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Distortions in Resource Allocation and Bank Lending: The Malfunction of Financial Intermediation

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Distortions in Resource Allocation and Bank Lending: the Malfunction of Financial Intermediation

Akira Otani*, Shigenori Shiratsuka**, and Takeshi Yamada***

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Abstract

In this paper, we empirically analyze the interaction between the distortions in the real side of the economy (real distortion) and those in the financial side of the economy (financial distortion) in Japan after the 1990s. We focus on protracted economic stagnation after the bursting of the asset price bubble, and the subsequent recovery in economic activity and restoration of financial system stability. We use the intersectoral differences in relative factor prices as an indicator for the real distortion, and use the gap between the actual and benchmark loan portfolios, based on the mean-variance approach to maximize risk adjusted returns from loan portfolios, as an indicator for financial distortion. We show that both distortions sharply deteriorated in the late 1990s and improved in the 2000s. In addition, we conduct panel data analyses using data at individual bank level as well as at industry level to examine the interaction between the two distortions: the interaction was negative in the late 1990s, but reversed to positive in the 2000s.

Key Words: Efficiency in Resource Allocation, Interaction between Real and Financial Distortions, Mean-Variance Approach

JEL Classification Code: G21, G28, O47

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I. Introduction

A number of theoretical and empirical studies have examined the causes of Japan's protracted economic stagnation after the 1990s.[1]

Focusing on the real economic factors, Hayashi and Prescott (2002) decompose GDP growth rate, assuming complete factor markets, and show that declines in work hours and TFP (total factor productivity) growth induced Japan's long-lasting stagnation in the 1990s.[2] Nakakuki, Otani, and Shiratsuka (2004) and Miyagawa (2006) point out that misallocations of productive resources due to incomplete factor markets led to the long-lasting poor economic performance during the period of Japan's protracted economic stagnation after the 1990s.

Focusing alternatively on the financial factors, Hoshi and Kashyap (1999) show that the malfunction of financial intermediation was caused by the non-performing loan problem after the bursting of the asset price bubble against the background of financial deregulations: on the one hand, large firms shifted from bank borrowing to capital-market financing, and, on the other hand, banks were forced to make aggressive lending to small and medium-sized firms as well as construction and real estate industries. Sekine, Kobayashi, and Saita (2003), Hoshi (2003), and Peek and Rosengren (2005) show that banks with impaired capital are likely to make additional loans to troubled firms. This empirical evidence indicates that these firms keep employing productive resources owing to the forbearance loan and thus this behavior of banks could exert a negative effect on economic activity.

As for the relation between economic factors and financial factors, Nagahata and

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[1] Structural problems are pointed out as one of the major factors behind the long lasting economic stagnation. Maeda, Higo, and Nishizaki (2001) categorize causes of structural impediments into four: (i) rigid corporate governance; (ii) inefficiency of the non-manufacturing sector; (iii) the issue of non-performing assets with the generation and bursting of the asset price bubble; and (iv) the savings-investment imbalance. They argue that all of these are "impediments to the efficient allocation of resources." In this paper, we focus on inefficient resource allocations due to distortions in the real side and the financial side of the economy, rather than individual factors behind the structural problems, from macroeconomic viewpoints.

[2] Kawamoto (2005) estimates the pure technological progress by adjusting industrial return on scale, labor and capital utilization, and reallocation of productive resources among industries, and shows that it did not decelerate in the 1990s.

Sekine (2005) demonstrate that corporate investment of small enterprises which have not issued corporate bonds decreased drastically owing to the deterioration in the main banks' balance sheet conditions. Caballero, Hoshi, and Kashyap (2006) show that industries with many zombies (insolvent firms enjoying interest concession) exhibit more depressed job creation and low productivity growth, suggesting that an increase in loans to zombies exerts a negative impact on the real economy.

Okina and Shiratsuka (2002) suggest the mechanism behind the interaction between real distortions and financial distortions.[3] That is, they look back at Japan's experiences after the bursting of the asset price bubble, and argue that significant declines in asset prices impaired banks' capital positions and their intertemporal risk smoothing function. Then, they conjecture that the resultant financial instability amplified the adverse effects of the bursting of the asset price bubble on the real side of the economy.[4] The previous studies on Japan's prolonged economic stagnation mentioned above, however, analyze the real economic factors and the financial factors separately, and do not fully explore their interaction.

In this paper, we attempt to analyze the interaction between the distortions in the real side of the economy (real distortion as misallocations in factor markets) and those in the financial side of the economy (financial distortion as a deviation of banks' behavior from profit maximization, including "forbearance lending" and "credit crunch") during the period of Japan's protracted economic stagnation after the 1990s and the subsequent recovery. We construct indicators to trace each distortion and then empirically analyze their relation.

We use the intersectoral differences in relative factor prices as an indicator for the real distortion, employed in Nakakuki, Otani, and Shiratsuka (2004). We also use the gap between the actual and benchmark loan portfolios, based on the mean-variance approach to maximize risk adjusted returns from loan portfolios, as the indicator for financial distortion. The previous literature, including Sekine, Kobayashi, and Saita

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[3] Saito (2006) argues that macroeconomic policy which was intended to lower the real interest rate caused excess capital accumulation in the low productivity sector in the late 1980s, resulting in a decrease in capital productivity in the 1990s.

[4] See Allen and Gale (1997) as literature which theoretically shows the banks' intertemporal risk smoothing function.

(2003) and Peek and Rosengren (2005), regards the provision of additional loans to troubled firms as a distortion in bank loan portfolios. Banks, however, try to keep troubled firms alive not only by providing additional loans, but also by rolling outstanding loans over, and providing financial assistance such as the forms of debt forgiveness and debt equity swaps. The indicator for the financial distortion used in this paper grasps more comprehensive distortions in bank loan portfolios including not only forbearance lending but also other types of financial assistance and credit crunch.[5]

Our empirical evidence suggests two points. First, both distortions in factor markets and banks' loan portfolios drastically deteriorated in the late 1990s, followed by remarkable improvement in the 2000s. Second, the panel data analyses show that the interaction between the two distortions produced persistent adverse effects, triggered by the bursting of the asset price bubble in the late 1990s, but such negative interaction reversed to positive as the financial system has stabilized in the 2000s.

This paper is structured as follows. In Section II, we explain the indicator for the distortions in factor markets, proposed in Nakakuki, Otani, and Shiratsuka (2004), and examine the time-series movements of the estimates. In Section III, we formulate an indicator for the distortions in bank loan portfolios using the gap between the actual and benchmark loan portfolios, based on the mean-variance approach to maximize risk adjusted returns from loan portfolios. In Section IV, we conduct panel data analysis to investigate the relation between real and financial distortions, thereby showing the interaction between the two. In Section V, we offer a concluding discussion by examining implications for prudential policy.

II. Distortions in Resource Allocation in the Real Side of the Economy

Nakakuki, Otani, and Shiratsuka (2004) estimate the distortions in resource allocation using the intersectoral differences in relative factor prices, proposed by Johnson (1966) and Jones (1971). In this section, we explain the indicator for the distortions in factor

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[5] Caballero, Hoshi, and Kashyap (2006) and Hoshi (2006) identify zombies by classifying firms based on the assumption of whether their paying interest rate is less than the minimum required interest rate calculated by the prime rate. This identification measure includes not only forbearance lending conducted at low rates but also debt equity swaps and debt forgiveness.

markets, employed in Nakakuki, Otani, and Shiratsuka (2004), and examine the time-series movements of the estimates. The estimates suggest that the distortions in non-manufacturing industries, including construction and wholesale and retail trade, dramatically worsened toward the end of the 1990s and are improving in the 2000s. Then we carry out a growth accounting exercise, incorporating the effects of misallocation in factor markets, to show that the recent economic recovery depends partly on the improvement in resource allocation.

