The Impact of Monetary Base on Bank Lending in Japan

Qing-yuan Sui*

June, 2022

Abstract We empirically investigate the impact of liquidity provision by the Bank of Japan to the lending behavior of private banks in the period of quantity easing. We pay special attention to the credit provision from banks to different industries, especially to the manufacturing and the household sectors. Our results show that the liquidity provision of the Bank of Japan promoted the private banks' lending to the household sector but not to the manufactural industry. These results are consistent with the recent studies on the limits of credit provision to economic growth. It also suggests that there is no much room for the Bank of Japan to stimulate private credit provision by liquidity easing. In today's Japan, banks did not or could not respond to allocate funds to sectors that are more supportive to the economic growth.

1 Introduction

In the first twenty years of this century, during which Japan's economy suffered a long and chronic recession, one of the most prominent changes among various policy measures is that of the monetary base. The amount of monetary base in Japan increased from 68.6 trillion Yen at the end of fiscal year 2000 (March, 2001) to 643.6 trillion Yen at the end of fiscal year 2020 (March 2021), which is much larger than the amount of GDP in fiscal year 2020 (535.5 trillion Yen). As the changes of monetary stock were relatively stable, the changes of monetary base were mainly caused by the increase of reserve deposits of private banks in the Bank of Japan that are not legally required.

Considering the function of central bank and its involvement with private banks in the contemporary world, it is hard to imagine that such large-scale increase in monetary base could have any real effects on the whole economy without the corresponding actions of the private banks. This paper empirically investigate how the large-scale increase of

*Faculty of Economics and Business Administration, Yokohama City University. Seto 22-2, Kanazawa-ku, Yokohama, Japan, 236-0027. I gratefully acknowledge the Yu-cho Foundation(Grant-in-Aid for Research, 2021) for their financial support.

monetary base affected bank lending behaviors. While many studies focusing on the same issue investigated the positive impact of centrol bank liquidity provision on total lending (Brown et al. (2015), Shioji(2019, 2020), Montgomery and Volz(2019)), our empirical strategy is to look at the impact of monetary base on lending to different sectors, especially that of manufacturing and household sectors.

Japan has been believed as the most successful country in the world with economic growth and development before 1980s. However, Japan maintained the lowest level of economic growth among the G5 countries since 2000. These phenomena troubles not only policy-makers but also the academic researchers. Our study is motivated by the following two considerations. One is that, as shown in Fig.1, comparing the large increase in the measures of monetary policy (monetary base, M2), the changes of total bank lending or GDP have been within a relatively narrow range in the last two decades. Although the above mentioned studies positively evaluated the impacts of monetary policy to bank lending, these effects are at most weak. In order to consistently explain the quantitatively week responses of bank lending to the unconventional monetary policy, we need to ask, are there any qualitative changes in the bank' lending behavior accompanied with the unconventional policy?

The second consideration is based on some recent studies pointing out that the relationship between credit and economic growth may not be linear and the lending provision to different sectors may have different consequences to economic growth. Arcand et al.(2015) find that there is a limit in the positive effect between financial depth and economic growth. There is, in particular, a threshold around 100% of credit to GDP ratio above which credit expansion starts to negatively affect economic growth. In Japan, it is well known that in the bubble era, the banking industry in Japan greatly increased lending at a much higher pace than that of the real economy. The ratio of demestic bank lending to GDP jumped from 61% in 1980 to 98% in 1989. It seems that this high ratio was above the threshold pointed by Arcand et al. [1] Beck et al. (2012) separately estimate the growth-enhancing effects of credit supplies to different sectors. While the credits to industrial positively affect economic growth, the credits to household sector do not. Hoshi and Kashyap (1999) predict that as the credit expansion was accompanied with bubble, there should be a large scale shrinkage of bank loans (20%-30%) in the following ten years in order to return Japanese economy to the normal state. In fact the total amount of domestic bank lending dropped from 478 trillion Yen in March 1995 to 402 trillion Yen in March 2005 and the number menbership bank in Japanese Bankers Association changed from 144 in March 1999 to 112 in March 2020, although not all of the exits were due to bankruptcy. However, after March 2005, the ratio of domestic bank lending to GDP turned to increasing and reached the level even higher than that in the bubble era in March 2020. Fig.2 shows the ratio of domestic bank lending to GDP from 1955 to 2020. Needless to say, the U-shaped recovery of the lending to GDP ratio reflects effect of the unprecedented liquidity easing policy by the central bank. Then how should the liquidity

[1]The definition of financial depth in Arcand et al.(2015) also includes credit provision besides banking sector, which means the overall lending provision at the end of bubble era largely surpassed the critical level considered by Arcand et al.

easing policy affect the economy when the whole banking industry needs to contract its lending size in order to return to its steady state? In order to answer this question, it is helpful to see how the monetary policy influences lending to different industries.

The sample period in this study is from March, 2001 to March, 2019, which correponds the execution of unconventional monetary policy in Japan. The sample banks are the member banks of Japanese Bankers Association. The main finding shows that (1) the impact of monetary policy to the overall lending supply was week; (2) while household lending positively stimulated by the monetary policy, manufacturing lending was negatively influnced by monetary base; (3) the main results are not changed by including real estate or financial sector lending to household lending or taking dynamic method in the estimation. These results are consistent with the previous studies suggesting a positive but week response of the bank lending to the monetary policy. To the extent that household credit is not associated with economic growth, our results also indicate that the so-called lending channel in Japan is week in Japan.

The remaining part of the paper is organized as follows. In section 2, we summarize the basic characters of monetary policy and bank lending behavior in the last two decades. Section 3 discusses the previous related studies and introduce the empirical hypothesis. In section 4, we describe the data and the methodology used in this paper. Section 5 reports the estimation results. In section 6, we concludes the paper and discuss some unsolved problems.

