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## Regulation Policy and Credit Crunch: Evidence from Japan

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### Abstract

This paper aims to answer the following question: what is (are) the cause(s) of the severe reduction in bank credits in Japan between 1999 and 2005? The answer to this question becomes very interesting if we know that during the above mentioned period an *ultra*-expansionary monetary policy has been implemented by the Bank of Japan. A theoretical lending-supply model is built. The methodological contribution of this work stands on the test of three credit crunch-hypotheses, all together. The estimation results show that during the period of study a credit crunch was, indeed, taking place and it is attributed to bankers' *precautionary* behavior rather than direct regulatory capital worries. The strengthening of the regulatory environment started in 1998 can explain the conservative lending behavior of Japanese banks during the period of study.

**Keywords:** credit crunch , voluntary-risk reduction hypothesis, bank regulation, dynamic model.

JEL classification: C23, G21, G28

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## 1. Introduction

The observation of the Japanese bank lending data since the beginning of the 1990s shows that until the last years of this decade the lending growth rate was alternating between positive and negative figures (Chart 1). However, since 1998, this alternation has changed and the year-to-year changes in bank credits have become persistently negative for almost five years. The registered figures during these five years were even lower than what has been registered in 1997; a year of a severe credit supply contraction (i.e., a *credit crunch*) according to many researches.

Thus, the question that one can ask is: What is (are) the cause(s) of this severe reduction in the availability of bank credits in Japan during the period (1999–2005)? The answer to this question becomes highly interesting if we know that during the abovementioned period an *ultra*–expansionary monetary policy has been implemented by the Bank of Japan; namely the *Zero–Interest Rate Policy* (the ZIRP) and the *Quantitative Easing Policy* (the QEP).

The low availability of bank credits can, evidently, be attributed to whether a weak lending enthusiasm on the part of banks (i.e., *supply side factors*) or a lower market demand for loans (i.e., *demand side factors*). Note that if the reduction in credits is attributed to supply–side factors, such a phenomenon is called by economists a *credit crunch*. This paper aims to find some answers to the abovementioned question.

Numerous economists have been interested on bank lending behavior and the credit crunch phenomenon, especially after the adoption by many developed countries of the capital regulation framework of the *Basel Accords* in 1988. Several research works have proven that this new framework, the regulatory capital ratio (i.e., the BIS ratio) in particular, was responsible for the credit crunches occurred in many developed countries such as the U.S. in the early 1990s and Japan in 1997.

In this paper we build a theoretical lending–supply model that will constitute the theoretical base on which stand the lending–supply regression that will be estimated afterwards.

With regard to the Japanese literature the methodological contribution of this work stands on the test of three credit crunch–hypotheses, all together, instead of just one hypothesis; that is the *impact of the capital adequacy ratio hypothesis*.

Working on a panel data of Japanese banks throughout the period between 1999 and 2005, the estimation results show that during the abovementioned period a credit

crunch was taking place and this credit crunch is attributed to bankers' *precautionary* and *risk-averse* behavior rather than direct regulatory capital worries as it was proven in 1997 by some research works. Indeed, bankers' worries about the risk of bankruptcy in conjunction with managers' concerns about their personal *specific human capital* have, obviously, weakened the enthusiasm and the willingness of the Japanese financial intermediaries to grant new loans. Several factors can explain such a prudent and a precautionary lending policy on the part of banks during the period of study; namely: 1) the strengthening of the regulatory environment after the adoption in 1998 of the *prompt corrective action* (the PCA) and the subsequent reinforcement of the legal pursuit measures that aim to clarify the liability of the executives of failed financial institutions, 2) the expected toughening in fund raising after the lift of the full coverage of all types of deposits projected to be in 2001,<sup>1</sup> 3) the abatement of the moral hazard problem in the system after allowing some financial institutions previously considered as *too-big-to-fail* to bankrupt<sup>2</sup> and 4) the persistent shrink in asset prices.

The remainder of this paper is organized as follows: Section 2 discusses the lending activity of Japanese banks during the period (1999–2005). Section 3 presents a literature review. Section 4 presents the theoretical framework. Section 5 provides the model specification. Section 6 describes the data and section 7 shows the results. And finally we conclude.

## 2. Overview of the Japanese Banking System

Since the fiscal year (henceforth, FY) 1999 through almost the third quarter of the FY2005 the lending volume has continued its declining tendency that started in the second half of the 1990s, but at a faster pace. The volume of loans was decreasing on average at approximately 4 percent every year<sup>3</sup> compared to an average of +0.3 percent each year between FY1992 and FY1998. In total, commercial banks' lending<sup>4</sup> has decreased by almost 20 percent<sup>5</sup> during the period between 1999 and 2005 against a total increase of two percent between FY1992 and FY 1998.

The decline in credits was more severe for the major banks than the regional

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<sup>1</sup> Later this date was postponed by one year.

<sup>2</sup> The Hokkaido Takushoku Bank failed on November 1997...etc.

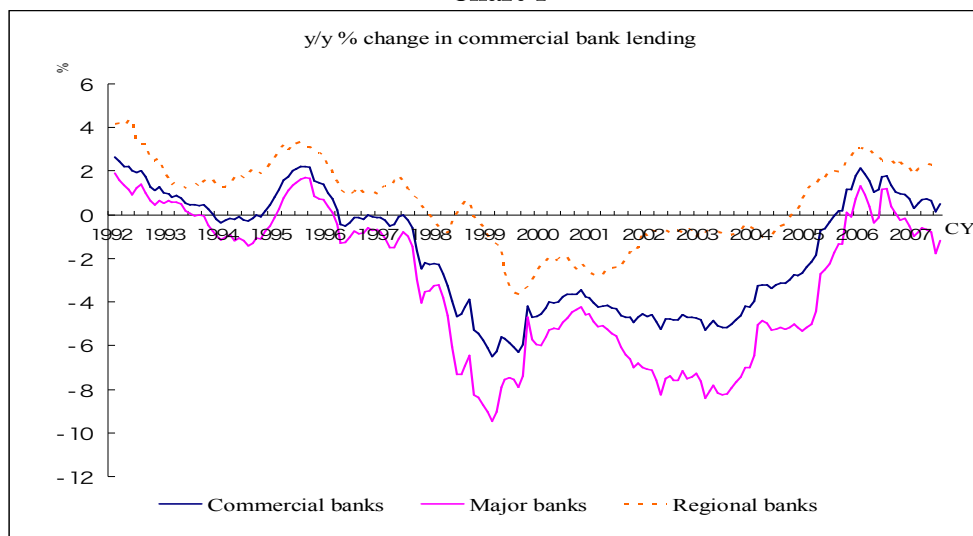
<sup>3</sup> (-5) percent until FY 2003

<sup>4</sup> It is intended by commercial banks: city banks, long-term credit banks, trust banks and regional banks and regional banks II.