A. Distortions in Intersectoral Resource Allocation

Suppose that perfect competition holds and that the production function of each sector is homogeneous to degree one and defined by the equation below,

$$Y_i = A_i F_i(K_i, L_i),$$

where the subscript *i* denotes sector and *Y*, *A*, *K*, and *L* represent output, TFP, capital stock, and labor input, respectively. Dividing the above equation by labor input yields labor productivity ($y = Y/L$), which can be expressed by the capital-labor ratio ($k = K/L$) as follows:

$$y_i = A_i f_i(k_i),$$

where $f_i(k_i)$ is $F_i(K_i / L_i, 1)$. Since the ratio of wages (w_i) to the rate of return on capital (r_i) in sector *i* is equal to the ratio of labor's marginal productivity to capital's marginal productivity, the equation below holds:

$$\frac{w_i}{r_i} = \frac{f_i(k_i) - f_i'(k_i)k_i}{f_i'(k_i)}. \tag{1}$$

The labor share in sector *i* (α_i) equals $1 - f_i'(k_i)k_i / f_i(k_i)$ and capital share ($1-\alpha_i$) equals $f_i'(k_i)k_i / f_i(k_i)$.[6] Using them, (1) can be transformed as follows:

[6] Estimating the real distortion, we assume the labor share and capital share are constant during the sample period.

$$w_i / r_i = a_i k_i,$$

where a_i corresponds to $\alpha_i /(1-\alpha_i)$. Under the condition that perfect competition holds and productive resources move freely among sectors, the ratios of wages to the rate of return on capital are identical in each sector. If the factor mobility is not perfect due to some reasons, however, the ratios are not identical. We assume that the ratio of wages to the rate of return on capital for sector *i* is 1/ γ_i times that of the base sector (i = 1 and we use the electrical machinery, equipment, and supplies industry as the base industry).[7] In this case, the ratio of relative factor prices in sector *i* to the base sector can be expressed as follows:

$$\gamma_i = a_i k_i / a_1 k_1. \tag{2}$$

Note that γ_i = 1 implies that the marginal condition holds between these sectors. If γ_i exceeds unity, sector *i* has a lower capital-labor ratio than that of the base sector. That means labor input is too large and/or capital input is too low. Conversely, if γ_i is less than unity, the capital-labor ratio of sector *i* is too high. That is, the degree of divergence of γ_i from unity represents the distortions in productive resource allocation.[8]

Figure 1 depicts the estimates of γ for each sector in 1990, 2000, and 2004. In this figure, the estimates of γ for the manufacturing industries, except food products and beverages, remain almost unchanged. In contrast, those for many sectors in non-manufacturing industries, such as construction and wholesale and retail trade, rise towards 2000 after the bursting of the asset price bubble but decline in 2004 although the level of estimates far exceeds unity. This observation implies that the capital-labor ratios for these sectors remained considerably below the optimal level and the distortions in resource allocation worsened in the 1990s, but improved in the 2000s.

We compute the aggregate indicator for distortions in the whole economy by the

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[7] In this paper, we use the electrical machinery, equipment, and supplies industry as the base industry in estimating γ.

[8] Note that the upper limit of γ is infinity if γ exceeds unity, and its lower limit is zero if it is less than unity. It is, therefore, necessary to use the deviation of γ from unity if it exceeds unity and the deviation of its reciprocal from unity if it is less than unity, in order to extract degree of distortion.

average of γ weighted by the sector's share of nominal GDP. The distortions worsened in the 1990s and dramatically improved in 2001. Since 2001, they have continued to improve gradually (see Figure 2)[9].

B. Decomposition of GDP Growth Rate with Distortions in Resource Allocation

Let us quantify the effect of distortions in resource allocation on economic growth.

Nakakuki, Otani, and Shiratsuka (2004) incorporate the effect of distortions in resource allocation into the decomposition of labor productivity growth rate proposed by Syrquin (1986). They employ the equation below to decompose GDP growth rate:

$$\begin{aligned}\frac{\Delta Y}{Y} &= \sum_{i=1}^{n}\frac{Y_i}{Y}\frac{\Delta A_i}{A_i} + \frac{\Delta L}{L} + (1-\alpha)\frac{\Delta k}{k} \\ &\quad - \sum_{i=1}^{n}\frac{Y_i}{Y}(1-\alpha_i)\left\{\frac{\Delta\gamma_i}{\gamma_i} - \sum_{j=1}^{n}\left(\frac{S_j}{\gamma_j a_j}\Big/\sum_{m=1}^{n}\frac{S_m}{\gamma_m a_m}\right)\frac{\Delta\gamma_j}{\gamma_j}\right\} \\ &\quad - \sum_{i=1}^{n}\frac{Y_i}{Y}\left[(1-\alpha_i)\left\{\sum_{j=1}^{n}\left(\frac{S_j}{\gamma_j a_j}\Big/\sum_{m=1}^{n}\frac{S_m}{\gamma_m a_m}\right)\frac{\Delta S_j}{S_j}\right\} - \frac{\Delta S_i}{S_i}\right],\end{aligned} \tag{3}$$

where S_i denotes the share of labor input for sector i. The first to third terms on the right-hand side of equation (3) are identical to the GDP decomposition under the assumption of complete factor market. The fourth and fifth terms show the effect of factor market distortions. The fourth term represents the impact of intersectoral capital allocation induced by changes in γ when the capital-labor ratio for the economy is held constant. The fifth term indicates the changes in labor input share.[10] Comparing the decomposition of GDP growth rate under the assumption that the factor market is complete and equation (3), we see that TFP in the former case is the sum of the TFP

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[9] In computing the weighted average of γ, we use the deviation of γ from unity if it exceeds unity and the deviation of its reciprocal from unity if it is less than unity.

[10] The effect of changes in labor input share consists of two parts. One is the indirect effect of changes in labor input on the GDP growth rate through changes in the capital-labor ratio of individual sectors. The other is the direct effect of changes in labor input share among high and low labor productivity sectors on the GDP growth rate.

growth rate and the effect of factor market distortions in equation (3). This indicates that the TFP growth rate estimated under the assumption of complete factor market is not the "true" TFP growth rate, because this assumption ignores the negative effect of factor market distortions.

Table 1 shows the results of decomposing Japan's GDP growth rate based on equation (3).[11,12] In the 1990s after the bursting of the bubble (1992–2000), the GDP growth rate decelerates, since the positive contributions of both accumulation in capital and TFP declined and the contribution of labor input turns negative. Moreover, the effect of intersectoral differentials in factors' marginal productivity turns negative.[13]

In the 2000s (2001–2004), the negative contribution of labor input expands, and the positive contribution of capital accumulation declines. Moreover, the positive contribution of changes in labor input share declines due to a shift of labor input to low productivity sectors, including the service industry. The positive contribution of TFP, however, increases and moreover the contribution of intersectoral differentials in factors' marginal productivity dramatically improves. This suggests that improvements

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[11] The following data are used in breaking down the GDP growth rate. Y: real GDP, L: product of workers and their average work hours, α: nominal employee compensation divided by nominal domestic factor income, and K: product of real capital stock and capacity utilization. The source for Y, L, and α is the Cabinet Office, *National Account*. The source for K is the JIP database. For details of the JIP database, see Fukao *et al*. (2003). Note that because data for capital stock and capacity utilization is released only up to 1998 in the JIP database, we use data in the Annual Report on Gross Capital Stock of Private Enterprises as those for capital stock since 1999 and estimate the data for capital utilization since 1999 using capital utilization in the Industrial Production Index for manufacturing industries and electric power consumption for non-manufacturing industries.

