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Impact of the Fund-Provisioning Measure to Stimulate Bank Lending in Japan^{*}

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Abstract

This paper uses financial data from individual banks to quantitatively analyze how the Bank of Japan's "Fund-Provisioning Measure to Stimulate Bank Lending," decided for introduction in October 2012, affected banks' outstanding loans. We estimated the causal impact of the measure using propensity score matching to address the selection bias stemming from the voluntary basis of participation in this program. The results indicate a statistically significant difference in the outstanding loans between the participating and non-participating banks, suggesting that the Fund-Provisioning Measure to Stimulate Bank Lending helped increase lending.

JEL Classification: E50, E51, E52, E58, G21, C23

Keywords: Unconventional monetary policy, Lending facility, Bank lending, Propensity score matching

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1. Introduction

The global financial crisis in the late 2000s prompted central banks worldwide to implement unconventional monetary policies to stabilize financial systems, stimulate economic activity, and address persistently low inflation. As nominal interest rates reached the zero lower bound, unconventional monetary policy measures, such as forward guidance and asset purchase programs, became common. Additionally, "lending facilities" have been introduced as an unconventional monetary policy measure to supply liquidity to financial institutions and influence the lending channel. Under such measures, central banks passively provide loans to financial institutions on request in exchange for eligible collateral. In Japan, the Bank of Japan (BOJ) decided to introduce the "Fund-Provisioning Measure to Stimulate Bank Lending" (hereafter, the Program) at the Monetary Policy Meeting in October 2012 to encourage financial institutions' aggressive action and help increase the proactive credit demand of firms and households. Similar programs to promote lending have been implemented in the Euro area and the United Kingdom (UK), generating an active debate over their effectiveness.

Under the Program, the BOJ provides low-interest and long-term funds to financial institutions in exchange for eligible collateral; the maximum amount a financial institution can borrow is determined based on the net increase in their lending.¹ The Program aims to directly influence the lending behavior of financial institutions by reducing funding costs and providing them with stable financing. Since its introduction in 2013, the amount of funds under the Program has grown to approximately 80 trillion Japanese yen (JPY). At the same time, the overall loans outstanding by financial institutions have increased by around 300 trillion JPY; however, these developments alone cannot confirm a causal relationship between these developments—whether loans outstanding would have grown less without the Program. From a policy standpoint, understanding whether the Program has helped increase lending is important.

This paper examines the Program's lending promotion effect in Japan.² Our analysis shows

¹ In addition to the Program, which the BOJ introduced to promote financial institutions' aggressive action and help increase the proactive credit demand of firms and households, the BOJ has implemented other measures to support corporate financing. These include the "Special Funds-Supplying Operations to Facilitate Corporate Financing" and the "Special Funds-Supplying Operations to Facilitate Financing in Response to the Novel Coronavirus (COVID-19)." Additionally, to achieve price stability over the medium to long-term, the BOJ has introduced measures to support various private-sector initiatives, such as the "Fund-Provisioning Measure to Support Strengthening the Foundations for Economic Growth" and the "Funds-Supplying Operation to Support Financial Institutions in Disaster Areas."

² For an analysis of the impact of monetary easing measures over the past 25 years on the financial system, see Bank of Japan Financial System and Bank Examination Department (2024). For a discussion on the effects of interest rate declines resulting from large-scale monetary easing on the function of financial

a statistically significant difference in the outstanding loans between participating and nonparticipating banks, implying that the Program participants increased the loan supply.

The contribution of our analysis is empirically assessing the impact of the Program on bank lending. While the Program uptake by financial institutions has steadily increased, to the best of our knowledge, this is the first quantitative analysis of its policy effects in Japan. The analysis could extend beyond the impact on outstanding loans, including impacts on financial institutions' behavior through changes in interest rate risks and impacts on the real economy; however, given the challenge of addressing these factors, this study focuses on whether the Program has successfully promoted loan growth.

The rest of this paper is structured as follows. Section 2 provides an overview of the Program and outlines the channels through which it affects the real economy. Section 3 explores similar measures introduced in other countries and reviews related literatures. Section 4 discusses the analytical methodology, and Section 5 presents the results. Section 6 concludes.

2. Overview and Transmission Channels of the Program

2.1 Overview of the Program

The BOJ decided to introduce the Program at the Monetary Policy Meeting in October 2012 to promote financial institutions' aggressive action and help increase the proactive credit demand of firms and households. The Program was first operated in June 2013, providing financial institutions with low-interest, long-term loans (up to 4 years at an annual rate of 0.1%) based on net increases in their outstanding loans from 2012 Q4 (see Chart 1). To support Japan's economic growth by capturing global demand, loans to calculate the maximum amount of borrowing under the Program cover loans to investment funds and loans in foreign currencies for overseas firms. Since its introduction, financial institutions have actively used the Program (see Chart 2).