<sup>5</sup> Statistics on the Deposits and Loans Market of the BoJ, 2008

banks. As shown by chart 1, major bank lending has, annually, decreased by more than 6 percent during a large part of FYs 2003 and 2004.

**Chart 1**



Source: BoJ

Note that the period (FY1999–FY2005) was characterized by two *ultra*-expansionary monetary policies namely *the Zero Interest Rate Policy* (the ZIRP) and *the Quantitative Easing Policy* (the QEP).<sup>6</sup>

As shown in chart 1, the annual growth rates of bank loans during the ZIRP–QEP period were the lowest since 1992 and even more negative than what had been realized in FY 1997; which was empirically proven to be a *credit crunch*<sup>7</sup> year by a broad literature (Woo, 2003 and Watanabe, 2007).

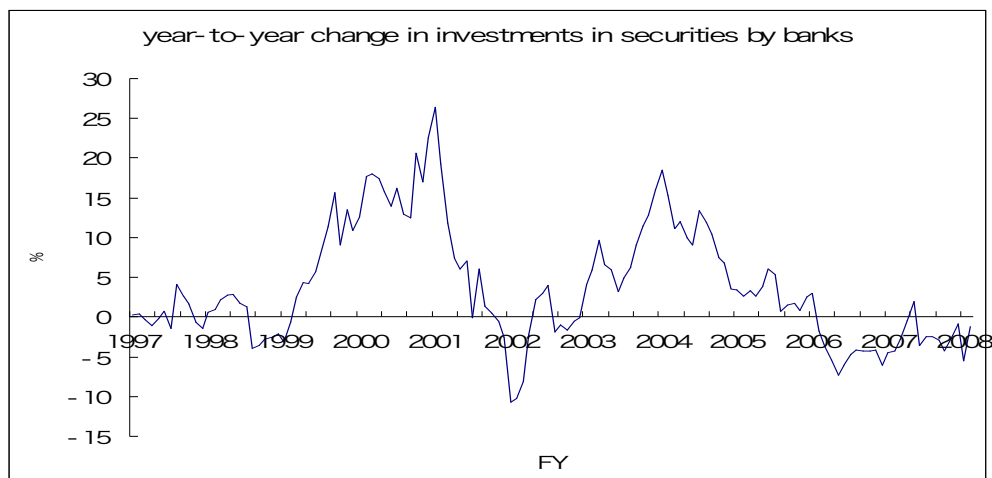
Outwardly, there are many signs of the occurrence of a *credit crunch*, during the period from FY1999 through FY2005, that motivate the investigation of this phenomenon in more depth. It is important to note that the balance sheet assets reallocation from loans to securities, as shown by charts 1 and 2, is considered in the literature as the *hallmark* of a *credit crunch* phenomenon (Wagster, 1999). Baba *et al* (2005) conclude that during the ZIRP–QEP period many factors including the *unwillingness* on the part of banks to extend new loans, due to capital limitations, have prevented firms with lower credit standings from *enjoying the easing effect of monetary*

<sup>6</sup> The expressions “the period (FY1999 – FY2005)” and “the ZIRP – QEP period” will be used interchangeably in this dissertation.

<sup>7</sup> To be defined later.

policy.<sup>8</sup>

Chart 2



Source: BoJ

In short, this research aims to answer the following questions:

*What are the causes behind the observed reduction in the availability of bank loans during the period (FY1999–FY2005)? Are these causes inherent to the suppliers' internal conditions or to the market conditions?*

### 3. Literature Review

Since the commencement of the implementation of the capital measurement system – commonly referred to as the *Basle Capital Accord* – by developed countries in the early 1990s, many economists have been interested in the impact of the *Risk-Based Capital Requirement* (RBC) and other types of regulatory capital standards on the banking behavior, particularly the lending activity. The underlying hypothesis tested is whether the pressure to meet the capital adequacy requirements could constrain banks from granting new loans as issuing new equity involves costs associated to the asymmetric information between investors and banks. The binding capital requirement applied on banks could cause a *credit crunch* and therefore harm seriously the real economy.

Bernanke et al. (1991) work constitutes a cornerstone paper in the *credit crunch* empirical literature. In their paper, they defined the *credit crunch* phenomenon as “*A significant leftward shift in the supply curve for bank loans, holding constant both the*

<sup>8</sup> The other factors developed by the authors are: the difficulty to issue bonds and the distressed asset markets.

*safe real interest rate and the quality of potential borrowers”.*

In their empirical investigation on the causes of the credit slowdown experienced by the U.S. banking system in the early 1990s recession, Bernanke et al. find arguments in favor of a *capital crunch* occurrence.<sup>9</sup> They argue that the *beginning-of-period* capital ratio was more stringent on the lending activity of small banks than the lending activity of large banks.

Peek and Rosengren (1995a), focusing on New England, argue that the formal regulatory actions, such as capital requirements, have played a key role in the *credit crunch* of the early 1990s. In another paper, Peek and Rosengren (1995b) provide evidence that capital-constrained and unconstrained banks react *differently* to the changes in the federal funds rate. A major implication of their findings is that the financial situation of the banking sector should be taken into account by the monetary policymakers. In a third paper, Peek and Rosengren (1995c) adopt an interesting approach that consist in focusing on deposits (*liabilities*) rather than loans (*assets*) to test the *capital crunch* hypothesis. This new approach aimed to limit the effect of the loan demand shocks. The authors find evidence of a *capital crunch* by obtaining a strong positive relationship between a bank’s capital shock and the growth rate of its deposits. Peek and Rosengren insist on the need of a greater appreciation by the regulators of the macroeconomic impact of the bank regulatory policy.

Conversely, Berger and Udell (1994) found that the *Risk-Based Capital* ratio (henceforth, the RBC)<sup>10</sup> does not explain *much* of the credit reallocation away from lending between 1990 (first quarter) and 1992 (second quarter). According to these authors the reduction in loan demand is primarily responsible for the observed fall in bank credits in the U.S. during the mentioned period. The one important methodological contribution, which differentiates their research work relatively to other papers, consists in including a *control period* in order to determine definitive conclusions about the existence a *credit crunch*.<sup>11</sup>

With regard to Japan many studies have been conducted also in order to test the implications of the *Basle Accords* on the credit activity. Honda (2002) and Montgomery (2005) have proved empirically the binding effects of these accords on bank credits. Ito

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<sup>9</sup> Expression first used by Richard Syron who was a member of the Federal Reserve Board’s monetary policy committee 1989-1994. In short capital crunch means a fall in bank capital.

<sup>10</sup> The Basel ratio and the risk-based capital ratio are used interchangeably.