[12] In breaking down the GDP growth rate, the qualities of labor input are assumed to be identical among every sector. It follows that labor reallocation from low labor productivity sectors to high productivity sectors results in increased labor productivity for the economy. In reality, however, the quality of labor input and expertise necessary for production activity varies among firms and sectors. Thus, the shift of labor allocation to sectors that require different expertise could lead to wasted human capital and a decrease in labor productivity. Some cautions are thus in order in interpreting the empirical results.

[13] On the face of it, the negative contribution of factor market distortions may look small, compared with other factors. It should be noted, however, that the above result shows the estimate of the direct impacts of factor market distortions, so it ignores the indirect impacts, including deceleration in capital accumulation due to factor market distortions.

in productive resource allocation push up GDP growth rate, thereby strengthening the momentum toward sustainable growth.

III. Distortions in the Financial Side of the Economy

In this section, we propose a framework to quantitatively evaluate distortions in loan portfolios as distortions in resource allocation in the financial side of the economy. We calculate the hypothetical loan portfolios based on the mean-variance approach to maximize risk adjusted returns from loan portfolios as a benchmark and then estimate the gap between actual and benchmark loan portfolios.[14]

Many previous studies employ the criterion of distortions in bank loan portfolios to judge whether additional loans are to be provided to troubled firms just to avoid bankruptcy. To keep insolvent firms alive, banks not only provide additional loans (forbearance lending), but also maintain their loans, or even provide financial assistance in the form of debt forgiveness and/or debt equity swaps to firms whose loans should be called in from the standpoint of risk adjusted return. Moreover, banks do not provide sufficient funds to growing firms (credit crunch), since an increase in non-performing loans impairs banks' capital and thus deteriorates their risk-taking ability. It is thus deemed effective to use the gap between actual loan portfolios and benchmark ones, instead of additional loans, in order to grasp the comprehensive distortions in bank loan portfolios.

A. Distortions in Bank Loan Portfolios

We define the benchmark bank loan portfolio as one that maximizes the Sharpe ratio, i.e. return divided by risk, in the total loan portfolios (see Figure 3).[15] Although banks hold

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[14] The mean-variance approach is widely used in estimating banks' benchmark asset portfolios. For example, Buch, Driscoll, and Ostergaard (2004) estimate the gaps between actual banks' portfolios in international investment and benchmark portfolios that maximize risk adjusted return. They then show that the gaps between actual and benchmark portfolios are attributable to information asymmetry between home and foreign countries and capital controls.

[15] Note that we implicitly assume that banks are price-takers and are exogenously given the size of their loan portfolios. The benchmark loan portfolios estimated by the mean-variance approach in this paper are not necessarily equal to "true" optimal portfolios, considering banks' specialty in small

various assets other than loans including bonds, we focus on the loan allocation in industries in order to analyze banks' financial intermediation function.

The benchmark loan portfolios of each bank are defined as the portfolios which maximize the Sharpe ratio taking into account the stickiness of bank loans:

$$\underset{a_{1,k},\cdots,a_{n,k}}{Max} \frac{\sum_{i=1}^{n} a_{i,k} E[X_i]}{\sqrt{\sum_{i=1}^{n} a_{i,k}^2 Var[X_i] + 2\sum_{i=1}^{n}\sum_{j=i+1}^{n} a_{i,k} a_{j,k} Cov[X_i, X_j]}}, \tag{4}$$

$$s.t. \quad \forall i = 1,\cdots,n, \quad \tilde{a}_{i,k}/1.5 \le a_{i,k} \le 1.5\tilde{a}_{i,k}, \quad \sum_{i=1}^{n} a_{i,k} = 1,$$

where subscript k denotes banks. X_i is a random variable representing returns from loans to industry i. a_i and $\tilde{a}_i$ are the loan ratio to industry i and the average of its actual values in the past, respectively. The constraint means that the range of adjustments in loan ratios to each industry is restricted to 1/1.5 – 1.5 times the average of actual loan ratios, which incorporates the fact that bank loan portfolios are adjusted only gradually.[16]

Distortions in each bank's loan portfolio can be measured as the gap between the actual loan share and benchmark loan share. Letting $a^*_{i,k}$ denote the benchmark loan ratio to industry i by bank k, bank k's distortion in loan portfolio is defined by:

$$\delta_k = \sum_i \left| a^*_{i,k} - a_{i,k} \right|. \tag{5}$$

Note that we use the average and variance of lending rates after subtracting the default rate (1992–2005). Lending rates are hypothetical long-term loan rates by industry estimated from data on long-term debt outstanding, short-term debt outstanding, corporate bond outstanding, and interest payment in *Financial Statements Statistics of Corporations by Industry* of the Ministry of Finance.[17] Default rates by industry are the

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and medium-sized firm financing. We also implicitly assume that banks are risk averse by employing the maximization of Sharpe ratio in their loan portfolios.

[16] Our estimation results remain almost unchanged; even the constraint on the range of adjustment of loan ratios to each industry is widened, from the current range of 1/1.5 – 1.5 times the actual loan ratios, to 1/3 – 3 times.

[17] Long-term interest payments and short-term interest payments are not available in *Financial*

rate of private and legal bankruptcies calculated from the data in *Metrics Data for Estimation of Probability of Default* of Teikoku Databank.[18] We also use individual banks' loan and discounts outstanding by 13 industries and estimate each bank's distortion in its loan portfolio.[19] The variance-covariance matrix is calculated by using the standard deviations of lending rates after subtracting default rates and the correlation matrix obtained from stock prices by industry (1985–2005, quarterly data).[20]

B. Results of Estimating Distortions in Bank Loan Portfolios

Figure 4 depicts the distortions in loan portfolios of the whole banking sector by the average of δ_k, each bank's distortions in its loan portfolio, weighted by its loans outstanding. The figure demonstrates that the gaps between the benchmark and actual portfolios increased towards 1998, then declined sharply to 2002, and then increased again gradually.[21] The figure also plots the contributions of manufacturing and

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Statements Statistics of Corporations by Industry. We therefore assume that the ratio of short-term loan rate to long-term loan rate including corporate bond rate is equal to the ratio of short-term prime rate to long-term prime rate, and estimate the hypothetical long-term loan rate.

[18] We first estimate the default rates of large, medium, and small enterprises from the data in *Metrics Data for Estimation of Probability of Default*. Then, we compute the default rates by industry from the average default rates of each size of enterprise weighted by its debt outstanding.

[19] Specifically, we use data for food products and beverages, textiles, chemicals, basic metals, machinery, electrical machinery, equipment and supplies, transport equipment, construction, electricity, gas and water supply, wholesale and retail trade, real estate, transport and communications, and service activities.

[20] Lending rates after subtracting default rates are influenced largely by market interest rates, which are common to all industries, regardless of differences in default rates among industries. In the sample period including the end of the 1980s to the middle of the 1990s when the market interest rates significantly fluctuated, this tendency becomes clearer. If we use variance-covariance matrix from data of lending rates after subtracting default rates for the full sample period (1985-2005), the benefits of loan portfolio diversification are considered to be underestimated. It is, therefore, necessary to exclude the effects of fluctuations in market interest rates in estimating benchmark loan portfolios. In this paper, we use stock prices by industries because they are often used as a proxy for credit risks and are available on a high frequency basis for a long period.