2 Monetary policy in recent Japan

Japan is the first country who stated the unconventional monetary policy, although the expression of "unconventional" was only used after many other countries adopted similar policies. Our basic concern is how the unconventional monetary policy in Japan affected bank lending. As the monetary policy during this period is already well documented in other studies, for example Shioji(2020), here we only focus on the movement of policy interest, monetary base and bank lending.

Fig.3 shows the changes of uncollateral overnight rate, which is the policiy interest rate. Roughly speaking, the policy interest rate in Japan has been zero from 2000 to 2021. There are several exceptional periods when interest rates have increased, but the increase is small and the period of increase is very short. In fact, the monthly average policy interest rate has been never larger than 0.6% during this period.

Fig.4 reports the amount of monetary base and the ratio of realized to legally required reserve. When the policy interest rate hit the zero bound, it is difficult to futher lower interest rate. The Bank of Japan started to increase the supply of monetary base, especially after 2013. As shown in Fig.4 the increase of monetary base reflects the holding of excess reserve. Excess reserve holding happens when the realized/required ratio exceed 100%. This began to rise rapidly after 2013 and reached a level of 4000% in 2022. In this paper, we use reserve holding by individual bank as the indicator of monetary policy. and see how this measure involved with different kind of bank lending.

We have discussed that the changes of total bank lending were relatively small comparing with the changes of monetary base or M2 and lending to different sectors was quite different. Fig.5 shows the changes of lending share to each industry from 1971 to 2019. It is widely known that during the bubble era, bank lending shifted from manufacturing industry to real estate industry. However, this shift started at least from years much earlier than the bubble era. After the burst of bubble, the lending share to real estate industry was relatively stable. The lending share to manufacturing industry continues to decrease. By the end of 2010s, the ratio of manufacturing lending to the total lending was around 10In contrast, lending to household largely increased. By the end of 2010s, household is the largest sector absorbing bank credit. In the estimation of this paper we will see how the excess reserves affect lending to different sectors.

3 Related Studies

Two strands of researches related to our study. One is the researches that directly investigate the impact of monetary policy to bank linding. Some studies emphasized the positive effects of unconventional monetary policy on private lending (Brown et al. (2015), Shioji (2019, 2020), Montgomery and Volz (2019)). There are two problems in these studies. One is that If monetary policy is effective to increase bank lending, why the total bank lending had kept a pace so slow to increase comparing other monetary measures (Fig.1). Another problem is that all these studies simply take the whole volume of bank lending as the target. Few of them ask the question of that which kind of lending was influenced or not, and what are the differences between lending to differnent industries or sectors.

The second strand of researches related to this study are on the relation of bank lending to economic growth or the differences of credit to different sectors in promoting economic development. Arcand et al. (2015) emphasize the non-linear relation between credit to private sector and economic growth. They successfully confirmed that when the credit to the private sector reaches 100%, further financial depth will start to negatively affect economic growth. There are good reasons to worry that this scenario may fit well with Japan's economy. The ratio of domestic bank lending to GDP largely increased in a relatively short period accompanied with the bubble. It is possible that these sudden changes were not supported by the real economic fundamentals. In fact, Hoshi and Kashyap (1999) even predict that from the following certain years Japanese banking industry should shrink its asset and lending size in order to keep the system sustainable.

Beck et al.(2012), Bezemer and Zhang (2019) also point out some limitations of bank lending to economic development but from a different angle. Beck at al.(2012) compare the growth-enhancing effects between enterprise credit and household credit. They find that the enterprise creidt is possitively associated with economic growth but the latter is not. Bezemer and Zhang (2019) find that changes in credit composition deeply correlated with the occurence of crisis. They even suggest that morgage credit may damage the real economy. These studies that the relation between credit and economic development may not be quantitatively linear, and also qualitatively different by different credit composi-

tion. It is natural to ask the question, how the unconventional monetary policy in Japan influenced the lending behavior by assuming that the impact may be different for different industries or different sectors.

4 Methodology and data sample

4.1 Methodology

The main results are based on the standard panel data estimation. We pay attentions to the potential endogeneity problem by introducing instrumental variables.

We also estimate the impact of monetary policy to bank lending using dynamic panel method. The lending supply function is defined as follows,

$$y_{i,t} = \alpha + \beta_1 g\_boj_{i,(t-1)} + \beta_2 x_{i,(t-1)} + v_i + u_{i,t}$$

where $y_{i,t}$ stands for the growth rate of total lending, lending to manufacturing and lending to househoud sector for bank i in period t. $g_{i,t}$ is the growth rate of reserve, which is defined as the sum of cash holding and deposit in the central bank for bank i in period t. $x_{i,t}$ stands for other control variables. The control variables in clude bank size, which is defined as the logarithm of total asset; non-performing loan ratio, capital ratio, and loan interest rate, which is defined as the ratio of lending interest revenue to total lending. To avoid the problem of endogeneity, we take one period lag for all the independent variables,

Our main concern is the impact of resere growth to lending to each sectors. especially the differences between manufacturing lending and lending to other sectors.

Because demand side factors are not explicitly included in the estimation function, it is possible that some independent variables, especially growth rate of reserve reflect certain demand side changes. A bank may increase its reserve holding partly because the Bank of Japan enlarged the market operation, and partly because this bank is facing weak credit demand. In order to control the possible biases, we employ instrumental variables in the estimation. employing instrumental variables. The candidates are the prefectural annual fire occurence per 10,000 people and the annual new baby-born per 1,000 people. We assume these two variables are highly correlated with the demand side factors but independent with the bank's supply factors. The results will be shown by fixed or random model. The model selection is based on Hausman test.