<sup>11</sup> They define the credit crunch as a reduction in the credit supply relative to the normal supply.

and Sasaki (1998) argue that the risk-based capital requirement was a serious hurdle only for *internationally* active banks, i.e., city banks.

Peek and Rosengren (1997) argue that capital constraints brought on by the decline in the Japanese stock market were associated with the decrease in credits made by Japanese banks' branches in the U.S. market. Using the cross-section data of March 1993,<sup>12</sup> Ueda (1993) analyzes the effects of the bad loans, the latent capital gains, and the RBC ratio on bank lending in Japan and shows that the RBC did affect negatively the lending growth rate of city banks. Yoshikawa et al (1994) examine the same data and found that it was a *demand* decline rather than a *supply* shift that explains the plunge in granted credits. Honda et al (1995) attempt to measure the impact of the capital requirement ratio and the non-performing loans on the lending and show that these financial conditions affect *only* major banks' lending behavior.

Woo (2003), using the market-based capital ratio instead of the publicly available regulatory capital adequacy ratios, finds no evidence supporting the *capital crunch* hypothesis in the early years of the 1990s. Conversely, he finds that weak banks tended to increase their lending more rapidly than well-capitalized banks revealing, accordingly, the laxity of the regulatory policy in Japan during that time. Nevertheless, his paper gives strong evidence in favor of the occurrence of a *capital crunch* in 1997. Watanabe (2007) confirms this result and proves that the 1998's public funds injections into constrained banks did not offset the negative lending supply shock of the previous year. However, the author suggests that these public funds injections may have prevented the declining aggregate demand from getting worse.

#### 4. Model

On the basis of a micro-foundation analysis of a representative banking firm, we build an intertemporal lending model that will constitute the theoretical backbone of a regression to be estimated afterwards. It is worth to mention that, according to Rochet (2008), in today's banking activity one-period models necessarily miss important consequences of bank solvency regulations. Some of the credit crunch literature adopts an intertemporal approach.<sup>13,14</sup>

This micro-foundation analysis reposes on the maximization of a regulatory-

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<sup>12</sup> 21 city bank, long-term credit and trust banks and 129 regional banks.

<sup>13</sup> Bernanke et al. (1991), Ogawa and Kitasaka (2000) and Montgomery and Shimizutani, (2007).

<sup>14</sup> From an econometric point of view, dynamic models have the advantage of keeping away the problem of simultaneity that we can face with static models.



constrained profit function of a representative bank  $i$ . The first order condition–derived equation is then used to determine the loan–supply function. The same approach has been followed in Ogawa and Kitasaka (2000), Montgomery (2004) Montgomery and Shimizutani (2007).

In short, the theoretical approach consists in the maximization of *the profit function* of a bank  $i$ , under the subsequent two constraints:

- 1) *The balance sheet identity.*
- 2) *The prudential regulation constraint.*

#### 4.1 Theoretical Framework

Consider a representative banking firm  $i$  that has the following balance sheet structure:

<i>Assets</i>	<i>Capital and Liabilities</i>
<ul style="list-style-type: none"> <li>▪ <i>Loans (L)</i></li> <li>▪ <i>Securities (S)</i></li> </ul>	<ul style="list-style-type: none"> <li>▪ <i>Capital (K)</i></li> <li>▪ <i>Position in Money Market (M)</i></li> <li>▪ <i>Deposits (D)</i></li> </ul>

Thus, we have at time  $t$  the following balance sheet identity,

$$L_t + S_t = K_t + D_t + M_t \quad t = 0 \dots \infty \quad (1)$$

The bank  $i$  is assumed to be risk–neutral and pursue a profit maximization objective in a *perfectly competitive* credit market. Therefore, the interest rate,  $r^L$ , is considered as given. Moreover, the interest rates on the securities,  $r^S$ , the deposits,  $r^D$ , and the money market,  $r^C$ , are also assumed to be given.<sup>15</sup>

If the bank  $i$  is constrained by the prudential regulation, the following capital constraint a la Kashyap and Stein (1994) applies:

$$\mu L_t \leq K_t \quad (2)$$

Where:  $\mu$  is the minimum regulatory-imposed level of the capital–to–assets ratio.

According to the balance sheet structure, the representative bank  $i$ 's revenue is composed by interest incomes on loans and securities:

$$r_t^L L_t \quad (3)$$

$$r_t^S S_t \quad (4)$$

In the other hand, the bank  $i$  is subject to the following costs:

<sup>15</sup> The last argument is not illogical since interest rates on the money market are fixed by the Central Bank.

a) Interests paid on deposits:  $r_t^D D_t$  (5)

b) Interests paid on the position on the money market:  $r_t^C M_t$  (6)

c) Cost of default on loans:  $\theta_t L_t$  (7)

The theta,  $\theta_t$ , is the percentage of defaults on loans that depends on some macroeconomic factors to be spelled out shortly below.<sup>16</sup>

d) Adjustment costs:<sup>17</sup> It is assumed that the bank i's adjustments costs have the following –quadratic–function

$$\frac{h_0}{2} L_t^2 + \frac{h_1}{2} (L_t - L_{t-1})^2 \quad (8)$$

Where:  $h_0 > 0$  and  $h_1 > 0$ <sup>18</sup>

Statement of the optimization problem:

The profit of the representative bank i is the discounted sum of the future net cash flows. Hence, after taking into account equations (1) to (8), the profit function  $\pi$  becomes as follows:

$$\pi_i = E \sum_{i=0}^{\infty} b^i \left[ \left( r_{t+i}^L L_{t+i} + r_{t+i}^S S_{t+i} \right) - \left( D_{t+i} r_{t+i}^D + r_{t+i}^C M_{t+i} + \theta_{t+i} L_{t+i} + \frac{h_0}{2} (L_{t+i})^2 + \frac{h_1}{2} (L_{t+i} - L_{t+i-1})^2 \right) \right] \quad (9)$$

Where:

$$i = 0 \dots \infty$$

*E[.]*: mathematical expectation operator conditional on the information available in period t.

*b* is the discount factor assumed to be equal one when  $i = 0$

Replacing M by its expression,  $M_t = L_t + S_t - K_t - D_t$ , the profit function (9) is then read:

$$\pi_i = E \sum_{i=0}^{\infty} b^i \left[ \left( r_{t+i}^L L_{t+i} + r_{t+i}^S S_{t+i} \right) - \left( D_{t+i} (r_{t+i}^D - r_{t+i}^C) + r_{t+i}^C L_{t+i} + r_{t+i}^C S_{t+i} - r_{t+i}^C K_{t+i} + \theta_{t+i} L_{t+i} + \frac{h_0}{2} (L_{t+i})^2 + \frac{h_1}{2} (L_{t+i} - L_{t+i-1})^2 \right) \right] \quad (10)$$

<sup>16</sup> With a purpose of simplification it is assumed that bank i's customers default on loans and not on interests' income. Therefore,  $\theta$  applies only on the stock of loans and not on the underlying amount of interests.

