statistics of Corporations by Industry changed a few times. If the dispersion of ROA jumps discontinuously in one of these years, it is unlikely to indicate a jump in the inefficiency, but likely to show sampling and aggregation problems of the statistics. The sampling method by capital-based categories changed in 1996 and 2009, and the industry classification changed in 2004 and 2009. Moreover, various institutional changes might affect our results. We need to pay particular attention to the changes in the accounting system. For example, the market-value based accounting for the non-financial firms was introduced in 2000 and the international accounting standards started to be adopted in 2009. Here, we examine Figure 8 by dividing it into five phases.

The first phase in Figure 8 is between 1983 and 1990, before the economic bubble burst. During this phase, the ROA dispersion stays about the same with no significant change. This contrasts with studies on financial crises, which often blame easing of lending terms during the pre-crisis boom (Claessens, et. al. 2014; Leukhina and Figueroa 2015). At least in the latter half of this period, the bubble era, it cannot be said that the ROA dispersion was rising.

Next, the second phase is between 1991 and 1995, after the bubble burst and before the sampling method for each capital-based category changes significantly. In this phase, the ROA dispersion increases rapidly. This is rather consistent with the studies on the Japanese zombie firms (Caballero, Hoshi, and Kashyap 2008) and on the inefficiency of capital allocation during the recession of the US business cycle (Eisfelt and Rampini 2006).

The third phase is from 1996 to 2003, during the banking crisis and before the change of industry classification. During this phase, the ROA dispersion is almost stable, except for the year 2003. The jump from 1995/96 to 1997 is likely to be affected by the institutional changes, and hence the ROA dispersion should be regarded already higher in 1995. It can be

Figure 8. Changes in the Gini Coefficients of ROA
(The box plot of 30 Gini coefficients from the resampled data for each year. The solid line in the middle of the box indicates the median value of the 30 Gini coefficients, the top of the box is the 3rd quartile, the bottom is the 1st quartile. The upper and lower tip values of the whiskers indicate the upper and lower adjacent values.)




said that the zombie problem remained unsolved, if not increased, during this period. The ROA dispersion jumps high in 2003, but this year might have been affected by proactive solutions of non-performing loans led by politicians together with the spread of the market-value based accounting.

The fourth phase is from 2004 to 2008, when the economy was relatively in the boom (i.e., 2002-2008 is the 14th cycle according to the Cabinet Office definition). We set the range until 2008 since various institutional changes were made in 2009. From 2004 (or 2002), it can be said that the ROA dispersion is trending upward. This phase is different from the bubble era in the latter half of the 1980s (the $11^{th}$ cycle), and consistent with the literature claiming too much easing in lending terms during the economic boom.

Lastly, the fifth and the last phase in Figure 8 is between 2009 and 2017, after the global financial crisis and after various institutional changes. Since 2009 is the year of the Global Financial Crisis, we look at the trend from 2010. The ROA dispersion is relatively stable or increasing slightly. Yet, the peculiar movement in the last year, 2017, makes it difficult to determine the trend. The ROA dispersion in 2010 seems to be lower than that in 2008, but as mentioned earlier, the jump before and after an institutional change does not necessarily reflect the ROA dispersion itself. Rather, the level in 2008 might have been maintained in 2010. After that, a slight increase in the ROA dispersion continued. This might reflect the re-increase of zombie companies under the expansionary monetary policy and expanding financial support for small and medium-sized enterprises (such as the SME Financing Facilitation Act).

The Gini coefficient of ROA measures the inequality in firms' access to the capital markets. Other indicators of inequality such as the Theil Index and the Coefficient of Variation are theoretically considered to have a more solid foundation than the Gini coefficient. These

Figure 9. Changes in the Theil Index of ROA
(The box plot means the same way as in the case of the Gini coefficient in Figure 8.)