[21] We conduct three robustness checks on the estimation result. First, we divide the estimation period into three sub-sample periods and estimate the benchmark portfolios in each sub-sample period. The directions of the changes in the estimated distortions in loan portfolios over the

non-manufacturing industries and shows that the movements of the gap are attributable largely to the gap in the non-manufacturing industry.

Next, Figure 5 depicts the distortions in loan portfolios of major banks and regional banks, computed as a weighted average of individual banks' distortions by using the outstanding amount of their loans as a weighting factor. On the one hand, distortions of major banks drastically increased during the period of financial crisis in 1997 and 1998 but drastically declined towards 2003, then increased afterwards. On the other hand, distortions of regional banks were constant in the 1990s and declined moderately towards 2003, but increased afterwards. This result demonstrates that the significant deterioration in the distortions in the bank loan portfolios in the late 1990s was largely brought about by major banks. That is, this observation suggests that the distortions in loan portfolios of the banking sector were concentrated to major banks in the course of the financial crises in 1997 and 1998.[22]

The figure also shows that the distortions in loan portfolios increased gradually after 2003 for the banking sector as a whole as well as for major banks and regional banks separately. This is attributable mainly to an increase in distortions in loans to the real estate industry. In this context, it should be noted that the estimates are affected by the inconsistency in the coverage of non-recourse loans between the outstanding amount of loans to the real estate industry and lending rates after subtracting default rates.

That is, the data used in the estimation of benchmark loan portfolios are lending rates and default rates of business enterprises in each industry, and SPC (special purpose company), which is the borrower of the real estate non-recourse loans,[23] is not

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sub-sample periods remain almost unchanged. Second, we take the alternative assumption of maximizing returns while variance remains constant, instead of maximizing the Sharpe ratio. In this case, the directions of the changes in the estimated distortions remain almost unchanged. Third, we use ROAs by industries (1985 to 2005) instead of lending rates after subtracting default rates. The results also remain almost unchanged.

[22] We should note that behind the difference between the distortions of major banks and those of regional banks in the late 1990s lies the fact that the major banks were forced to increase the loans outstanding to large enterprises with bad business conditions as main banks due to regional banks' refusal to extend loans to them.

[23] In non-recourse loans, repayments of principal and interest are secured solely on cash flow and the value of the real estate pledged as collateral, and the lender has no recourse against other assets

covered. The outstanding amount of such loans has increased recently. In the estimation of benchmark loan portfolios, however, the risk-return balances for the non-recourse loans to real estate related businesses are not considered. On the other hand, the non-recourse loans to real estate related businesses are covered by the total outstanding amount of loans to the real estate industry. Recent increases in the non-recourse loans to real estate related businesses thus widen the gaps between benchmark and actual shares of loans to the real estate industry.

As for recent changes in bank loans to the real estate industry, the non-recourse loans have remarkably increased since 2003. We estimate the distortions in loan portfolios on the additional assumption that the loan share to the real estate industry has remained constant since 2003 in order to remove the effect of the non-recourse loans. As a result, the distortions of major banks and regional banks have been broadly flat since 2003, and the general trend of the figure remained unchanged before 2002 (Figure 6).

C. Distortions in Bank Loan Portfolios and Functioning of Bank's Financial Intermediation

The gaps between benchmark loan portfolios, based on the mean-variance approach, and actual loan portfolios correspond to the loans with insufficient returns relative to their risks. Therefore, for an individual bank, a larger distortion in its loan portfolio means a higher probability of suffering from non-performing loans in the future.

At the same time, however, if a bank actively takes risks in the form of a distortion in its loan portfolio within its capital position during a recession, a bank can be said to be playing an appropriate role in smoothing risks over time. Under a bank-based financial system, a bank accumulates internal reserves when the economy is sound and absorbs losses stemming from firms' poor business performance or bankruptcy during a recession, thereby acting as a buffer against short-term shocks.

It should be noted, however, that the risk-smoothing function of the banking system, observed in normal times, will be suddenly lost if the system encounters a shock that erodes banks' net capital to the extent it threatens their soundness. That is, a

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of the borrower.

bank with a large distortion in its loan portfolio compared with its capital position, is more likely to be bounded by the capital constraint and lose their financial intermediation function. Therefore, it is deemed effective to compare distortions in the loan portfolios with the capital positions in order to detect whether banks' financial intermediation function is impaired.

Let us review the relation between distortions in loan portfolios and non-performing loans in order to confirm our conjecture. Figure 7 depicts changes in distortions in loan portfolios and non-performing loan ratios, indicating that distortions in loan portfolios precede non-performing loans.

We further estimate the equation below using individual banks' data to investigate whether the above leads-and-lags relation exists between distortions in loan portfolios and non-performing loan ratios at an individual bank level:

$$Badloan_{k,t} = c_k + c_t + a\delta_{k,t-j},$$

where $Badloan_{k,t}$ and $\delta_{k,t}$ are bank k's non-performing loan ratio and the distortions in its loan portfolio at time t, respectively. j represents a lag period. c_k and c_t denote dummy variables representing fixed effects of individual banks and each period.

Table 2 shows the estimation results. In Table 2, distortions in loan portfolios with one-year lag through three-year lag influence the non-performing loan ratio, and the effect of distortions in loan portfolios with two-year lag is the largest. This result demonstrates that the distortions in loan portfolios precede non-performing loans.

Let us next examine the relation between distortions in loan portfolios relative to banks' capital positions and possibility of bankruptcy. Concretely, we compare the ratios of distortions to Tier I capital by splitting our sample into two: the ratios for bankrupted and consolidated banks in the year before they disappear from the sample and the highest ratios of existing banks (Table 3).[24] The table shows that the former is significantly higher than the latter. This result suggests that a comparison of distortions in loan portfolios and bank's capital positions enables us to assess the risk of malfunction of banks' financial intermediation and the capacity for fulfilling their

[24] Many major banks are international standard banks and thus their required capital ratio is higher than that of regional banks (domestic standard banks). In the calculation, therefore, we do not utilize the data of major banks but those of regional banks and second regional banks.

financial intermediation function.

Then, we compare the distortions in loan portfolios and banks' Tier I capital in both major banks and regional banks to examine banks' financial intermediation functioning. On the one hand, the loan portfolio distortions for major banks drastically worsened in the late 1990s and those for major banks and regional banks have improved in the 2000s. On the other hand, Tier I capital held by major banks increased in 1999 owing to injection of public funds, followed by a decrease due to aggressive disposal of non-performing loans, and increases since 2003, while Tier I capital of regional banks remained almost unchanged (Figure 8). As a result, the ratios of loan portfolio distortions to Tier I capital in regional banks were not that high and have declined moderately since 1999. As for the major banks, the ratios sharply rose in the late 1990s reflecting the drastic worsening of loan portfolio distortions, regardless of injection of public funds. This observation suggests that potential imbalances accumulated especially in major banks and thus the financial system was destabilized in the late 1990s, resulting in the malfunctioning of its financial intermediation function. In the 2000s, risks held by both major banks and regional banks have been contained and banks have enough capacity to positively fulfill their financial intermediation function (Figure 9).

IV. Relation between Distortions in Resource Allocation and Distortions in Bank Loan Portfolios

The real distortion estimated in Section II (see Figure 2) and the financial distortion estimated in the previous section (see Figure 3) show similar movements, although both distortions are estimated by completely different methods, suggesting a possible relation between them. In this section, we empirically investigate whether any interaction exists between them, using data at individual bank level as well as that at industry level.

