



Discussion Paper Series

No.137

**Listening to the Market: Estimating Credit
Demand and Supply from Survey Data**

Satoru Kanoh
Chakkrit Pumpaisanchai

February 2006

**Hitotsubashi University Research Unit
for Statistical Analysis in Social Sciences**

A 21st-Century COE Program

Institute of Economic Research
Hitotsubashi University
Kunitachi, Tokyo, 186-8603 Japan
<http://hi-stat.ier.hit-u.ac.jp/>

Listening to the Market: Estimating Credit Demand and Supply from Survey Data

Satoru Kanoh*
Chakkrit Pumpaisanchai**

February 2006

Abstract

The literature referring to the credit slowdown has been plagued by the identification problem of whether a decline in a bank's credit is derived from the demand or the supply side. This paper proposes an original approach in directly estimating the credit demand and the credit supply from survey data. Using the TANKAN and the recently published Senior Loan Officer survey data, the paper demonstrates that the observed lending amount did not change much during the period of study; however, the observed lending amount deviated, as one might expect, from the estimated credit demand and credit supply for every firm size. This credit mismatch presents evidence of credit market imperfections and is of interest for further investigation as a possible explanation of firms' liquidity constraints and banks' lending mechanisms.

Key words: Credit demand, Credit supply, Survey data, Japanese Economy

JEL classifications: C42, C51, E10, O53

* Institute of Economic Research, Hitotsubashi University, Kunitachi, Tokyo 186-8603, JAPAN

** Graduate School of Economics, Hitotsubashi University Kunitachi, Tokyo 186-8603, JAPAN

1. Introduction

Issues of credit crunch are largely studied as a possible reason for Japan's recession during the last decade, as Japan confronted a period of low economic growth. The average growth rate of GDP decreased from 7.80% in 1990 to -1.45% in 2001. Asset prices, both stock and land prices, declined steadily, while many financial indicators also worsened. The long-term lending rate decreased from 7.85% to 1.78% during the same period. The total bank lending growth rate dropped from 10.36% in 1990 to -3.37% in 2001. Much literature examines the correlation between the aggregate output and the bank debt in the view that the decline in the financial sector may possibly influence the real sector mainly through the decrease in bank credit. This argument is based on the credit view that monetary policy influences the economy, at least in part, by altering the flow of bank credit.

However, the existing empirical literature along this line of thought is plagued by the identification problem of whether the decrease in credit is derived from the demand or the supply side. Did a credit crunch really take place in Japan during the 1990s? The decrease in bank credit can be initiated by the banks themselves through regulation, or as a result of their own financial health, which is referred to as a "credit crunch". The decrease in credit may also occur because of a decrease in demand from firms. The ability to identify the cause of the decrease in credit is necessary, since it will have different policy implications in attempts to stimulate the economy.

This paper, using an original approach, is the first attempt to analyze the issue utilizing information from qualitative survey data. Estimating credit demand and credit supply separately assists in avoiding the simultaneous problem, which is a controversial issue in the study of changes in bank lending. Survey data provides many advantages in analyzing the issue. First, it contains qualitative information about the credit market that is not included in the observed credit data. A survey of the firms' opinions about lending attitudes

of financial institutions and a survey of the banks' lending policies complement the information on the credit market from both the borrower's and the lender's sides. This data is especially important as it is expected that the market is inefficient. Asymmetric information, imperfect competition, and irrationality of participants are among factors that are likely to cause credit market imperfections.

Under such conditions, the observed market may be in disequilibrium and information from each side assists in a better understanding of the overall picture. Non-price information contained in the bank's lending standards is also another advantage of the survey. Banks are likely to consider their lending practices not exclusively on the interest rate, but also a firm's capacity to repay the debt, a firm's collateral, or the banks' own limitations. Further, survey data is compiled and published more rapidly than official statistics. Survey data provides timely information in an environment of rapid change in technology, financial markets, and regulations. Qualitative survey data that contains the viewpoint of related parties in an economy can be an important data source for policy makers.

The survey data used in this study are from the "Lending attitude of financial institutions" published from the Bank of Japan (BOJ) TANKAN and "Change in bank's lending standard for approving applications from firms" from the recent Bank of Japan Senior Loan Officer Opinion Survey on Bank Lending Practices at Large Japanese Banks, which have been compiled since 2000. The survey contains specific information that could be obtained only from the lenders, such as the lending standards or changes in the terms and conditions of lending. To our knowledge, this study is the first to use the survey data on the change in banks' lending standards in the credit market in Japan. The rest of this paper is organized as follows. The next section reviews the literature on the credit crunch, the identification problems, and various methodologies that have been applied to mitigate the problem. Section 3 presents the data used in the estimation and the model specification. Section 4

explains the estimation results and discusses their implications. The last section provides the concluding remarks.

2. The Supply-versus-Demand Puzzle

The Council of Economic Advisers (1992) defines a credit crunch as a situation when the supply of credit is restricted below the range usually identified with prevailing market interest rates and the profitability of investment projects. Bernanke and Lown (1991) defined it as a significant leftward shift of the supply curve for bank loans, holding constant both the safe real interest rate and the quality of potential borrowers. Nevertheless, there does not appear to be a general consensus on a precise definition. Even so, what is more important is to identify the cause of the decrease in credit, i.e., the identification problem. A decline in bank lending may be derived from a tight monetary policy or regulations that induced banks to limit their lending. Alternatively, firms demand less credit because of poor economic prospects or other factors. This observational equivalence problem is called the supply-versus-demand puzzle (Bernanke, 1993).

In an effort to solve the identification problems, Kashyap et al. (1993) examine the behavior of the mix of short-term loans between bank credit and commercial paper, as commercial paper is only a form of non-bank debt. They concluded that when monetary policy was tightened, bank lending decreased, while commercial paper issuance rose sharply. They argue that the decrease in bank lending occurred from the supply side: if bank lending falls because of a reduction in loan supply, then non-bank sources of credit should rise as firms search for alternative lenders. However, if bank lending decreases as a result of a decline in demand, then all forms of credit should fall. In spite of these results, their model is based on an implicit assumption of homogeneous demand by large and small firms.

Oliner and Rudebusch (1996) modify the Kashyap et al. paper by incorporating other forms of non-bank debt as well as long-term debt. They find no evidence that supports the bank lending channel. They use the Quarterly Financial Report for Manufacturing, Mining and Trade Corporations (QFR) data. By combining the data from large and small firms, they deduce the same result as Kashyap et al., that is, the ratio between bank lending and short-term loans declines. When large firms and small firms are considered separately, they find that the ratio does not decline. Oliner and Rudebusch argue that the reason for this is that the aggregate mix ratio has two parts: the portion of short-term debt between large and small firms; and the portion of bank and short-term debt of large and small firms. Monetary contraction redirects all types of credit from small firms to large firms that rely less on bank debt. This results in a change in the short-term debt portion between large and small firms. Meanwhile, the portion of bank and short-term debt for both large and small firms does not change. Their concluding advice is that an economy has to be treated as including heterogeneous agents.

Oliner and Rudebusch (1996) find similar results to Gertler and Gilchrist (1993, 1994). Gertler and Gilchrist demonstrate that bank lending to small firms declines following a tight monetary policy, while bank lending to large firms actually rises. In addition, the ratio of bank loans to sales following a tight monetary policy is roughly constant for small firms, while it tends to rise sharply for large firms. Large firms thus appear to borrow to mitigate the impact of declining sales, but small firms do not. The important conclusion from these studies is that firms of different sizes have different financing behavior and hence the size effect should be taken into consideration.

Another way of mitigating the problem is an attempt to control lending demand by including explanatory variables that represent the banks' lending demand. Berger and Udell (1994) use a time dummy to compare bank lending behavior between "normal" time as a control period and "crunch" time. They argue that credit crunch exists only if there is a change in loan supply behavior between the two time periods. It is not a credit crunch if

certain borrowers were denied credit in both periods. Peek and Rosengren (1995a, 1995b) control for demand by limiting the empirical analysis to a cross-section of banks in a single region that faced the same economic downturn. They also control for other factors that might be related to differences in demand shocks across institutions, such as a bank's size and type of lending and service.

There are some studies focusing on the Japanese experience in the late 1990s. Watanabe (2004) mitigates the endogenous problems between bank capital and bank lending by constructing a unique instrument for the bank capital. The author argues that the "within bank" share of real estate lending in the late 1980s is an effective instrument. He finds that aggregate lending was negatively affected by capital shortages in the fiscal year 1997. Banks cut back their lending in response to a large negative capital shock from the Prompt Corrective Action (PCA) regulation framework introduced in 1997. Even during the recovering positive capital shock in 1998 and 1999, the net impact of capital shocks of those three years on bank lending was negative and the "credit crunch" was a major factor behind the recession. Woo (2003) carried out year-by-year cross-section regressions between bank lending and the several proxies of bank capital from 1991 to 1997 using Japanese bank data. The author finds a positive and statistically significant correlation between bank capital and lending growth in 1997 and concludes that the shortage of bank capital is mainly responsible for contraction of bank lending.

