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Causes and Consequences of Their Decline in the 1990s

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Sectoral Credit Shifts in Japan: Causes and Consequences of Their Decline in the 1990s*

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Abstract

In this paper, we construct a simple measure of sectoral credit shifts, defined as the dispersion of growth rates of bank loans across sectors, and investigate what effects they had on Japan's economy and what accounted for their development. We find that (i) during the 1990s, the amount of sectoral credit shifts declined significantly, which was responsible for—in conjunction with effects from falls in land prices and aggregate outstanding loans—the stagnated real growth; and (ii) the decline in the credit shifts in the 1990s reflected weakened financial intermediation rather than a decrease in the size of sectoral shocks. These results are consistent with the view that financial intermediation was weakened by the exacerbated non-performing loan problems after the collapse of the asset price bubble, and thus prevented credits from shifting to relatively efficient sectors.

JEL Classification Number: E51, G21, O16

Keywords: credit, sectoral shock, growth, non-performing loan

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1 Introduction

This paper investigates the effects of **sectoral credit shifts** on the economy by constructing a simple measure of them, defined as the dispersion of growth rates of bank loans across sectors. We are particularly interested in what effects they had on Japan's economy on top of effects from changes in **aggregate outstanding loans**. Existing empirical studies regarding non-performing loan (NPL) problems and the credit channel of monetary policy have mainly focused on changes in the **aggregate outstanding loans**, and have examined their relationships with asset prices and real growth (Bayoumi (1999), Morsink and Bayoumi (1999), Ogawa (2000), etc.). However, no study has looked into the relationships between the **sectoral credit shifts** and those variables.

We are also interested in what accounted for the development of the sectoral credit shifts. In theory, the amount of credit shifts is attributable, at least, either to the size of sectoral shocks or to the efficiency of financial intermediation. The former (sectoral shock) is based on the real-business-cycle (RBC) hypothesis, whereas the latter (financial intermediation) is related to the financial accelerator hypothesis. Although they are not necessarily mutually inconsistent, it is interesting to see which hypothesis was more relevant for the development of the credit shifts in Japan.

Our findings in this paper can be summarized as follows:

- The sectoral shifts of credits had substantial impacts on the economy. It will be seen, in Section 2, that (i) the amount of sectoral credit shifts decreased significantly in the 1990s; and (ii) this decline, in conjunction with the effects from declines in land prices and aggregate outstanding loans, hampered real growth.
- The decline in the sectoral shifts of credits in the 1990s reflected weakened financial intermediation rather than a decrease in the size of sectoral shocks. In Section 3, we find some evidence that lends itself well to this claim, including:
  - the size of sectoral shocks measured by job vacancies did not drop in the 1990s;
  - the share of firms answering "severe" in the *Tankan* (the Short-term Economic Survey of Enterprises in Japan) diffusion index on the lending attitudes of financial institutions did not decrease even at the time of lax monetary policy; and
  - the sectoral credit shifts tended to be squeezed at the less-healthy banks.

These results are consistent with the view that the financial intermediation was weakened by the exacerbated NPL problems after the collapse of the asset price bubble, and thus prevented credits from shifting to relatively efficient sectors. The effects of sectoral credit shifts have to be taken into account—in addition to changes in land prices and aggregate outstanding loans—when analyzing the impacts of NPL problems on Japan's economy.

2 A Measure of Sectoral Credit Reallocation

2.1 Specification and Its Development

We calculate the following measure as the credit shifts across sectors.

$$\sigma_t^L = \left[\sum_{i=1}^{N} \left(\frac{l_{it}}{L_t} \right) (\Delta_4 l_{it} - \Delta_4 L_t)^2 \right]^{1/2}, \tag{1}$$

where l_{it} is outstanding loans to industry i at time t; L_t is aggregate outstanding loans at time t ($L_t = \sum_{i=1}^{N} l_{it}$); and Δ_4 denotes the operator which takes a year-on-year growth rate of a variable. When a large amount of credits are reallocated from one industry to another, the dispersion of credit growths across sectors is expected to increase, which implies the wider differences between $\Delta_4 l_{it}$ and $\Delta_4 L_t$. The measure takes the squared sum of these differences with weights given by loan shares of each industry. Thus, σ_t^L increases when more credits shift across sectors.[1]

In fact, σ^L declined significantly from the 1980s to the 1990s (Figure 1).[2] Similar declines are observed for annual growths of aggregate outstanding loans ($\Delta_4 L$); land prices ($\Delta_4 Lp$); and real output ($\Delta_4 y$).[3] In the 1980s, credits shifted actively across sectors, while land prices swelled and aggregate loans expanded rapidly. At the same time, real output grew fast. With hindsight, it might be true that some of credits reallocated in the latter half of the 1980s—in the midst of the bubble period—have not necessarily been poured into profitable sectors such as real estate projects. However, on average, credits shifted vigorously during the 1980s, even if we take into account a temporal drop around 1981. In the 1990s, land prices plummeted, loans slowed abruptly, and σ^L fell. So did real growth.

[1] In fact, the idea of the sectoral shift measure comes from Lilien (1982), who calculates a measure of sectoral labor shifts. If we substitute the amount of outstanding loans to the number of employees, σ^L becomes Lilien's index (except that he uses quarterly changes instead of annual changes):