It is possible that the lending behavior depends on the results in the past time. That is, $y_{i,t}$ may be dynamicly evolved the its lag value. The lending supply function may be defined as follows,

$$y_{i,t} = \beta_1 y_{i,(t-1)} + \beta_2 x_{i,t} + \beta_3 w_{i,t} + v_i + u_{i,t}$$

where

$y_{i,t}$ indicates the growth rate of credit supply of bank i in t to certain sector. $x_{i,t}$ the bank's characteristics that may be predetermined, that is, it may not be exogenous and correlated with previously determined $y_{i,t}$ but not infected by any credit supply measures

in the future. $W_{i,t}$ are the exogenous variable. By differenciating we can delete the individual effect of n_i,

$$\Delta y_{i,t} = \beta_1 \Delta y_{i,(t-1)} + \beta_2 \Delta x_{i,t} + \beta_3 \Delta w_{i,t} + \Delta u_{i,t}$$

However, $\beta_i, i = 1, 2, 3$, could not be consistently estimated by the standard fixed or random effect model, because the difference term of $\Delta y_{i,(t-1)}$ and the difference term of $\Delta u_{i,t}$ are correlated.

$$E(\Delta y_{i,(t-1)} \Delta u_{i,t}) \neq 0$$

Still we can consistently estimate the parameters by using appropriate moment conditions. Allerano and Bond(1991) suggests to use the lagged variables of $Y_{i,t}$ as legitimate instrument varialbes, which are not correlated with the error term but correlated with the endogenous variables. The moment conditions are as follows,

$$E(y_{i,(t-1-j)} \Delta u_{i,t}) = 0, j \geq 1$$

Other endogeneous or pre-determined variables could be treated in the same way. Blundell and Bond(1998) suggests that together with the conditions on the differenced equation, the conditions on the level equation could also form part of appropriate moment conditions. By the latter conditions the problem of weak instruments can be avoided, although assumption on the initial lagged variable of $y_{i,t}$ and individual effects is needed. to the level equation, that is,

$$E(\Delta y_{i,(t-1-j)}(v_i + u_{i,t})) = 0, j \geq 1$$

We also show the results of dynamic panel estimation based on system GMM approach.

4.2 Data sample

Data used in this paper are mainly taken from *Nikkei NEEDS Financial Quest*. We also hand collect data from individual bank's security report or the web sites of Japanese Bankers Association in the cases that the data are missing in *Nikkei NEEDS Financial Quest* but available by these sources.

We choose the period from 2001/3 to 2019/3 as our sample period because the Bank of Japan started quantity easing from 2001. Annual data are used in this study because same important measures are not available for the half-year frequence.

There are some difficulties in tackling data of individual bank.

For banks that included estimation sample, we exclude these that went bankrupt during the sample period. We also delete the bank-year observations that experienced merger or aquisition. As the *Nikkei NEEDS Financial Quest* contains many missing values for industrial lending, we hand-collected them when these data are available from individual bank's security report.

For the reserve data, as pointed in Shioji(2020), the offically published data are only reported before the fiscal year 2013. However, the equivalent measure is available from the cash flow sheet in the concolidated financial statement. Our sample includes 115 regional banks. Due to missing value in some cases and the exclusion of merger or acquisition bank-year observation, the data are in the umbalanced panel form.

5 Empirical results

5.1 Discribtive statistics of variable

Table 1 shows the basic statistics of variables for the estimation sample. We should note that the figures in Table 1 do not include mega banks. We calculate the basic statistics for period 2001/3-2019/3, for which we also express it as the whole period; 2001/3-2012/3, the first half period and 2013/3-2019/3, the second half period.

There are large differences among lending growth rate to diffenent indutries. The differences are quite similar for the three periods. The lending to household sector (g_pers), real estate industry (g_persfudo) and finance and insurance industries (g_persfudokink) show the largest increase for all the three periods. The growth rates of the total lending (g_loan)are also positive but quite smaller than that of the abover three sectors. The growth rate of manufacturing lending is the lowest, not statisticlly different from zero for all the three periods. The manufacturing lending is about 11% for the whole period and has a lower level for the second half period than that of the first half.

Another worth-noting fact is the growth rate of reserve (g_boj). The whole, first half and second half period average of g_boj are 25%, 17% and 38%, respectively, which reflect the bold easing monetary policy of Abenomics.

We can also observe from Table 1 that the conditions of these regional banks have been improved. The non-performing loan ratio (npl) was lowering and kept at quite low level in the second half period. The capital ratio (r_cap) was increasing and attained at 11% in the second half period. However, the lending interest rate, which is deined as the ratio of interest revenue to total lending was decreasing. The average of this measure is only 1.43% in the second half period. Needless to say, this fact reflects the low interest monetary policy. Considering the basic business model for a typical bank is to intermediate deposit to lending, the low interest revenue may heavily burden the banking management. Bank size heavily and negatively influenced for the total lending and household lending but not for manufacturing lending.

5.2 Results of panel estimation using instrumental variable

Table 2-4 report the results based on panel estimation method for 2001/3-2019/3, 2001/3-2012/3 and 2013/3-2019/3, respectively. In order to control the endogeniety of reserve holding, we use prefectural new baby borth rate and the fire occurence as instrumental variables.

Table 2 shows the resuts for the whole period. The variables indicating bank health condition (npl, r_cap) show fairly reasonable influences to the lending behavior. npl negatively affected and r_cap negatively affected total lending and manufacturing lending, respectively. However, these health condition measures do not show any signifiant influences to household lending (g_pers), which indicates that the lending behavior may be based on some different logic to that of manufacturing or total lending.

The impacts of bank's reserve-holding to lending to each different sectors, which are

our main concern in this study, are interesting. The total lending received a positive, although not significant influence from the increase of reserve-holding. However the impact from reserve-holding to manufacturing and household lending are completely different. Manufacturing lending is negatively and significantly affected by the increase of reserve-holding and household lending received a positive and significant influence from it.

These results tell us as long as lending to different secors has different implications for the business cycle (Mian (2018)), it is meaningless to the impact of liquidity easing to the whole credit provision, especially in a period when the total lending volume changed very mildly.

5.3 Results of dynamic panel estimation

As a robust check, Table 5 - Table 7 show the results for lending to the sum of household and real estate industry and the sum of household, real estate and finance and insurance industries. All of the impacts of liquidity easing to lending to these sectors are positive although they are week in the first half period.