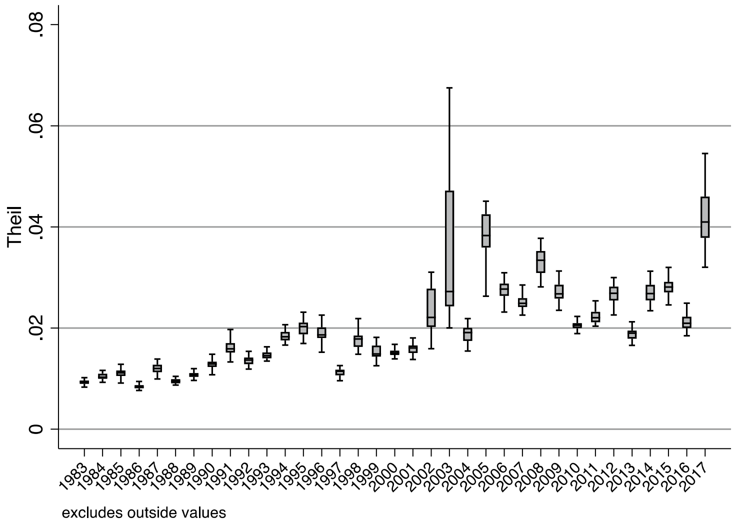
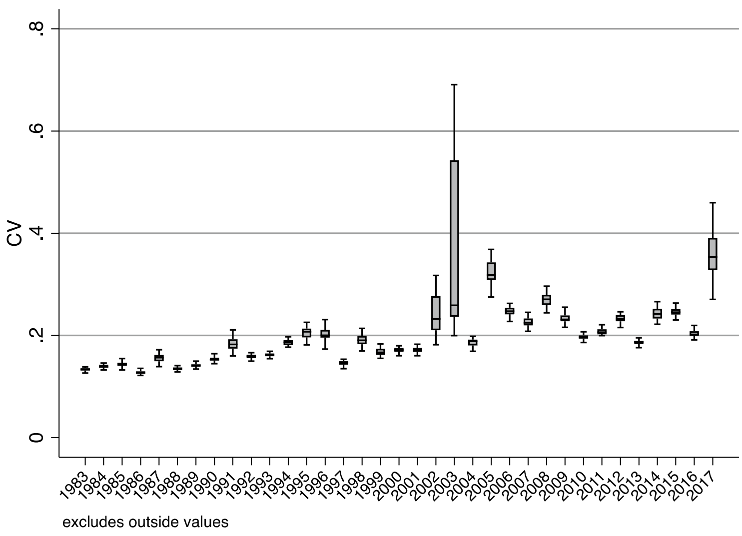
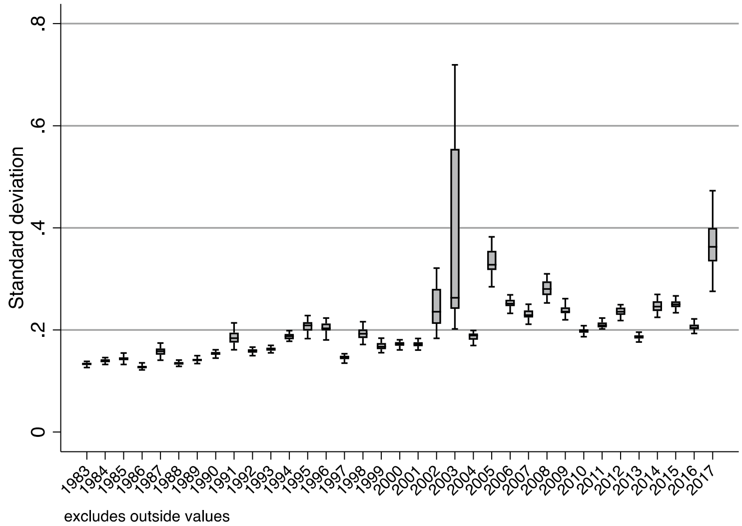



Figure 10. Changes in the Coefficient of Variation
(The box plot means the same way as in the case of the Gini coefficient in Figure 8.)



are shown in Figure 9 and Figure 10. These indicators measure the dispersion (inequality) and are not affected by the variations in mean values similarly to the Gini coefficient. However, to compute these indicators, we use the error terms of the regressions plus one, meaning that there is almost no variation in the mean values. Particularly, the Coefficient of Variation is defined as the ratio of the standard deviation to the mean, and we can look at the standard deviation itself (Figure 11). Almost the same arguments based on the Gini coefficient can be said for any of these alternative indicators.

Figure 11. Changes in the Standard Deviation
(The box plot means the same way as in the case of the Gini coefficient in Figure 8.)




## VI. Conclusion

Using the firm-level data of the Financial Statements Statistics of Corporations by Industry, we carefully measure the efficiency of capital allocation across Japanese non-financial firms from 1983. We measure the efficiency as a dispersion in the ratio of operating income to total assets (return on assets, ROA).