Apart from the identification problem, there is literature that applies survey data in analyzing firm investment, where a variable from the survey data is added to the model as a proxy of liquidity problems. Motonishi and Yoshikawa (1999) use the TANKAN diffusion index that measures the banks' willingness to lend as an indicator of possible financing constraints. The index is calculated as the proportion of firms' experience with the present lending attitude of financial institutions to be "accommodative" minus that of firms whose experience is "severe". They find that the financing constraints do significantly influence

investment in small firms, but not investment in large firms. Ogawa (2002) also uses the index as a proxy of financial distress. His study uses micro data from *Hojin Kigyo Tokei Nenpo* (the Annual Report of Financial Statements Statistics of Corporations) of the Ministry of Finance. The lending attitude of financial institutions has significantly positive effects on investment of small firms. Moreover, the cross-terms of the firm-size dummies with the variable are insignificant for most of the cases. The author concludes that the lending attitude of financial institutions does influence the firm's investment activities, irrespective of firm size. The effect of the debt–asset ratio on investment is significantly negative for small firms, while it is also significant but to a lesser extent for larger firms.

3. Data and Methodology

3.1 Data

In estimating the credit demand and supply, the study uses information from two surveys, that is, the Senior Loan Officer Opinion Survey on Bank Lending Practices at Large Japanese Banks (Loan Survey) and the Short-Term Economic Survey of Corporations (*Tanki Keizai Kansoku Chousa*, TANKAN), both compiled by the Bank of Japan. For estimation of credit supply, the question of “Change in bank's lending standard for approving applications from firms” from the Loan Survey is used. The survey was initiated in 2000 and asks banks the following question:

(Q1) Over the past three months, how have your bank's credit standards for approving applications from firms and households changed?

1. Eased considerably
2. Eased somewhat
3. Remained basically unchanged
4. Tightened somewhat
5. Tightened considerably

The Loan Survey aims to measure quantitatively the view of senior loan officers at large Japanese banks concerning the loan market. A multiple-choice questionnaire is used to derive the respondents' views of the demand for loans from firms and other borrowers, standards and terms of loans, and other matters. The respondents to the survey are 50 private banks that are large in terms of their lending volume. The aggregate loan size of these banks accounts for approximately 75% of the loan market of Japanese private banks (city banks, regional banks, regional banks II, trust banks, long-term credit banks, and shinkin banks). The latter three groups of banks in the survey are small banks that appear to match small firms in the TANKAN survey. The large lending portion that is covered in the survey is a good representation of the Japanese credit market in contrast to the U.S. case, where only about 60 are surveyed from about 8,000 banks, covering approximately 60 % of the credit market.

However, this survey may be prone to some bias, since respondents may answer in favor of the supervisory institution that conducts the survey, the Bank of Japan. They may suspect that their answer may be used for a supervisory action against them. However, previous literature that used this type of loan survey data found the data to be very useful in forecasting banks' lending and economic growth, e.g., Lown and Morgan (2002). The Loan Survey in Japan has been compiled for only five years, but is expected to be an important source of data on credit markets in the future.¹

The TANKAN survey of banks' lending attitudes is used to estimate the credit demand. This judgment survey was initiated from the second quarter of 1983 and asks firms the following question.

¹ The EU also initiated a similar survey in 2003 (Berg et al., 2005). The U.S. has collected data since 1964, but the results are officially available only from 1967 (Lown and Morgan, 2002).

(Q2) Choose one of three alternatives which best describes the current change of lending attitude of financial institutions.

1. Accommodative
2. Not so severe
3. Severe

The TANKAN is based on a quarterly survey conducted by the Bank of Japan. The survey started in 1957 and is considered to be one of the most important information sources about the Japanese economy. The sample enterprises for the TANKAN are selected from all private enterprises in Japan that have capital of 20 million yen and higher, but exclude financial enterprises. The required number of sample enterprises varies by industry and size classification. The number of sample firms is approximately 10,500. The surveyed firms are classified by size into small, medium, and large firms. The survey consists of both qualitative (judgment) surveys and quantitative surveys. For qualitative surveys, responding enterprises are asked to choose one among three alternatives as the best description of prevailing conditions, excluding seasonal factors, at the time of the survey and three months beforehand. For quantitative surveys, responding enterprises are asked to provide the nominal yen amount of the various items, such as commercial paper, total assets, and total liabilities, at the end of the preceding quarter. Qualitative surveys take place on a quarterly basis, while quantitative surveys take place both on a quarterly and annual basis. Loan Survey and lending attitude survey data are presented in Figure 1 and Figure 2.

These two survey datasets are more suitable than others surveys in estimating credit demand and supply for at least two reasons. First, in estimating the credit supply, the Loan Survey is the only survey in Japan that questions banks directly. It contains specific information that can only be obtained from the lenders, such as lending standards and changes in terms and conditions of lending. Second, in estimating the credit demand, this study uses the bank's lending attitude, which the literature uses as a proxy of the bank's

willingness to lend or supply side. However, it is firms who answered the question; hence, the survey contains information by firms who answered the question, i.e., the credit demand.

The remaining data used in this study are the aggregated data of firms, the banking industry, and macroeconomic data, and are listed in Table 1. The firms' liquid assets, liquid securities assets, cash and deposit, CP, bonds, and loans are provided from the quantitative survey compiled in the TANKAN. The fixed assets, land value, leverage ratio, sales, operating, and net profit data are provided from Financial Statements Statistics of Corporations (*Hojin Kigyo Tokei Chousa*) by the Ministry of Finance. The interest rate, stock market index, and banking industry data are provided from the Bank of Japan. GDP data is from the Economic and Social Research Institute, Cabinet Office and CPI is from the Statistics Bureau, Ministry of Internal Affairs and Communications. All data are seasonally adjusted on a quarterly basis and expressed in real values.

3.2 Methodology

In this paper, we propose an original model based on qualitative survey data. The objective is to derive the credit demand and supply functions from the survey data. The survey respondents compare what they have in mind with the observed situation then choose the answer that best represents them. Note that both surveys have been used in previous studies but were usually included as a control variable in regression.

The estimation of credit supply begins with modeling the mechanism of how each bank responds to the questionnaire (Q1). The study models the mechanism in the following way. There is a potential variable by which each bank determines how to answer the question regarding "change in lending standard" in the Loan Survey at period t :

$$ba_{it} = (cs_{it} - l_{it-1}) / l_{it-1}, \quad (3.1)$$

where cs_{it} is the unobserved bank's credit supply at period t and l_{it-1} is the observed lending amount at period $t-1$. For the observed lending amount, it could be thought that the same lending amount may have different effects for firms of different sizes. As a result, it is better to change the specification as divided by l_{it-1} of each size class to control for the size effect. Then we assume that a bank chooses "eased considerably" if $ba < \delta_1$, "eased somewhat" if $\delta_1 < ba < \delta_2$, and so on, where δ_i is a cutoff parameter. We also assume $cs_{it} \sim N(l_{it-1}\mu_t, (l_{it-1}\sigma)^2)$.

The proposition of the above formulation can be explained as follows. A bank compares its "willing to lend level" or credit supply with the observed lending amount, then chooses the answer that best represents them. If the bank is willing to lend more than the existing lending level, they would answer "eased lending standard considerably or eased somewhat", depending on their willingness to lend level. On the other hand, if the bank considers that the existing lending level is too high, they would answer "tightened lending standard somewhat or considerably".

Suppose each bank's credit supply can be written as follows:

$cs_{it} = c_0 + c_1x_{1it} + \dots + c_kx_{kit}$. Then $\sum cs_{it} = \sum c_0 + \sum c_1x_{1it} + \dots + \sum c_kx_{kit}$, that is, $CS_t = c_0 + c_1X_{1t} + \dots + c_kX_{kt}$. Therefore, the parameters c_i can be estimated using aggregate data without a loss generality. By dropping the subscript i , the above model could be written as:

$$BA_t = \left(\frac{CS_t - L_{t-1}}{L_{t-1}} \right).$$

Proposition

The responses of an individual bank, ba_t , can be expressed by the following functions of an aggregated variable BA_t .

$$\begin{aligned}\Pr\{\delta_1 > ba_t\} &= \Phi(\alpha_1 + \beta BA_t) \\ \Pr\{\delta_2 > ba_t > \delta_1\} &= \Phi(\alpha_2 + \beta BA_t) - \Phi(\alpha_1 + \beta BA_t) \\ \Pr\{ba_t > \delta_2\} &= 1 - \Phi(\alpha_2 + \beta BA_t)\end{aligned}\quad (3.2)$$

in which Φ is the distribution function of $N(0,1)$, and α_1 , α_2 , and β are unknown parameters with constraint $\alpha_1 < \alpha_2$. See appendix for the proof.

