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Corporate Bond Purchases**

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Spillovers of the Bank of Japan's Exchange Traded Fund and Corporate Bond Purchases*

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Abstract

This study examines the spillovers of the Bank of Japan's (BOJ's) exchange-traded fund (ETF) and corporate bond (CB) purchases on bank operations and the supply of bank loans for public and private firms not subject to BOJ purchases. The results show that, first, following the introduction of the BOJ's purchases in 2010, the total lending of highly exposed banks decreased; instead, such banks invested more in securities compared to less exposed banks. Second, evidence suggests a small but negative effect of the purchase program on bank investment and performance ratios. The decline in targeted firms' bank loans may have intensified banking competition and encourage highly affected banks to engage more in risk-taking activities, which might adversely affect banks. Third, consistent with the increase in exposed banks' risk-taking incentives, the impact on bank loans of public ineligible firms is shown to be insignificant, while SMEs with higher exposure to the BOJ's program had more favorable loan terms such as larger loan amounts and lower interest rates after the policy implementation. However, this positive impact on SMEs is not strong enough to improve firms' performance.

JEL classification: E52; G21; G32.

Keywords: Unconventional monetary policy; Risk asset purchases; Risk-taking channel; Firm financing; Bank-firm relationship;

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1. Introduction

After the 2008 global financial crisis, central banks in many advanced countries have begun to implement unconventional monetary policy such as quantitative easing policy and forward guidance, mostly to overcome the zero-lower bound. At that time, Japan had made certain strides in applying unconventional monetary policy, and one of the key measures taken by the Bank of Japan's (BOJ's) after the crisis is the risky assets purchase program implemented since 2010, under which the BOJ purchased asset-backed securities, commercial paper, corporate bonds (CBs), exchange traded funds (ETFs), and Japan real estate investment trusts (J-REITs). The BOJ has affirmed that the objective of this policy is to ensure stability in financial markets and facilitate corporate financing, and although there have been a number of studies examining the policy effect on different aspects such as on credit spreads (Suganuma and Ueno (2018), stock market and stock prices (Harada and Okimoto (2019)), firm performance (Gunji et al. (2021)) and investment (Charoenwong et al. (2019)), the evidence obtained is insufficient to conclude whether the BOJ's ultimate goal of facilitating financing in implementing the policy has been achieved or not.

In this study, I focus on the above open question and study the spillover effects of the BOJ's ETFs and CBs purchases on bank operations and the supply of bank loans for public and private firms not subject to BOJ purchases. Among five types of risky assets purchased by the BOJ, ETF and CB were chosen as research targets because the purchasing amounts of these two types of assets were the highest, and more importantly, bonds and stocks are the two major sources for public firms to raise external funds. It should be noted that this study concentrates on the indirect impact rather than the direct impact of the BOJ's ETF and CB purchases, and is a follow-up study of Nguyen (2021). Nguyen (2021) finds that the ETF and CB purchases by the BOJ have had considerable effects on the capital structure and the securities issuance activities of public firms whose stocks and/or bonds were subjected to the purchases ("targeted

firms”, hereafter). Importantly, the author also shows that after the policy intervention, targeted firms have been raising external capital from the public market more frequently with larger amounts, while significantly reducing bank debt compared to control firms, which implies that the demand for bank loans is likely to decrease. This research takes it one step further by answering the following research questions: (1) How do the changes in loan demand of targeted firms affect banks’ lending activities, risk-taking and financial soundness? (2) Does the BOJ’s ETF and CB purchases have any impacts on the bank loan supply for firms not included in the purchases (referred to as “non-targeted firms” hereafter)? If such spillover effects exist, what are the characteristics of firms that receive additional bank loans?

For the analysis, I employ data from two main sources, namely Nikkei NEEDS Financial Quest (Nikkei FQ) and the database of Teikoku Databank (TDB), for the period from 2009 to 2018. From Nikkei FQ, I collect data on listed non-financial firms and banks, including balance sheet information and loan-level information between banks and these listed firms. On the other hand, TDB database covers balance sheet information of a large number of small and medium enterprises (SMEs) in Japan, and at the same time allows me to capture the relationship between banks and firms by providing the names of 10 banks (at maximum, and in order) that have transaction relationships with those SMEs.

From this comprehensive dataset, I begin by calculating each bank’s exposure to the BOJ’s ETF and CB purchase policy and then employ the difference-in-differences approach (DID) to estimate the spillover effect of the policy on banks’ total lending, investment and performance. In the next step, from bank-firm relationship data, I assess each firm’s exposure to the BOJ’s policy and utilize the propensity score matching difference-in-differences method (PSM-DID) to evaluate the spillovers on the bank loan amount received by public and private non-targeted firms (i.e., public firms not eligible for BOJ purchases and private SMEs). Finally, for SMEs, I also examine changes in the interest rate as well as the impact on firm performance.