A. Effect of Real Distortions on Financial Distortions

Below, we quantitatively investigate the effect of the real distortion on the financial distortion, using individual banks' data.

Peek and Rosengren (2005) empirically show that banks under a capital

constraint tend to provide additional loans to economically insolvent firms in order to postpone loss realization into the future. We conduct an empirical analysis to confirm their findings using the more comprehensive measure of loan portfolio distortions and the mechanism behind the improvement in loan portfolio distortions in the 2000s. We estimate the equation below:[25]

$$\delta_{k,t} = c_k + c_t + a_1 READ_{k,t-1} + a_2 ROE_{k,t-1} + a_3 CCR_{k,t-1} + a_4 CAP_{k,t} + a_5 CCR_{k,t-1} \times CAP_{k,t}, \quad (6)$$

where subscript k denotes bank. δ_k and $READ_k$ are each bank's loan portfolio distortion and the real distortion which the bank faces, respectively, and higher values mean higher distortions.[26] *ROE* is ROE based on net operating profits from the core business[27] and *CCR* is credit cost rate. *CAP* is a dummy variable that takes one if the bank's capital ratio is less than 2 percentage points above the required capital ratio and zero if not, as is used in Peek and Rosengren (2005). The required capital ratios for international standard banks and domestic standard banks are 8% and 4%, respectively. Suppose that banks under capital constraint and with high credit cost are likely to delay necessary responses to their loan portfolio distortions, resulting in an increase in loan portfolio distortions. In this case, the parameter on the interaction term between *CCR* and *CAP* is positive. In the estimation, we add year dummy variables as explanatory variables and use the data for 129 banks that include bankrupted and consolidated banks in the past for the period from 1993 to 2005.

Table 4 summarizes the estimation results for the fixed effect model.[28] The

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[25] There may be an endogeneity problem. Since we do not have proper instrumental variables, we use a one-year lag in the estimation to avoid the problem.

[26] We use the degree of divergence of indicator for distortions in the resource allocation estimated in Section II (γ) in calculating $READ_k$. That is, we use the degree of divergence of γ from unity if γ is larger than unity and the degree of divergence of its reciprocal from unity if γ is less than unity. As for $READ_k$, for major banks it is the weighted average using disaggregated industrial nominal GDP as weight. $READ_k$ for regional banks is the weighted average with industrial nominal GDP in the prefecture where the bank's headquarter is located as weight.

[27] Net operating profits from core business are calculated as follows: net operating profits – net realized bond related gains/losses + net transfers to allowances for possible loan losses + loan write-offs in trust account. *ROE* represents profitability in the core business.

[28] Since the Hausman test statistic is 28.30 and the corresponding *p*-value is 0.00, the fixed effect

estimated coefficient for *READ* is significantly positive, implying that larger real distortions lead to larger loan portfolio distortions. The coefficient for *ROE* is statistically insignificant, even though higher profitability implies larger funds for disposing of non-performing loans, thus possibly inducing low loan portfolio distortions. The coefficient for *CCR* is significantly negative, suggesting that higher credit cost induces banks to restrain loans to firms with high default risk, thereby reducing loan portfolio distortions. The coefficient for *CAP* is significantly negative, showing that banks under a capital constraint tend to reduce distortions in their loan portfolio. The coefficient for the interaction term between *CCR* and *CAP* is, as expected, significantly positive. This result demonstrates that banks under capital constraint and with high credit cost tend to delay disposing of their loans to insolvent firms in order to avoid incurring additional credit costs.

Focusing on the parameters on the year dummies, they were negative from 1999 to 2001 and have been positive since 2003 (Figure 10). The reason why they have been positive since 2003 is that distortions in loan portfolios have increased due to the recent increase in real estate non-recourse loans.[29] Negative parameter values from 1999 to 2001 suggest that banks' behavior dramatically changed in the early 2000s.[30]

B. Effect of Financial Distortions on Real Distortions

We next estimate the equation below using industry level data to analyze whether an increase in financial distortions worsens real distortions:[31, 32]

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model was selected.

[29] In order to confirm this result, we estimate equation (6) using the data for individual banks' distortions estimated on the assumption that the loan share to the real estate industry is constant from 2003. In this case, the parameters on the year dummies were significantly negative in 2001 and have been positive but statistically insignificant since 2003.

[30] In the early 2000s the Financial Services Agency introduced the Bank Examination Manual and began special inspections of major banks according to the Manual. This change in the stance of financial policy may affect the changes in banks' behavior. More empirical examinations are needed to confirm this conjecture.

[31] In the estimation, we use the data for 12 industries whose real economic and loan portfolio distortions are estimated: food products and beverages, textiles, chemicals, basic metals, machinery, transport equipment, construction, electricity, gas and water supply, wholesale and retail trade, real

$$READ_{it} = c + c_t + a_1 IFIND_{i,t-1} + a_2 EX_{i,t-1} + a_3 RP_{i,t}, \quad (7)$$

where subscript *i* denotes industry. *READ* represents real distortions measured as the difference of relative factor prices among industries.[33] *IFIND* is the standardized financial distortion, which is calculated as the gap between the optimal loan ratio and actual loan ratio to the industry divided by the actual loan ratio[34] *EX* is the difference between expected growth in the industry's final demand for three years ahead and industry's expected GDP growth rate for three years ahead, indicating the degree of optimism and pessimism.[35] Positive and negative *EX* means optimism and pessimism, respectively. *RP* represents the relative prices of the industry compared with the electric machinery, equipment and supplies industry, based on deflator by industries.[36]

Expected signs of a_1, a_2, and a_3 are all positive. a_1 is expected to be positive if large financial distortions worsen real distortions. a_2 is expected to be positive because a pessimistic industry has an incentive to restructure in order to avoid further deterioration in business conditions, thus improving distortions in resource allocation. The reason why a_3 is expected to be positive is that large changes in relative prices necessitate large economic adjustments.

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estate, transport and communications, and service activities. Since the electrical machinery, equipment, and supplies industry is the base industry in estimating distortions in resource allocation and its γ always takes a value of one, we do not use the industry in the estimation.

32 Since there may exist an endogeneity problem, we use a one-year lag of *FIND* and *EX*.

33 We use the degree of divergence of γ from unity if γ is larger than unity and the degree of divergence of its reciprocal from unity if γ is less than unity to calculate *READ*.

34 $IFIND_i$ is calculated by $\left|a_i^* - a_i\right| / a_i$. The reason why the financial distortions are normalized is as follows. The benchmark loan ratio to each industry is estimated as the ratio in a total loan portfolio. Therefore, even if the distortions in loans to one industry are large, the gap between the benchmark and actual loan ratio to the industry is small when the ratio of loans to the industry is small in the total loans outstanding. To avoid this problem, we normalize the financial distortion indicator by the gap divided by the actual loan ratio.

35 We use the data of *Result of Questionnaire on Firms' Behavior* by the Cabinet Office.

36 The reason why we use relative prices for the electrical machinery, equipment, and supplies industry is that the indicator for distortions in resource allocation is estimated by supposing the industry as the base industry.

Since industries with large distortions and small distortions may behave differently, we split the data into two groups: 6 industries with the largest distortions in resource allocation and the other 6 industries with the smallest distortions, and estimate equation (7) for each group. We employ the pooled OLS estimation and incorporate year dummies in estimating equation (7).