Chart 3 summarizes several amendments (such as expanding eligible collateral and raising the maximum amount) that likely contributed to broader financial institutions' participation and increased the Program uptake.³ Specifically, in June 2014, the maximum loan amount was raised to twice a financial institution's net loan growth. In June 2015, a framework was established to allow financial institutions that were members of financial cooperatives'

intermediation, see Abe et al. (2024).

³ Sugo and Vergote (2020), in their analysis of the Euro area, highlight that promoting the use of TLTROs (a lending facility similar to the Program discussed later) depends on the setting of lending rates and the availability and composition of eligible collateral.

central organizations (such as the Shinkin Central Bank, the Shinkumi Federation Bank, the Rokinren Bank, and the Norinchukin Bank) without a current account at the BOJ to participate. In March 2016, the Program's loan interest rate was lowered to 0% after the introduction of the negative interest rate policy. From June 2016, twice the increase in uptake was added to each financial institution's "Macro Add-on Balance" under the Complementary Deposit Facility.⁴ That is, under the negative interest rate policy, current account deposits at the BOJ were divided into three tiers: the "Basic Balance" (a rate of +0.1% was applied), the "Macro Add-on Balance" (a rate of 0% was applied), and the "Policy-Rate Balance" (a rate of -0.1% was applied). The "Policy-Rate Balance" was determined as the total current account balances minus the sum of the "Basic Balance" and the "Macro Add-on Balance." Therefore, a larger uptake of the Program increased the Macro Add-on Balance (thereby reducing its "Policy-Rate Balance"), allowing financial institutions to conduct arbitrage using their three-tiered reserve structure. In June 2020, rolling over the repayment amount was allowed under certain conditions to support financial institutions that had consistently increased lending and contributed to the continuation of powerful monetary easing. In June 2016 and September 2019, the eligible collateral required for financial institutions was expanded.⁵

2.2 Transmission Channels

The Program is expected to promote more active lending by financial institutions to firms and households by reducing funding costs and increasing the risk-taking capacity of financial institutions (see Chart 4).

First, the Program can decrease lending rates of financial institutions by offering funding at lower interest rates than other funding sources. The Program's interest rate was set at 0.1% until the December 2015 operation, and then lowered to 0% from the March 2016 to the March 2024 operation.⁶ Chart 5 compares the Program's lending rate with the funding costs

⁴ Under the Complementary Deposit Facility, the BOJ applies interest rates to financial institutions' excess reserves (current account balances and special reserve account balances at the BOJ in excess of required reserves held by financial institutions subject to the reserve requirement system).

⁵ In December 2015, it was decided to accept housing loans portfolio as collateral through a trust scheme and foreign currency-denominated loans on deeds as eligible collateral. Furthermore, the introduction of additional measures were decided in April 2019, including the relaxation regarding the eligibility standards for debt of companies and municipal governments.

⁶ Note that, at the March 2024 Monetary Policy Meeting, it was decided that the Bank would provide loans under the Program with an interest rate of 0.1% and a duration of one year. The maximum amount of funds that each eligible counterparty can borrow was also decided to be equivalent to the net increase in outstanding loans. At the July 2024 Monetary Policy Meeting, it was determined that the lending rate for new operations would be set to the average rate applied under the Complementary Deposit Facility

of alternatives, such as term deposits, negotiable certificates of deposits (CDs), and corporate bonds. On average, the Program's lending rate remained about 2 basis points lower than that of CDs, 10 basis points lower than term deposits, and 19 basis points lower than corporate bonds. Using the Program may allow financial institutions to offer lower lending rates, potentially boosting funding demand among firms and households.⁷ After introducing the Program, BOJ (2013) reported that financial institutions reduced mortgage rates. Some financial institutions have also established special funds to stimulate the regional economy via lending through the Program.

Second, the Program facilitates stable funding sources for financial institutions, enhancing their risk-taking capacity. Interest rate risk is one factor that influences financial institutions' willingness to take on risks. Specifically, financial institutions typically secure short-term funding (e.g., demandable deposits) while facilitating long-term investments (e.g., corporate loans), creating a duration gap between asset and liability maturity. A larger duration gap increases sensitivity to interest rate changes (i.e., increased interest rate risk), which affects the equity's net worth and limits financial institutions' risk-taking. The Program reduces this duration gap and lowers the interest rate risk by allowing financial institutions to obtain long-term funding at fixed rate.⁸ Lower interest rate risk allows financial institutions. The effects of interest rate risk and maturity mismatches on bank lending have been well documented (Bernanke and Gertler, 1995; Gambacorta and Mistrulli, 2004). In addition to the interest rate risk, a stable funding source by the central banks can reduce the liquidity risk.⁹

during the loan term.