The results show that the BOJ's ETF and CB purchases have had a considerable impact on highly affected banks, which are banks that provide a large amount of loans to policy-targeted public firms, and their client SMEs, but not on their client non-targeted public firms as follows. First, following the introduction of the BOJ's ETF and CB purchases in 2010, the total lending ratio of highly exposed banks decreased; instead, such banks invested more in securities than those less exposed to the policy. Second, evidence suggests a negative effect on bank investment and performance ratios, although the magnitude of this effect was small. It is highly possible that the decline in targeted firms' bank loans may have intensified banking competition and encourage highly affected banks to engage more in risk-taking activities to search for yield, which might adversely affect their health, lending capacity and performance. On the other hand, by holding more securities, banks were able to mitigate the risk of asset price fluctuations, because it is under this program that financial institutions can sell their risk assets to the BOJ to transfer risks. Third, consistent with the increase in exposed banks' risk-taking incentives, the impact on bank loans of public ineligible firms is shown to be insignificant, while SMEs with higher exposure to the BOJ's program had more favorable loan terms such as larger loan amounts and lower interest rates after the policy implementation. The differential effects on public and private firms could be explained by the difference between the level of financial constraints and the existence of alternative financing choices for these two groups of firms. Presumably, the reduction in borrowing demand of targeted firms may have created more capacity on exposed banks' balance sheets, and those banks then use idle funds to increase loan provisions to risky private firms, thereby strengthening the bank lending channel. However, this positive impact on SMEs is not strong enough to improve firms' performance, as measured by ROA.

The remainder of the study is organized as follows. Section 2 reviews the related literature, while Section 3 provides an overview of the BOJ's ETF and CB purchase policy. Next, Section

4 describes the hypotheses, empirical approach, and data used. Section 5 presents summary statistics and the regression results, and Section 6 offers conclusions.

2. Related Literature

Regarding the BOJ's purchases of CBs and/or ETFs, some authors have found considerable effects of the policy on various aspects, such as the impact of BOJ CB purchases on credit spreads (Suganuma and Ueno (2018)); or the impact of BOJ ETF purchases on stock market and stock prices (Harada and Okimoto (2019)), firm performance (Gunji et al. (2021)) and investment (Charoenwong et al. (2019)). However, none of these studies investigate the impact on banks and/or firm financing.

Rather, this study is more related to earlier studies that have documented the transmission of large-scale asset purchases (LSAPs) implemented by central banks of developed countries through bank lending to the real economy. Starting with the US Federal Reserve's (Fed's) LSAPs, Rodnyansky and Darmouni (2017) conclude that the Fed's mortgage-backed securities (MBS) purchases have led to an expansion in bank lending by improving banks' balance sheets through the "net-worth channel" and "liquidity channel". Chakraborty et al. (2020) also examine the effect of the Fed's MBS purchases and find that exposed banks stimulated their mortgage lending, but further emphasize that these banks reduced commercial and industrial lending at the same time, suggesting that the MBS purchases have caused a crowding-out effect. Nevertheless, these two studies differ from my research in that they focus on MBS – a completely different type of asset from ETF and CB, and through this kind of intervention, the authors observed a direct effect instead of a spillover effect through policy-targeted firms' financing choice.

Closest to my study in this literature on LSAPs are Grosse-Rueschkamp et al. (2019) and Betz and De Santis (2019), who analyze the spillover effects of the European Central Bank (ECB's) corporate bond purchases under the Corporate Sector Purchase Programme (CSPP)

introduced in 2016. In particular, Grosse-Rueschkamp et al. (2019) firstly propose a “capital structure channel” of monetary policy, which predicts that following the ECB’s purchases of CBs, eligible firms (i.e., firms whose bonds are eligible for the purchases) substitute bank loans with bond debt. As a result, weak banks’ lending constraints are relaxed, and these banks later increase lending to financially constrained private firms, generating spillovers to the real economy. Using a DID framework, they find evidence consistent with this channel. Betz and De Santis (2019) corroborate the capital structure channel and show that the CSPP improves the bank-dependent SMEs’ access to credit by employing data on the exact bonds purchased by the ECB; but they argue that the results hold regardless of the quality of exposed banks’ balance sheets.

Similar to Grosse-Rueschkamp et al. (2019) and Betz and De Santis (2019), a major purpose of this study is to examine the impact on firms not directly affected by central bank risky asset purchases (BOJ purchases of ETFs and CBs) transmitted through the capital structure channel. The findings are consistent with those studies, that highly exposed banks extend loans to their client SMEs but not to their client public non-targeted firms. However, in the case of the BOJ’s purchases, the observed impact on SMEs is much weaker than that of the ECB’s purchases found by previous studies, and it is not large enough to generate positive impacts on corporate performance. In addition, I also investigate the extensive impacts of the risky asset purchase policy on the banking sector and find unintended spillover effects on exposed banks’ total loan provisions and real outcomes such as investment and performance. These findings have not been documented before to the best of the author’s knowledge.