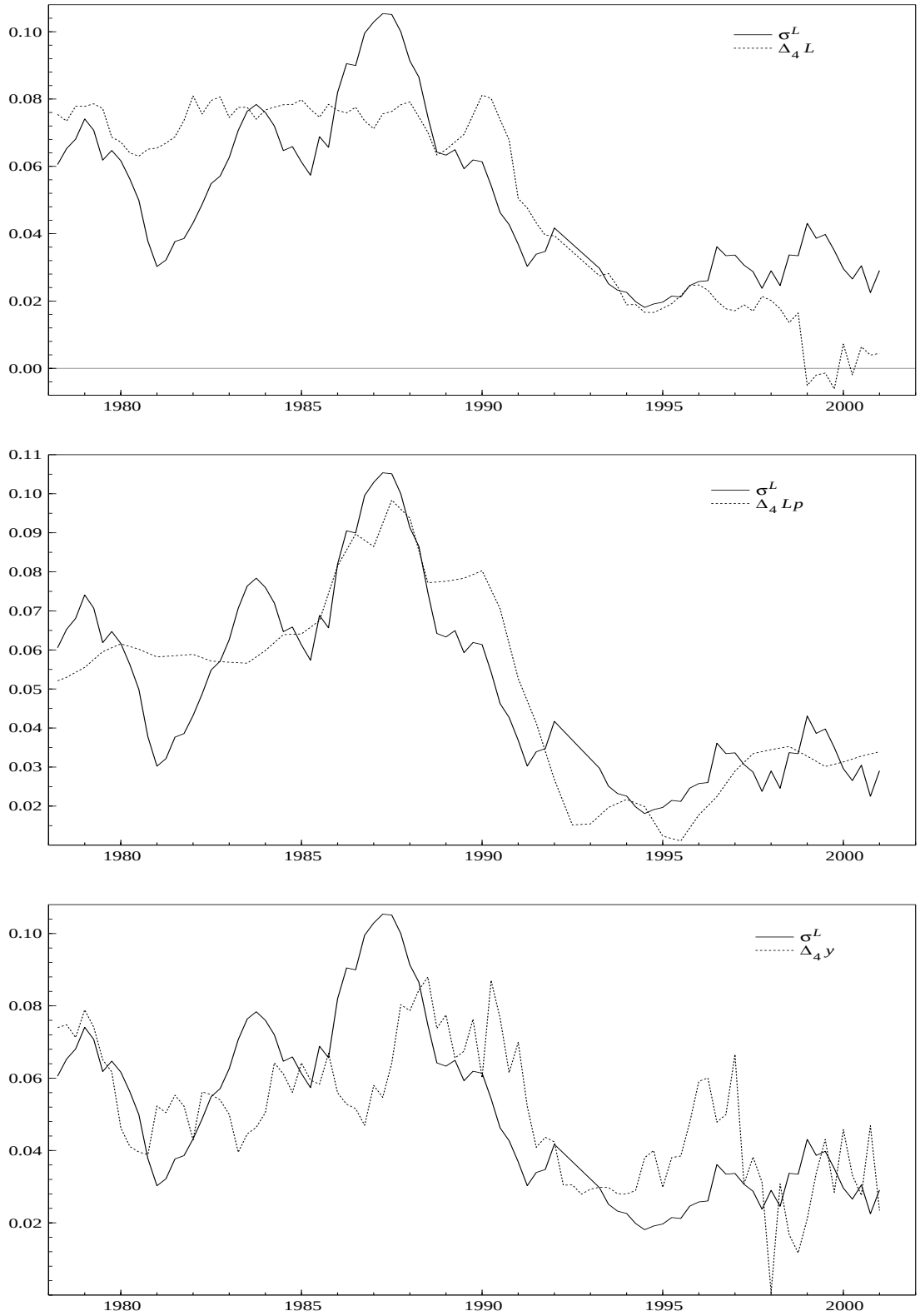
$$\sigma_t^E = \left[\sum_{i=1}^{N} \left(\frac{e_{it}}{E_t} \right) (\Delta_4 e_{it} - \Delta_4 E_t)^2 \right]^{1/2},$$

where e_{it} is the number of employees of industry i at time t; and E_t is its equivalence of whole industries. Lilien computes this measure as a proxy for the size of sectoral shocks and investigates its relationship to the unemployment rates. Prasad (1997) calculates the Lilien's index using Japanese labor statistics.

[2] σ^L is calculated from 22 industries of *Loans and Discounts Outstanding by Industry* (Bank of Japan). Overdrafts at the current accounts were not included in the series up to 1992Q1, and have been included since then. The figures for FY1993 are obtained from a linear interpolation of σ^L in 1992Q1 and that in 1993Q2.

[3] Similar to σ^L, $\Delta_4 L_t$ in FY1993 is obtained from a linear interpolation of $\Delta_4 L_t$ in 1992Q1 and that in 1993Q2. $\Delta_4 Lp$ is calculated from *Land Price Index* (commercial purposes in six major cities) compiled by Japan Real Estate Institute. Figures for Q2 and Q4 are obtained from linear interpolations of adjacent quarters. $\Delta_4 y$ on the SNA93 basis is spliced to that on the SNA68 basis in 1980Q4.

Figure 1: Sectoral Credit Shifts (1)



Note: Means and ranges of $\Delta_4 L$ (aggregate outstanding loans), $\Delta_4 Lp$ (land prices), and $\Delta_4 y$ (real output) are matched with those of σ^L.

Since 1998, σ^L improved slightly while aggregate outstanding loans decreased further. The further loan contraction was due to the write-offs of NPLs possessed by failed banks and their transfers from nationalized banks. Since NPLs were more concentrated in certain industries such as real estate, construction, retail, and other financial services, those final disposals of NPLs made a wider gap among industries in terms of changes in outstanding loans. This explains the increase in σ^L at the time of contraction in $\Delta_4 L$.

The following refinements do not alter the above observed trend in sectoral credit shifts—high in the 1980s and low in the 1990s.

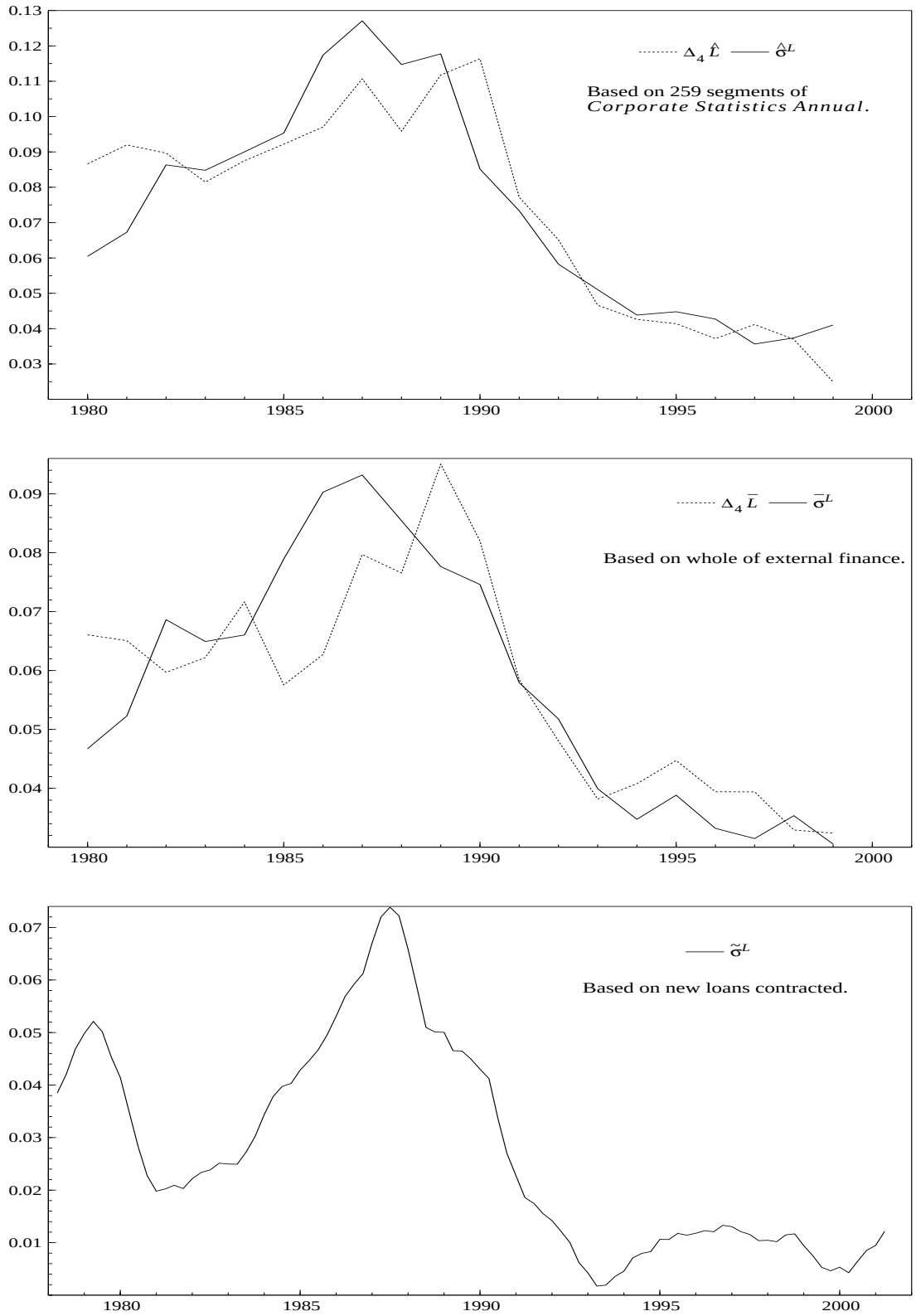
1. First, we try to go down further to finer segment decomposition. In equation (1), we calculate σ^L based on 22 industries. Since credits are supposed to shift from uncompetitive firms to competitive firms (or from unprofitable projects to profitable projects, if we go further down the road), conceptually we might need to look at financial transaction data at the inter-firm (or inter-project) level instead of the inter-industry level. However, because no corporate financial data which covers small and medium sized enterprises—supposedly more dependent on bank loans—exists at the inter-firm level, we use *Corporate Statistics Annual* (Ministry of Finance), which enables us to examine 259 segments (based on 37 industries and seven capital categories[4]). The upper panel of Figure 2 shows thus calculated credit shift measure ($\hat{\sigma}^L$) together with corresponding aggregate outstanding loans ($\Delta_4 \hat{L}$) from the same statistics. Both of them share the similar trends as σ^L and $\Delta_4 L$ in Figure 1.