⁷ The transmission channel to the real economy through reduced funding costs has also been argued in the Bank of England's Funding for Lending Scheme (FLS) and the European Central Bank's Targeted Longer-Term Refinancing Operations (TLTRO) (BOE, 2012; ECB, 2015). Additionally, ECB (2015) notes that (i) TLTRO reduces funding demand of participating banks through the financial market; thus, the reduced aggregate demand in the financial market potentially lowers funding costs for non-participating entities. ECB (2015) also argues that (ii) reduced wholesale funding (e.g., corporate bond issuance) by participating banks may promote portfolio rebalancing of investors. Furthermore, (iii) the central bank's commitment to offering long-term and low-rate lending could strengthen the effect of forward guidance.

⁸ Bank of Japan (2024) notes that from the end of 2022 to the end of September 2023, the duration gap of financial institutions shrunk due to the uptake of the Program and funds-supplying operations against pooled collateral.

⁹ ECB (2014) reported the results of the Euro Area Bank Lending Survey (BLS), which showed that most banks answered improvement in liquidity as a key impact of TLTRO on their financial position. Renne (2014) also observed that long-term funding from central banks contributes to improvements in the Net Stable Funding Ratio (NSFR). For the general discussion on the liquidity channel of monetary policy through lowering liquidity risk to promote banks' lending, see BCBS (2011).

3. Overview of Lending Facilities by Overseas Central Banks and Literature

Similar lending facilities have been introduced in various jurisdictions to stimulate lending. This section provides an overview of comparable programs introduced by overseas central banks, followed by a review of the literature on the effects of such measures and their relationship with our research.

3.1 Lending Facilities by Overseas Central Banks

Chart 6 summarizes the main features of the major lending facilities introduced in the Euro area and the UK to encourage lending.¹⁰ Like the BOJ Program, these facilities supply liquidity to financial institutions with incentives to increase the outstanding loans to increase the maximum amount to uptake and lower funding costs.

Specifically, the European Central Bank (ECB) introduced the Targeted Longer-Term Refinancing Operations (TLTRO) from September 2014 to June 2016 to bolster the transmission of monetary policy by increasing the credit supply (Draghi, 2014). The ECB set borrowing limits based on each bank's outstanding loans as of the end of April 2014 and subsequent net loan increases. Each bank also received a benchmark¹¹ based on its net loan growth from May 2013 to April 2014; prepayment was required in April 2016 if a bank's loan growth fell below its benchmark. The ECB later introduced TLTRO-II (June 2016 to March 2017) and TLTRO-III (September 2019 to December 2021), adding more incentives for loan growth and modifying how borrowing limits were calculated.¹²

The Bank of England (BOE) also launched the Funding for Lending Scheme (FLS), which was in effect from August 2012 to January 2018, to encourage lending to households and companies (BOE, 2012). Like the BOJ's Program and the ECB's TLTRO, the maximum amount of the FLS increased as financial institution's outstanding loans grew. Furthermore, it offered a preferable funding rate as the financial institution increased outstanding loans.¹³

¹⁰ Other similar measures were introduced during the COVID-19 pandemic, such as the Bank of England's Term Funding Scheme with additional incentives for small- and medium-sized enterprises (TFSME) in April 2020 and the Federal Reserve's Paycheck Protection Program Liquidity Facility (PPPLF) in April 2020.

¹¹ The benchmark was zero if the net loan increase from May 2013 to April 2014 was zero or greater. If the net loan increase was below zero, the benchmark was adjusted to consider the downward trend. Specifically, the monthly average of net loan increases during this period, denoted as NL, was used as follows: for the March 2015 operation, the benchmark was set at 9NL, and for operations from June 2015 onward, the benchmark was set at 12NL.

¹² Unless otherwise specified, "TLTROs" hereafter refers to these three series of the measure as a whole.

¹³ The BOE subsequently made policy amendments, including the change in the calculation method of

Other unique FLS features include the fact that the BOE did not lend directly to financial institutions, but provided Treasury bills (TBs) in exchange for eligible collateral.¹⁴ The FLS was also available on each business day, while the BOJ's and the ECB's measures were offered every quarter.

3.2 Literature Review

Assessing whether these lending facilities increased financial institutions' lending has important policy implications. Research on unconventional monetary policies has advanced, and studies on the impact of lending facilities, especially in the Euro area, have accumulated. This paper is most related to these studies.

Numerous studies used detailed data on bank finances and lending, showing that banks participating in these programs increased loans outstanding and reduced lending rates more than non-participating banks (Altavilla et al., 2020a,b; Afonso and Sousa-Leite, 2020; Da Silva, 2021; Kwapil and Rieder, 2021; Albertazzi et al., 2018; Barmeier et al., 2023). For example, Altavilla et al., (2020a) reported that banks participating in TLTROs increased their outstanding loans by 2.5% after one year and 7.5% after 2 years compared to non-participating banks. Some studies suggest that TLTROs boosted corporate lending rather than consumer lending (Laine, 2021; Bats and Hudepohl, 2019; Esposito et al., 2020). Studies on lending rates also found that TLTROs lowered lending rates by approximately 20 basis points (Benetton and Fantino, 2018; Esposito et al., 2020). Additional research indicated an indirect effect whereby TLTROs eased the lending attitudes of non-participating banks through intensified competition in the lending market (Andreeva and García-Posada, 2020).