Table 8 - Table 13 show the similar results by dynamic panel estimation. The message is quite similar with Table 2-7, that is, the lending promotion effects are only observable in household sector, real estate industry or finance and insurance industry, but not in manufacturing indusry.

6 Concluding remarks and discussion

In this study, instead taking the whole lending volume as the target of monetary policy, we separately checked the impact of monetary policy to lending to different sectors, especially lending to manufacturing and lending to househoud. We find that the central bank's liquidity provision had a very limited influence on total lending and even negative influence to manufacturing lending. However the household lending was significantly promoted by the Quantity Easing.

Combined with the results from the previous studies(Beck et al. (2012), Arcand et al. (2015), Bezermer et al.(2019)), our results indicate the limit of central bank policy in stimulating credit provision to get out of the recession in the last two decades.

Figure 1: GDP and Some Monetary Indicators

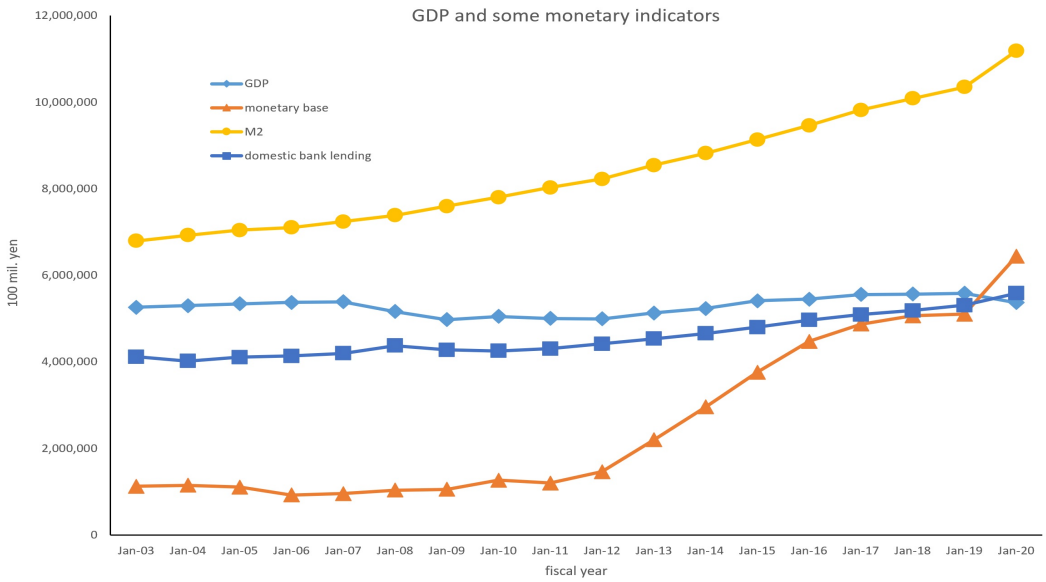

Figure 2: Ratio of domestic bank lending to GDP

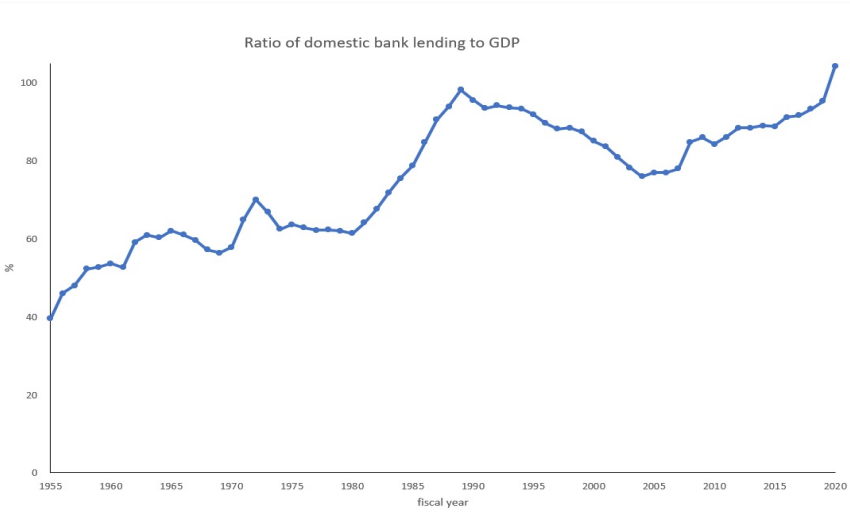

Figure 3: Policy Interest Rate

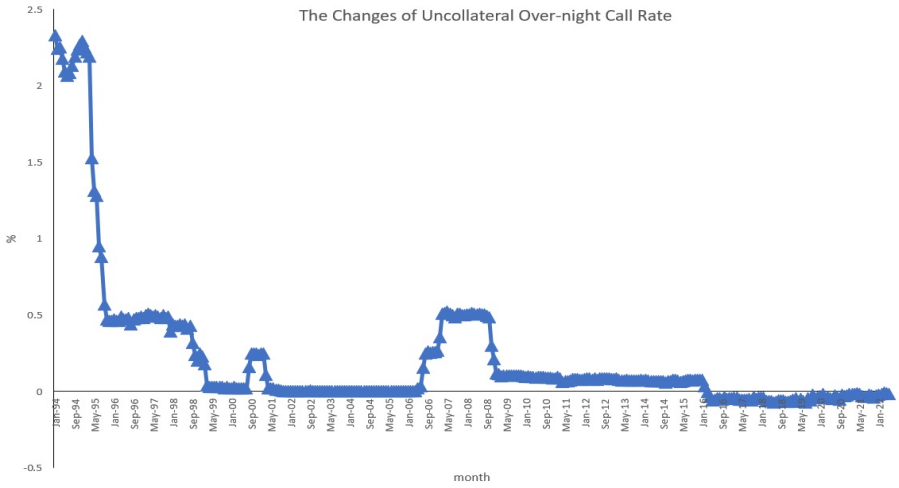

Figure 4: Monetary Base and Realized/required Reserve Ratio

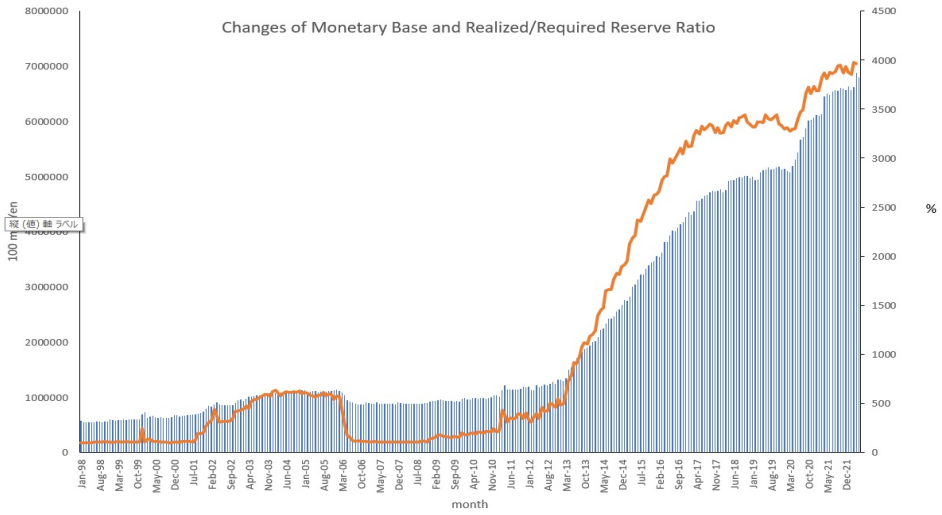

Figure 5: Industrial Lending by Domestic Banks

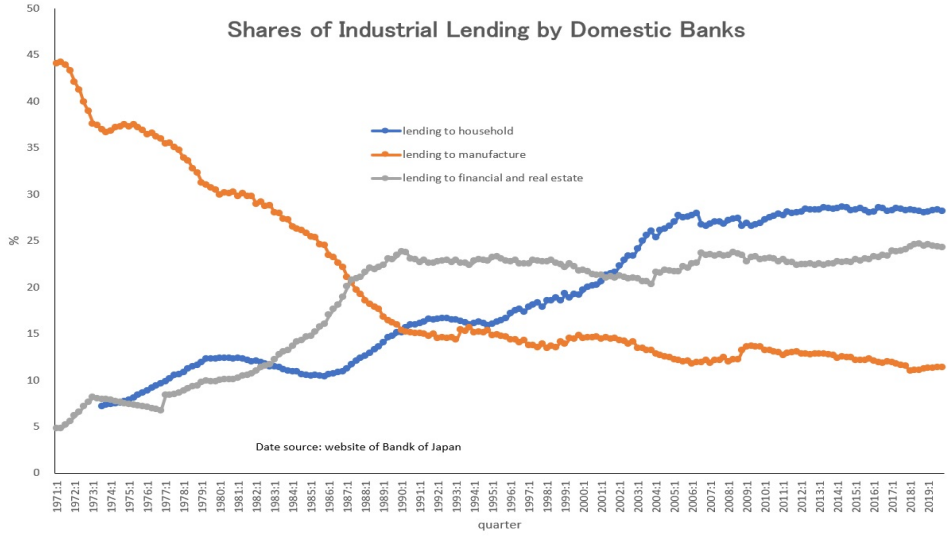

Table 1: Descriptive statistics

	mean	std dev	min	max
	2001/3-2019/03			
g_loan	1.74	3.34	−16.74	17.10
g_manu	−0.71	7.33	−33.64	47.10
g_pers	3.31	6.89	−42.65	77.01
g_persfudo	3.88	5.20	−21.23	44.02
g_persfudokink	3.68	4.97	−19.10	34.78
r_manu	10.88	4.74	1.33	26.62
g_boj	24.72	78.54	−83.70	782.26
npl	4.50	2.75	0.78	19.01
r_cap	10.17	2.06	2.17	20.90
size	14.50	0.92	12.08	16.64
l_rate	1.95	0.55	0.72	3.59