This paper also connects to another strand of literature that establishes the relationship between monetary policy changes, banks’ risk-taking behavior and financial stability. To begin with, a considerable number of studies (e.g., Altunbas et al. (2014), Jiménez et al. (2014), Dell’Aricca et al. (2017)) have found evidence of the risk-taking channel of monetary policy,

which implies that persistently low interest rates could result in higher risk tolerance of banks. Low interest rate mainly influences bank risk-taking through the positive impact on asset valuations (which potentially affects banks' estimations of income, probabilities of default and price volatilities), or by inducing banks' incentive to "search for yield" as suggested by Rajan (2005). Notably, in the review paper of Albertazzi et al. (2020) on monetary policy and banking stability, the authors discuss the role of the risk-taking channel in the era of unconventional monetary policy characterized by a low interest rate environment and a flat term structure, and claim that this channel could be the dominant component of the transmission mechanism of LSAPs to the real economy. After conducting a comprehensive review, they conclude that the impact of unconventional monetary policies implemented by the Eurosystem on banking stability is positive in general. Although some adverse effects have been addressed, which includes the negative impact on banks' intermediation capacity and profitability due to low interest margins, possible excessive risk-taking and moral hazard problems, they could be offset by some positive effects such as stabilizing the economy after the crisis and restoring the functioning of financial intermediation.

While there have been numerous studies on this topic focusing on Europe, only a few existing studies (e.g., Nakashima et al. (2020) and Kawamoto et al. (2020)) examine the causal relationship of the BOJ's unconventional monetary policy measures and bank behavior. Nakashima et al. (2020) find that an increase in the share of unconventional assets (i.e., long-term Japanese government bonds (JGBs), commercial papers, CBs, ETFs, stock, and J-REITs) held by the BOJ induces risky banks with low liquidity ratio to stimulate lending to risky firms. They argue that the unconventional asset ratio could gauge the exogenous monetary policy changes, thus the paper suggests the existence of the risk-taking channel in Japan. Kawamoto et al. (2020), on the other hand, find that instead of risky banks, highly capitalized banks tend

to lend more to low-return borrowers, and this stems from the prolonged low interest rate environment and the intense competition among banks.

Unlike those studies mentioned above, this paper contributes to this strand of literature by providing empirical evidence on the spillovers on banks of a particular unconventional monetary policy measure – the risk asset purchase program – which is transmitted through changes in policy-targeted firms’ financing choice. Following the BOJ’s ETF and CB purchases, targeted firms replaced bank loans with bond debt, and this reduction in loan demand is likely to affect banks’ risk-taking as suggested by the capital structure channel. It should be noted that from a financial stability standpoint, moderate but not excessive risk-taking of banks could be effective in promoting financial sustainability and stability. Therefore, it is important to understand whether this transmission channel works for Japan, and more broadly, whether central bank asset purchases (the BOJ’s ETF and CB purchases) can promote financial stability via affecting banks’ risk appetite.

Last but not least, this study also adds new insights on the importance of the bank-firm relationship as well as credit supply conditions on firm financing by showing that exogenous shocks to banks caused by changes in financing decisions of policy-targeted public firms can in turn affect private borrowing firms. In countries with a main bank system such as Japan, many firms have close and long-term relationships with banks, and bank debt is one major source of debt financing especially for private firms. Klein (2014) evaluates the macroeconomic implications of SMEs’ tight lending conditions and suggests that access to bank credit of SMEs plays a critical role to recover from the crisis. In addition, a tight bank-firm relationship may reduce the information asymmetry problem, resulting in loose lending restrictions and more favorable borrowing terms. However, if a bank holds more information about the firm than others and chooses to make use of this unique position to enhance their own interests, the hold-up problem may prevail, and firm financing can be negatively affected.

Kysucky and Norden (2016) conduct a meta-analysis and show that, overall, strong relationships are beneficial for the borrowers, but the lending outcomes depend on the relationship dimensions such as duration, exclusivity (e.g., number of relationships, main bank status).

Regarding the considerable impact of supply shocks on firm financing and capital structure choices, for instance, Leary (2009) investigates two changes in bank funding constraints in the United States (i.e., the introduction of negotiable CDs in the early 1960s and the imposition of regulatory interest rate ceilings in 1966) and concludes that these loan supply shocks had differential effects on firms' leverage ratios and the mix of bank vs. non-bank debt. Some other studies have shown that negative shocks on banks could harm client firms: they increase the interest rate to their client firms (Kang and Stulz (2000)), and negatively affect firms' investment (Hosono et al. (2016)).

3. The BOJ's Purchases of ETFs and CBs

Outline of the BOJ's ETF and CB purchases

To alleviate the impact of the 2008 global financial crisis and stimulate the economy, the BOJ adopted Comprehensive Monetary Easing (CME) in October 2010. A key component of CME was the Asset Purchase Program, under which the BOJ purchased risky assets, including asset-backed securities, commercial paper, CBs, ETFs and J-REITs. This purchase program which aimed to ensure financial stability and facilitate corporate financing was meant to be a temporary measure, but in practice, the BOJ has extended the program and continued to intervene to this day.

Remarkably, following the introduction of Quantitative and Qualitative Monetary Easing (QQE) in April 2013, the purchases of ETFs have been increased on a massive scale. Consequently, the BOJ's ETF holdings rose significantly and exceeded all other risk assets'

holdings amount. As of May 2021,¹ the outstanding amount of ETFs is 36.1 trillion yen, whereas the outstanding amount of CBs is 7.6 trillion yen², account for 5.02% and 1.05% of the BOJ's total assets, respectively. Given such a large-scale intervention, the BOJ's purchases of ETFs and CBs were shown to have positive impacts on policy-targeted firms' access to external funds (Nguyen (2021)), and could potentially have spillover effects on bank lending, as well as on the financing activities of non-targeted firms.