Few studies have examined the impact on the real economy, such as output, investment, and consumption. Balfoussia and Gibson (2015) reported the estimates that if all TLTRO funds had been directed to private-sector lending, TLTROs could have raised industrial production in the Euro area by 5.7% and retail sales by 2.9% cumulatively over four years. Churm et al. (2015) estimated that the quantitative easing policy and the FLS raised real gross domestic product (GDP) by 0.8% and inflation by 0.6% at their peak by reducing banks' funding costs in the UK. Conversely, Perdichizzi et al. (2023) found that in areas in Italy with high TLTRO uptakes, funds were not directed toward profitable investments. This situation resulted in

the maximum amount available to promote lending to small and medium-sized firms, and inclusion of lending by non-bank entities within the consolidated groups.

¹⁴ Financial institutions that obtained the TBs were expected to use them as collateral to raise funds from the financial market, thereby increasing their loan supplies.

relative declines in GDP and corporate investment, suggesting a negative impact of TLTROs on economic growth. Research on real economic impacts remains limited, and further studies are needed.

Prior studies also emphasized that participation in lending facilities is voluntary; therefore, addressing selection bias is crucial when identifying policy effects; for instance, banks with higher loan demands from firms and households may be more likely to participate. Studies have employed various methods to overcome this issue, including instrumental variable approaches (Benetton and Fantino, 2018; Andreeva and García-Posada, 2020; Esposito et al., 2020), matching (Haan et al., 2019; Laine, 2021; Barmeier et al., 2023), high-frequency identification (Altavilla et al., 2020a,b; Mosk and Vassallo, 2024), and regression kink design (Albertazzi et al., 2018). Instrumental variables are the most widely used approach. For example, Benetton and Fantino (2018) used loans outstanding in April 2014 as an instrument for TLTRO participation.¹⁵ In contrast, Laine (2021) estimated the likelihood of participation in TLTRO (propensity score) based on each bank's financial data before the TLTRO announcement (e.g., ex-ante borrowings from the central bank), constructed quasi-experimental data by matching based on the propensity scores, and estimated policy effects using a difference-in-differences (DID) approach. This approach is the most related to our analysis.¹⁶

4. Methodology

This section outlines our analysis framework to assess how the Program affects financial institutions' outstanding loans. Chart 7 shows that financial institutions' outstanding loans and borrowing under the Program have increased concurrently; however, the Program's maximum amount the financial institutions can borrow is determined based on the net increases in loans outstanding. Therefore, the causal relationship between the Program uptake and increases in outstanding loans remains unclear. Additionally, the voluntary framework of program participation complicates the identification of its effects. For example, financial institutions facing strong borrowing demand from firms tend to have higher loan growth and are more likely to use the Program. In this case, the issue of the selection bias is due to firms' unobservable borrowing demand. Simply comparing the loan growth between

¹⁵ The maximum amount available for the TLTROs in the September and December 2014 operations was 7% of the loans outstanding as of April 2014. The authors argue that it is an appropriate instrumental variable because this available amount was pre-determined before the operation and most banks used most of the maximum amount.

¹⁶ Laine (2021) demonstrated consistent results with the propensity score matching when the instrumental variable method was employed.

program participants and non-participants could lead to biased estimates of the Program's effect on lending.

Prior studies have widely used instrumental variable methods to tackle this selection bias; however, identifying appropriate instruments in Japan is challenging due to data constraints and differences in program design.¹⁷ Therefore, we follow Laine (2021) and use a propensity score matching to address the issues and quantitatively analyze the Program's impact on outstanding loans.¹⁸ Propensity score matching is a statistical technique that constructs a quasi-experimental dataset of a control group (non-participants) when randomized controlled trials are not feasible. This approach is advantageous when the appropriate instruments is unavailable and issues of the weak instruments matter.

The specific procedures are as follows. First, we use the following logit model to estimate each institution's probability of using the Program (propensity score) at the end of fiscal 2013 (March 2014) based on characteristics like the year-over-year changes in loans outstanding before the policy announcement.

$$P(B_{i,FY2013} > 0) = \frac{exp(\boldsymbol{\beta}' \boldsymbol{x}_{i,FY2011})}{1 + exp(\boldsymbol{\beta}' \boldsymbol{x}_{i,FY2011})}.$$
(1)