r_fire	40.19	9.64	0.90	69.63
r_newb	8.31	1.07	4.98	12.71
	2001/3-2012/03			
g_loan	0.94	3.37	−16.74	14.33
g_manu	−0.72	8.10	−33.64	47.10
g_pers	3.03	7.65	−42.65	77.01
g_persfudo	3.50	5.70	−21.23	44.02
g_persfudokink	3.20	5.36	−19.10	34.78
r_manu	11.54	4.83	2.28	26.62
g_boj	17.44	72.49	−80.09	472.29
npl	5.57	2.80	1.29	19.01
r_cap	9.96	1.91	2.17	16.98
size	14.39	0.89	12.08	16.35
l_rate	2.23	0.39	0.72	3.56
r_fire	43.76	9.09	0.90	69.63
r_newb	8.65	0.95	6.05	12.71

(continued)

	mean	std dev	min	max
	2013/3-2019/03			
g_loan	3.18	2.75	−10.69	17.10
g_manu	−0.69	5.72	−28.80	33.72
g_pers	3.80	5.24	−22.59	48.49
g_persfudo	4.54	4.07	−9.38	31.70
g_persfudokink	4.54	4.03	−10.15	30.94
r_manu	9.71	4.34	1.33	20.24
g_boj	37.61	86.83	−83.70	782.26
npl	2.58	1.15	0.78	12.76
r_cap	10.55	2.27	5.85	20.90
size	14.69	0.92	12.34	16.64
l_rate	1.43	0.38	0.80	3.59
r_fire	33.78	6.89	16.15	61.97
r_newb	7.70	1.01	4.98	12.03

Note: g_loan, g_manu g_pers g_persfudo and g_persfudokink stand for the annual growth rate of total lending, manufactural lending, household lending, sum of household and real estate sector lending and sum of household, real estate and financial sector lending. The figures are in percentage.

r_manu is the ratio of manufacturing to total lending. The figures are in percentage.

g_boj is the growth rate of the sum of cash holding and deposits in the central bank's account. The figures are in percentage.

npl is non-performance loan ratio, defined as the ratio of risk-management lending to total lending. The figures are in percentage.

r_cap is capital ratio. The figures are in percentage.

l_rate is the lending rate defined as the ratio of interest revenue to total lending. The figures are in percentage.

size is the logarithm of total asset.

r_fire and r_newb are the prefectural fire occurence per 10,000 people ratio and new-baby born per 1000 people ratio.