<sup>17</sup> In addition to interest cost there are several costs associated with banking activities. Blackwell and Santomero (1982), Lane (1985) and Stanhouse (1983) argue that if banks want to issue loans to the general public, then the banks must devote resources to the evaluation of the credit rating of the customer, as well, as the administration and monitoring of the loan during its duration. If there is a change in the amount of the loans issued by the banks, then the banks need to adjust the amount of the resources allocated to loan activities.

<sup>18</sup> The smoothness of the stock of loans trend and the plausible estimation results, as we will see later, dismiss the potentiality of a very-near-to-zero value for  $h_0$  and  $h_1$ .

Thus, the maximization of the bank i's profit function  $\pi$  under the prudential regulation constraint (2) can, mathematically, be stated as follows:

$$\text{Max}\pi_i = E \sum_{i=0}^{\infty} b^i \left[ \left( r_{t+i}^L L_{t+i} + r_{t+i}^S S_{t+i} \right) - \left( D_{t+i} (r_{t+i}^D - r_{t+i}^C) + r_{t+i}^C L_{t+i} + r_{t+i}^C S_{t+i} - r_{t+i}^C K_{t+i} + \theta_{t+i} L_{t+i} \right) \right] \text{s/c}$$

$$\mu L_t \leq K_t$$

The maximization of the profit function (10) subject to the prudential regulation constraint (2), yields the following Euler equation:

$$E[L_{t+1}] = \frac{(h_0 + h_1(1+b))}{bh_1} L_t - \frac{1}{b} L_{t-1} - \frac{1}{bh_1} (r_t^L - r_t^C) + \frac{1}{bh_1} \theta_t + \frac{\mu}{bh_1} \lambda_t \quad (11)$$

Where,  $\lambda_t$ , is the *Lagrange* multiplier associated with the prudential regulation constraint.

## 5. Empirical Model

### 5.1 Credit Crunch Hypotheses

The theoretical model defined in the previous section will represent the backbone of the lending–supply function that will be estimated later in this paper. However, in order to explore thoroughly the type of a potential credit crunch that might have been taking place during the ZIRP–QEP period, some other credit crunch hypotheses should be tested in conjunction with the prudential regulation hypothesis.<sup>19</sup> Consequently, some other hypotheses–representative variables should be taken into account by the model defined earlier. Wagster (1999) says that the empirical literature regarding the U.S.–credit crunch has examined several supply–side hypotheses in addition to the *impact of the capital adequacy ratio hypothesis*<sup>20</sup> (Syron, 1991; Bernanke et al, 1991; Peek and Rosengren, 1995a), principally<sup>21</sup>:

- *The voluntary risk-reduction hypothesis*, also called *the risk aversion hypothesis* (Bacon and Wessel, 1991; Hancock and Wilcox, 1992).
- *The intensive regulatory scrutiny hypothesis* (Owens and Schreft, 1993; Greenspan, 1992; LaWare, 1991).

*c-1- The voluntary risk-reduction hypothesis or the risk-aversion hypothesis:*

<sup>19</sup> Also called the *impact of the capital adequacy ratio hypothesis*, represented by the prudential constraint in equation (2)

<sup>20</sup> Also called *the impact of loan losses on bank equity capital hypothesis*.

<sup>21</sup> The credit crunch literature includes also another hypothesis called *the introduction of new capital regulations hypothesis* (Baer and McElravey, 1994). Through the test of this hypothesis, economists wanted to investigate the impact of the *Basle Accords* on the behavior of banks.

Shrieves and Dahl (1992 and 1995) point out that the bank's *private incentives* to reduce risks (i.e., loans) are consistent with *the bankruptcy cost avoidance* and *the managerial risk aversion* theories of capital structure and risk taking behavior (Orgler and Taggart, 1983 and Saunders et al 1990). According to these theories, banks may have an incentive to reduce their portfolio risk in order to reduce the *probability of bankruptcy* and therefore avoid the expected bankruptcy costs.<sup>22</sup> Managers, as well, may have an incentive to reduce the risk of *bank insolvency* below the level desired by stockholders since managers, who are assumed to be compensated with risky fixed claims on the bank and who, have firm and industry *specific human capital*, have a great deal to lose personally in the event of the risk of *bank insolvency*. The managerial risk aversion theory finds bases also in Dewatripont and Tirole (1993) who state that in order to avoid *interference* from debtholders (or their representative<sup>23</sup>), managers would be more disciplined.

According to Shrieves and Dahl (1995), bankers' *conservatism* can, practically, increase as a result of some regulatory changes –such as imposing heavy fines on managers– and/or perhaps as a result of the changing economic climate.

Obviously, during the period between 1999 and 2005 there are many signs of an increased conservatism among Japanese banks. Firstly, as shown by the chart 3, there is no uniformity in the decreasing pace among the credit categories.<sup>24</sup> Secondly, as shown by the charts 1, 2 and 4, the period of study is characterized by an asset reallocation from loans to securities in *conjunction* with an increase (or unchanged) risk-based capital ratio. Thirdly, some regulatory reforms carried out just before and during the ZIRP–QEP period might have diminished the *willingness* of banks to lend in ways which extended beyond the targeted loan-specific limitations. Indeed, the banking supervisory body won more independence from the political influence and the legal pursuit measures related to the clarification of the liability of the executives of failed financial institutions were strengthened.

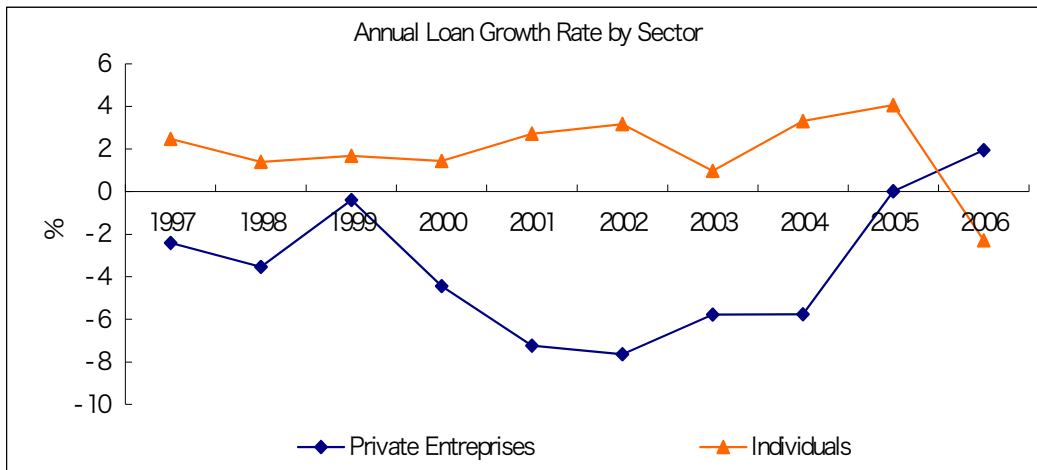
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<sup>22</sup> The value of expected *bankruptcy costs* is an increasing function of *the probability of bankruptcy*.