In Equation (1), subscript *i* represents the financial institution, $B_{i,FY2013}$ is the amount of the borrowing under the Program, and $x_{i,FY2011}$ represents a vector of financial institution attributes at the end of fiscal year 2011 (March 2012). Financial institution attributes include the ratio of loans to total assets, the year-over-year changes in outstanding loans, and the capital adequacy ratio. Additionally, we suspected financial institutions that borrowed significant funds from the BOJ in advance were more likely to use the Program. Therefore, we used the borrowing under the "Fund-Provisioning Measure to Support Strengthening the Foundations for Economic Growth"¹⁹ (hereafter, Growth-supporting Program) divided by the total assets. The details of the Program were disclosed after the October 2012 Monetary

¹⁷ One might think the net loan growth is one of promising instrument variables for the analysis in Japan because the maximum amount available under the Program is determined based on the net loan growth from the reference date; however, the maximum available amount was set after the policy announcement in October 2012, leaving open the possibility of endogeneity. Furthermore, as ex-ante loan growth may reflect corporate funding demand, it may not satisfy the exclusion restriction of the instrument variable.

¹⁸ Propensity score matching has been used not only by Laine (2021) to analyze the policy effects of TLTROs on bank lending but also by Williamson and Forbes (2014) and Cattaneo (2010) to examine the impact of smoking on health.

¹⁹ This measure was first operated in September 2010, and was expected to act as a catalyst to further stimulate financial institutions' efforts to strengthen the foundations for economic growth by providing them with low-interest, long-term funding from the BOJ.

Policy Meeting; thus, we use explanatory variables as of the end of fiscal year 2011 (March 2012) to address endogeneity.

Second, we construct the quasi-experimental dataset of the participating financial institutions and their counterparts with the closest value of the propensity score estimated by Equation (1).

Third, the DID method is applied to estimate the Program's impacts. The estimation equation is as follows:

$$log(Y_{i,t}) = \sum_{\tau=2010}^{T} \gamma_{\tau} \times I(B_{i,FY2013} > 0) \times D_{t,\tau} + \delta_i + \eta_t + \varepsilon_{i,t.}$$
(2)

In Equation (2), subscript *i* represents the financial institution, *t* represents the fiscal year, and $Y_{i,t}$ is the outcome variable measuring the policy effect. $I(B_{i,FY2013} > 0)$ is a dummy variable that equals 1 if the financial institution used the Program and 0 otherwise. $D_{t,\tau}$ is a year dummy, and $\varepsilon_{i,t}$ is the residual. Fixed effects, δ_i and η_t , control time-invariant characteristics of financial institutions and time-variant macroeconomic trends, respectively. As the outcome variable $Y_{i,t}$, we first use outstanding loans and then use the outstanding amount of securities holding given that the Program does not restrict fund use and possibly affects financial institutions' securities investments.

The time-dependent parameter (γ_{τ}) captures the impact of the Program on outstanding loans and securities holding. A positive γ_{τ} value suggests the Program increased lending. For securities investments, a positive value of the parameter implies that the Program encouraged investments in securities. In contrast, a negative value may imply incentives to decrease securities investments to increase loan supply. Note that DID requires the parallel trend assumption: there are no ex-ante differences in the outcome variable between participants and non-participants. In our model, γ_{τ} is estimated for each fiscal year; therefore, the insignificant value of the parameter before the introduction of the Program supports that the parallel trend assumption is satisfied.

Data sources are as follows. Data on the borrowing of individual financial institutions under the Program and the Growth-supporting Program are from the BOJ's data. Other data, such as financial statements from financial institutions, are from Bloomberg. The estimation period is from fiscal 2009 to 2019, ending before the onset of the pandemic. This methodology identifies policy effects by comparing the outcome variables of participants and non-participants; thus, there are some caveats to note. First, the effects could not be estimated if all financial institutions used the Program; therefore, our analysis focuses on regional banks because sufficient participants and non-participants existed. Major banks are omitted because most used the measure, as shown in Chart 8. We also exclude banks with data discontinuities due to mergers during the estimation period. *Shinkin* banks can access the Program through central organizations of financial cooperatives; these are also excluded because observing the uptake of individual financial institutions is challenging. Consequently, our analysis results should be interpreted with latitude, as they may not fully capture the impact across all institutions.

5. Estimation Results

5.1 Baseline Model

Chart 9 presents the estimation results of the logit model in Equation (1), which examines the factors that influence the probability of using the Program. The results indicate that the uptake of the Growth-supporting Program and the capital adequacy ratio has a statistically significant influence on the likelihood of participation. This outcome may imply that financial institutions that used the Growth-supporting Program in advance faced relatively strong funding demand from firms and had a business environment conducive to using the Program.²⁰ The significance of the capital adequacy ratio suggests that institutions with a greater capacity for risk-taking are more likely than other institutions to participate in the Program.