2. Next, we take into account capital market transactions. Reflecting the financial liberalization since the latter half of the 1980s, Japanese firms, particularly large-sized enterprises, began to use bond and equity markets as sources of external finances. As of the end of March 2001, private nonfinancial corporations issued 318 trillion yen in shares and 83 trillion yen in other securities (bonds, commercial papers etc.) against 450 trillion yen in loans (*Flow of Fund statistics,* Bank of Japan). If firms relied more on the capital market, σ^L based on bank loans might misrepresent the underlying trend of sectoral shifts of financial resources. At the middle panel of Figure 2, based on 259 segments of *Corporate Statistics Annual*, we calculate $\bar{\sigma}^L$ by adding other means of external finance (bills, other liquid debts, bonds, equities) to bank loans in equation (1). $\Delta_4 \bar{L}$ corresponds to the aggregate external finances used for calculating $\bar{\sigma}^L$. Again, both $\bar{\sigma}^L$ and $\Delta_4 \bar{L}$ share the similar trends as σ^L and $\Delta_4 L$ in Figure 1 in that they were high in the 1980s and low in the 1990s.[5]

[4]Seven categories are stockholders' equity of "less than ¥2 million"; "¥2 million–¥5 million"; "¥5 million–¥10 million"; "¥10 million–¥50 million"; "¥50 million–¥100 million"; "¥100 million–¥1 billion"; and "more than ¥1 billion."

[5]The fact that σ^L and $\bar{\sigma}^L$ share similar trends implies that financing from capital markets did not compensate a decline in that from banks. This indicates that bank loans were still quite dominant in Japan, in particular those to small and medium sized enterprises. See Hoshi and Kashyap (1999) for a related topic.

Figure 2: Sectoral Credit Shifts (2)



Note: Means and ranges of $\Delta_4 \hat{L}$ and $\Delta_4 \bar{L}$ are matched with those of $\hat{\sigma}^L$ and $\bar{\sigma}^L$, respectively.

3. Finally, we calculate σ^L on a gross basis by substituting new loans contracted to changes in outstanding loans ($\Delta_4 l_{it}$ and $\Delta_4 L_t$ in equation (1)). In cases where the same amount of loans happened to be repayed as the amount of new loans contracted within an industry, σ^L would omit these transactions as no change would be observed in $\Delta_4 l_{it}$ nor $\Delta_4 L_t$. Therefore, one might argue that a gross basis measure would be more desirable. At the bottom panel of Figure 2, we try to examine the significance of this claim by replacing changes in outstanding loans with new loans contracted as:

$$\tilde{\sigma}_t^L = \left[\sum_{i=1}^{N} \left(\frac{l_{it}}{L_t} \right) \left(\frac{\sum_{k=0}^{3} \tilde{l}_{i,t-k}}{l_{i,t-4}} - \frac{\sum_{k=0}^{3} \tilde{L}_{t-k}}{L_{t-4}} \right)^2 \right]^{1/2},$$

where $\tilde{l}_{it}$ and $\tilde{L}_t$ are new loans contracted at time t for industry i and for whole industries, respectively. Because of data limitation (*Loans and Discounts Outstanding by Industry,* Bank of Japan), $\tilde{\sigma}^L$ is based on only seven industries; and loans are those for purchasing equipment. As seen, the trend in $\tilde{\sigma}^L$ quite resembles that in σ^L in Figure 1.

2.2 Land Prices, Bank Loans and Real Output

Prior to seeking causes of the fall in the sectoral credit shifts in the 1990s, we will see their consequences first—what effects they had on Japan's economy in conjunction with effects from changes in aggregate outstanding loans. A simple VAR (Vector Autoregressive) model is estimated for this purpose. Because of lack of prior knowledge about the structural relationships among these variables, we think that a simple VAR is an appropriate vehicle to start with, as it requires minimal restrictions. Ogawa, Kitasaka, Yamaoka, and Iwata (1996) and other previous studies show that bank lending was significantly affected by land prices from the 1980s to the 1990s. For this reason, our VAR model includes the growth rate of land prices ($\Delta_4 Lp_t$) together with that of aggregate outstanding loans ($\Delta_4 L_t$), the sectoral credit shifts ($\ln \sigma_t^L$), and the growth rate of real output ($\Delta_4 y_t$).[6] The VAR is estimated with quarterly data from 1978Q2 to 2001Q1 using four lags chosen by the AIC.

First, to obtain rough idea about the relationships among those variables, we run a series of bivariate Granger (non-)Causality tests (Table 1). The hypotheses that $\Delta_4 Lp$ did not cause in the Granger's sense $\Delta_4 L$, $\ln \sigma^L$ and $\Delta_4 y$ respectively are rejected. The hypotheses that $\Delta_4 L$ did not cause $\ln \sigma^L$ and $\Delta_4 y$ are rejected; also are the hypothesis that $\ln \sigma^L$ did not cause $\Delta_4 y$. Although the hypothesis that $\Delta_4 y$ did not cause $\Delta_4 L$ is rejected, it seems that $\Delta_4 Lp$ took the lead followed by $\Delta_4 L$, $\ln \sigma^L$, $\Delta_4 y$. Therefore, we set the ordering of the VAR as $\Delta_4 Lp_t$, $\Delta_4 L_t$, $\ln \sigma_t^L$, $\Delta_4 y_t$.[7]

[6] Natural logarithm is taken to impose a non-negative constraint on σ^L, which should not be negative by definition.