Purchasing rules for ETFs and CBs

To date, the BOJ is the only central bank that implements the ETF purchase program, and thus has become a major shareholder of many Japanese listed companies. From the beginning of the ETF purchases 2010 until recently – March 2021, two main types of ETFs to be purchased were ETFs that track the Tokyo Stock Price Index (TOPIX) and the Nikkei 225 Stock Average (Nikkei 225)³. At first, the BOJ had focused more on purchases of Nikkei 225 ETFs, but since then, it has gradually put more weight on ETFs tracking the TOPIX instead of the Nikkei 225. In March 2021, the BOJ announced that only ETFs whose prices track the TOPIX shall be purchased from April 2021⁴. This major amendment of the BOJ might stem from concerns about the potential negative impacts of the large purchases of Nikkei 225 ETFs on stock prices and corporate performance as obtained by previous studies (e.g., Harada and Okimoto (2019), Gunji et al. (2021)).

As for the purchases of CBs, according to the BOJ's principal terms and conditions,⁵ the BOJ conducts purchases via multiple-price competitive auctions where counterparties bid their desired yield at which they wish to sell CBs to the BOJ; and CBs to be purchased must satisfy

¹ For details, see: <https://www.boj.or.jp/en/statistics/boj/other/acmai/release/2021/ac210510.htm/>.

² The BOJ had maintained the maximum outstanding amount of CBs at 3.2 trillion yen from 2012 until before the outbreak of COVID-19. However, on April 27, 2020, the BOJ has decided to conduct additional CB purchases in response to the pandemic: although the new outstanding amount of CBs was set to about 3 trillion yen, additional CBs would be purchased with the maximum outstanding amount of 7.5 trillion yen.

³ From 2014 to March 2021, ETFs tracking the JPX-Nikkei Index 400 were also purchased by the BOJ.

⁴ https://www.boj.or.jp/en/announcements/release_2021/rel210323d.pdf.

⁵ For details, see: https://www.boj.or.jp/en/mopo/measures/term_cond/yoryo83.htm/.

the general criteria, have a remaining maturity of 1 to 3 years and a rating of BBB or higher by an eligible rating agency, or if they do not have a rating of BBB or higher, they must be fully guaranteed by a company rated BBB or higher.

Notably, after the Covid-19 pandemic spread in Japan in early 2020 and caused significant economic losses, to facilitate and mitigate the negative impact on corporate financing, the BOJ decided to substantially expand the purchases of risk assets, including ETFs and CBs. Specifically, on April 27, 2020⁶, the BOJ announced that, for the time being, it would implement some temporary measures, including (i) doubling its annual ETF purchases from 6 trillion yen to a maximum of 12 trillion yen, (ii) loosening the maturity criteria for CB purchases, whereby corporate bonds with a remaining maturity of more than 3 years and up to 5 years are also eligible for the purchases, as well as (iii) conducting additional CB purchases as described in the footnote 2 above.

4. Methodology and Data

4.1. Hypotheses

As introduced in Section 1, Nguyen (2021) showed that following the introduction of the BOJ's ETF and CB purchases, treatment firms (i.e., whose stocks and/or bonds are included in the purchases) have been raising external capital from the public market more frequently, while significantly reducing bank debt compared to control firms. This result is incorporated to construct the following hypotheses regarding the indirect impacts of the BOJ's ETF and CB purchases on banks and firms not included in the purchases.

Hypothesis 1 (impact of the BOJ's purchases on banks): *Following the introduction of the BOJ's ETF and CB purchases in 2010, banks that are more exposed to the BOJ's purchases reduce their total lending as compared to the less exposed banks because of the significant*

⁶ https://www.boj.or.jp/en/mopo/mpmdeci/state_2020/k200427a.htm/

reduction in loan demand of targeted firms. Alternatively, highly exposed banks invest more in securities and increase lending to non-targeted firms.

Specifically, this study considers highly exposed banks as those that have close relationships with the targeted listed firms and provide a large amount of loans to these firms. Following the implementation of the ETF and CB purchases by the BOJ, a significant reduction in bank borrowing by target firms may have created more space on the balance sheets of highly affected banks. These banks can then use the idle funds to purchase new risk assets and increase loan provisions to other firms (non-targeted firms), thereby consolidating their assets portfolio and generating the spillovers through the bank lending channel. Also, under this purchasing program, the BOJ purchases risk assets held by financial institutions. Accordingly, by increasing the securities holdings, banks' balance sheets will be less affected by asset price movements, as the market risks could be transferred to the BOJ. Therefore, highly exposed banks will likely increase the ratio of securities to total assets.

On the other hand, the decline in loan demand of targeted firms may have increased competition among banks. As a result, banks may have engaged more in risk-taking activities and increased the demand for riskier lending to search for yield as suggested by the risk-taking channel, which may potentially adversely affect bank health, lending capacity and profitability. In short, the BOJ's ETF and CB purchase policy may have both negative and positive spillovers on banks that are exposed to the purchases. The aggregate impact on total bank lending, investment and performance may have been small or even negative.