Chart 10 compares the distribution of the estimated propensity scores between the raw dataset and matched dataset artificially constructed using the nearest neighbor method. After matching, the distribution of the propensity scores of non-participants is closer to that of the participants. Chart 11 summarizes the covariates before and after matching. A standardized mean difference (SMD) near 0 and a variance ratio close to 1 indicate a balanced covariate. The chart shows that, after matching, the SMD and the variance ratio for the Growth-supporting Program (as a ratio to total assets) change to -0.07, and 1.03, respectively, supporting an improvement in the covariate balance. The SMDs for many other variables are also below 0.25 in absolute value, indicating an improvement in the covariate balance.²¹

²⁰ This result is consistent with Laine (2021), who reported that banks with larger amount of ex-ante borrowing from the central bank were more likely to use TLTROs.

²¹ Stuart (2010) discussed that previous studies argued that the absolute value of the SMD should be less than 0.25, and the variance ratio should fall between 0.5 and 2. In our analysis, the variance ratios for some variables, such as net income ROA, do not meet these criteria; however, excluding these variables did not produce significant changes in the estimation results, which may serve as a validation check.

The top panel of Chart 12 displays the Equation (2) estimation results for the difference in loans outstanding between participants and non-participants.²² As shown, over the 7 years following the policy announcement, cumulative loans outstanding for participants were approximately 6% higher than those for non-participants. This statistically significant result implies that the Program may have encouraged loan provisions by financial institutions. Additionally, the insignificant parameter before the policy announcement supports the parallel trend assumption. The bottom panel of Chart 12 shows the estimation results when using securities holdings as the dependent variable. The point estimates are negative; however, none of the parameters is statistically significant across periods, suggesting no significant impact of the Program usage on securities investments. These results are align with the findings from previous overseas studies that lending facilities have contributed to loan growth; however, these results should be interpreted with latitude.

Two important caveats should be considered when interpreting these results. First, this paper estimates the Program's policy effect as the difference in loans outstanding between program participants and non-participants; however, it does not capture the impact on the overall economy. For instance, if financial institutions' lending attitudes become more accommodative nationwide due to intensified competition in the loan market, this paper's results may underestimate the overall effect. Conversely, if the difference in loans outstanding between participants and non-participants reflects a reallocation of loans, the results may overestimate the Program's effect. Second, this paper analyzes the impact of Program's usage on outstanding loans as of its 2013 introduction; we do not examine the effects of the amount of uptake or any dynamic changes in incentives to use the Program over time.

5.2 Robustness Checks

We conducted several robustness checks, including (i) setting the caliper (the maximum distance for which two observations are potential neighbors) in propensity score matching, (ii) adding control variables to the DID estimation, and (iii) using the Mahalanobis distance for matching instead of the propensity scores.

First, no caliper (maximum allowable difference) was set on the propensity score during matching in the baseline model. Setting a narrower caliper reduces the sample size by excluding unmatched institutions; however, this approach enables more balanced dataset

²² Since the maximum amount of the Program is determined by the outstanding loans, including loans to households and overseas corporations, the loans outstanding in our analysis cover all branches, all currencies, and all clients.

construction, which may improve some biases in the policy effect estimation. Chart 13 shows the distribution of propensity scores before and after matching when a caliper is applied. Chart 14 displays the corresponding DID estimation results. Following Austin (2011), the caliper is set at 0.2 standard deviations of the propensity score, and unmatched samples are excluded. Chart 14 shows that the cumulative impact on loans outstanding over 7 years is approximately 6%, similar to the baseline results. The impact on securities holdings remains statistically insignificant.

Second, in Equation (2), only fixed and time-fixed effects are used as control variables; however, various factors beyond these variables can influence loan supply and demand. Additional control variables are included in the DID estimation for robustness to address this issue. Controls include the capital adequacy ratio, net income ROA, and non-performing loan ratio (representing risk-taking capacity). We also include proxies for funding demand, such as the unemployment rate, population (log), and number of firms (log) in each financial institution's headquarters' prefecture. These variables may be endogenous to the dependent variable; therefore, lagged values are used. The results in Chart 15 are consistent with the baseline model.

Finally, we checked the robustness of the results using the Mahalanobis distance for matching instead of the propensity scores.²³ King and Nielsen (2019) recommended alternative methods to propensity score matching, especially with small samples, as it can increase covariate imbalance and model dependence. Following this suggestion, Barmeier et al. (2023) estimated policy effects using the Mahalanobis distance for matching. Accordingly, our analysis also tests the results using the Mahalanobis distance as an alternative to propensity scores. Chart 16 shows a cumulative increase in the outstanding loans of approximately 5%, broadly consistent with the baseline results.

6. Conclusion

This paper demonstrates that financial institutions have actively used the "Fund-Provisioning Measure to Stimulate Bank Lending" to provide them with long-term funding at low interest rates. Following the methodology in the previous studies, our analysis tackles issues like

$$d_{ij} = \sqrt{\left(X_i - X_j\right)' \Sigma^{-1} \left(X_i - X_j\right)},$$

²³ Specifically, the dataset is constructed by matching financial institutions that minimize the Mahalanobis distance (d_{ij}) defined by the following equation:

where the subscripts *i* and *j* represent financial institutions. X_i is the vector of attributes, and Σ denotes the variance-covariance matrix. The attributes of the financial institutions are the same as the variables used in propensity score matching.

selection bias and quantitatively examines whether the Program contributed to the increase in lending.