Ordered logistic regression is used for estimation because of the ordinal nature of the survey data. In particular, this paper uses the following specification:

$$\ln\left(\frac{\Pr(y \leq i)}{1 - \Pr(y \leq i)}\right) = \alpha_i + \beta \left[\frac{c_0 + c_1 X_{1t} + \dots + c_k X_{kt} - L_{t-1}}{L_{t-1}} \right], \quad i = 1, \dots, J-1, \quad (3.3)$$

where $c_0 + c_1 X_{1t} + \dots + c_k X_{kt}$ is our credit function, $\{\alpha_i\}$ are the cutoff levels, and β is the parameter to be estimated from the ordered logit model with $\alpha_{i-1} < \alpha_i$. Since almost none of the banks answered that they tightened their lending standard during the sample period, the data is combined into 3 categories: eased (eased considerably and eased somewhat), remained unchanged, and tightened (tightened considerably and tightened somewhat).

The specification 3.3 thus becomes:

$$\begin{aligned}
\ln\left(\frac{\Pr(y \leq i)}{1 - \Pr(y \leq i)}\right) &= \alpha_i + \beta[(c_0 + c_1 X_{1t} + \dots + c_k X_{kt}) / L_{t-1} - 1] \\
&= (\alpha_i - \beta) + \beta c_0 \frac{1}{L_{t-1}} + \beta c_1 \frac{X_{1t}}{L_{t-1}} + \dots + \beta c_k \frac{X_{kt}}{L_{t-1}} \\
&= (\alpha_i - \beta) + d_0 \frac{1}{L_{t-1}} + d_1 \frac{X_{1t}}{L_{t-1}} + \dots + d_k \frac{X_{kt}}{L_{t-1}},
\end{aligned}$$

where $d_i = \beta c_i, i = 0, \dots, k$. In order to estimate the credit supply, it is necessary to identify β . When the optimal aggregated lending amount is equal to the actual aggregated lending amount, it may be reasonable to assume that the proportions that a bank chooses (1) and (3) are equal. In that case, $\alpha_1 = -\alpha_2$. Then β could be estimated as the sum of the intercept divided by the numbers of the cutoff levels as $[(-\alpha_2 - \beta) + (\alpha_2 - \beta)] / (-2)$.

The respond mechanism for firms to estimate the credit demand is specified in a similar way to the credit supply. That is, corresponding to (3.1), we consider a potential variable $fa_{it} = (cd_{it} - cs_{it}) / cs_{it}$, where cd_{it} is the unobserved credit demand that we want to estimate, and cs_{it} is the estimated credit supply. We also assume that $cd_{it} \sim N(cs_t \omega_t, (cs_t \kappa)^2)$. Note that both the credit demand and the credit supply are in the same period, t. By dropping the subscript i, the above model can be written as follows.

$$FA_t = \left(\frac{CD_t - CS_t}{CS_t} \right)$$

Let CD and CS be the sum of cd_i and cs_i over all firms then FA is the value that determines how firms will answer the question regarding ‘‘Lending attitude of financial institution’’ in

the TANKAN survey. Existing literature uses the bank's lending attitude as the bank's willingness to lend. Note, however, that even though the survey asks about the bank's lending attitude, it is the firms who answered the question. Therefore, we consider that this answer reflects the firms' credit demand. Corresponding to (3.3), the credit demand specification will become:

$$\ln\left(\frac{\Pr(y \leq i)}{1 - \Pr(y \leq i)}\right) = \pi_i + \lambda \left[\frac{c_0 + c_1 X_{1t} + \dots + c_k X_{kt} - L_{t-1}}{L_{t-1}} \right], \quad i = 1, \dots, J-1, \quad (3.4)$$

where CS_t , which may be estimated by \hat{CS}_t , is the aggregate supply obtained in the previous step.

The estimation is carried out for three size classes: small, medium, and large firms. Different firm sizes tend to exhibit different financing patterns. Neglecting this difference distorts the results, as Oliner and Rudebusch (1996) have pointed out. Variables for the estimation of credit demand and supply estimation are selected by the stepwise variable selection with the Akaike Information Criteria (AIC) and the Bayesian Information Criteria (BIC). The candidate variables for the stepwise regression for the credit supply are firms, banks, and macroeconomic variables. The candidate variables for the credit demand are firms' data and macroeconomic variables, listed in Table 1.

4. Results

Table 2 presents the estimation results. The variables that are used for estimation of the credit supply for large firms are the bank's equities and the firm's sales volume. The stock market index and the firm's net profit are used for medium firms and the fixed assets for small firms. The fact that the variables that are selected for credit supply estimation are also

derived from the firm's side for every size class is quite intuitive; the bank's decision on lending depends on a firm's economic conditions. Note also that for small firms the selected variable is the fixed assets, which in most of the literature is used as the firm's collateral. The bank's own limitations also influence credit supply for large firms, while the macroeconomic conditions affect medium firms' credit supply.

For estimation of the credit demand, the variables used are GDP and the long-term lending rate for all class sizes. Figure 3 demonstrates the estimated credit demand and the credit supply, using the parameters in Table 3, together with the observed lending amount. Figure 3 reveals that the credit supply is larger than the credit demand for large firms, whereas the credit supply is at the same level as the credit demand for medium firms and the credit supply is smaller than the credit demand for small firms. These estimation results are also consistent with the literature on firm size and liquidity constraint; small firms tend to face more credit constraints than large firms. We can clearly derive from the estimation that, for all firm sizes, both the levels of the estimated credit supply and credit demand are above the observed lending amount. If the observed lending amount is at the credit market equilibrium, the estimated credit supply and credit demand should be equal, or at least close to each other and to the observed lending amount.

Another interesting interpretation of the results concerns the level of the interest rate in the credit market. The appearance of the credit supply being above the credit demand and credit demand being close to the observed lending amount for large firms implies that the prevailing interest rate level is higher than the equilibrium interest rate. Figure 4 illustrates this situation. A similar interpretation for small firms would mean that the prevailing interest rate level is lower than the equilibrium interest rate. In other words, the interest rate could be higher for small firms that require more credit and could be lower for large firms that require less credit. The credit supply function is reestimated including the interest rate in the credit supply function, but the variable is not significant and the model's AIC

becomes larger. This absence of correlation between interest rates and bank lending is also pointed out by Lown and Morgan (2002).

In the case of Japan, the analysis may be more interesting for the 1990s period. However, as was mentioned above, the Loan Survey data is available only from 2000, although the TANKAN survey data and the other data of the same variables that are used in the above estimation are available from the 1990s. Therefore, the credit supply function can be extrapolated using the parameters obtained in the 2000–2004 period. Using the extrapolated value of the credit supply, the extended credit demand is estimated in the same way as previously.

Figure 5 presents the estimated results for the extended period. From the figure, the credit supply is more than the credit demand for large firms. The slump of the estimated credit supply in 1998 is the result of the decrease in banks' equity, caused by the decrease of undivided profit and voluntary reserves.² For medium firms, the estimated credit supply in the extended period falls off to the estimated credit demand level periodically, but in general stays higher than the credit demand. The estimation for small firms exhibits a different story. The excess credit demand that appeared in the previous estimation appears to have started at the end of 1997. Before 1997, the credit supply was more than the credit demand.

The results so far suggest that, right after the burst of the bubble in the Japanese economy in 1990, there was still enough credit in the market. The supply of credit for large and medium firms, in general, continued at their higher levels than credit demand from the beginning of the 1990s to 2004. Only for small firms was the credit supply estimated to be

² Japan changed its BIS regulations in 1998. The banks that operate only in Japan can choose to have the BIS ratio at 4% (previously 8%). This may have caused the decrease of the reserves.

less than credit demand. The results for small firms may not be so unexpected, since much of the literature points out the liquidity constraints and size effect. Banks may reduce their lending to small firms, which tend to have more asymmetric information problems, and instead may increase their lending to medium and large firms. The most interesting result derived from the estimation is that the estimated credit demand and supply deviate from the observed lending amounts. As one might guess, the reasons for this are the credit market frictions or imperfections.