Hypothesis 2 (impact of the BOJ's purchases on non-targeted firms):

- H2A – spillovers on public ineligible firms: *The spillovers of the BOJ's ETF and CB purchases on bank loans of public ineligible firms may have been small because these firms are less financially constrained compared to private firms and due to the increase in highly exposed banks' risk-taking incentives.*

- H2B – spillovers on private firms: *In contrast, highly affected SMEs may have had more favorable loan terms such as higher loan amounts and lower interest rates following the introduction of the program in 2010. If these impacts are strong enough, it may have resulted in higher performance outcomes of the affected private firms due to the relaxation of financial constraints.*

4.2. Data and Variables

To examine the above hypotheses, I construct a comprehensive data set for the period from 2009 to 2018, which contains information on firms' and banks' characteristics as well as loan information from two main sources, namely Nikkei FQ and TDB database. From Nikkei FQ, I collect financial statements and corporate attribute information on banks and listed non-financial firms on the TSE1 and TSE2. Firms' short and long-term borrowing data (i.e., short and long-term borrowings classified by financial institutions) is also obtained from this data source. The dataset includes 122 banks and 1,312 public firms listed on TSE1 and TSE2, of which 968 are not subject to CB purchases (i.e., firms whose bonds are not eligible for CB purchases in all years) and 271 are not subjected to ETF purchases (i.e., TSE2 firms). Of the remaining 1,041 TSE1 firms, 152 firms are components of the Nikkei 225 index.

On the other hand, data of private firms are collected from the database of TDB – one of the largest corporate database providers in Japan. The company's comprehensive database covers financial data of over 2 million companies, which includes corporate basic information such as industry category, location, date of establishment, as well as financial statement data. In this study, for the analysis on SMEs, I utilize data on establishment date and balance-sheet information to compute outcome variables and firm characteristic variables. Furthermore, TDB's financial dataset also contains the identity of up to ten banks that have transaction relationships with each firm. This information is used to address the bank-firm relationship and construct firm exposure variables (i.e., independent variables related to BOJ's purchasing

program). Because SMEs data contains some extreme values, the data are winsorized at 0.5 and 99.5 percent to remove outliers. To implement the PSM-DID method which will be presented in more detail below, only firms that appeared in both pre and post-treatment period (i.e., before and after 2010) are included in the sample, and the dataset consists of 248,369 SMEs in total.

As explained in the introduction and the hypotheses, this study focuses on investigating the spillovers on two subjects, which are banks and firms. Corresponding to the research purposes, all variables used in this study can be divided into two main groups: bank variables and firm variables. Within each group, I further divide the variables into three categories: dependent variables, independent variables related to BOJ purchases, and control variables. The definition of all variables is provided in Table 1.

[Table 1]

In particular, the first part of the study analyzes the indirect effect of BOJ ETF and CB purchases on banks' asset portfolio and banks' outcomes, represented by four dependent variables: *loan ratio*, *securities ratio*, *investment ratio*, and *ROA*. The key independent variables are Bank Exposure variables, which measure each bank's exposure to the BOJ's ETF or CB purchases on annual basis, and are calculated based on loan-level data of public firms. A bank is considered to be highly affected by the BOJ's ETF and CB purchase policy if, after the introduction of the program in 2010, the bank's lending to policy-targeted firms⁷ accounts for the majority of the bank's lending to all firms listed on TSE1 and TSE2. As for bank characteristics, I use three variables: *deposit ratio*, *capital adequacy ratio (CAR)*, and *profitability*.

⁷ Similar to Nguyen (2021), policy-targeted firms are defined as N225 firms in the case of ETF purchases and CB-Eligible firms in the case of CB purchases. CB-Eligible firms are firms that rated BBB or higher and have issued bonds eligible for CB purchases, i.e., bonds with a remaining maturity of 1 year to 3 years.

After addressing the effect on banks, in the second part, I study the effect on the financing activities and performance of public and private firms not included in BOJ purchases using a number of outcome variables such as *loan ratio*, *interest*, and *firm ROA*. These non-targeted firms are likely to be more affected if the banks with which they have the closest relationships are highly affected by the policy. The borrowing data shows that, on average, 44.6, 24.5, and 15.6 percent of each listed firm’s bank loans came from its first, second and third main bank, respectively. Therefore, the treatment variable – *ETF/CB-Firm Exposure* – is defined to equal one (meaning, firm *i* is highly exposed to the BOJ’s ETF or CB purchases) if the average exposure of the firm’s top three main banks in the post-intervention period is above the sample mean value. To match firms in the treatment and control groups, I employ some firm characteristic variables, which are *firm tangibility*, *size*, *profitability*, and *age*.

4.3. Methodology

To investigate whether the hypotheses are correct, I first examine the impact of the BOJ’s ETF and CB purchases on banks using the DID method and then explore the impacts on their client firms that are not directly affected by the BOJ’s purchases by employing the PSM-DID approach. These non-targeted firms are divided into two groups: public ineligible firms and private SMEs. Note that throughout the analysis, I study the impact of the BOJ’s ETF and CB purchases independently considering that, initially, the impacts of both ETF and CB purchases on the bank debt of targeted firms are in the same direction (Nguyen (2021)). The model specifications are as follows.