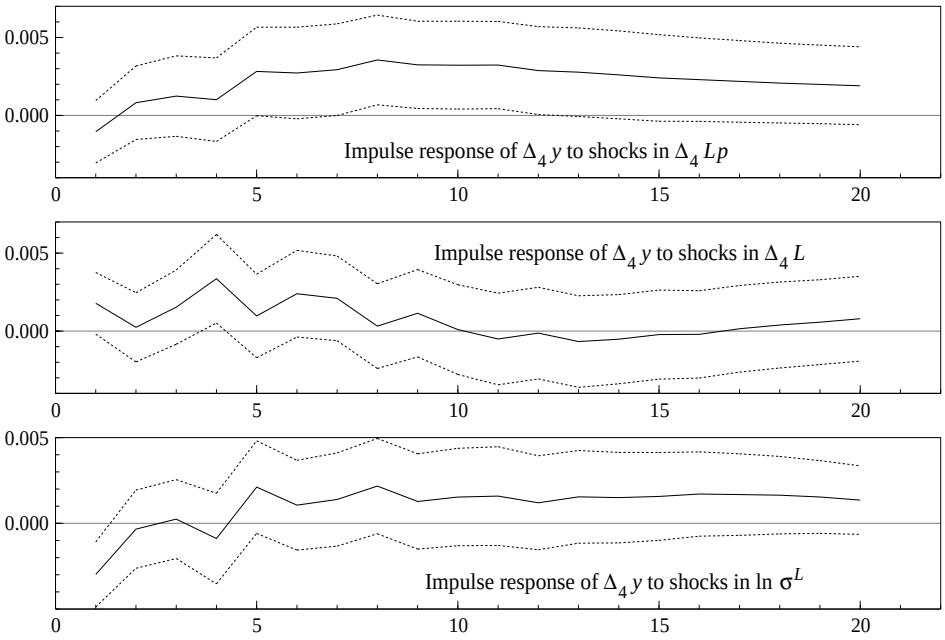
[7] Qualitative results were not altered by changing the ordering of these variables.

Table 1: Bivariate Granger Causality Tests

Y \ X	$\Delta_4 Lp$	$\Delta_4 L$	$\ln \sigma^L$	$\Delta_4 y$
$\Delta_4 Lp$	...	0.44	2.06	0.89
	...	(0.781)	(0.094)	(0.476)
$\Delta_4 L$	3.32*	...	0.70	2.81*
	(0.014)	...	(0.592)	(0.031)
$\ln \sigma^L$	4.55**	2.51*	...	1.56
	(0.002)	(0.048)	...	(0.193)
$\Delta_4 y$	3.76**	2.98*	3.95**	...
	(0.007)	(0.024)	(0.006)	...

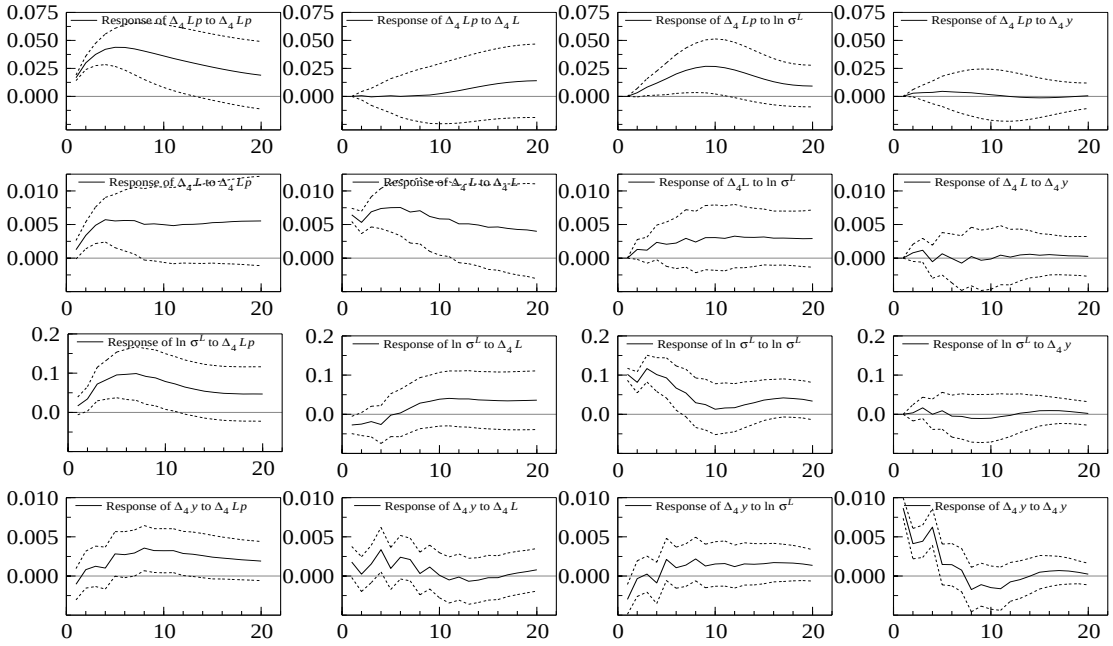
Note: 1. Y_t is regressed on X_{t-i} where $i = 1 \ldots 4$.
2. Figures in parentheses are p-values.
3. ** denotes significance at the 1% level and * at the 5% level.

Figure 3: Impulse Responses of Real Output



Note: The dotted lines denote approximately 2S.E. bands.

Figure 4: Impulse Responses



Note: The dotted lines denote approximately 2S.E. bands.

The impulse response functions of real output are reported in Figure 3. (The impulse responses of all variables are shown in Figure 4. Those in Figure 3 correspond to the left three panels at the bottom of Figure 4.) Shocks in land prices (upper panel), aggregate outstanding loans (middle panel) and sectoral credit shifts (lower panel) have positive effects on real output. The effects of shocks in $\Delta_4 Lp$ and $\ln \sigma^L$ last longer compared with that of $\Delta_4 L$ shock, which becomes almost negligible after eight quarters.

Although this is a slight digression, we can easily confirm that the fall in land prices dampens real growth via a drop in the sectoral credit shifts as well as via a decline in aggregate outstanding loans. This can be seen in impulse response functions of real output (Figure 5), where the effects of shocks in $\Delta_4 Lp$ become considerably smaller when either $\Delta_4 L$ or σ^L is treated as an exogenous variable. By estimating the impulse responses with making either of these variables exogenous, impulse shocks through these variables are fixed. Therefore smaller magnitude of responses imply that there are transmission channels that go through these exogenous variables.