4.1 Mismatch in Credit Market

An important assumption in studying the credit market is that the observed quantity of the bank loans is either the equilibrium value given by the intersection of the demand and the supply curves in the bank loan market, or the short-side between them. Suppose that the lending amount for firm i , l_i , is determined by the minimum of a firm's credit demand, cd_i , and the bank's credit supply, cs_i , that is:

$$l_i = \min(cd_i, cs_i).$$

Note that this assumption is only for the individual level (cd_i, cs_i). When these individuals are summed into the aggregate level L , it is possible that the observed value is not the minimum of the aggregate demand, CD , and the aggregate supply, CS , because:

$$\min(CD, CS) = \min(\sum cd_i, \sum cs_i) > \sum \min(cd_i, cs_i) = \sum l_i = L.$$

If the credit market functions perfectly, implying that there is no asymmetric information between lenders and borrowers and competition is perfect, the firms with good profitability prospects can raise credit more easily with less cost than the firms with poor profit potential. Because of the law of one price, the interest rate should provide all the information that both lenders and borrowers require in order to make rational decisions. Needless to say,

these assumptions are rarely satisfied in the real market. Mismatch in the credit market appears in the existence of idle funds with potential profitability that are unexploited.³ In this study, the level of mismatch is calculated as the smallest quantity between the credit supply and the demand minus the observed lending amount: $\{\min(CS_t, CD_t) - L_t\} = \min(CS_t - L_t, CD_t - L_t)$. From the definition, if there is no mismatch, the lending amount should be determined by the minimum of the credit supply and the credit demand. This is the short-side condition.

Figure 6 presents the estimated credit mismatch. Medium firms show the highest level of mismatch, followed by small firms and then large firms. The lowest mismatch level that is close to zero for large firms is predictable. Large firms tend to have fewer information problems and receive more consideration from banks than medium and small firms. What needs to be emphasized is that even if small firms have higher credit constraints than medium firms, there is more mismatch for medium firms than for small firms.

Figure 7 reveals the demand–supply gap for the extended period 1990–2004 and they resemble the results from Figure 5. The credit demand–supply gaps and mismatch levels for each class size are presented in Figure 8. Recent literature referring to the credit market in Japan advocates the presence of inefficiency in the Japanese banking industry that explains this mismatch. Caballero, Hoshi, and Kashyap (2004) argue that Japanese banks keep rolling over lending to insolvent firms to avoid the loss of loans. This behavior limits the banks' lending capacity to lend to profitable firms.

³ Mismatch may arise from imperfect information, matching frictions (Diamond, 1990), or fear of debt unpaid (Hart and Moore, 1994).

5. Conclusions

The literature on the credit slowdown confronts the identification problem of whether the cause of reduction is generated from the demand side or the supply side. This paper proposes a unique methodology for estimating the credit demand and the credit supply from survey data. The Loan Survey initiated in 2000, compiled from the lenders' side, and the TANKAN, compiled from the borrowers' side, are used separately in the estimations for large, medium, and small firms.

The study reveals many interesting results. The estimation demonstrates that during 2000–2004, the credit supply was larger than the credit demand for large and medium firms, while it was smaller than the credit demand for small firms. When the estimation period is extended, it is revealed that the excess credit demand for small firms commenced at the end of 1997, the year of the Asian crisis and the eve of the 1998 BIS regulations. After confronting these difficult conditions, Japanese banks responded by limiting new lending to small firms and instead lent to large and medium firms.

Another interesting result to be emphasized is that the estimated credit demand and the credit supply deviate from the observed lending amount for all class sizes. The result provides evidence of credit market imperfections. This phenomenon is likewise observed in the labor market, where job vacancies and unemployment coexist. The credit mismatch is the largest for medium firms and the smallest for large firms; however, this study cannot give a precise explanation, since the cause of mismatch is not specified. Nevertheless, we speculate that the inefficiency in the Japanese banking industry might be a possible cause for the mismatch.

Appendix

Under assumption stated in methodology section, the conditional probabilities that a bank responds to the questionnaire by choosing each of the three categories are given as:

$$\begin{aligned}\Pr\{\delta_1 > BA_t \mid L_{t-1}\} &= \Pr\{(\delta_1 - \mu_t + 1)/\sigma > (BA_t - \mu_t + 1)/\sigma\} \\ &= \Pr\{(\mu_t + 1)/\sigma - (\mu_t / \sigma) > Z\}\end{aligned}$$

$$\begin{aligned}\Pr\{\delta_2 > BA_t > \delta_1 \mid L_{t-1}\} &= \Pr\{(\delta_2 - \mu_t + 1)/\sigma > (BA_t - \mu_t + 1)/\sigma > (\delta_1 - \mu_t + 1)/\sigma\} \\ &= \Pr\{(\delta_2 + 1)/\sigma - (\mu_t / \sigma) > Z > (\delta_1 + 1)/\sigma - (\mu_t / \sigma)\}\end{aligned}$$

$$\begin{aligned}\Pr\{BA_t > \delta_2 \mid L_{t-1}\} &= \Pr\{(BA_t - \mu_t + 1)/\sigma > (\delta_2 - \mu_t + 1)/\sigma\} \\ &= \Pr\{Z > (\delta_2 + 1)/\sigma - (\mu_t / \sigma)\}\end{aligned}$$

Where Z denotes a random variable distributed as the standard normal. Note that these probabilities are independent of l_{t-1} , implying the probabilistic mechanisms of bank's responses are common to all firms, irrespective of the levels of their lending level. Therefore, the marginal probabilities, after integrating out with respect to their distributions, are also expressed by the same function as (3.2).

It can be shown that μ_t is estimated by (CS_t/L_{t-1}) . Throughout this paper, small letters such as cs_t , l_{t-1} refers to individual variables, whereas capital letters such as CS_t , L_{t-1} refer to aggregated macro economic variables. Let us denote the densities of cs_t , l_{t-1} and $(cs_t|l_{t-1})$ by $g(cs_t)$, $h(l_{t-1})$ and $f(cs_t|l_{t-1})$ respectively. From the aforementioned assumption, the expectation of $(cs_t|l_{t-1})$ is calculated as:

$$\int cs_t f(cs_t | l_{t-1}) dcs_t = \mu_t l_{t-1}$$

On the other hand, the means of cs_t and l_{t-1} can be estimated by (CS_t/N_t) and (L_{t-1}/N_t) respectively. Further, denote the joint density of cs_t and l_{t-1} by $i(cs_t, l_{t-1})$. Then,

$$\begin{aligned} E(cs_t) &= \int cs_t g(cs_t) dcs_t = \int cs_t \left\{ \int i(cs_t, l_{t-1}) dl_{t-1} \right\} dcs_t \\ &= \iint cs_t f(cs_t | l_{t-1}) h(l_{t-1}) dl_{t-1} dcs_t \\ &= \int \left\{ \int cs_t f(cs_t | l_{t-1}) dcs_t \right\} h(l_{t-1}) dl_{t-1} \\ &= \int \mu_t l_{t-1} h(l_{t-1}) dl_{t-1} \\ &= \mu_t E(l_{t-1}) \end{aligned}$$

and μ_t can be, therefore, estimated by (CS_t/L_{t-1}) without large sample fluctuations.

References

Berg, J., Rixtel, A. van, Ferrando, A., Bondt, G. de, Scopel, S., 2005. The Bank Lending Survey for the EURO Area. European Central Bank, Occasional Paper Series no. 23.

Berger, A.N., Udell, G.F., 1994. Did Risk-Based Capital Allocate Bank Credit and Cause a “Credit Crunch” in the United States? *Journal of Money, Credit and Banking* v26 n3, 585-633.

Bernanke, B.S., 1993. Credit in the Macroeconomy. Federal Reserve Bank of New York Quarterly Review, spring.

Bernanke, B.S., Lown, C.S., 1991. The Credit Crunch. *Brookings Papers on Economic Activity* 1991 (2), 205-248.

Caballero, R.J., Hoshi, T., Kashyap, A.K., 2004. Zombie Lending and Depressed Restructuring in Japan

Council of Economic Advisers (1992): Economic Report of the President. Washington, United States Government Printing Office.

Diamond, P., 1990. Pairwise Credit in Search Equilibrium. *Quarterly Journal of Economics* v105 i2, 285-319.

Gertler, M., Gilchrist, S., 1994. Monetary Policy, Business Cycles, and The Behavior of Small Manufacturing Firms. *Quarterly Journal of Economics* v109 i2, 309-340.

Gertler, M., Gilchrist, S., 1993. The Role of Credit Market Imperfections in the Monetary Transmission Mechanism: Argument and Evidence. *Scandinavian Journal of Economics* 95(1). 43-64.