Table 2: Monetary base and bank lending in 2001/3-2019/3, instrumental panel estimation

	(1) g_loan	(2) g_manu	(3) g_pers
g_boj_{-1}	0.0036	-0.1024**	0.1590***
	(0.33)	(-2.47)	(2.90)
npl_{-1}	-0.2354***	-0.5193***	-0.2162
	(-4.60)	(-2.70)	(-0.85)
r_cap_{-1}	0.2451***	0.6057***	-0.2509
	(4.25)	(2.80)	(-0.88)
$size_{-1}$	-2.6870***	0.4517	-12.3559***
	(-3.25)	(0.15)	(-3.01)
l_rate_{-1}	-2.3223***	0.8694	-2.3391*
	(-8.15)	(0.81)	(-1.65)
number of obs	1989	1973	1973
number of banks	115	115	115
method	fixed	fixed	fixed

t statistics in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Note: The dependent variabls of g_loan, g_manu g_pers are defined as the annual growth rate of total lending, manufactural lending and household lending. These figures are in percentage.

g_boj is the growth rate of the sum of cash holding and deposits in the central bank's account. The figures are in percentage.

npl is non-performance loan ratio, defined as the ratio of risk-management lending to total lending. The figures are in percentage.

r_cap is capital ratio. The figures are in percentage.

l_rate is the lending rate defined as the ratio of interest revenue to total lending. The figures are in percentage.

size is the logarithm of total asset.

r_fire and r_newb are the prefectural fire occurence per 10,000 people ratio and new-baby born per 1000 people ratio.

Table 3: Monetary base and bank lending in 2001/3-2012/3, instrumental panel estimation

	(1) g_loan	(2) g_manu	(3) g_pers
g_boj_{-1}	-0.0088	-0.0280	0.0846*
	(-0.53)	(-0.72)	(1.78)
npl_{-1}	-0.2903***	-0.5747***	0.0254
	(-5.73)	(-4.78)	(0.17)
r_cap_{-1}	0.2458***	0.3290**	0.2333
	(3.61)	(1.99)	(1.16)
$size_{-1}$	-0.1319	-0.2732	0.4319
	(-0.85)	(-0.73)	(0.94)
l_rate_{-1}	-0.1169	-2.0835**	-0.2302
	(-0.28)	(-2.11)	(-0.19)
number of obs	1274	1261	1261
number of banks	114	114	114
method	random	random	random

t statistics in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Note: The dependent variabls of g_loan, g_manu g_pers are defined as the annual growth rate of total lending, manufactural lending and household lending. These figures are in percentage.

g_boj is the growth rate of the sum of cash holding and deposits in the central bank's account. The figures are in percentage.

npl is non-performance loan ratio, defined as the ratio of risk-management lending to total lending. The figures are in percentage.

r_cap is capital ratio. The figures are in percentage.

l_rate is the lending rate defined as the ratio of interest revenue to total lending. The figures are in percentage.

size is the logarithm of total asset.

r_fire and r_newb are the prefectural fire occurence per 10,000 people ratio and new-baby born per 1000 people ratio.

Table 4: Monetary base and bank lending in 2013/3-2019/3, instrumental panel estimation

	(1) g_loan	(2) g_manu	(3) g_pers
g_boj_{-1}	0.0504*	0.0697	0.0504*
	(1.65)	(0.50)	(1.93)
npl_{-1}	-0.4576	-0.2651	-1.1813
	(-1.22)	(-0.75)	(-1.58)
r_cap_{-1}	-0.0128	0.2973	-0.5004
	(-0.06)	(1.23)	(-1.28)
$size_{-1}$	-0.2294	-0.9646	-10.5839*
	(-0.33)	(-0.95)	(-1.65)
l_rate_{-1}	0.0850	-2.1410	-2.2983
	(0.07)	(-1.44)	(-0.84)
number of obs	715	712	712
number of banks	113	113	113
method	random	random	fixed

t statistics in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Note: The dependent variabls of g_loan, g_manu g_pers are defined as the annual growth rate of total lending, manufactural lending and household lending. These figures are in percentage.

g_boj is the growth rate of the sum of cash holding and deposits in the central bank's account. The figures are in percentage.

npl is non-performance loan ratio, defined as the ratio of risk-management lending to total lending. The figures are in percentage.

r_cap is capital ratio. The figures are in percentage.

l_rate is the lending rate defined as the ratio of interest revenue to total lending. The figures are in percentage.

size is the logarithm of total asset.

r_fire and r_newb are the prefectural fire occurence per 10,000 people ratio and new-baby born per 1000 people ratio.