From the variance decomposition of the forecast standard errors, it is also found that land prices, aggregate outstanding loans, and sectoral credit shifts have significant impacts on real output (Table 2). For instance, at the 20th quarter, the effect of $\ln \sigma^L$ (13.4%) is larger than that of $\Delta_4 L$ (8.5%), suggesting that $\ln \sigma^L$ affects $\Delta_4 y$ in a longer term than $\Delta_4 L$ does. The effect of land prices on real output at the 20th quarter (33.1%) is

Figure 5: Impulse Responses of Real Output to Shocks in Land Prices

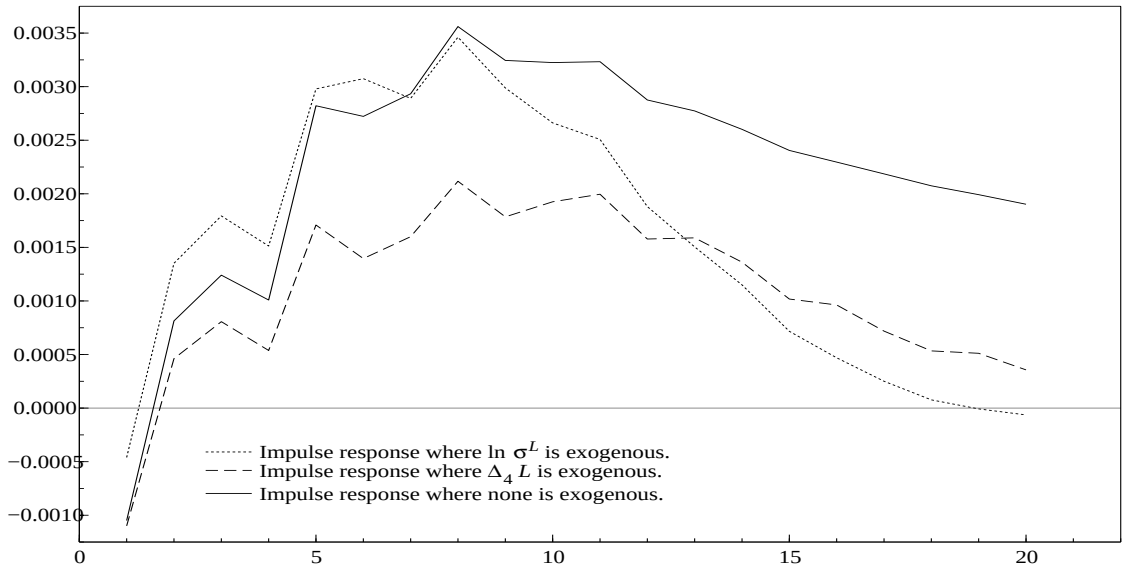


Table 2: Variance Decomposition of Real Output

Period	S.E.	$\Delta_4 Lp$	$\Delta_4 L$	σ^L	$\Delta_4 y$
4	0.0121	2.4	9.3	5.4	82.9
8	0.0142	16.4	11.3	8.9	63.5
12	0.0157	26.4	9.7	9.8	54.0
16	0.0166	31.0	8.9	11.7	48.4
20	0.0173	33.1	8.5	13.4	45.0

Table 3: Historical Decomposition of Real Output

	90Q1-2001Q1		
		90Q1-94Q4	95Q1-01Q1
	$\Delta_4 y$ (average)		
(A) Actual	1.7%	2.1%	1.3%
(B) Prediction	3.4%	4.0%	2.9%
(A)-(B)	-1.7%	-1.9%	-1.6%
	Contribution to (A)-(B)		
$\Delta_4 Lp$ shocks	-0.9%	-1.1%	-0.8%
$\Delta_4 L$ shocks	-0.4%	-0.3%	-0.5%
$\ln \sigma^L$ shocks	-0.5%	-0.6%	-0.4%
$\Delta_4 y$ shocks	0.1%	0.1%	0.1%

quite large, but, as seen above, most of this effect is considered to go through aggregate outstanding loans and sectoral credit shifts.

The historical decomposition of the actual path of real output also indicates significant impacts of the sectoral credit shifts. Using the data up to 1989Q4—the peak of the bubble period—we decompose the actual path of real output growth from 1990Q1 to 2001Q1 into the part predicted by the endogenous variables and the remainder (the shock). The shock is then divided into the parts explained by innovations in each variable (Table 3). The average growth rate is predicted 3.4%, of which output shocks themselves account for 0.1%, possibly because of factors undefined in this model such as monetary easing or implementation of government economic packages, which raised growth rates. On the contrary, land prices, aggregate outstanding loans and sectoral credit shifts exerted downward pressure on economic growth. Negative shocks from sectoral credit shifts are particularly noticeable in the first half of the 1990s. Thereafter, in the latter half of the 1990s, the size of their negative shocks decreased somewhat, while that of aggregate loans increased. This reflected, as mentioned above, final disposals of NPLs from the balance sheets of failed banks and nationalized banks.

3 What Caused the Decline in Credit Shifts in the 1990s?

In this section, we will turn to causes of the decline in the sectoral credit shifts. The previous section confirms that as a consequence of their decline, real growth decelerated together with effects from the falls in land prices and aggregate outstanding loans. As shown, the fall in land prices was responsible for a decline in the sectoral credit shifts. However, as seen in the historical decomposition, negative shocks of the credit shifts, which were not due to the fall in land prices, had a significant impact on real growth,

particularly during the first half of the 1990s.

Sectoral shifts of credits are thought to be affected by two factors: One is the size of sectoral shocks. If an industry becomes more competitive and profitable thanks to the invention of new products or new technology (i.e., sector-specific shocks), it might require more resources such as labor and/or capital so that it expands its business fast. To finance these additional resources, credits are likely to shift from a less-competitive sector to a more-competitive sector. Hence σ^L varies according to how much sectoral shocks the economy faces.[8]

The other factor of the sectoral credit shifts is the efficiency of financial intermediation. Suppose, for some reason, financial intermediation became utterly inefficient and totally disrupted. In this case, credits would not shift across sectors, even if the economy experienced the large size of sectoral shocks. Thus, σ^L varies according to the efficiency of financial intermediation.

In short, σ^L fluctuates according to the size of sector-specific shocks and the efficiency of financial intermediation. That is, the measure can be seen as a proxy for sectoral shocks if there is no change in the efficiency of financial intermediation, and vice versa.

From this discussion, we may say:

- The decline in the credit shifts in the 1990s could be due to a decrease in the size of sector-specific shocks. If this is the case, it implies that the economy was largely driven by real shocks. That is, the stagnation in Japan's economy in the 1990s can be explained by the real-business-cycle (RBC) theory.[9]
- The decline in the credit shifts could be due to weaker financial intermediation. This interpretation is broadly consistent with the financial accelerator hypothesis, which emphasizes the role of bank lending in a transmission mechanism of monetary policy (Bernanke and Gertler (1995)).

In what follows, we will see that the latter interpretation is rather plausible by investigating (i) the sectoral shocks measured by job vacancies; (ii) the shares of correspondences to *Tankan*'s survey on lending attitudes; and (iii) the relationship between the sectoral credit shifts and bank health indicators.