Hart, O., Moore, J., 1994. A Theory of Debt Based on the Inalienability of Human Capital. *Quarterly Journal of Economics* v109 i4, 285-319.

Kashyap, A.K., Stein, J.C., Wilcox, D.W., 1993. Monetary Policy and Credit Conditions: Evidence from the Composition of External Finance. *The American Economic Review*, 83(1), 78-98.

Lown, C.S., Morgan, D.P., 2002. Credit Effects in the Monetary Mechanism. *Federal Reserve Bank of New York Economic Policy Review*, May, 217-235.

Motonishi, T., Yoshikawa, K., 1999. Causes of the Long Stagnation of Japan during the 1990s: Financial or Real? *Journal of Japanese and International Economies* 13, 181-200.

Ogawa, Kazuo, 2003. Financial Distress and Corporate Investment: The Japanese Case in the 90s. *Empirical Analysis of Economic Institutions Discussion Paper Series No.9*

Oliner, S.D., Rudebusch, G.D., 1996. Monetary Policy and Credit Conditions: Evidence from the Composition of External Finance: Comment. *American Economic Review* v86 n1, 300-309.

Peek, J., Rosengren, E.S., 1995a. Bank Regulation and the Credit Crunch. *Journal of Banking and Finance* v19 i3-4, 679-692.

Peek, J., Rosengren, E.S., 1995b. The Capital Crunch: Neither a Borrower nor a Lender Be. *Journal of Money Credit and Banking* v27 n3, 625-638.

Watanabe, Wako, 2004. Prudential Regulation, the “Credit Crunch” and the Ineffectiveness of Monetary Policy: Evidence from Japan.

Woo, David, 2003. In Search of “Capital Crunch”: Supply Factors Behind the Credit Slowdown in Japan. *Journal of Money, Credit, and Banking*, v35 n6, 1019-1038.

Table 1: List of candidate variables for stepwise selection

Variables	Included as a candidate variable in the estimation of		Source
	Credit supply	Credit demand	
Bank data			
Equities	yes	no	Statistics, BOJ
Loan loss reserve	yes	no	Statistics, BOJ
Profit	yes	no	Statistics, BOJ
Lending capacities	yes	no	Statistics, BOJ
Firm data			
Commercial paper	yes	yes	TANKAN, BOJ
Liquid assets	yes	yes	TANKAN, BOJ
Cash and deposits	yes	yes	TANKAN, BOJ
Liquid securities	yes	yes	TANKAN, BOJ
Fixed securities	yes	yes	TANKAN, BOJ
Fixed assets	yes	yes	MOF
Land value	yes	yes	MOF
Sales volume	yes	yes	MOF
Leverage ratio	yes	yes	MOF
Profit	yes	yes	MOF
Macro data			
Short-term lending rate	yes	yes	Statistics, BOJ
Long-term lending rate	yes	yes	Statistics, BOJ
Stock market index	yes	yes	Statistics, BOJ
Consumer price index	yes	yes	Statistics bureau
GDP	yes	yes	Cabinet office

Notes: All data are seasonal adjusted on quarterly basis, are in real value and are classified by size into large, medium and small firms.

Table 2: Estimation results

Variables	Large firms		Medium firms		Small firms	
	Supply	Demand	Supply	Demand	Supply	Demand
Bank equities	-32.52** (15.58)					
Firm sales	-37.54*** (10.93)					
Stock market index			-15.44*** (5.14)			
Firm profits			-13.38*** (3.70)			
Firm fixed assets					-47.64*** (11.69)	
Long-term lending rate		2.32*** (0.45)		1.83*** (0.33)		1.06*** (0.24)
GDP		-0.91*** (0.10)		0.22** (0.11)		-0.40*** (0.07)
Constant		771.05*** (69.40)		155.37*** (15.19)		168.90*** (44.21)

Variables are selected by stepwise variable selection with the best Akaike Information Criteria (AIC) and Bayesian Information Criteria (BIC). Standard errors are in parentheses, *** denotes significant at 1% level, ** at 5% level, * at 10% level.

Table 3: Estimated parameters

Variables	Large firms		Medium firms		Small firms	
	Supply	Demand	Supply	Demand	Supply	Demand
β	77.53	-54.47	21.46	-10.29	60.74	-11.56
Bank equities	0.42					
Firm sales	0.48					
Stock market index			0.72			
Firm profits			0.63			
Firm fixed assets					0.78	
Long-term lending rate		0.04		0.18		0.09
GDP		-0.02		0.02		-0.03

Notes: Parameters estimated from Table 2, as explained in methodology section.

Figure 1: Changed in credit approving standard to each firm size

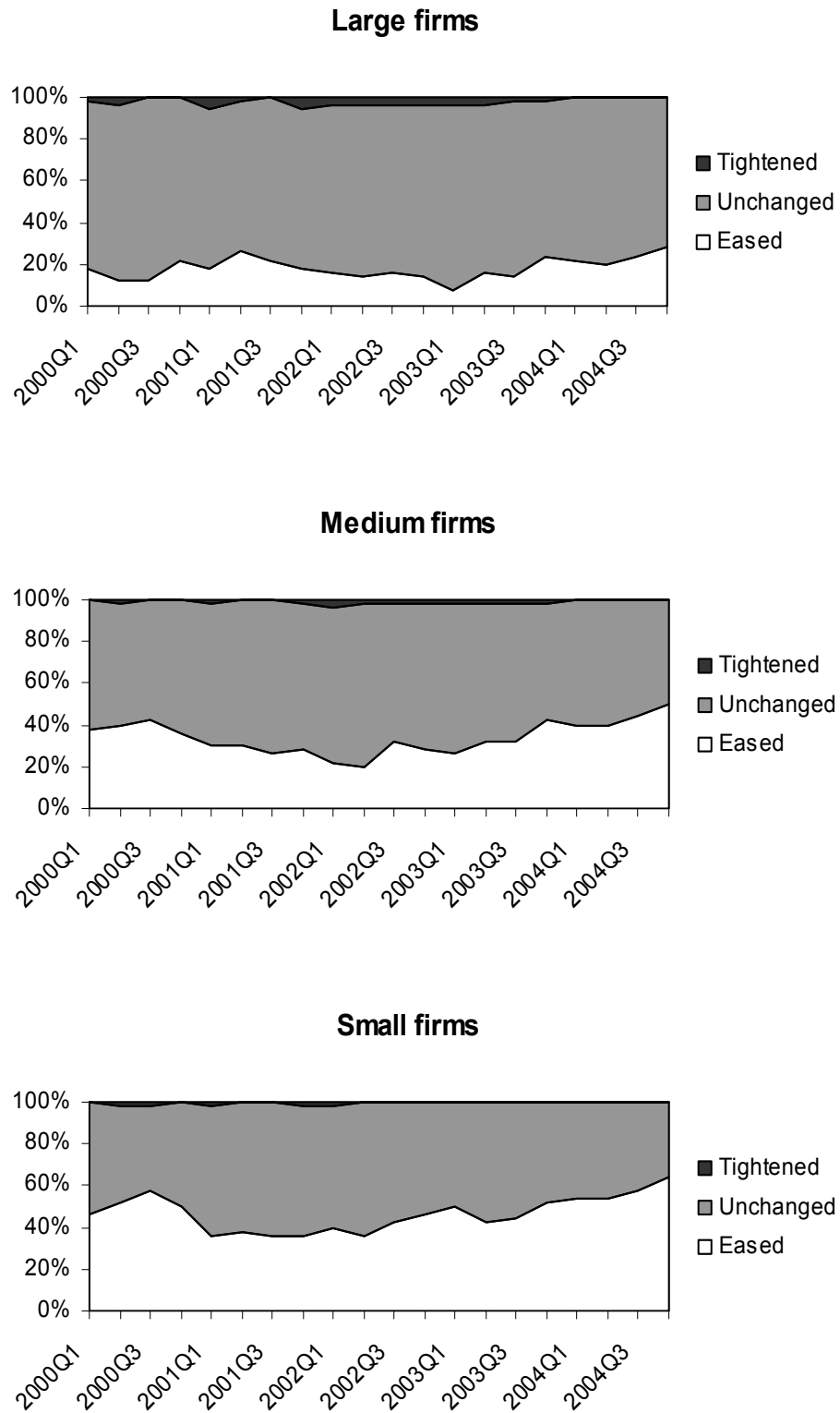
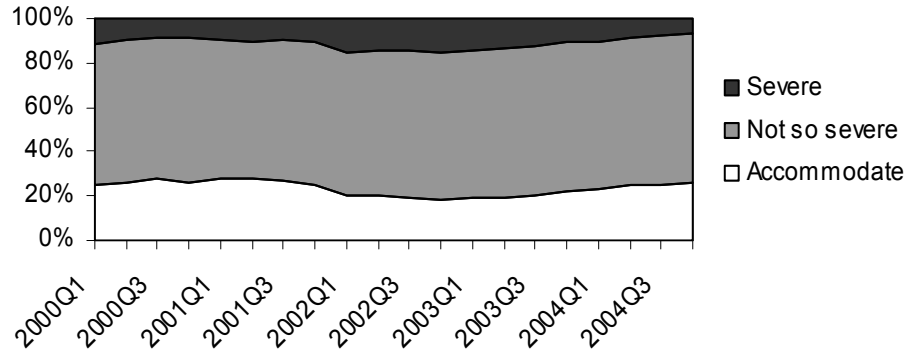
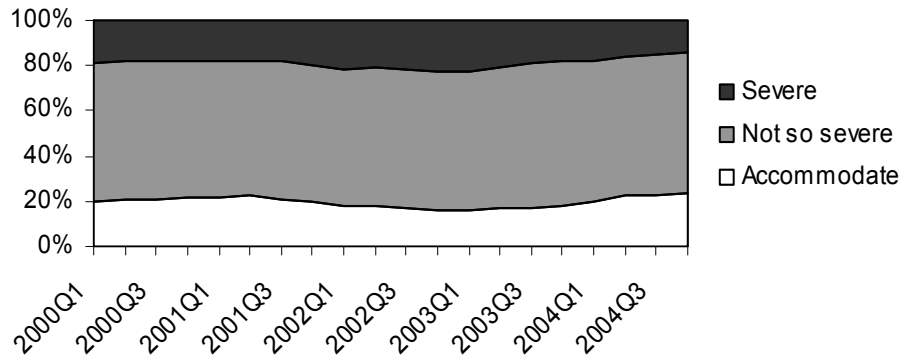