The results indicate a statistically significant difference in outstanding loans between program participants and non-participants, showing relatively larger loan growth for participants. This finding remains consistent when a caliper in the propensity score differences is applied in the matching and when additional control variables are included. This outcome supports our estimates' robustness and implies that the Program has supported loan growth.

Notably, this study estimates the policy effect solely as the difference in loans outstanding between program participants and non-participants; thus, the Program's aggregate macroeconomic impact on total lending requires careful interpretation. The relative importance of various transmission channels, how the Program uptake affects the magnitude of impacts, and changes in participation incentives remain unclear. In particular, researches on the impacts of lending facilities on real economic activities are limited, highlighting the need for future studies. Future research can conduct in-depth analyses of policy effects, which are important for deepening our understanding of monetary policy implementation.

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Chart 1: Overview of the Fund-Provisioning Measure to Stimulate Bank Lending (As of the Introduction)

	To promote financial institutions' aggressive action and			
Purpose	help increase the proactive credit demand of firms and			
	households			
Form of loans	Loans backed by pooled collateral			
Maximum				
outstanding	Unlimited			
amount of loans				
Duration of loopo	1, 2, or 3 years			
	(subsequent rollovers shall not exceed 4 years)			
Loan rates	0.1% (annual rate)			
	• A wide range of loans, including to individuals and			
	foreign corporations			
Support objective	\cdot The maximum amount of loans is the increase in the			
	average amount outstanding of loans from October to			
	December 2012.			
Eligible	Depository financial institutions and the Development			
counterparts	Bank of Japan Inc.			

Chart 2: Borrowing from the Program



Note: Latest data as of end-March 2024. Source: Bank of Japan.

Date	Overview			
Oct. 2012	Announce an introduction of the Program			
June 2013	Begin the offer			
June 2014	 Enhance the maximum amount of loans up to the twice the net increase in their lending (announced in Feb. 2014) Fix the duration and loan rates as 4 years and 0.1%, respectively (financial institutions have an option to make prepayment every year) (announced in Feb. 2014) 			
June 2015	 Introduce a new framework for enabling financial institutions that do not have a current account at the BOJ to use the Program through their central organizations (such as the Shinkin Central Bank, the National Federation of Credit Cooperatives, the Rokinren Bank, and the Norinchukin Bank) (announced in Jan. 2016) 			
Mar. 2016	 Lower the loan rates to 0 % following the introduction of the negative interest rate policy (announced in Jan. 2016) 			
June 2016	 Introduce a new framework for adding twice the amount of increase in the usage of the Program to their Macro Add-on Balance (announced in Mar. 2016) Expand eligible collateral (beneficial interest of a trust in housing loans, etc.) (announced in Dec. 2015) 			
Sep. 2019	 Expand eligible collateral (privately-placed municipal bonds and loans on deeds to municipal governments) (announced in Apr. 2019) 			
June 2020	 Allow to roll over either the whole or part of the amount of repayment for a long-term (4 years) at a low-interest rate (0%), depending on the lending situation (announced in Dec. 2019) 			



Chart 4: Transmission Channel

Chart 5: Comparison of Interest Rates among Funding Sources



Note: "Term deposits (maturity of 4-5 years)" and "Negotiable certificates of deposit (maturity of 360 days or more)" are on new contracts. "Corporate bonds (maturity of 4-5 years, AA-rated)" is the average of the compounded return calculated in the basis of quotation reporting. For term deposits, the outliers (those month-overmonth difference exceeds the 5 percentile value of each tail) are replaced by previous values. Corporate bond ratings are based on the Rating and Investment Information, Inc.

Source: Bank of Japan; Japan Securities Dealers Association.

	Japan < Fund-Provisioning Measure to Stimulate Bank Lending>	Euro Area <tltro></tltro>	United Kingdom <fls></fls>	
Purpose	To encourage more proactive lending by financial institutions and stimulate stronger funding demand from businesses and households	To enhance the functioning of the monetary policy transmission mechanism by supporting the provision of credit to the real economy	To address the concerns that the intensification of the crisis in the euro area caused funding costs to increase and loans to be restricted	
Framework	Long-term, low-interest funding to financial institutions proportionate to their loan growth	Long-term, low-interest funding to financial institutions proportionate to their loan growth	Low-interest rate lending of UK Treasury bills (not appearing directly on the balance sheet of the BOE)	
Period	from June 2013	from Sep. 2014 to June 2016	from Aug. 2012 to Jan. 2018	
Loan rates (Commission rate)	Until Dec. 2015: 0.1% From Mar. 2016 to Mar. 2024: 0%	Until Dec. 2014: Policy rate +0.1% From Mar. 2015: Policy rate	From 0.25 to 1.5% (determined by loan growth)	
Support objective	A wide range of loans (including loans for individuals and foreign corporations, excluding loans for financial institutions and government)	Loans to non-financial corporations and households (excluding loans for house purchases)	Loans to non-financial corporations (Gradually tapered by removing targets such as large corporates)	
Incentives	 Maximum availability expands as the loan amount increases Twice the Program usage is added to Macro Add-on Balance (to avoid a negative interest rate) 	 Maximum availability expands as the loan amount increases (three times the increase in loans relative to the benchmark since March 2015) Prepayment is required in the case of the loan amount below the benchmark 	 Maximum availability expands as the loan amount increases The rental fee is added in proportion to the percentage decrease in the outstanding loans 	