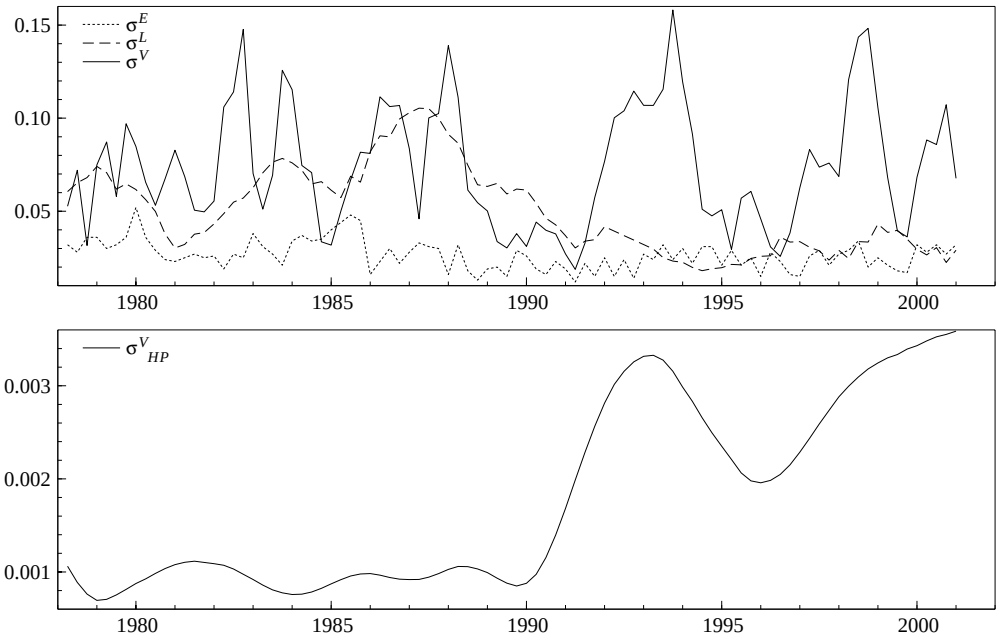
3.1 Sectoral Shocks Measured by Job Vacancies

Neither σ^L nor σ^E necessarily reveals the size of sectoral shocks. This is because they are based on the actual amount/number of credits/employees that shifted across sectors.

[8] As Abraham and Katz (1986) point out, in theory, the measure may respond not only to sector-specific shocks but also to aggregate demand shocks. However, in reality, it does not seem so responsive to disturbances in aggregate output shocks (Figure 4).

[9] In fact, a standard textbook like Romer (1996) introduces Lilien (1982), which is the labor equivalent to our measure, as a measure of sectoral shocks and discussed it from the viewpoint of the RBC.

Figure 6: Sectoral Shocks Measured by Job Vacancies



Note: σ^L_{HP} is from Maeda, Higo, and Nishizaki (2001).

For instance, when shifts of credits or labors are disrupted by NPL problems or by a rigid employment system, observed σ^L and σ^E do not change even if some shocks occurred across sectors. To measure magnitudes of sectoral shocks, we should examine how much factor of production is required in each industry. Here, we use a measure of sectoral shifts, in which bank loans are replaced by job vacancies to examine sectoral shocks.

$$\sigma^V_t = \left[\sum_{i=1}^{N}\left(\frac{v_{it}}{V_t}\right)\left(\Delta_4 v_{it} - \Delta_4 V_t\right)^2\right]^{1/2}, \tag{2}$$

where V_t is an aggregate vacancy at time t, v_{it} is a vacancy in industry i at time t.

Thus calculated σ^V shows that the size of sectoral shocks did not diminish in the 1990s (Figure 6, upper panel).[10] This reflected the high dispersion across sectors such that declines in job vacancies at the manufacturing sector were offset by the non-manufacturing sectors (finance (1980s), construction, services etc.).[11]

[10] σ^V is calculated from nine industries of *Report on Employment Services* (Ministry of Health, Labor and Welfare). σ^E is calculated from 10 industries of *Monthly Labor Survey* of the same Ministry. The survey reclassified "plastic" from "other manufacturing" to "chemical" in 1985. The figures for 1985 are obtained from a linear interpolation of Δe_{it} in 1984Q4 and that in 1986Q1. To make a precise comparison among σ^L, σ^E and σ^V, the classification of industries should have been identical among them. However, we have not made such adjustments as we are more interested in measuring σ^L as precisely as possible using a detailed industrial classification.

[11] Reflecting a series of fiscal packages, job vacancies at the construction industry in the first half of

To smooth out the cyclical fluctuations of σ^V, following Fujita (1998), we apply the Hodrick-Prescott filter to the level of job vacancies instead of taking their annual growth. The obtained series (denoted as σ^V_{HP} in the bottom panel of Figure 6) indicates a surge in the size of sectoral shocks in the 1990s.

These results contradict the RBC type interpretation, since the size of sectoral shocks in the 1990s appears, at least, as large as that in the 1980s. Indeed, σ^V might be distorted as it is calculated from a rather small number of industries; it does not capture the tendency that more firms have made job offers through non-governmental agencies so that they are not counted as job vacancies in the statistics; and it tends to be more responsive to shocks in labor-intensive sectors. However, it is highly likely that the size of sectoral shocks did not decrease in the 1990s in Japan, when emerging economies, particularly those in the East Asia, recorded miraculous growth (before they hit the crises) and information technology flourished all over the world.

3.2 Evidence from *Tankan* Survey

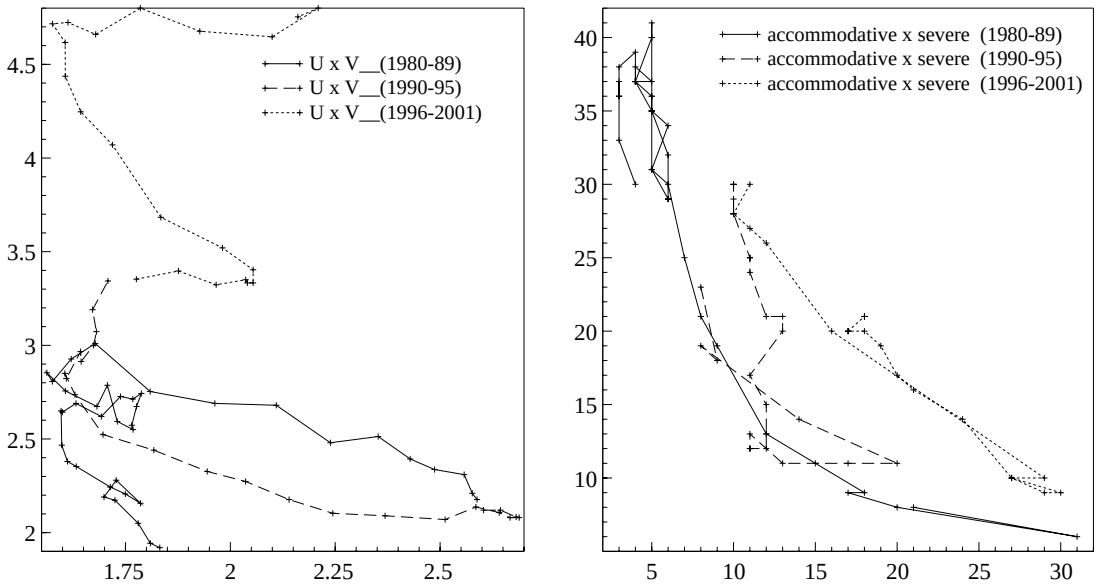
Tankan's Diffusion Index on lending attitudes of financial institutions also gives some evidence for a decline in the efficiency of financial intermediation. In the right panel in Figure 7, the horizontal axis corresponds to the share of firms replying lending attitudes as "severe", and the vertical axis corresponds to that of firms replying as "accommodative". Under normal circumstances, we expect some trade-off relationship between the two shares, which depicts the curve from southeast to northwest in the figure. This is because the share of "severe"-judging firms increases while that of "accommodative"-judging firms decreases under monetary tightening and vice versa.