Figure 2: Bank's lending attitude

Large firms



Medium firms



Small firms

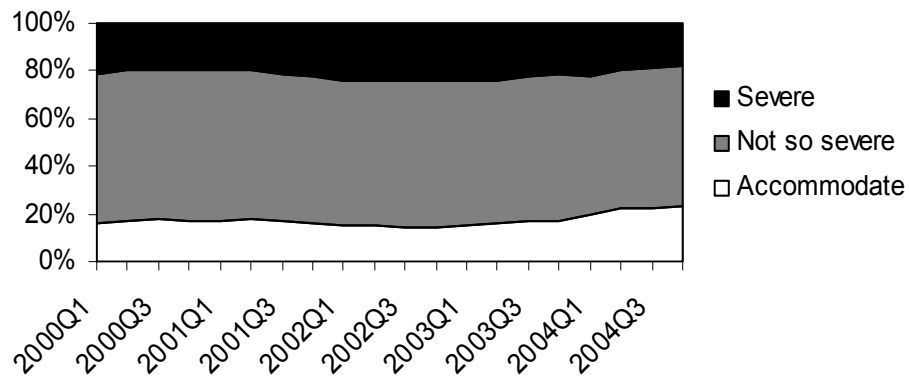
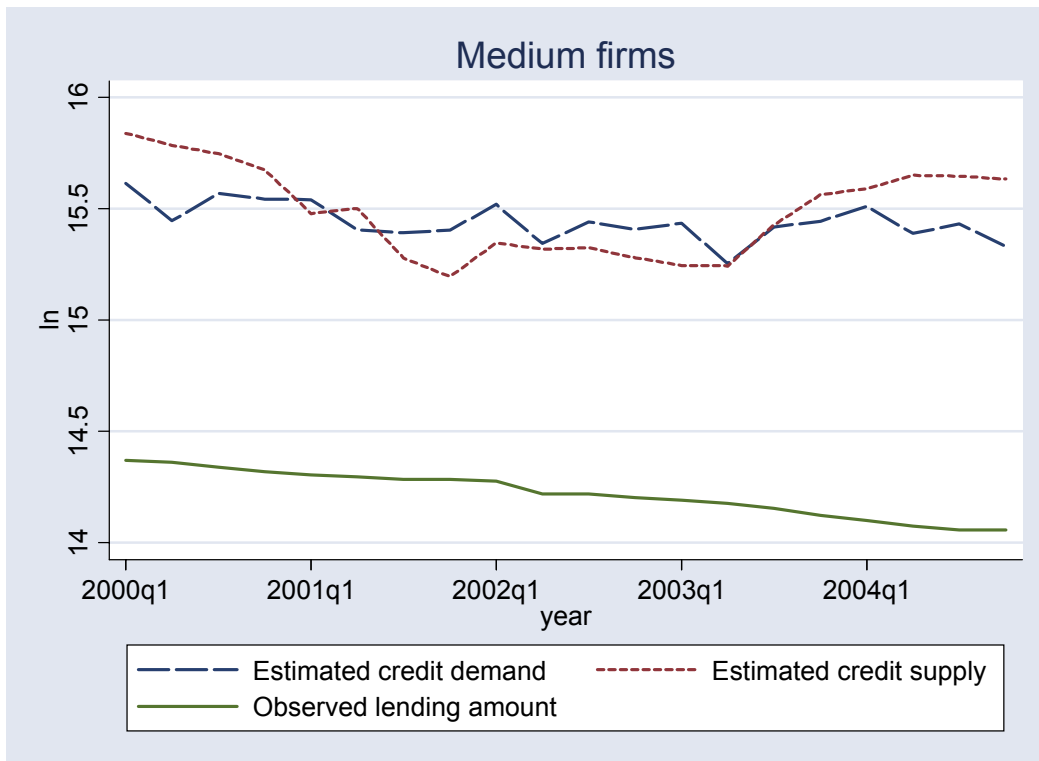
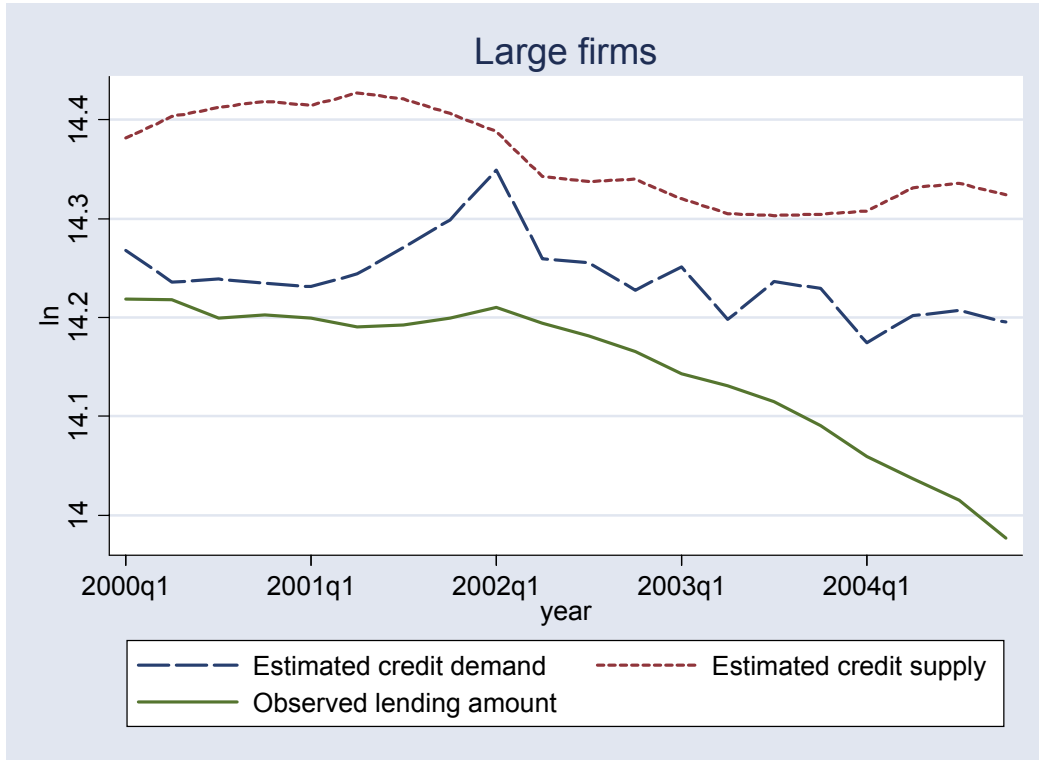