<sup>23</sup> The debtholders representative is indeed the regulator of banks.

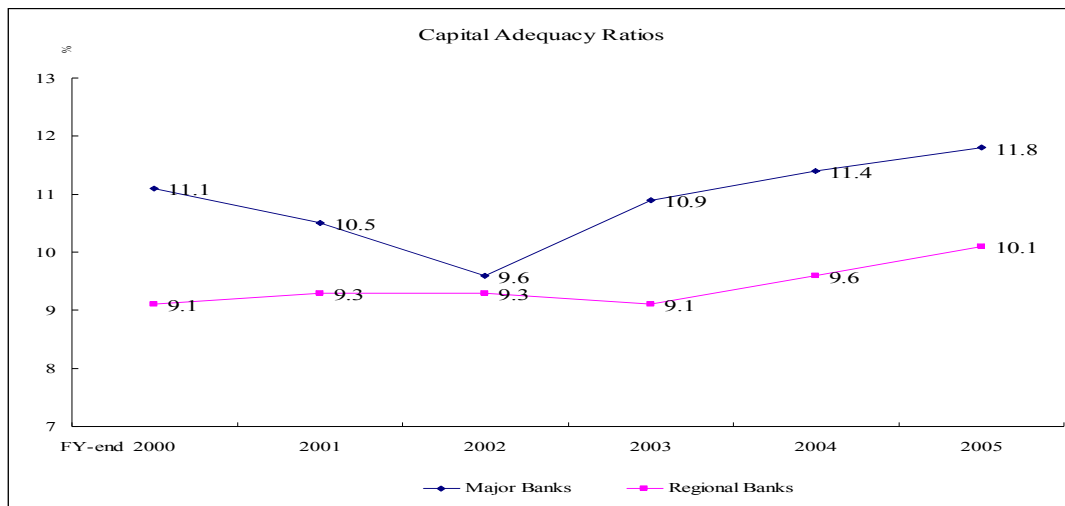
<sup>24</sup> Note that when calculating the BIS or the Tier1 ratios, the weight applied to private sector's loans is 100%

**Chart 3**



Source: BoJ

**Chart 4**



Source: BoJ

*c-2- The intensive regulatory scrutiny hypothesis:*<sup>25</sup>

There are many evidences that motivate the investigation of the potential impact of the regulatory scrutiny on banks lending decisions in Japan. As a matter of fact, some dramatic changes in bank regulations have been implemented by the Japanese government since the late of the 1990s. These risk-control measures refer, principally, to: 1) the ratification of the Bank of Japan law that established its independence and explicitly confirmed the right to examine its counterparty financial institutions, 2) the reform of the banking law by establishing the *Prompt Corrective Action* (henceforth *the*

<sup>25</sup>

In Bernanke et al. (1991)'s terms this factor is called "overzealous regulation."

PCA) procedure and the Financial Supervisory Agency (the FSA).<sup>26</sup> The FSA was established with the purpose to oversee the rehabilitation of the financial sector and improve supervision, 3) enhancement of the disclosure standards on banks' assets quality, 4) the obligation to disclose banks' financial information on a consolidated basis. It is important to mention that, since the beginning of the 2000s, the FSA has conducted two rounds of special inspection leading to more realistic loans quality assessment.

Moreover, and following the same reasoning as LaWare (1991), it is worth noting that after the costly failures of financial institutions in the second mid of the 1990s, there might be a *natural* tendency from Japanese examiners to become more *pessimistic* and *skeptical* in their evaluation of loans.

## 5.2 Model

### 5.2.1 Assumptions

With the purpose to estimate the model in equation (11), several additional assumptions have yet to be taken:

a – The cost of default on loans,  $\theta$ , depends on some macroeconomic factors. According to the *debt-deflation theory* as extended by Tobin (1980), the *erosion* of collaterals because of deflation forces banks to restrict credits to borrowers. In this sense, Keynes (1932) argued that “...the decline in prices during the great depression eroded the value of the margin that provided the security offered by the borrowers to the lender....” This development has threatened the solvency of U.S. banks at that time (Wolfson, 1996). Hence, we can say that the cost of default,  $\theta$ , depends on the collaterals' prices evolution. Indeed, as the collaterals' prices increase, the security provided to lenders is consequently enhanced, and therefore the cost of default on loans,  $\theta$ , decreases (and vice-versa).

The cost of default on loans depends also on the evolution of the economic climate as well. In fact, a recessionary business cycle exerts pressures on the corporate sector cash flows and harms, consequently, its creditworthiness and its ability to reimburse its debts and arrears. As a result, the costs related to the default on loans jumps during recessions.

According to the above analysis, the percentage of defaults on loans,  $\theta$ , can be

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<sup>26</sup> The old name of the current Financial Service Agency.

formulated as a function of the changes in collateral prices and business conditions. Since Japanese banks rely massively on *lands and real estates* as collaterals<sup>27</sup> the *land price growth rate* will be employed as a representative variable for the collateral price changes. To reflect changes in business conditions the *GDP* growth rate is employed.

For the sake of simplification, it is assumed that  $\theta$  is a linear function on land price and GDP growth rates:

$$\theta_t = \theta\left(\left(\frac{\Delta LP}{LP}\right)_t; \left(\frac{\Delta GDP}{GDP}\right)_t\right)$$

Where:  $\frac{\partial \theta}{\partial \left(\frac{\Delta LP}{LP}\right)} < 0$  and  $\frac{\partial \theta}{\partial \left(\frac{\Delta GDP}{GDP}\right)} < 0$

b – The *Lagrange* multiplier,  $\lambda$ , in the equation (11) per se is not observable and therefore must, for empirical purposes, be substituted by an observable proxy. The unobservable variable,  $\lambda$ , is interpreted as the marginal increase of the bank *i*'s objective function – i.e., the profit function – when the inequality constraint,  $\mu L \leq K$ , is relaxed by one unit. The degree to which the inequality constraint is severe might be measured by how distant the observed capital adequacy ratio is from the required level (either 8% or 4%). It can be argued, hence, that as the risk-based capital ratio goes downturn, as the *Lagrange* multiplier  $\lambda_t$  increases. Consequently, this argument justifies the inclusion of the observable BIS ratio as a proxy of the unobservable ( $-\lambda_t$ ) in the equation (11).

c – Although, the *impact of the capital adequacy ratio hypothesis* is usually represented in the literature by whether the BIS ratio or the Tier1 ratio, there are some limits and no consensus among researchers concerning the effective representative variables that can reflect the second and the third hypotheses (Shrieves and Dahl, 1995). Indeed, In order to represent the *voluntary risk-reduction hypothesis* in the equation (11), we should hire a variable that embodies the bankers' perceived *expected* risk of insolvency.<sup>28</sup> We follow Berger and Udell (1994) and employ the *unweighted book-based capital ratio (the BBCR)* as a representative variable for *the voluntary risk-reduction hypothesis*.<sup>29</sup> The underlying logic lies firstly on the *bankruptcy cost*

<sup>27</sup> Shimizu (2000)

<sup>28</sup> Bankers could be managers and/or owners of the banking firm.