In the case of weaker financial intermediation, the curve is anticipated to shift northward since the share of firms replying "severe" does not decline even at the monetary easing. If some firms suffered from the credit crunch, they continued to reply "severe" even when the authorities tried to ease monetary policy. Or if some unprofitable firms survived owing to the forbearance policy of the banks, they might continue to reply "severe", expecting another round of refinancing negotiation with banks. In other words, if banks had ceased the forbearance policy, these firms would have exited from the market so that the number of firms replying "severe" would have decreased.

In fact, there was an apparent shift in the curve northward in the early 1990s. Thereafter, the curve has not shifted back to south—on the curve, the share of replying "severe" increased and that of "accommodative" decreased at the time of financial crisis around 1997, when Hokkaido Takushoku Bank and Yamaichi Securities went bankrupt; after that, reflecting public money injection to banks, the share of replying "severe" decreased and that of "accommodative" increased. This is consistent with Figures 1 and 2, where the sectoral credit shifts declined significantly in the former half of the 1990s and have not

the 1990s contributed to the high σ^V at that time. However, we have reservations that the credit should have been shifted to this sector as the most competitive leading industry.

Figure 7: Efficiency of Labor Market and Credit Market



Note: For the left panel, the vertical axis is the unemployment rate and the horizontal axis is the job vacancy rate. For the right panel, the vertical axis is the share of firms answering "accommodative" at the *Tankan*'s Survey on lending attitudes of financial institutions, and the horizontal axis is that of firms answering "severe".

recovered much since then.[12]

3.3 Bank Health and Sectoral Credit Shifts

Finally we will examine the relationship between individual bank health and sectoral credit shifts made by the corresponding banks. If we can establish the relation that a bank with the weaker financial position has the less active sectoral credit shifts, we can conclude that the decline in the credit shifts in the 1990s was due to weaker financial intermediation. This is because, for an individual bank, its healthiness is supposed to be independent from the size of sectoral shifts.

We run the following panel regressions to see the relationship between bank health and its credit reallocation:

$$\ln \sigma_{jt}^{L} = \alpha X_{j,t-1} + d_t + \eta_j + \nu_{jt}. \tag{3}$$

where X_{jt} is a bank health indicator of bank j at time t; d_t is a time-specific effect; η_j is a bank-specific effect; and ν_{jt} is an idiosyncratic effect. σ_{jt}^{L} is calculated from outstanding

[12] As is well known, there was a shift in the Beverage curve in the left panel of Figure 7, which indicates the declining efficiency in the labor market in the 1990s.

Figure 8: Sectoral Credit Shifts at City and Long-term Credit Banks

Note: 1. Means and ranges of $\Delta_4 L$ are matched with those of σ^L.
2. Outstanding loans are aggregated over banks on calculation of $\Delta_4 L$.
3. σ^L is calculated as the simple average of those at individual banks.

loans by industry (six industries) for 14 banks from the Nikkei Financial Quest database. The chosen 14 Banks are 11 city banks and three long-term credit banks, some of which ceased to exist due to mergers, bankruptcy, or nationalization.[13] These banks are supposed to hold the role of main banks in Japan (Aoki and Patrick (1994)). Although the number of industries is rather small, the average of σ^L_{jt} shares a similar trend which we saw in Figures 1 and 2, in that it declined significantly in the 1990s (Figure 8). For the bank health indicator, the likelihood of default is calculated for each bank from its balance-sheet and share price using option pricing theory (Oda (1999), Fukao (2000)). We also use banks' rating dummies of Aaa to Baa3 obtained from Moody's. Furthermore, we run regressions of changes in outstanding loans of bank j (ΔL_{jt}) in place of $\ln \sigma^L_{jt}$ on the same explanatory variables.

Estimation results support that worsened bank health was responsible for a decline in sectoral credit shifts in the 1990s. A significantly positive coefficient on the default ratio implies that banks with the higher likelihood of default owing to, say, dilution of capital in line with swelling NPLs, are less active in reallocating credits across sectors (column (1) of Table 4). Similarly, the larger coefficients on the better ratings means that banks with the higher credit risk are more reluctant for shifting credits (column (2)). Meanwhile, banks with less healthy financial positions—the higher default likelihood or the lower ratings—tend to squeeze their loans more (columns (3)-(4)).

[13] σ^L_{jt} for a bank merging at time t is obtained from a linear interpolation of those of $t-1$ and $t+1$.

Table 4: Panel Regressions on Bank Health Indicators

	(1)		(2)		(3)		(4)	
Dependent	$\ln \sigma_{jt}^L$		$\ln \sigma_{jt}^L$		ΔL_{jt}		ΔL_{jt}	
Banks	14		14		14		14	
Samples	131		119		131		119	
R^2	0.27		0.43		0.11		0.43	
Default(-1)	-2.53	(2.41)			-0.77	(2.10)		
Aaa(-1)			1.35	(2.10)			0.10	(0.95)
Aa1(-1)			1.41	(2.08)			0.01	(0.05)
Aa2(-1)			1.30	(2.04)			0.01	(0.09)
Aa3(-1)			0.83	(1.36)			-0.07	(0.67)
A1(-1)			0.51	(0.84)			-0.12	(1.13)
A2(-1)			0.53	(0.88)			-0.15	(1.49)
A3(-1)			0.56	(0.95)			-0.15	(1.50)
Baa1(-1)			0.41	(0.71)			-0.16	(1.67)
Baa3(-1)			0.38	(1.14)			-0.15	(2.65)
T1991	0.26	(1.90)	-0.24	(1.28)	0.06	(1.25)	-0.06	(1.89)
T1992	-0.06	(0.44)	-0.17	(1.15)	-0.05	(0.99)	-0.05	(1.85)
T1993	-0.15	(1.08)	-0.20	(1.44)	-0.02	(0.32)	-0.03	(1.24)
T1994	-0.76	(5.35)	-0.46	(3.80)	-0.08	(1.68)	-0.02	(0.78)
T1995	-0.17	(1.14)	0.18	(1.48)	-0.08	(1.60)	-0.002	(0.09)
T1996	-0.27	(1.83)	-0.001	(0.004)	-0.06	(1.14)	0.04	(1.75)
T1997	-0.06	(0.42)	0.18	(1.34)	-0.09	(1.70)	-0.01	(0.29)
T1998	0.41	(1.97)	0.22	(1.58)	0.06	(0.82)	0.02	(0.81)
T1999	0.40	(2.09)	0.41	(2.24)	0.02	(0.32)	0.03	(0.88)

Notes:

1. The sample period is FY1990 to FY1999. The coefficients on Baa2 (rating dummy) and T1990 (time dummy) are normalized to nil.
2. Figures in parentheses are t-values.
3. Within group estimation of unbalanced panel by *DPD for Ox* (Doornik, Arellano, and Bond (1999)).