Figure 3: Estimated credit demand and supply, 2000-2004



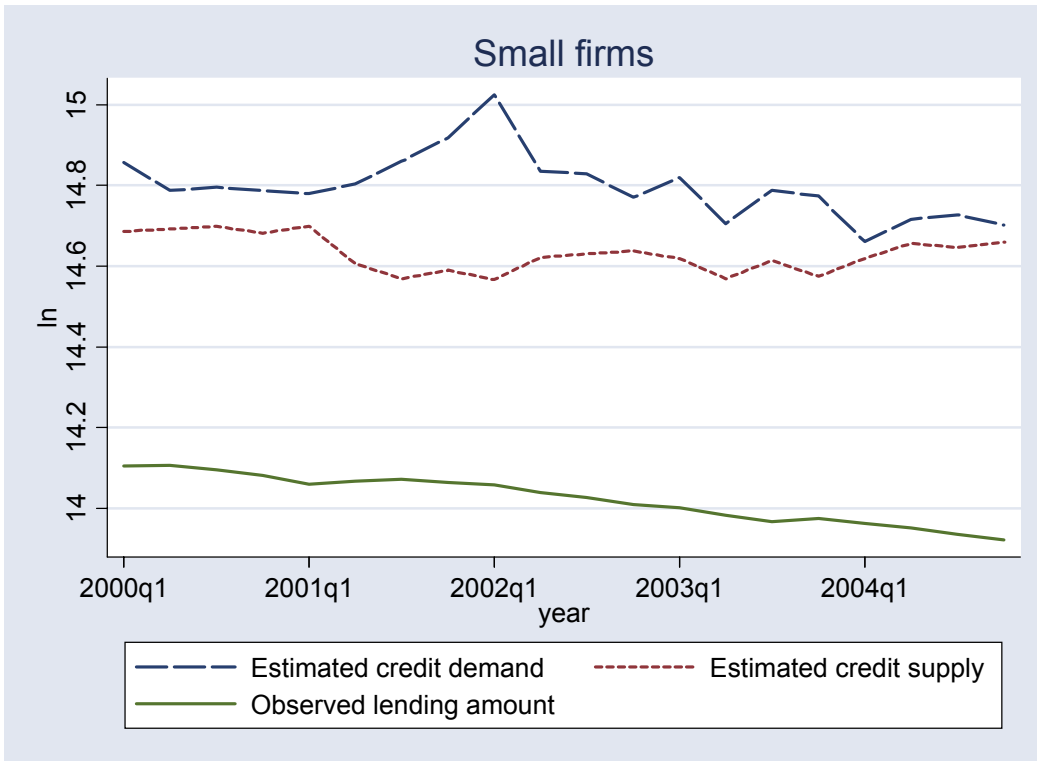


Figure 4: Estimated equilibrium interest rate

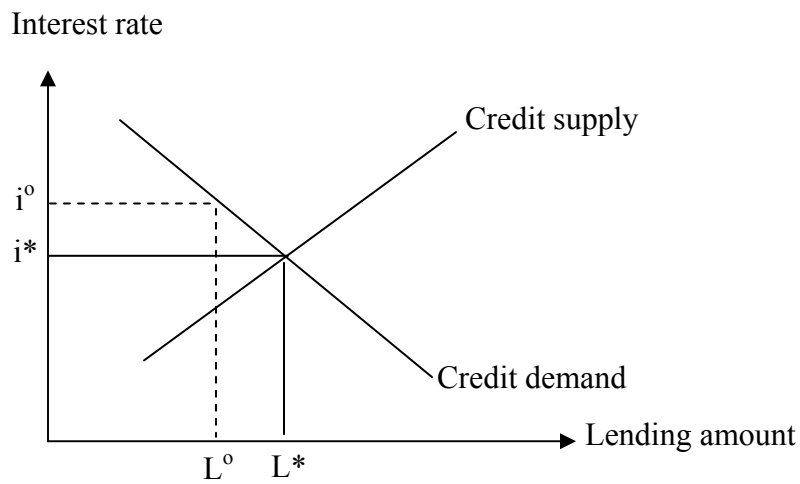
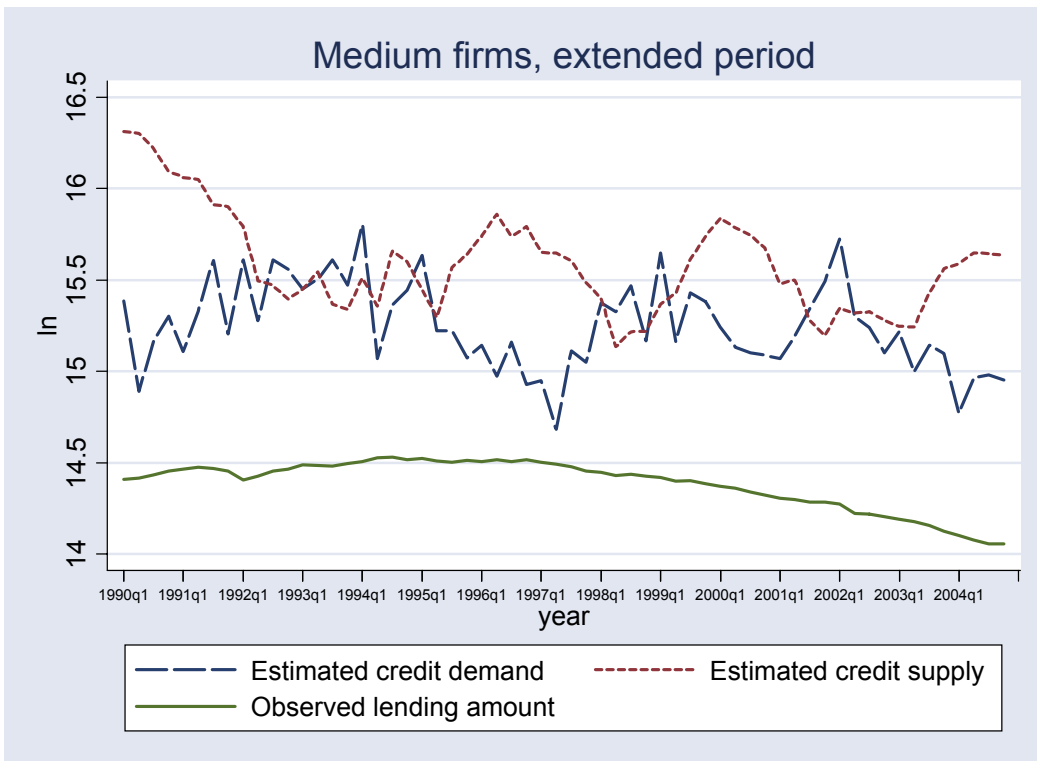
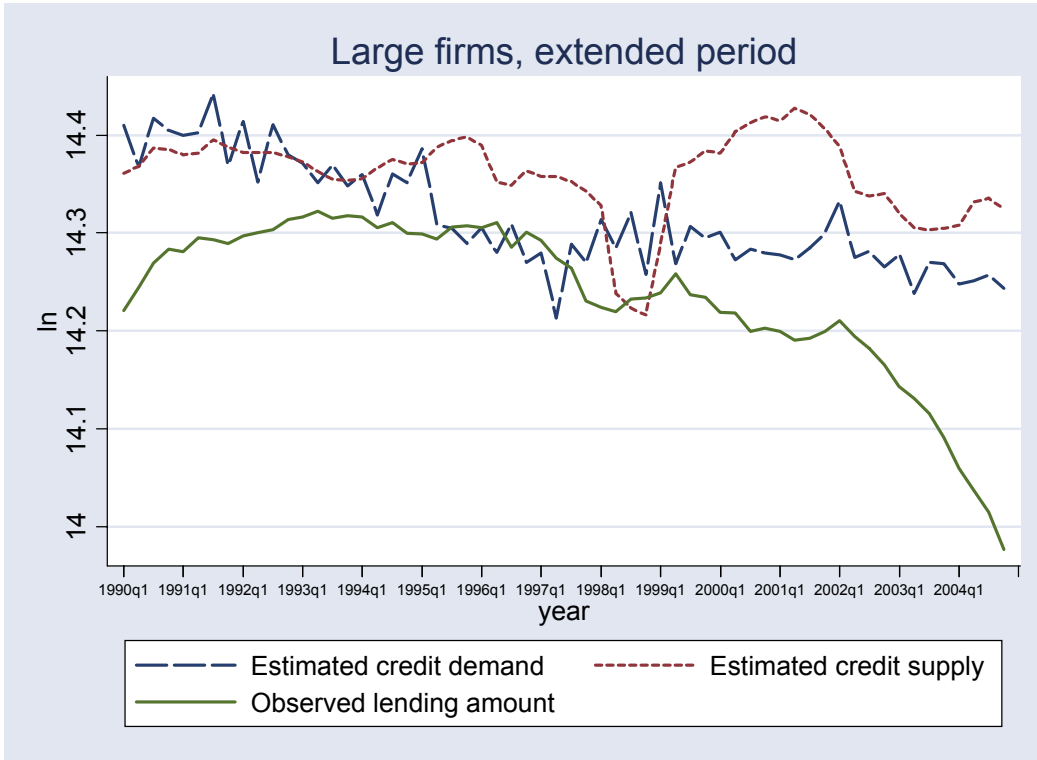