Table 5: Monetary base and bank lending in 2001/3-2019/3, additional evendence

	(1) g_persfudo	(2) g_persfudokink
g_boj_{-1}	0.0649**	0.0571**
	(2.44)	(2.33)
npl_{-1}	-0.1872	-0.1102
	(-1.51)	(-0.96)
r_cap_{-1}	-0.1905	-0.0850
	(-1.37)	(-0.66)
$size_{-1}$	-8.0614***	-6.8905***
	(-3.69)	(-3.42)
l_rate_{-1}	-2.6476***	-2.5439***
	(-3.81)	(-3.97)
number of obs	1952	1952
number of banks	115	115
method	fixed	fixed

t statistics in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Note: The dependent variabls of g_persfudo is defined as the annual growth rate of the sum of lending to household and real estate. g_persfudokink is the annual growth rate of the sum of lending to household, real estate and finance and insurance industries. These figures are in percentage.

g_boj is the growth rate of the sum of cash holding and deposits in the central bank's account. The figures are in percentage.

npl is non-performance loan ratio, defined as the ratio of risk-management lending to total lending. The figures are in percentage.

r_cap is capital ratio. The figures are in percentage.

l_rate is the lending rate defined as the ratio of interest revenue to total lending. The figures are in percentage.

size is the logarithm of total asset.

r_fire and r_newb are the prefectural fire occurence per 10,000 people ratio and new-baby born per 1000 people ratio.

Table 6: Monetary base and bank lending in 2001/3-2012/3, additional evidence

	(1) g_persfudo	(2) g_persfudokink
g_boj_{-1}	0.0533	0.0192
	(1.49)	(0.66)
npl_{-1}	-0.1317	-0.0393
	(-1.07)	(-0.39)
r_cap_{-1}	0.1084	0.0433
	(0.45)	(0.22)
$size_{-1}$	-8.7545**	-5.1027*
	(-2.49)	(-1.80)
l_rate_{-1}	-1.8564	0.4863
	(-0.90)	(0.29)
number of obs	1247	1247
number of banks	114	114
method	fixed	fixed

t statistics in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Note: The dependent variabls of g_persfudo is defined as the annual growth rate of the sum of lending to household and real estate. g_persfudokink is the annual growth rate of the sum of lending to household, real estate and finance and insurance industries. These figures are in percentage.

g_boj is the growth rate of the sum of cash holding and deposits in the central bank's account. The figures are in percentage.

npl is non-performance loan ratio, defined as the ratio of risk-management lending to total lending. The figures are in percentage.

r_cap is capital ratio. The figures are in percentage.

l_rate is the lending rate defined as the ratio of interest revenue to total lending. The figures are in percentage.

size is the logarithm of total asset.

r_fire and r_newb are the prefectural fire occurence per 10,000 people ratio and new-baby born per 1000 people ratio.

Table 7: Monetary base and bank lending in 2013/3-2019/3, additional evidence

	(1) g_persfudo	(2) g_persfudokink
g_boj_{-1}	0.0435**	0.0425
	(2.04)	(1.34)
npl_{-1}	-1.2013*	-0.5324
	(-1.96)	(-1.27)
r_cap_{-1}	-0.1765	0.0717
	(-0.54)	(0.30)
$size_{-1}$	-12.4252**	-0.4540
	(-2.34)	(-0.60)
l_rate_{-1}	-4.0414*	-0.5983
	(-1.81)	(-0.46)
number of obs	705	705
number of banks	102	102
method	fixed	random

t statistics in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Note: The dependent variabls of g_persfudo is defined as the annual growth rate of the sum of lending to household and real estate. g_persfudokink is the annual growth rate of the sum of lending to household, real estate and finance and insurance industries. These figures are in percentage.

g_boj is the growth rate of the sum of cash holding and deposits in the central bank's account. The figures are in percentage.

npl is non-performance loan ratio, defined as the ratio of risk-management lending to total lending. The figures are in percentage.

r_cap is capital ratio. The figures are in percentage.

l_rate is the lending rate defined as the ratio of interest revenue to total lending. The figures are in percentage.

size is the logarithm of total asset.

r_fire and r_newb are the prefectural fire occurence per 10,000 people ratio and new-baby born per 1000 people ratio.

Table 8: Dynamic panel estimation results, 2001/3-2019/3

	(1) g_loan	(2) g_manu	(3) g_pers
g_loan_{-1}	-0.0562***		
	(-25.91)		
g_manu_{-1}		0.0196**	
		(2.26)	
g_pers_{-1}			-0.0030*
			(-1.67)
g_boj_{-1}	0.0734***	0.0086	0.0883***
	(5.23)	(0.26)	(3.48)
npl_{-1}	0.0207	-0.5769***	0.6425***
	(0.52)	(-5.96)	(7.93)
r_cap_{-1}	0.4580***	1.3988***	-0.0272
	(8.16)	(9.17)	(-0.28)
$size_{-1}$	-11.9469***	-9.6283***	-13.7979***
	(-16.65)	(-6.52)	(-12.19)
l_rate_{-1}	3.7396***	6.6136***	-0.6493
	(10.19)	(8.36)	(-0.84)
number of obs	1998	1968	1968
number of banks	115	115	115

t statistics in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Note: For the definitions of each variable, see Table 2-4.

Table 9: Dynamic panel estimation results, 2001/3-2012/3

	(1) g_loan	(2) g_manu	(3) g_pers
g_loan_{-1}	-0.0842***		
	(-20.04)		
g_manu_{-1}		0.0167	
		(1.39)	
g_pers_{-1}			-0.0315***
			(-4.70)
g_boj_{-1}	0.1016***	-0.0009	0.0809
	(3.90)	(-0.02)	(1.30)
npl_{-1}	0.1075**	-0.5958***	0.8316***
	(2.00)	(-5.42)	(7.13)
r_cap_{-1}	0.3881***	1.4228***	0.0387
	(3.96)	(5.04)	(0.20)
$size_{-1}$	-15.9131***	-8.6141***	-19.7933***
	(-10.96)	(-4.80)	(-9.62)
l_rate_{-1}	3.9380***	5.3605***	3.3454**
	(8.13)	(3.54)	(2.45)
number of obs	1127	1258	1258
number of banks	114	114	114

t statistics in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Note: For the definitions of each variable, see Table 2-4.