<sup>29</sup> It is worthy to note that Shrieves and Dahl (1995) argue that finding an indicator that adequately captures changes in expectations regarding loan risk is not an incontestable task. In fact, the percentage of non-performing loans, used in some of the literature, measures the quality of the loans

*avoidance* and *the managerial risk aversion* theories. Secondly, *the voluntary risk reduction hypothesis* would be more identified with the *unweighted* book-based capital ratio (the BBCR) which is a *purser* measure of the *–expected–* risk and less related to the *regulation* than the *weighted* capital-to-asset ratios and the percentage of the non-performing loans.

With regard to *the intensive regulatory scrutiny hypothesis*, we employ the percentage of non-performing loans (the NPL) as a representative variable in the lending supply function (11). In fact, it is highly expected that as the percentage of delinquent loans increases in the balance sheet as the intensity of scrutiny applied by the regulator on the banking firm increases.<sup>30</sup>

Burger and Udell (1994) recommend that it is necessary that all risk variables, (i.e., the BIS, the BBCR, the NPL), be included in the loan-supply functions together since they are expected to have a high degree of intercorrelation; if some of the risk variables were excluded, then, their effect may be falsely incorporated in the measured effects of the included risk variables, possibly, yielding improper support for one hypothesis when the other is true. This point represents a methodological advantage of this research with regard to previous works in the Japanese credit crunch literature.

Finally, an important theoretical device is further used. Indeed, it is assumed that, on the basis of the information available in period  $t$ , the bank  $i$  forms its expectations *rationally*.<sup>31</sup> Therefore, the expected future lending level,  $E[L_{t+1}]$ , can be substituted by the actual lending value,  $L_{t+1}$ , and a forecast error term,  $\xi_{t+1}$ ; consequently we have:  $E[L_{t+1}] = L_{t+1} + \xi_{t+1}$ .

#### 4.2.2 Regression

After considering the abovementioned assumptions, the estimable equation of the dynamic model (11) becomes as follows:

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which have already been made and hence does not necessarily reveal risk expectations. Moreover, if changes in risk perception or risk aversion are a manifestation of some changes in the regulatory climate, it is difficult to distinguish their effects from the more direct impact of changes in regulatory minimum capital requirements which is a separate focus in the analysis.

<sup>30</sup> The regulatory reforms of the late 1990s and the subsequent rounds of portfolio examination carried out by the FSA represent some evidence in favor of the increase in the scrutiny of the regulator (as opposed to the laxity of the first half of the 1990s proved by Woo (2003)) and the high quality of the NPLs as an indicator of the scrutiny. Berger and Udell (1994) employ the same variable.

<sup>31</sup> This theoretical device was employed in Ogawa and Kitasaka (2000).



$$L_{it} = \beta_0 + \beta_1 L_{it-1} + \beta_2 L_{it-2} + \beta_3 (r_{it-1}^L - r_{it-1}^C) + \beta_4 BIS_{it-1} + \beta_5 BBCR_{it-1} + \beta_6 NPL_{it-1} + \beta_7 \left( \frac{\Delta GDP}{GDP} \right)_{jt-1} + \beta_8 \left( \frac{\Delta LP}{LP} \right)_{t-1} + \xi_{it} \quad (12)$$

Where:

*BBCR*: the unweighted book-based capital ratio

*NPL*: the percentage of the non-performing loans in total loans

$$\beta_1 = \frac{(h_0 + h_1(1+b))}{bh_1}; \beta_2 = -\frac{1}{b}; \beta_3 = -\frac{1}{bh_1}; \beta_4 = \frac{\mu}{bh_1}; \xi_{it} \text{ is an error term}^{32}$$

All the other variables in the equation (12) are already defined earlier.

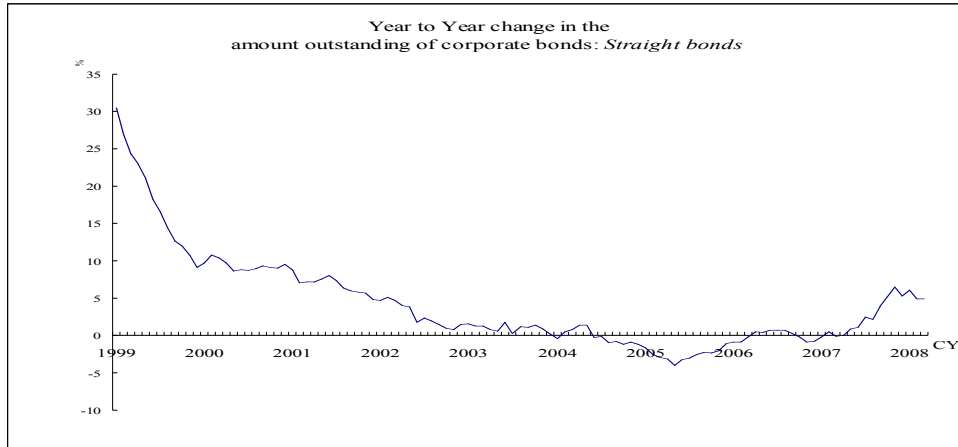
Needless to say that in addition to the supply-side explanation, represented by the capital ratios (the RBC and the BBCR) and the percentage of non-performing loans (the NPL), the land price and the GDP variables represent the demand-side explanation of the lending behavior. As noted earlier, the conjunction of falling prices of real estates (and other assets) and recessionary pressures on corporate cash flows affect adversely potential borrowers' net worth. Bernanke et al.(1991) argue that for a given set of investment opportunities, borrowers who are less creditworthy will have lower effective demand for external finance at given values of the safe real interest rate.<sup>33</sup> As shown by the chart 5, some support for the demand-side explanation comes from the fact that nonbank credit extensions also diminished substantially during the ZIRP-QEP period.

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<sup>32</sup> It should be noted that the forecast error  $\xi_{it}$  is uncorrelated with any variables contained in the bank's information set in period t under the rational expectation assumption. This property is very useful in solving the problem of simultaneity between lending level and capital adequacy ratios (the BIS and the Tier1 ratios).