Figure 5: Estimated credit demand and supply, extended period 1990-2004



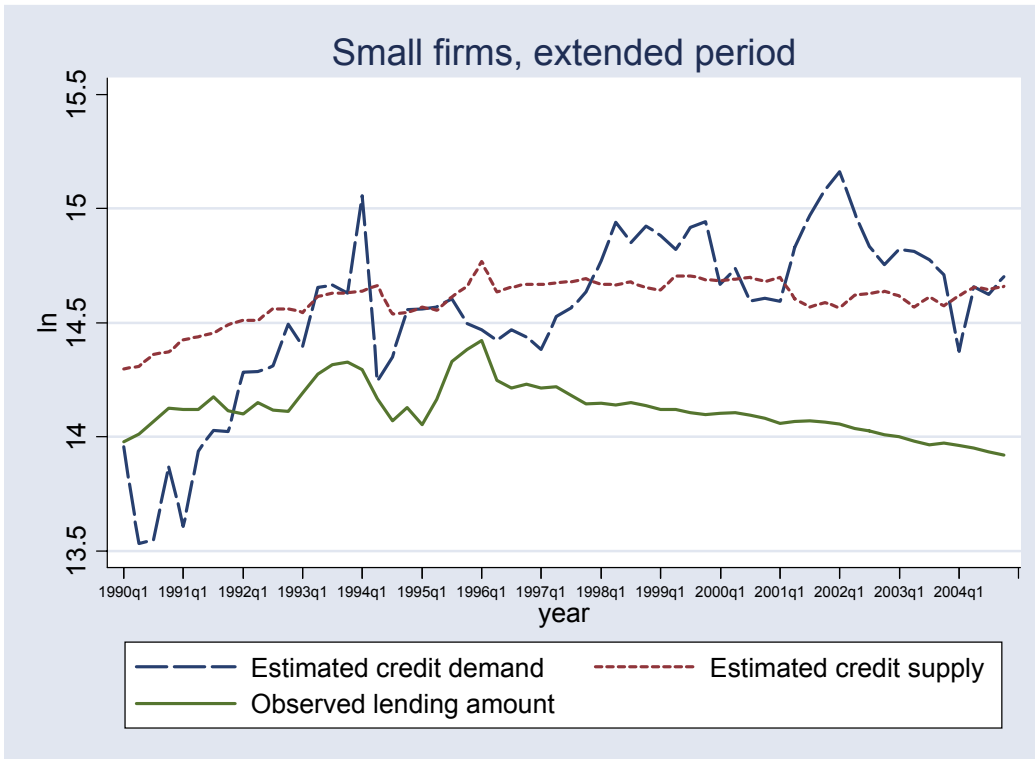


Figure 6: Estimated Credit mismatch

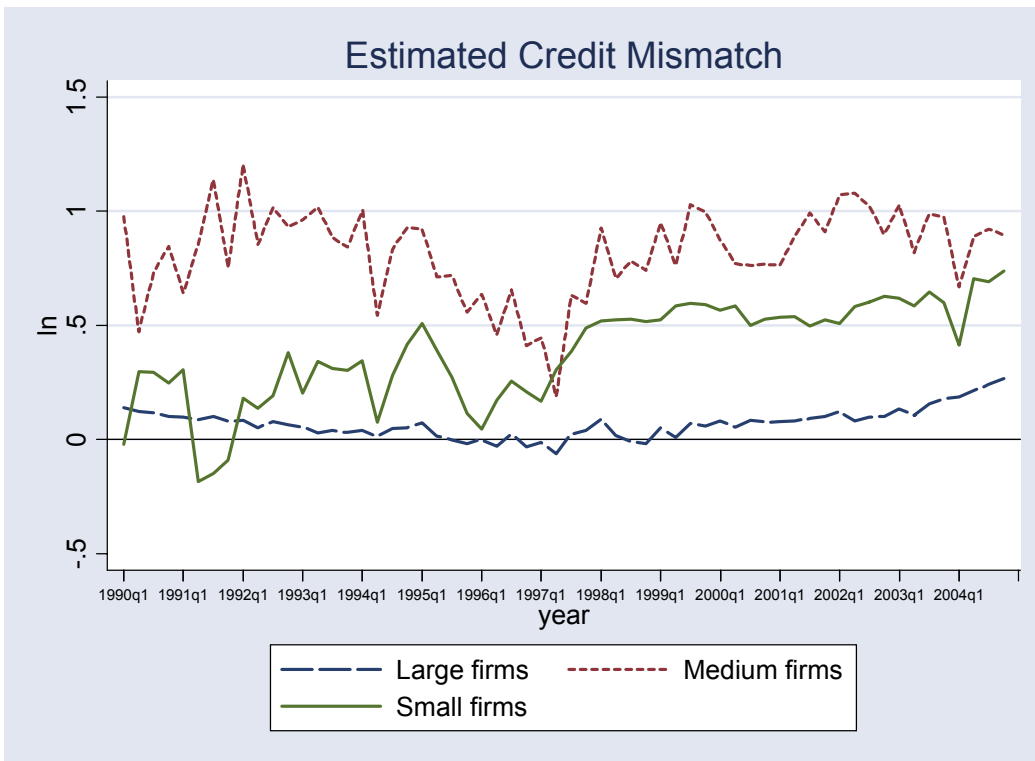


Figure 7: Credit demand-supply gap

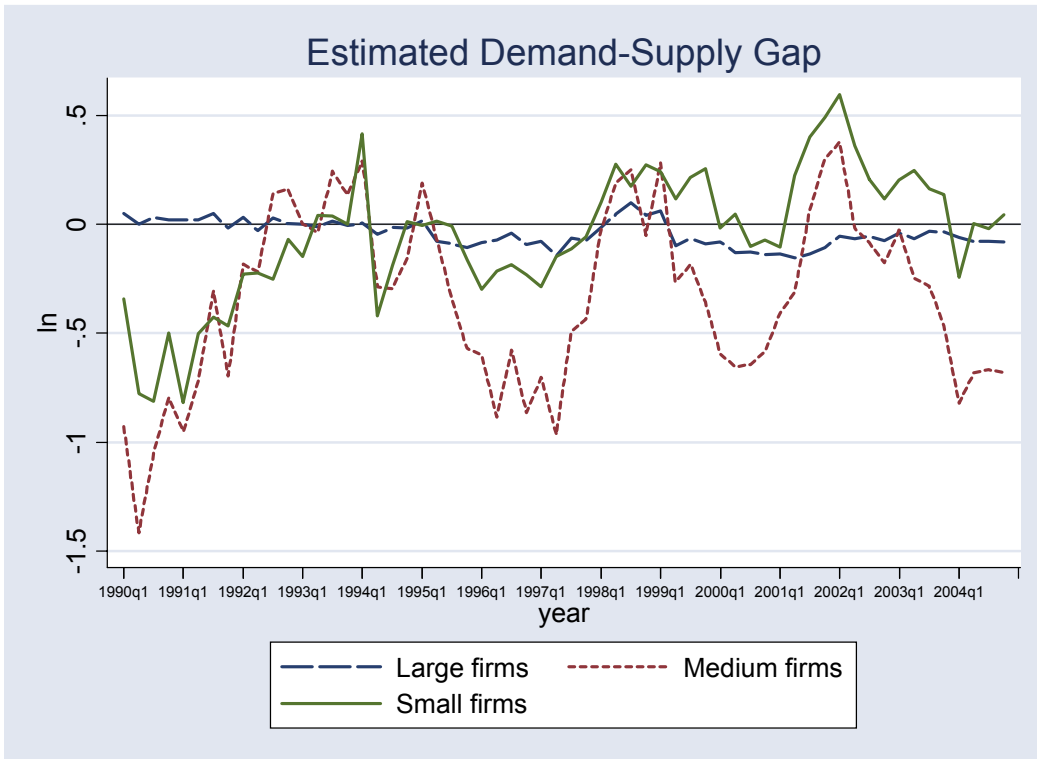


Figure 8: Credit demand-supply gap vs. credit mismatch