Table 10: Dynamic panel estimation results, 2013/3-2019/3

	(1) g_loan	(2) g_manu	(3) g_pers
g_loan_{-1}	0.0218		
	(1.42)		
g_manu_{-1}		0.0600*	
		(1.69)	
g_pers_{-1}			0.0591***
			(5.62)
g_boj_{-1}	0.0620***	-0.0277	0.0567
	(2.97)	(-0.42)	(1.59)
npl_{-1}	-0.4935**	-1.4287**	-0.5891*
	(-2.47)	(-2.54)	(-1.94)
r_cap_{-1}	0.6868***	0.1777	0.5087***
	(6.38)	(0.69)	(2.86)
$size_{-1}$	-2.7283***	5.1750***	-7.8074***
	(-4.13)	(3.61)	(-3.28)
l_rate_{-1}	0.3906	11.6377***	-4.8131***
	(0.61)	(6.92)	(-4.26)
number of obs	714	710	710
number of banks	106	103	103

t statistics in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Note: For the definitions of each variable, see Table 2-4.

Table 11: Dynamic panel estimation results, additional evidence, 2001/3-2019/3

	(1) g_persfudo	(2) g_persfudokink
g_persfudo$_{-1}$	-0.0070**	
	(-2.36)	
g_persfudokink$_{-1}$		-0.0121***
		(-3.52)
g_boj$_{-1}$	0.1274***	0.0871***
	(5.21)	(3.04)
npl$_{-1}$	0.1637**	0.3368***
	(2.37)	(4.40)
r_cap$_{-1}$	-0.1406*	-0.0070
	(-1.82)	(-0.08)
size$_{-1}$	-13.3096***	-13.7492***
	(-11.37)	(-10.73)
l_rate$_{-1}$	-0.0749	1.8010**
	(-0.11)	(2.40)
number of obs	1945	1945
number of banks	115	115

t statistics in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Note: For the definitions of each variable, see Table 5-7.

Table 12: Dynamic panel estimation results, additional evidence, 2001/3-2012/3

	(1) g_persfudo	(2) g_persfudokink
g_persfudo$_{-1}$	-0.0401***	
	(-5.10)	
g_persfudokink$_{-1}$		-0.0423***
		(-5.39)
g_boj$_{-1}$	0.1343**	0.1357**
	(2.43)	(2.27)
npl$_{-1}$	0.2895***	0.2864***
	(2.87)	(2.68)
r_cap$_{-1}$	-0.2136	0.1406
	(-1.46)	(0.90)
size$_{-1}$	-20.0026***	-19.1566***
	(-9.96)	(-8.51)
l_rate$_{-1}$	1.7530	4.0707***
	(1.43)	(3.16)
number of obs	1242	1242
number of banks	114	114

t statistics in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Note: For the definitions of each variable, see Table 5-7.

Table 13: Dynamic panel estimation results, additional evidence, 2013/3-2019/3

	(1) g_persfudo	(2) g_persfudokink
g_persfudo$_{-1}$	0.0340***	
	(3.28)	
g_persfudokink$_{-1}$		0.0387**
		(2.07)
g_boj$_{-1}$	0.0246	0.0130
	(0.84)	(0.34)
npl$_{-1}$	-0.5778*	0.2922
	(-1.87)	(0.83)
r_cap$_{-1}$	0.5703***	0.8455***
	(3.93)	(4.91)
size$_{-1}$	-4.4405***	-1.1679
	(-3.08)	(-0.82)
l_rate$_{-1}$	-4.2463***	-3.3441***
	(-5.12)	(-3.25)
number of obs	703	703
number of banks	102	102

t statistics in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Note: For the definitions of each variable, see Table 5-7.

Refernces

Arcand, J., Berkes, E. and U. Panizza (2015) Too much finance? *Journal of Economic Growth* 20, 105-148.

Arellano, M. and S., Bond (1991) Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations, *Review of Economic Studies* 58, 277-297.

Beck, T., Buyukkarabacak, B., Rioja, F., and N. Valev (2012) Who gets the credit? And does it matter? Household vs. firm lending across countries. *B. E. Journal of Macroeconomics: Contributions* 12(1), 1-44.

Bezemer, D. and L. Zhang (2019) Credit composition and the severity of post-crisis recessions. *Journal of Financial Stability* 42, 52-66.

Blundell, R. and S. Bond (1998) Initial condtions and moment restrictions in dynamic panel data models, *Journal of Econometrics* 87, 115-143.

Dell'Ariccia, G., Laeven L. and R. Marquez (2014) Real Interest rates, leverage, and bank risk raking. *Journal of Economic Theory* 149, 1, 65–99.

Heider, F., Saidi, F. and G. Schepens (2019) Life below zero: Bank Lending under negative policy rates. *Review of Financial Studies* 32, 10, 3727-61.

Hoshi, T. and A. Kashyap (1999) The Japanese banking crisis: Where did it come from and how will it end? *NBER Macroecnomics Annual* 14, 129-201.

Martinez-Miera, D. and R. Repullo (2017) Search for yield, *Econometrica* 85, 2, 351-378.

Matousek, R., Papadamou, S. and A. Sevicp (2019) The effectiveness of quantitative easing: Evidence from Japan, *Journal of International Money and Finance* 99, 1-15.

Montgomery, H. and U. Volz (2019) The effectiveness of unconventional monetary policy in Japan, *Journal of Economic Issues*, 53(2), 411-416,

Mian, A. and A. Sufi (2018) Finance and business cycles: The credit-driven household demand channel. *Journal of Economic Perspectives* 32, 3, 31-58.

Ogura, Y. (2020) Intensified Lending Competition and search-for-yield under prolonged monetary easing. *Journal of the Japanese and International Economies* 56, 1-16.

Shioji, E. (2019) Quantitative 'flooding' and bank lending: Evidence from 18 years of near-zero interest rate. *Journal of The Japanese and International Economics* 52, 107-120.

Shioji, E. (2020) Response of bank loans to the Bank of Japan's quantitative and quantitative easing policy: a panel data analysis. *Seoul Journal of Economics* 33, 3, 355-94.