Table 5 shows the estimation results. First, the parameter on financial distortions for industries both with large and small real distortions is positive and statistically significant, demonstrating that financial distortions worsen real distortions. The parameter value on financial distortions for industries with large real distortions is larger than that with small real distortions. Second, the parameters on expectation on future economic condition are negative for industries with large real distortions but positive and statistically significant for those with small real distortions. This result implies that sectors with small real distortions execute restructuring to reduce their distortions when they become pessimistic about their future economic condition but sectors with large real distortions do not execute sufficient restructuring even though they are pessimistic. Third, the parameters on relative price are positive and statistically significant for industries with large real distortions but statistically insignificant for those with small distortions.

C. Summary of Empirical Results

The above empirical analyses confirm the existence of interaction between real and financial distortions. The panel data analyses using data at individual bank level as well as that at industry level show that negative interaction existed between real and financial distortions in the late 1990s, but such negative interaction became positive, in which the improvement of financial distortion induced a decrease in real distortions, after the end of the 1990s. This finding suggests that in the 2000s, banks changed their lending behavior, as did recipient firms such as by cutting excess debt and taking measures to raise profitability.

V. Concluding Remarks

In this paper, we have empirically analyzed the interaction between the real and

financial distortions during the period of Japan's protracted economic stagnation after the 1990s. In doing so, we have focused on the protracted economic stagnation after the bursting of the asset price bubble, and the subsequent recovery in economic activity and restoration of financial system stability. Our empirical evidence suggests two points. First, both distortions in factor markets and banks' loan portfolios drastically deteriorated in the late 1990s, followed by remarkable improvement in the 2000s. Second, negative interaction existed between the two distortions in the late 1990s, but such negative interaction reversed and became positive in the 2000s.

The real distortion induced a decline in trend growth rates for an extended period of time due to a contraction of production possibility frontier by keeping troubled firms alive, and inefficient resource allocation in an intertemporal dimension through a slowdown in capital accumulation.[37] In addition, the financial distortion, accumulated in the banking sector as potential imbalances, suddenly materialized when a certain threshold was reached. The risk-smoothing function of the banking system was then suddenly lost when the system encountered a shock that eroded banks' net capital to the extent that it threatened their soundness. Moreover, the negative interaction between the real and financial distortions exacerbated adverse effects on the economy: the destabilized financial system worsened the misallocation of resources, thereby further destabilizing the financial system.

The market mechanism alone, however, is unable to resolve the real and financial distortions, since resolution of the distortions tends to put someone at a disadvantage. As a result, resource misallocation is likely to continue to exist. In particular, financial system instability makes it more difficult to resolve resource misallocations by the market mechanism alone. That is, under the circumstances where banks' capital positions are deteriorated and the financial system become unstable, loans to unprofitable firms become fixed and funds are not channeled to growing firms, thereby producing downward pressure on economic activity. It is crucially important to induce efficient resource allocation through macroeconomic policy including prudential policy in order to achieve not only financial system stability but also sustained

[37] See Okina and Shiratsuka (2005) on this point.

economic growth.[38]

[38] Bhagwati (1971) argues that the basic policy response to structural problems is to attack directly their sources by transferring economic resources between agents gaining and those losing from structural reform.

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Table 1

Decomposition of Japan's GDP Growth Rate

（%）

		1986–91 （a）	1992–2000 （b）	2001–04 （c）	(b)－(a)	(c)－(b)
GDP growth rate		4.71	1.23	1.14	－3.48	－0.09
TFP		2.05	0.78	0.96	－1.27	0.18
Labor input		0.39	－0.67	－0.79	－1.06	－0.12
Capital accumulation		2.26	1.12	0.97	－1.14	－0.15
Distortions		0.42	0.10	0.17	－0.31	0.06
	Factor's marginal productivity (γ)	0.05	－0.19	0.12	－0.24	0.31
	Labor input share	0.36	0.29	0.04	－0.07	－0.25

Table 2

Relation between Distortions in Loan Portfolios and Non-performing Loan Ratio

	1-year lag	2-year lag	3-year lag
$FIND_{-j}$	15.02^{***}(9.94)	15.53^{***}(6.35)	9.77^{***}(3.39)
R^2	0.63	0.63	0.61

Note: Estimation was conducted using the data for 138 banks. Estimation period is 1999–2005. *** denotes 1 percent significance level. Figures in parentheses are *t*-statistics.

Table 3

Comparison of Ratios of Loan Portfolio Distortions to

Tier I Capital of Bankrupted or Consolidated Banks with Those of Existing Banks

	Average	Std.
Bankrupted or Consolidated Banks	10.17(a)	7.63
Existing Banks	5.70 (b)	7.97
t-statistic [Test on the null hypothesis that (a) is equal to (b)]		14.78

Note: Data for bankrupted or consolidated banks (15 banks) are those of the year before they were bankrupted or consolidated. Data for existing banks (99 banks) are the maximum value from 1993 to 2005. Note that we use distortions in loan portfolios multiplied by loan volume as loan portfolio distortions.

Table 4

Estimation Results of Equation (6)

Dependent Variable: δ		
$READ_{-1}$	9.579^{***}	(4.11)
ROE_{-1}	−0.002	(0.11)
CCR_{-1}	-0.002^{**}	(2.51)
CAP	-1.392^{***}	(2.92)
$CCR_{-1}*CAP$	0.005^{*}	(4.07)
R^2	0.51	

Note: Estimation is conducted using data for 129 banks (1993–2005). ***, **, and * represent 1 percent, 5 percent, and 10 percent significance level, respectively. Figures in parentheses are *t*-statistics.

Table 5

Estimation Results of Equation (7)

	Dependent Variable: *READ*	
	Industry with higher distortion	Industry with lower distortion
c	-10.78**	0.22
	(2.22)	(0.26)
$IFIND_{-1}$	0.72*	0.32***
	(1.82)	(3.97)
EX_{-1}	-0.35	0.19***
	(1.62)	(4.61)
RP_{-1}	0.16***	-0.00
	(2.90)	(0.12)
R^2	0.23	0.53

Note: Industries with higher distortion are Food products and beverages, Mining, Construction, Electricity, gas and water supply, Wholesale and retail trade, and Transport and communications. Industries with lower distortion are Chemicals, Basic metals, Machinery, Transport equipment, Real estate, and Service activities. ***, **, and * represent 1 percent, 5 percent, and 10 percent significance level, respectively. Figures in parentheses are *t*-statistics.