4.3.1. Spillover effects of the BOJ’s ETF and CB purchases on banks

The first step in the analysis is to calculate the Bank Exposure variables, which measure the degree that banks are exposed to ETF or CB purchases after the BOJ starts to intervene as follows:

$$ETF(CB) \text{ Bank Exposure}_{jt} = \frac{\sum \text{Loan amount provided to ETF(CB) treatment firms}_{jt}}{\sum \text{Loan amount provided to all firms in TSE1\&2}_{jt}} \times Post_t$$

where ETF treatment firms are Nikkei 225 component firms; CB treatment firms are firms whose bonds are eligible for CB purchases; $Post_t$ is a dummy variable that equals one for the intervention period (i.e., the period after the introduction of CME on October 28, 2010) and zero otherwise. Thus, *Bank Exposure* of bank j in year t is defined as the interaction term between the continuous treatment intensity variable (i.e., the share of bank j 's total lending for ETF or CB treatment firms) and the Post-period dummy, and is the key variable of interest in the DID framework.

Next, to examine the effect of the BOJ's ETF or CB purchases on banks' total lending, investment and performance, I apply the following DID model:

$$Y_{jt} = \beta_0 + \delta \text{ETF(CB)Bank Exposure}_{jt} + X'_{jt}\beta + Z_j + \varepsilon_{jt} \quad (1)$$

where X_{jt} is a vector of bank-specific control variables (deposit ratio, capital adequacy ratio, bank profitability); Z_j is unobserved bank fixed effects, and ε_{jt} is the error term. For the dependent variable (Y_{jt}), Bank loan ratio, Securities ratio, Investment ratio and ROA are used in turn to gauge the impact on different aspects of banks. The standard fixed effects model is employed to estimate model (1). In the model, coefficient δ measures the treatment effect stem from an increase in the treatment intensity.

4.3.2. Spillover effects of the BOJ's ETF and CB purchases on non-targeted firms

Although the DID method is widely used to measure the treatment effect of an intervention that occurs over time, the DID estimator, which is the difference in trend between the treatment and control group, may include selection bias if the treatment and control group have significant differences in characteristics. For instance, larger and better-performed non-targeted firms are more likely to have transaction relationships with highly exposed banks, and thus are more exposed to the policy than smaller and riskier firms. To eliminate this potential selection bias, I combine the propensity score matching method (PSM) proposed by Rosenbaum and Rubin (1983) with DID approach to examine the spillovers of the ETF and CB purchases by

the BOJ on non-targeted firms.

In particular, the propensity score is defined as the probability that an individual receives a treatment: $p(X) \equiv Pr[D = 1|X]$, where D is the binary treatment variable, and X is a vector of observable characteristics. The PSM-DID method is applied for estimation in two steps: (1) $p(X)$ is estimated using the logit model; and (2) the DID treatment effect is computed by matching treatment units to control units based on the estimated propensity score from the first step. Therefore, through this process, each treated firm is matched to a control firm with similar characteristics, and the difference in their outcomes is interpreted as the treatment effect.

In addition, PSM-DID estimation requires some key conditions to be satisfied, which are the unconfoundedness, the overlap assumptions and the balancing property. Considering a panel data set with two periods $t = 0, 1$, the unconfoundedness assumption implies that the individual's trend in the control outcomes $\Delta Y(0) \equiv Y_{i,t=1}(0) - Y_{i,t=0}(0)$ is unconfounded conditional on observable characteristics: $\Delta Y(0) \perp D | X$. The overlap assumption indicates that each individual has a positive probability of being in the treatment or the control group, that is: $0 < Pr[D = 1|X] < 1$. On the other hand, to ensure the consistency of the estimator, the balancing property requires that $X \perp D | p(X)$, that is the treatment assignment and the observed characteristics are conditionally independent given the propensity score.

Following the above framework, in the analysis, I separate the data into two periods – the pre-intervention period (2009-2010), and the post-intervention period (2011-2018). The covariates X that predict treatment assignment are the average values of firm characteristics (firm tangibility, size, profitability, and age) on the pre-treatment period. The binary treatment variable D , ETF/CB-Firm Exposure, equals one for firm i if the average of ETF/CB-Bank Exposure of firm i 's top three main banks in the post-intervention period is above the mean value. Finally, the outcome of interest is the difference in outcome between the pre- and post-intervention periods, $\Delta Y_i \equiv Y_{i,post} - Y_{i,pre}$, which includes Δ Loan ratio, Δ Interest, and Δ Firm

ROA.

5. Empirical Results

This section presents the results of the analysis based on the approach described in the preceding section. It starts with the presentation of some statistics, then discusses the results of empirical analyses.

5.1. Summary statistics

[Table 2]

Table 2 provides summary statistics of bank and firm variables used in the study. First, Panel A presents the descriptive statistics of banks. On average, the share of loans in the bank's total assets is 63.72%, which is about 2.5 times higher than the average securities ratio of 25.0%. The means of bank investment ratio is 1.09%, while that of bank ROA is 1.25%. The statistics of bank exposure variables covering the post-intervention period (2011-2018) implies that on average, lending to firms eligible for CB purchases and Nikkei 225 component firms account for 31.83% and 14.38% of the bank's total lending to firms listed on TSE1 and TSE2, respectively. Regarding the bank characteristics, the average bank has a deposit ratio of 8.49% and a CAR of 11.33%. The mean value of proxy for profitability is 10.43.