<sup>33</sup> We should acknowledge, however, that the land price (LP) and GDP growth rates can be viewed as economic outlook indicators and considered, hence, by banks as indexes for the establishment of their future lending *supply* plans. This fact shows the difficulty of separating the decrease in demand that normally occurs in a recession from the diminished supply of loans. This difficulty was, according to Peek and Rosengren (1995 c), hampering the empirical investigation of credit crunches.

**Chart 5**



Source: Japan Securities Dealers Association

## 6. Data Set Description

The sample chosen comprises all commercial banks continuously active between FY 1999 and FY 2005. Since the *credit crunch* represents a change in bank behavior, banks affected by banking failure, liquidated or nationalized as well as banks having experienced rescue mergers or acquisitions are dropped from the sample because their end-of-period balance sheet is zero. Their inclusion would bias the results towards finding a relationship between capital and credits shrinkage that represent insolvency rather than changes in bank behavior.<sup>34</sup> The banking firms that changed their status from *internationally* active bank to *domestically* active bank (or the reverse), through the period of study, are dropped from the sample as well.

Merged banks are treated as one entity for the entire sample period.<sup>35</sup> As a result, the retained sample includes 108 banks (2 city banks, 103 regional banks and 3 trust banks) representing about 73 percent of the total banking assets in FY 2005.

Data sources are the Japanese Bankers Association Reports (Zenginkyo), the Bankscope Database (Bureau Van Dijk), the stock exchange markets reports, the Financial Statements of Japanese Banks and the Bank of Japan statistics.

<sup>34</sup> Sampling method used by Peek and Rosengren (c 1995) and Watanabe (2007)

<sup>35</sup> Method employed by Peek and Rosengren in many of their paper researches.

**Table 1. Descriptive Statistics**

<i>Major Banks</i>						
	N	Mean	Median	Stand. dev	Min	Max
Total Assets (billion yen)	35	60,193.1	25,612.4	54,722.8	11,888.8	162,395.5
Total adjusted outstanding amount of lending (billion yen)	35	32,300.6	11,881.8	29,267.2	7,219.2	84,384.8
Total amount of bad loans (billion yen)	35	1,961.8	960.1	2,171.1	77.474	9,060.4
BIS ratio %	35	11.26	11.36	1.32	6.71	14.6
<i>Regional Banks</i>						
	N	Mean	Median	Stand. dev	Min	Max
Total Assets (billion yen)	721	2,282	1,785.8	1,946.7	243.8	10,655.2
Total adjusted outstanding amount of lending (billion yen)	721	1,522.2	1,206.4	1,307.2	181.8	8,141.6
Total amount of bad loans (billion yen)	721	101	78.3	87.6	8	556.5
BIS ratio %	721	9.2	9.21	1.64	0.45	13.9

## 7. Results

Tables 2, provides the estimation results of the dynamic lending–supply model (12) for all viable banks during the sample period between FY1999 and FY2005. In all specifications, two risk-based capital ratios are used, namely the BIS ratio and the Tier1 ratio.<sup>36</sup>

The estimation method employed is the general method of moments technique (the GMM) originally developed by Hansen (1982). The list of instruments used in the estimation include the twice and thrice lagged lending growth rates,  $\Delta \ln(L)$ , the lagged interest rate differential,  $(r^L - r^C)$ , the lagged *weighted* risk – based capital ratio, the BIS ratio or the Tier1 ratio, the lagged *unweighted* book – based capital ratio, the BBCR, the lagged percentage of non-performing loans, the NPL, the lagged land price growth rate,  $\Delta \ln(LP)$ , and the lagged GDP growth rate, the  $\Delta \ln(GDP)$ . Before going into the depth of the analysis, note that in both regressions the tests of overidentification restrictions – i.e., the J-statistic – do not reject the null hypothesis at the one percent level.<sup>37</sup> This result reveals that the dynamic specification is not misspecified and the choice of the

<sup>36</sup> The software used for the econometric estimation is EVIEWS 6.

<sup>37</sup>  $H_0$ : All overidentification restrictions are valid.

instruments is satisfactory.

Regardless of the type of the *weighted* capital ratio employed, the estimation results in both regressions agree to each other. The *unweighted* BBCR coefficient estimates have the expected positive sign and are highly statistically significant in both regressions. This finding shows that, during the period of study, less-capitalized banks were more reluctant to grant new loans than well-capitalized ones.

Moreover, the regulatory weighted capital ratios and the NPL coefficient estimates have the right theoretical signs but are not significantly different from zero. The coefficient estimates of the monetary policy variable, namely the interest rate differential,  $(r^L - r^C)$ , have the theoretically predicted negative signs but are not significantly different from zero. This result shows clearly that the expansionary monetary policy implemented during the period of study was ineffective.

In general, these findings reveal that *expected-risk worries* rather than *regulatory concerns* were responsible for the reluctance of a broad number of Japanese banks to make loans.

**Table 2- Dynamic Model**

Dependent variable: $L_{jt}$	GMM	GMM
$L_{it-1}$	0.366655 *** (7.093634)	0.372340*** (7.119320)
$L_{it-2}$	0.081733 *** (3.006829)	0.079438*** (2.873483)
$(r^L - r^C)_{t-1}$	-20.25376 (-0.682863)	-17.49987 (-0.605501)
$BIS_{it-1}$	4.675904 (1.144461)	
$Tier1_{it-1}$		2.055220 (0.523092)
$BBCR_{it-1}$	11.26264 ** (2.168533)	12.62782** (2.278001)
$NPL\_share_{it-1}$	-0.523926 (-0.278845)	-1.318374 (-0.655646)
$(\Delta LP/LP)_{t-1}$	17.04311*** (3.257073)	16.81678*** (3.280330)
$(\Delta GDP/GDP)_{jt-1}$	0.516997 (0.612987)	0.429589 (0.489378)
J-statistic (p-value)	8.340113 (68.2%)	9.264896 (59.7%)
Number of Obs.	756	756

On the subject of the loan demand-side variables, both coefficient estimates are, in accordance with the theory, positive but only the lagged land price growth rate's coefficients are highly statistically significant. However, this result appears to confirm *private incentives-driven credit crunch* rather than a demand-side explanation. In fact, as it was pointed out by Shrieves and Dahl (1995), banker *conservatism* can rise as a result of an instable economic climate. The continuous shrink in the land prices (table 3) seems to confirm bankers' *precautionary lending policy* that the economic recovery, observed since the FY 2003 (table 3), was not sufficient to alleviate. These findings, hence, are in favor of *the voluntary risk-reduction hypothesis* rather than any other hypothesis.