Figure 1

Changes in Industrial Distortions in Resource Allocation

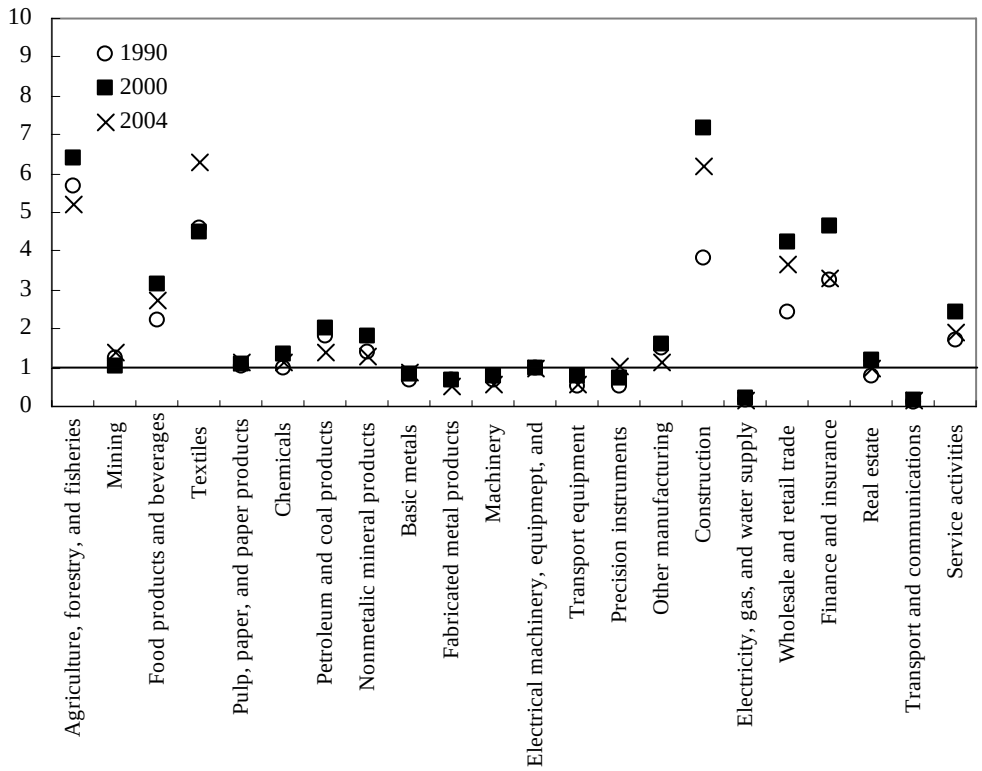
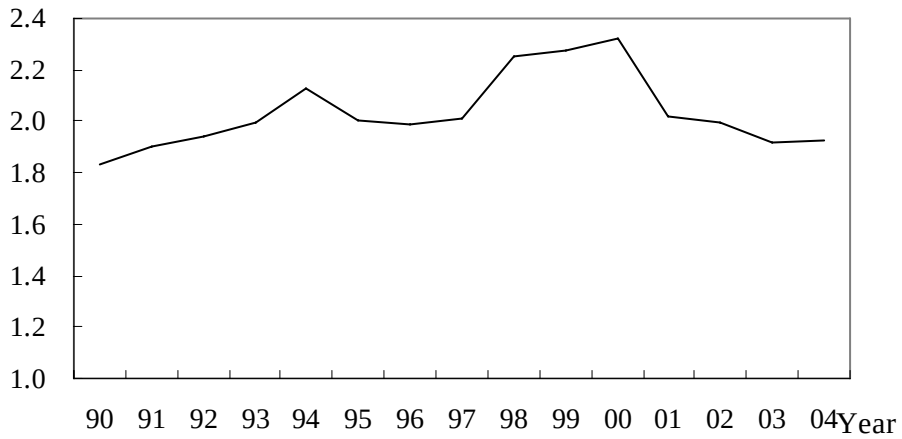


Figure 2

Distortion in Resource Allocation in the Whole Economy



Note: In computing the weighted average of γs with nominal GDP, we use γs' degree of divergence from unity if it exceeds unity and the degree of divergence of its reciprocal from unity if it is less than unity.

Figure 3

Benchmark Loan Portfolios and Actual Loan Portfolios

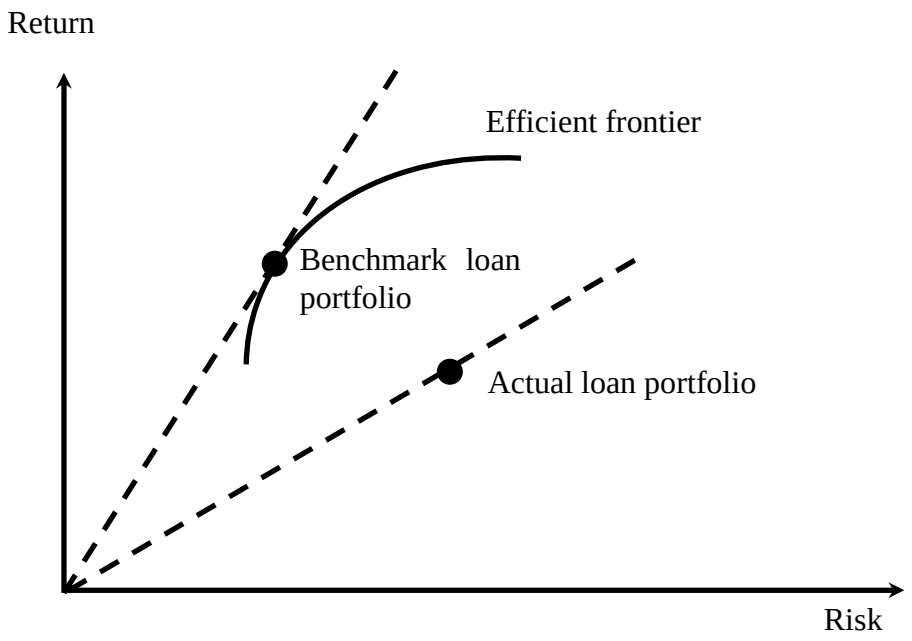


Figure 4

Changes in Distortions in Loan Portfolios

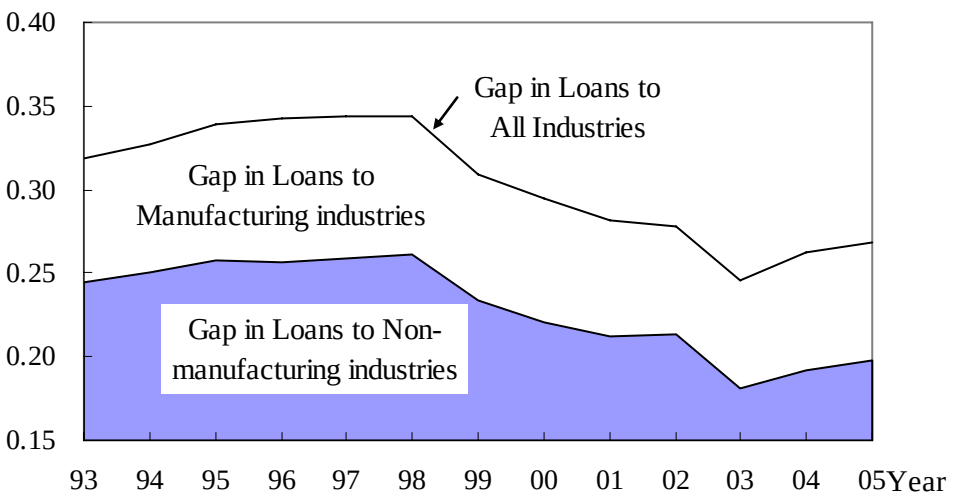
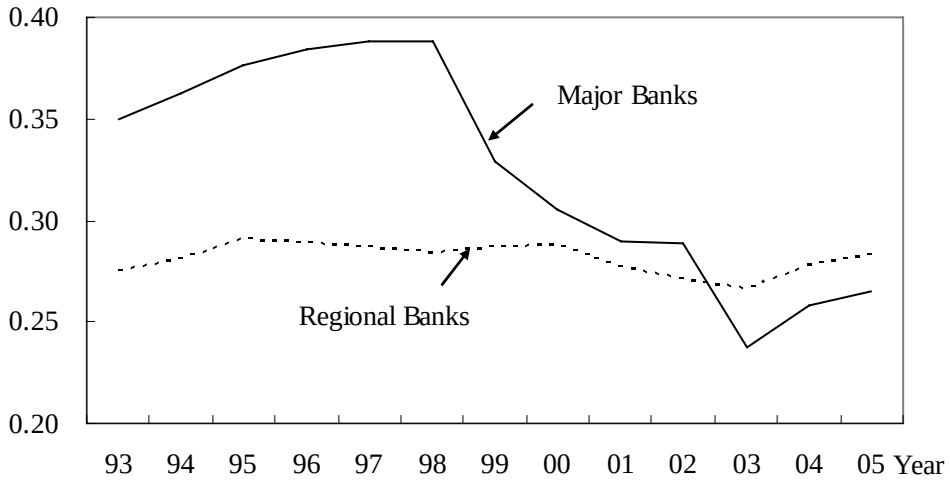


Figure 5

Changes in Loan Portfolio Distortions in Major Banks and Regional Banks



Note: Weighted average using loan volume as weight.