Chart 6: Main Features of the Major Lending Facilities

Note: For Japan, the framework before the March 2024 "Changes in the Monetary Policy Framework" is described. In Europe, TLTRO-II was also implemented from June 2016 to March 2017, and TLTRO-III from September 2019 to December 2021.



Note: "Loans outstanding" includes the loans from overseas branches of domestic banks. Latest data as of March 2024.

Source: Bank of Japan.





Note: Figures are shares of financial institutions that have used the Program at least once. Latest data as of March 2024. Source: Bank of Japan.

	P(B _{i,FY2013} >0)	
Loans/total assets (%) _{FY2011}	0.041	
Loans (y/y,%) _{FY2011}	0.005	
Growth-supporting Program/total assets (%)FY2011	1.976 **	
Capital adequacy ratio (%) _{FY2011}	0.319 *	
Total asset (log scale) _{FY2011}	-0.012	
Net income ROA (%) _{FY2011}	-0.372	
Non-performing loan ratio (%) _{FY2011}	0.302	
Number of Banks	94	
Number of participations in March 2024	46	
Pseudo R ²	0.11	

Chart 9: Estimation Result of the Logit Model

Note: Estimated for regional banks. To avoid a discontinuity in the data, banks that merged or split during the estimation period are excluded. * and ** denote statistical significance at the 10 % and 5 % levels, respectively.

Chart 10: Distribution of Propensity Scores





(2) After Matching



	SMD		Variance ratio	
	Before	After	Before	After
Loans/total assets	-0.03	0.12	0.83	1.09
Loans (y/y)	-0.08	0.14	0.84	2.31
Growth-supporting Program/total assets	0.56	-0.07	1.87	1.03
Capital adequacy ratio	0.38	0.21	1.89	2.07
Total assets (log scale)	0.16	0.01	1.48	1.75
Net income ROA	0.01	0.00	5.56	5.00
Non-performing loan ratio	0.13	0.01	1.91	1.54

Chart 11: Covariates

Note: Shows the standardized mean difference (SMD) and variance ratios for the covariates before and after matching.

Chart 12: Estimation Result

(1) Impact on Loans Outstanding



Note: Figures show the difference between outstanding loans and securities holding for participants and non-participants (as of March 2014) of the Program, as estimated by difference-in-differences (DID). Dark-shaded and light-shaded areas indicate 90% and 95% confidence intervals, respectively.

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Chart 13: Distribution of Propensity Scores in the Case with Caliper

Note: Figures are the estimated kernel density of the propensity scores of non-participants and participants. Figures shows when the caliper is set at 0.2 standard deviations (0.037) for matching.



(1) Impact on Loans Outstanding



Note: Figures show the difference between outstanding loans and securities holding for participants and non-participants (as of March 2014) of the Program, as estimated by difference-in-differences. Dark-shaded and light-shaded areas indicate 90% and 95% confidence intervals, respectively. Figures show when the caliper was set at 0.2 standard deviations (0.037) for matching.



(1) Impact on Loans Outstanding



(2) Impact on Securities Holding



Note: Figures show the difference between outstanding loans and securities holding for participants and non-participants (as of March 2014) of the Program, as estimated by difference-indifferences (DID). Dark-shaded and light-shaded areas indicate 90% and 95% confidence intervals, respectively. Figures show the case when the additional control variables that could affect the loan demands/supplies are included in DID estimation. These controls include the capital adequacy ratio, net income ROA, and non-performing loan ratio of financial institutions, as well as the unemployment rate, population (log), and number of firms (log) in the prefecture where the institution's headquarters is located. All are lagged one period.

Chart 16: Estimation Result in the Case of Using the Mahalanobis Distance



(1) Impact on Loans Outstanding



Note: Figures show the difference between outstanding loans and securities holding for participants and non-participants (as of March 2014) of the Program, as estimated by difference-indifferences. Dark-shaded and light-shaded areas indicate 90% and 95% confidence intervals, respectively. Figures show the case when the Mahalanobis distance was used for matching in place of the propensity scores.