Next, Panels B and C of Table 1 show the descriptive statistics of public and private firms which are not directly included in BOJ purchase programs. In each part, I further divide the sample into two groups (i.e., firms that are highly exposed to the policy and those that do not) based on the ETF or CB-Firm exposure variables, and implement t-tests to compare the means of these groups. The results in both panels B and C consistently suggest that, in most cases, the difference between the characteristics (firm tangibility, size, profitability, and age) of firms in the two groups are considerable and statistically significant. Therefore, it is reasonable to employ the matching method to control for sample selection bias when measuring the treatment effects of the BOJ's ETF and CB purchases on non-targeted firms.

In addition, Figure 1 provides more information about the bank exposure variable, particularly the average value of the ETF/CB Bank exposure variables of 122 banks in the post-intervention period. The figure indicates that banks differ substantially in terms of their exposure to the ETF and CB purchase policies. For the ETF purchases, more than half of the banks in the sample are not or almost not affected by the policy, and only 7 banks have an exposure of 0.5 or more. On the other hand, for the CB purchases, there are 28 banks - about 23% of the total number of banks are not or slightly affected, but 35 banks are exposed to the CB purchases by a high extent of over 0.5.

[Figure 1]

5.2. Spillover effects of the ETF and CB purchases on banks

First, the impact of the BOJ's ETF and CB purchases on banks is examined using model specification (1) and the FEM. Table 3 provides the regression results on the effect of the BOJ's ETF purchases, while Table 4 presents the effect of the BOJ's CB purchases.

[Table 3]

As shown in Tables 3, following the introduction of the ETF purchases in 2010, banks that are highly exposed to the ETF purchases have a 2.82 percentage point lower loan ratio but have a 0.9 percentage point higher securities ratio than less exposed banks after bank characteristics are controlled for. In addition, looking at the real effects on banks, the investment ratio and ROA of highly exposed banks are 0.17 and 0.41 percentage points lower than other banks.

[Table 4]

Meanwhile, Table 4 indicates that the loan ratio is 1.38 percentage points lower for banks with greater exposure to the CB purchases, while the securities ratio is 2.05 percentage points higher for those banks relative to banks with less exposure. Further, the investment ratio and ROA ratio of banks that are highly affected by the CB purchases decreased by 0.12 and 0.17 percentage points, respectively.

The results presented in Tables 3 and 4 confirm Hypothesis 1 that the BOJ's ETF and CB purchases have a significant impact on banks' asset structure and real outcomes (i.e., tangible investments, profitability). Following the introduction of the purchasing program in 2010, banks that have close relationships with policy-targeted firms faced with a considerable decline in borrowing demand. Consequently, the total lending of highly exposed banks has decreased compared to less exposed banks, and these banks use part of the idle funds to invest in securities. Banks may also have redirected lending to non-targeted firms, and the results of this analysis will be discussed in the next subsections. Moreover, the reduction in targeted firms' loan demand seems to make it difficult for banks to find borrowers and make profits on loans, which hurts bank health, and thus negatively affect bank investment and profitability: although these negative effects are small in magnitude, they are statistically significant at the 1 percent level.

To sum up, although several mechanisms by which central bank purchases of risky assets have positive effects on the banking sector could be pointed out, such as the transfer of risk (i.e., the BOJ purchases risk assets which are held by financial institutions, thus banks' balance sheet will be less affected by asset price fluctuations) or the strengthening of the bank lending channel as documented by Grosse-Rueschkamp et al. (2019), analysis in this study suggests that there may exist a negative impact on banks which is transmitted through changes in loan demand of targeted firms. Therefore, the BOJ needs to be cautious in implementing the asset purchases on a massive scale.

5.3. Spillover effects of the ETF and CB purchases on non-targeted public firms

Next, the impact of the BOJ's asset purchases on the bank loans of non-targeted public firms is examined. To estimate the average treatment effect (ATE) of Firm-Exposure on the outcomes of interest (i.e., $\Delta \text{Log}(\text{Loan Amount})$ and $\Delta \text{Loan ratio}$), the PSM-DID method is employed. Under this framework, a logit model was first used to estimate each firm's

propensity score, where covariates are firm characteristics (tangibility, size, profitability, and age). The ATEs of the ETF and CB purchases as well as the p-values are reported in Table 5.

[Table 5]

As can be seen in Table 5, the spillovers of the BOJ's ETF and CB purchases on bank loans of non-targeted firms are positive in sign, however, the p-values are all higher than 0.1 and hence the effects are statistically insignificant. This result is consistent with Hypothesis 2A, that the spillovers on non-targeted public firms are negligible, since these firms are initially less financially constrained than private firms and due to the increase in highly exposed banks' risk-taking incentives to search for yield. In addition, although this study does not investigate the effects of the BOJ's ETF and CB purchases on stock and bond prices, it is possible that after the policy introduction, the stock and/or bond prices of non-targeted public firms may have increased, and their cost of capital may have decreased due to the spillovers on the public markets. As a result, non-targeted public firms may increase the issue of equity or bond debt instead of relying more on bank loans.