Figure 6

Loan Portfolio Distortions Adjusting Loans to the Real Estate Industry

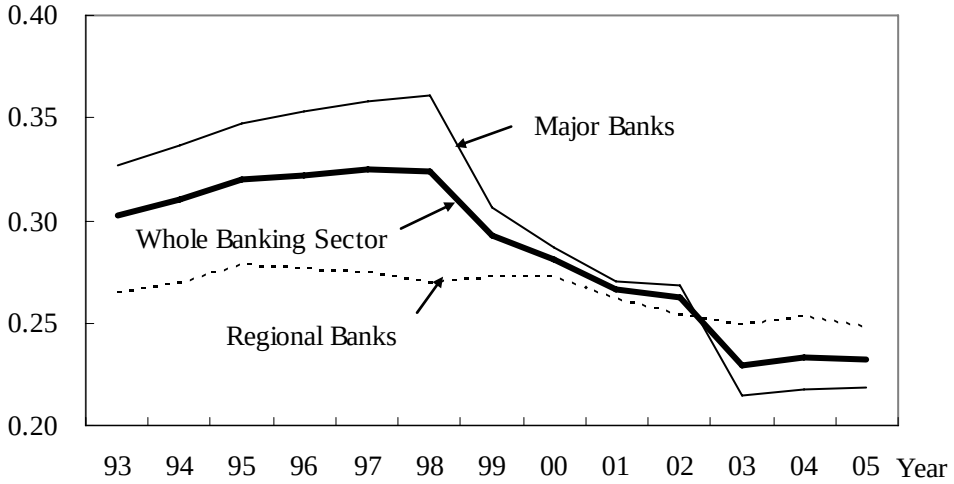
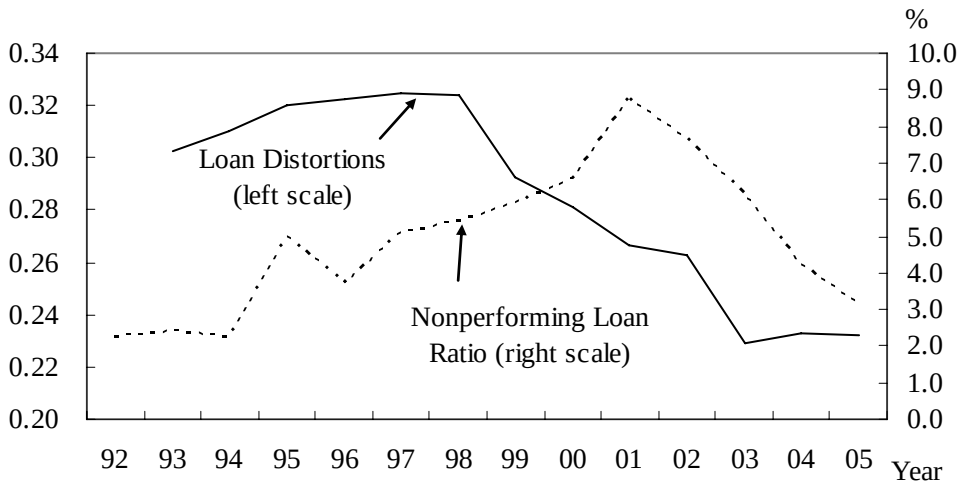


Figure 7

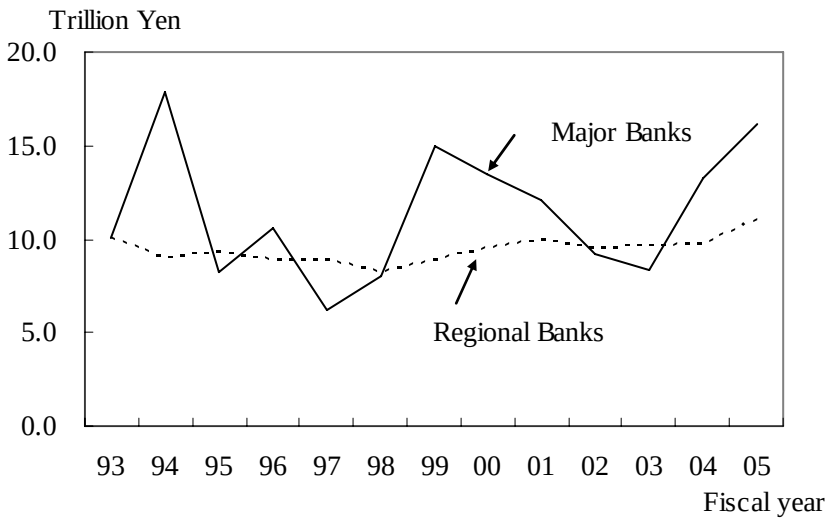
Relationship between Loan Portfolio Distortions and Non-performing Loan Ratio



Note: Non-performing loan ratio is defined as risk-monitored loans divided by total loans outstanding. Data for risk-monitored loans are published by FSA. Before 1994, they are the sum of bankrupt assets and delinquent assets, and in 1995 and 1996 they are the sum of bankrupt assets, delinquent assets and restructured loans. Note that data for loan portfolio distortions are those by calendar year, and data for non-performing loans are by fiscal year.

Figure 8

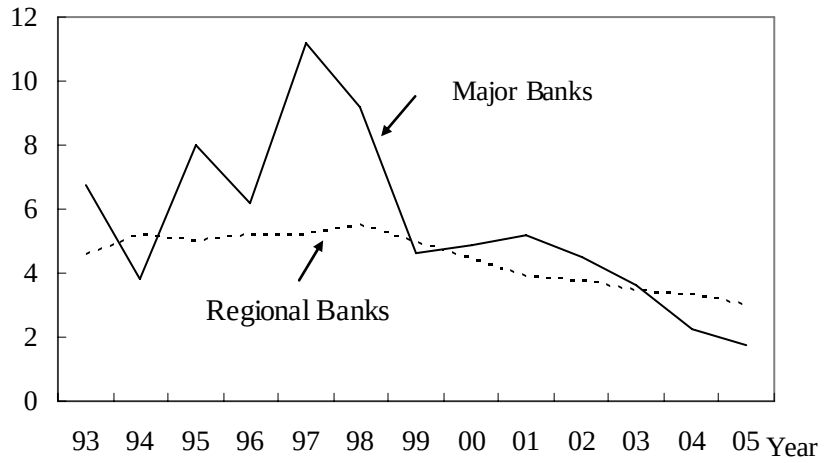
Changes in Tier I Capital Held by Major Banks and Regional Banks



Note: Data for international standard banks are Tier I capital, and those for domestic standard banks are the sum of common stock, capital surplus reserve, and earned surplus.

Figure 9

Changes in Ratio of Loan Portfolio Distortions to Tier I Capital of Major Banks and regional Banks



Note: We use distortions in loan portfolios multiplied by loan volume as loan portfolio distortions.

Figure 10

Changes in the Parameter Values on Year Dummy Variables

Note: The solid line and dotted lines represents estimate and their 95 percent significant range.