**Table 3- Selected Economic Indicators in Japan between FYs 1999 and 2006**

	Real GDP growth rate	Unemploy- ment rate	CPI	GDP deflator	Land Price (2000=100)
1999	0.7	4.7	-0.3	-1.4	106.1
2000	2.2	4.7	-0.8	-1.9	100
2001	-0.5	5.0	-0.7	-1.5	93.7
2002	0.1	5.4	-0.9	-1.6	87.4
2003	1.8	5.4	-0.3	-1.6	81.2
2004	2.3	4.7	0.0	-1.2	74.4
2005	2.6	4.4	-0.3	-1.3	69.1
2006	2.0	4.1	0.0	n.a.	65.7

Source: IMF and Japan Real Estate Institute

The empirical demonstration of the credit crunch and its risk–aversion (or voluntary) nature – as opposed to the regulatory-driven credit crunch of the late 1990s – confirms the arguments advanced earlier in favor of the investigation of *the voluntary risk–reduction (or risk–aversion) hypothesis*. The *precautionary lending policy* followed by the Japanese banks during the ZIRP–QEP period is most likely attributed to the regulatory changes and the economic and the banking environment that characterized Japan since the late 1990s particularly. Obviously, the adoption of the *Prompt Corrective Action* procedures (*the PCA*) in the late 1990s seems, in the light of the theory of Dewatripont and Tirole (1993)<sup>38</sup>, to have *disciplined* banks’ decision makers. Indeed, since the PCA is concise “*objective*” information–based procedures of public interventions in case of poor performance, bank managers appear to have started being more cautious than before about the *bankruptcy risk* of their institutions and that in order to avoid the *interference* of the regulator.<sup>39</sup> This behavior becomes more urgent when the economy is characterized by an instable growth and a non-stop shrink in collateral prices as it was the case during the ZIRP–QEP period. Thus, the PCA framework appears, clearly, to have disciplined Japanese bankers by weakening their *regulatory forbearance anticipations*. It is most likely that since the late 1990s<sup>40</sup> Japanese bankers have raised their *target* capital ratios (or *optimal* capital ratios) with the perspective to have a sufficient capital *buffer* that can absorb any potential shocks that might hit their financial institutions and cause their failure accordingly.

Note that further and not less important regulatory events have most likely increased the *sensitivity* of Japanese bankers towards risk. The first event is the

<sup>38</sup> This theory defines the principle of *external interference rights* in the internal management of the bank by the debtholders’ representative when it is not performing well.

<sup>39</sup> i.e. the debtholders representative

<sup>40</sup> The beginning of the period of study.

strengthening, since 1998, of the legal pursuit measures that aim to clarify the liability of the executives of failed financial institutions. The second event is the implementation, since 2002, of the Takenaka's<sup>41</sup> banking reinforcement policy whose objective was to resolve the longtime annoying problem of bad assets focusing especially on those held by major banks.<sup>42</sup> Moreover, from the perspective of the late 1990s, Japanese bankers likely wanted to reduce their *bankruptcy risk* so as to lower their *expected* cost of uninsured funding after the intended lift of the *blanket deposit guarantee* of all types of deposits expected to be in FY 2001<sup>43</sup> and its substitution by a *partial* coverage of the time deposits. Imai (2006), Murata and Hori (2006) and Inakura and Shimizutani (2008) have demonstrated, indeed, a significant increase in the deposit market discipline since 2002.

On the other hand, the series of bank failures that have occurred in Japan during the second mid of the 1990s might have served as a lesson for the “surviving” banking sector and, consequently, increased its risk-averseness and *self-discipline*.<sup>44</sup> It is worthy to note that the failure of an important and big bank such the *Hokkaido Takushoku Bank* on November 1997 has, according to Woo (2003), weakened the moral hazard in the system and particularly the “*too-big-to-fail*” sentiment.

## 8. Conclusion

Obviously, the empirical results attribute the severe and continuous decline in bank credits during the period between 1999 and 2005 to, principally, some supply-side factors confirming therefore our suspicion about the occurrence of a credit crunch. The test of three possible causes, all together, has revealed that this credit crunch is driven by bankruptcy-risk worries rather than direct regulatory capital worries as it was the case in 1997, according to a large consensus in the literature.

The regulatory reforms implemented by the authorities since the late 1990s and the deposit insurance design policy appear to have played an important role in

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<sup>41</sup> Heizo Takenaka a former Keio University professor was also the Minister of State for Economic and Fiscal Policy, replaced in October 2002, Hakuo Yanagisawa in the post of minister in charge of the FSA.

<sup>42</sup> Takenaka's policy is implemented through two programs: “The Program for Financial Revival” and “The Action Program Concerning Enhancement of Relationship Banking Functions”

<sup>43</sup> Later, this plan was postponed by one year and the blanket deposit guarantee was lifted in FY 2002.

<sup>44</sup> Saunders et al (1990) argue that risk-averse behavior may limit bank risk-taking.

increasing the awareness of the Japanese bankers toward their *expected* risk and in forcing them, accordingly, to pursue a more prudent lending policy throughout the period between 1999 and 2005. In fact, the adoption of the PCA's structured procedures of intervention in 1998 has, obviously, limited the *forbearance margin* that the banking supervisor used to have with distressed banks and reinforced therefore the *self-discipline*. Bankers have become more conscious about their bankruptcy risk especially in an environment characterized by a persistent fall in assets' prices.

It is worthy to note that the period (FY1999–FY2005) can be considered as an essential and an ineluctable adaptation period for the Japanese bankers to the highly significant regulatory reforms that were introduced by the government since the second half of the 1990s. Indeed, Japanese banks have had to follow a very prudent lending policy in order to adjust themselves to a new regulatory and banking environment. This adjustment has taken more than five years and the positive lending growth rates, registered since FY 2006, are signs of the return of the confidence to the banking sector.

This *conservative* lending policy has, most likely, weakened and delayed the effectiveness of the *ultra*–monetary policies conducted by the bank of Japan during the period (FY1999–FY2005); namely *the zero interest rate policy* (the ZIRP) and *the Quantitative Easing Policy* (the QEP). This argument finds support in Baba *et al* (2005) who concluded that during the ZIRP–QEP period many factors including the *unwillingness* on the part of banks to extend new loans, due to capital limitations, have prevented firms with lower credit standings from “...*enjoying the easing effect of monetary policy*<sup>45</sup>.” However, the regulatory reforms, which were to great extent responsible for this “*potential*” ineffectiveness in the short and the medium run, are essential for a sound banking sector and, accordingly, a much more effective monetary policy in the long run.

It is worthy to note that the direct impact of banks' *conservatism* on the effectiveness of the monetary policy needs further theoretical and empirical investigations. This would be a very interesting subject for future research.

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<sup>45</sup> The other factors developed by the authors are: the difficulty to issue bonds and the distressed asset markets.



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