In particular, we use the resampled data based on the bootstrap method that correct the changes in sampling of the Financial Statements Statistics of Corporations by Industry over time. While paying attention to changes in the accounting system and other factors, we divide the sampling period of 1983 to 2017 into five phases and study the trend in each phase.

First, we run a regression on ROA at firm level for each year. Regarding individual firms, we confirm that a higher risk premium is required as leverage increases, which is in line with previous studies. This is not a surprise. The leverage has declined in the economy as a whole in recent years, and in this respect, the corporate behavior as a whole does not seem to pose any problem. Moreover, the ratio of cash and deposit holdings in total assets has not increased much during the sample period. Holding cash and deposits is often said to be inefficient, but we find that cash and deposit holdings leads to a high ROA.

We remove the differences in balance sheets, industry characteristics, and other characteristics by running regressions, and measure the remaining dispersion of ROA across firms for each year. Then, we look at the changes in the ROA dispersion over time. In other words, we gauge the inefficiency of capital allocation across firms purely and systematically.

We do not observe inefficient capital allocation in the 1980s, during the bubble era particularly, while we find that capital allocation became inefficient rapidly after the bubble burst in the early 1990s. The inefficiency remained high and stable until 2003. Although we cannot compare the trend precisely due to the changes in the sampling method in 2004, it is difficult to say that the ROA dispersion has declined since. Rather, the inefficiency started rising again.

After the Global Financial Crisis of 2009, the ROA dispersion has been stable at a high level or increasing slightly. This suggests that firms with low ROA are preserved. Excluding the temporary effects of the Global Financial Crisis, this increasing trend of inefficient capital allocation has continued since 2004.

## References:

Abiad, Abdul, Nienke Oomes, and Kenichi Ueda, 2008, "The Quality Effect: Does Financial Liberalization Improve the Allocation of Capital?" *Journal of Development Economics*, Vol.87, pp.270-282.

Caballero, Ricardo J., Takeo Hoshi, and Anil K. Kashyap, 2008, "Zombie Lending and Depressed Restructuring in Japan." *American Economic Review*, 98 (5): 1943-77.

Cardarelli, Roberto, and Kenichi Ueda, 2006, "Awash with Cash: Why Are Corporate Savings So High?" Chapter IV, *World Economic Outlook*, IMF, April 2006 issue.

Claessens, Stijn, Kenichi Ueda, and Yishay Yafeh, 2014, "Institutions and financial frictions: Estimating with structural restrictions on firm value and investment," *Journal of Development Economics,* Vol.110, pp.107-122.

Claessens, Stijn, M. Syhan Kose, Luc Laeven, and Fabian Valencia, eds., 2014, *Financial Crisis: Causes, Consequences, and Policy Responses,* International Monetary Fund.

Rampini, Adriano A., and Andrea L. Eisfeldt, 2006, "Capital Reallocation and Liquidity," *Journal of Monetary Economics,* Vol.53, pp.369-399.

Hayashi, Fumio (1982), "Tobin's Marginal q and Average q: A Neoclassical Interpretation," *Econometrica*, Vol.50, No.1, pp.213-224.

Hennessy, Christopher A., 2004, "Tobin's Q, debt overhang, and investment," *Journal of Finance,* LIX (4), 1717-1742.

Hsieh, Chang-Tai, and Peter Klenow (2009), "Misallocation and Manufacturing TFP in China and India," *Quarterly Journal of Economics,* Vol.124, No.4, pp.1403-1448.

Leukhina, Oksana, and Nicolás Figueroa, 2015, "Lending Standards and Aggregate Productivity," *Journal of Economic Dynamics & Control*, Vol.59, pp.1-21.

Obstfeld, Maurice, 1994, "Risk-Taking, Global Diversification, and Growth," *American Economic Review*, Vol.84, No.5, pp.1310-29.

Ueda, Kenichi, and Khaliun Dovchinsuren, 2020, "Nihon Kigyo ni okeru Shikin Haibun no Koritsusei," *Financial Review*, Vol.142, pp.3-22.

Ueda, Kenichi, Akira Ishide, and Yasuo Goto, 2019, "Listing and financial constraints," *Japan and the World Economy,* Vol.49, pp.1-16.

Ueda, Kenichi, and Somnath Sharma, 2020, "Listing Advantages around the World," Journal of the Japanese and International Economies, forthcoming.