4 Conclusions

This paper constructs a simple measure of sectoral credit shifts, defined as the dispersion of growth rates of bank loans across sectors, and investigates what effects they had on Japan's economy and what accounted for their development. It finds that, in the 1990s, the amount of sectoral credit shifts declined significantly, and together with effects from declines in land prices and aggregate outstanding loans, stifled economic growth. It also finds that the drop in the credit shifts reflected weakened financial intermediation rather than a decrease in the size of sectoral shocks.

The above results can be interpreted as an example of aggregation problems with respect to outstanding loans. The fact that the sectoral credit shifts had significant effects on the real growth on top of effects from changes in aggregate outstanding loans implies that sectoral information cannot be ignored.[14] That is, we cannot treat aggregate outstanding loans as a variable that is determined by the sole representative agent. It is known that a wide range of macro-statistics have more or less similar problems. For instance, Hayakawa and Yoshida (2001) point out an aggregation problem associated with price indices, and Stoker (1986) confirms that of aggregate consumption functions. Similarly, even Lilien (1982) can be interpreted as an example of aggregation problems with respect to labor.

The paper shows that financial intermediation was weakened in the 1990s by impaired bank health, which reflected the exacerbated NPL problems. Sekine, Tanemura, and Saita (2001) discuss that the NPLs could hamper the real activities through a "credit crunch" and "forbearance"—banks might be reluctant from extending their credits to potentially profitable firms so that efficient firms are not brought up (credit crunch); and banks might also be reluctant from writing off bad loans to non-profitable firms so that inefficient firms survive (forbearance). Although at first sight they look quite different in that one is not to *expand* credits whereas the other is not to *shrink* credits, both of them have the same effect of preventing credits from shifting to relatively efficient sectors.

According to Schumpeter (1949), "The essential function of credit...consists in enabling the entrepreneur to withdraw the producers' goods which he needs from their previous employment, by exercising a demand for them, and thereby to force the economic system into new channels." (p.106) and "It is only thus [granting credit] that economic development could arise from the mere circular flow in perfect equilibrium." (p.107). From this point of view, we can interpret our empirical results indicating that financial intermediation, which was weakened by the NPL problems, stifled Japan's economy by preventing credits from shifting to relatively efficient sectors. Indeed, if banks do not withdraw their credits from inefficient firms, the economy will be held up as even inefficient firms will produce something, and also create demand through investment of their own and consumption of employees. In the long run, however, a continuous misallocation of resources

[14] Simple numerical examples are constructed in the following BOX to see that, in addition to changes in aggregate outstanding loans, the sectoral credit shifts have to be examined when there is concern about weaker financial intermediation.

will surely hamper economic growth.

In sum, this paper shows that a decline in sectoral credit shifts in the 1990s stemmed from weaker financial intermediation and in turn dampened real growth. This does not necessarily imply that any increase in sectoral credit shifts would be desirable, as the experience during the bubble period teaches us that credit might not always be reallocated to the profitable sector in an *ex post* sense. Nor does this paper necessarily imply that injection of public funds would restore bank health, as impaired bank health might reflect not only the banks' own scarce capital, but also lack of efficient bank management and proper credit assessment. As Maeda, Higo, and Nishizaki (2001) point out, stagnation of Japan's economy in the 1990s is thought to be rooted in a wide range of "structural" deficiencies including, in addition to weak financial intermediation, lack of flexibility in corporate management, inefficiency of the non-manufacturing sector, and many other factors.

As possible extensions of this research, first, it would be worthwhile to construct a more formal theoretical model. The analysis in this paper is based on a view related to a credit channel of monetary policy. However, as far as we know, no theoretical model has been constructed on the relationship between sectoral shifts of credit and economic growth. The endogenous growth model of Akiyama (1997) seems to be relatively close to the thrust of this paper, yet his model does not explicitly take sectoral credit shifts into account.

We also need further empirical studies, including an estimation of a more structural model. Our empirical results are based on a simple VAR model and a similarly simple panel analysis. Evidence found from job vacancies and *Tankan* D.I. supports our conclusion, but one may still argue that it is far from decisive evidence. Indeed, there are studies which claim, using microdata sets, that the accumulation of NPLs induced banks to take the forbearance policy and caused a credit crunch (Tsuru (2001), Sekine (1999)), but there has been no consensus about it. Though we always face considerable difficulty in gaining the *true* balance-sheet conditions of either firms or banks, we believe that further empirical studies on this subject are undoubtedly warranted.

[BOX] Outstanding Loans and Sectoral Credit Shifts

The following simple numerical examples are intended to clarify that sectoral credit shifts cannot be ignored when the economy is subject to sectoral shocks. Suppose that there are only two industries in the economy. Owing to some sectoral shocks, one becomes competitive/profitable and the other uncompetitive/unprofitable. At the end of last year, both industries had the same amount of outstanding loans: ¥10 billion.

- If a bank decreased the loan to the uncompetitive industry by ¥1 billion and extended that amount of loan to the competitive industry, credit would be reallocated properly but there would be no change in aggregate outstanding loans. That is, $\Delta_4 L_t = 0\%$ and $\sigma_t^L = 10\%$.
- If a bank could **not** decrease the loan to the uncompetitive industry (perhaps because of its "forbearance" policy) and could **not** increase the loan to the competitive industry (perhaps because of "credit crunch"), credit would not be reallocated at all. That is $\Delta_4 L_t = 0\%$ and $\sigma_t^L = 0\%$.

The point is that the above two cases would have the same $\Delta_4 L_t$ but would have totally different effects on the economy. The economy would grow faster in the former case, because of the better sectoral constellation of credits. Therefore, we need to look at the sectoral credit shifts to figure out the effects of credit channel.

However, this does not mean that we can ignore $\Delta_4 L_t$. The aggregate outstanding loan is informative when the economy is subject to macro-shocks such as a change in monetary policy. For instance,

- Because of the tighter monetary policy, the loans to both competitive and uncompetitive industries decreased by ¥1 billion, then $\Delta_4 L_t = -10\%$ and $\sigma_t^L = 0\%$.
- Because of the looser monetary policy, the loans to both competitive and uncompetitive industries decreased by ¥1 billion, then $\Delta_4 L_t = 10\%$ and $\sigma_t^L = 0\%$.

These examples show that σ_t^L does not respond to a macro-shock. For instance, if an incident such as collapse of a major bank made all remaining banks suddenly squeeze their loans to any industry for their liquidity concerns, then this could be a sort of macro-shocks. In this case, we cannot ignore $\Delta_4 L_t$.

Finally, "final disposal" (write-off, etc.) of bad loans has the following effect. Suppose that a bank wrote off ¥1 billion in bad loans to the uncompetitive industry, but did not increase its loans to the competitive industry for a while.

- The outstanding loans of the uncompetitive industry would decrease by ¥1 billion, i.e., $\Delta_4 L_t = -5\%$ and $\sigma_t^L = 5\%$.

This indicates that there are two opposite effects. Final disposals of the NPL exerted downward pressure on the economy as we expect an increase in unemployment and a decline in investment due to closures of unprofitable firms—this effect is captured as a decline in $\Delta_4 L_t$. However, it might increase the long-run growth rate because of better sectoral allocation of credit. That aspect is captured as an increase in σ_t^L.

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