Moreover, to check whether the overlap assumption and balancing condition hold, Figure 2 plots the estimated densities of the propensity score – the probability of being treated, while Figure 3 depicts the box plot of the propensity score for control and treated groups. Specifically, Figure 2(a) and 2(b) both show that neither plot indicates too much probability mass near 0 or 1, and there is a common region where the two estimated densities overlap each other, implying that the overlap assumption is not violated.

[Figure 2]

Figure 3 indicates that all covariates appear to be balanced after matching on the propensity score, as the box plots for the matched sample are nearly the same in both ETF (part a) and CB purchases (part b).

[Figure 3]

5.4. Spillover effects of the ETF and CB purchases on non-targeted private firms

Last but not least, I investigate the spillover effects of the BOJ's ETF and CB purchases on private firms. The empirical approach is similar to the previous analysis on non-targeted public firms. Using the PSM-DID method, estimates of the ATE and the corresponding p-values are reported in Table 6. Similar to the above subsection, plotting the propensity score density and balance box (not shown for brevity) shows that the overlap assumption and the balancing property are not violated.

[Table 6]

Table 6 indicates that the BOJ's asset purchases have a positive effect on SMEs' access to bank loans, thereby reducing the financial constraints of these firms. Specifically, SMEs with high exposure to the ETF and CB purchases have 3.18 and 0.99 percentage points higher loan amounts, and 0.80 and 0.36 percentage points higher loan ratio, respectively, compared to firms with similar characteristics but having low exposure to the policies. In addition, the ATE on interest rate is -2.86 percentage points for ETF purchases and -2.19 percentage points for CB purchases, suggesting that the BOJ's interventions also lower the highly exposed SMEs' cost of bank loans. This evidence suggests that the reduction in demand for bank loans of targeted firms has resulted in an increase in highly exposed banks' loan provisions to risky private firms, thus strengthening the bank lending toward SMEs.

However, the impact on firm ROA is very weak: the ATEs are -0.53 to -0.1 percentage points and are not statistically significant. Hence, the relaxation in bank lending constraints of SMEs is not strong enough to generate a real effect on firm performance. This finding is not in line with Grosse-Rueschkamp et al. (2019), who conclude that the ECB's CB purchases have a positive real effect on private firms, measured by asset growth and capital expenditures. To explain this, first, it should be noted that the ECB's and BOJ's CB purchase programs have some fundamental differences in terms of the eligibility criteria and purchasing rules. While

firms eligible for the CB purchases by the ECB need to be incorporated in a eurozone country and have an investment-grade rating, CB to be purchased by the BOJ must have a remaining maturity of 1 to 3 years and a rating of BBB or higher. The second difference is that whereas this study employs the matching method, Grosse-Rueschkamp et al. (2019) use the ordinary least squares model and control for fixed effects. Although the matching method eliminates the selection bias, one disadvantage of the model is that all firms established in the post-intervention period (2011-2018) are excluded from the sample; while the converse is true for the standard regression model. As a result, the PSM-DID estimators used in this study may underestimate the actual treatment effects, in contrast, the model utilized by Grosse-Rueschkamp et al. (2019) may overestimate the actual effect.

6. Conclusion

This study investigates the spillover effects of the BOJ's ETFs and CBs purchases transmitted through the reduction of policy-targeted firms' demand for bank loans. First, the DID approach was employed to estimate the impacts of the BOJ's purchases on the total lending, investment, and performance of banks having strong relationships with targeted firms. Next, the impacts on borrowing activities of public and private firms not directly included in the BOJ purchases were examined using the PSM-DID method. To understand whether the policies affect corporate outcomes, the impact on SMEs' performance was further examined.

The main results could be summarized as follows. First, following the introduction of the ETF and CB purchases in 2010, banks with higher exposure have a lower lending ratio and a higher securities ratio than banks with lower exposure to the BOJ purchases. Second, the empirical result suggests that the impacts on bank investment and performance are negative, although the size of these effects was small. Third, highly exposed banks extend loans and offer more favorable terms to their client SMEs, but not to their client public non-targeted firms. However, the positive impact on the financing activities of SMEs did not result in higher firm

performance, measured by ROA. These findings raise several concerns about the unintended effects on banking sectors when the BOJ continues to implement the ETF and CB purchases on a massive scale. Although the BOJ's interventions were shown to facilitate financing activities of private firms, the observed impact is relatively weak and there are no positive effects on their real outcomes. Moreover, the significant decline in targeted firms' bank loans causes intense competition among banks and encourages highly exposed banks to take more risks, which may deteriorate bank health, lending capacity, and performance.

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Tables and Figures

Table 1. Definitions of all variables

Variable	Definition
Bank variables	
<i>Dependent variables</i>	
Bank Loan ratio	Total loans and bills discounted / Total assets
Bank Securities ratio	Total securities/ Total assets
Bank Investment ratio	Bank's property, plant and equipment/ Total assets
Bank ROA	(Interest income – Interest expenses)/ Total assets
<i>Independent variables related to BOJ's purchasing program</i>	
Post dummy	Equals one if year $t > 2010$ and zero otherwise
ETF-Bank Exposure	$\frac{\sum \text{Loan amount provided to N225 component firms in year } t \text{ by bank } j}{\sum \text{Loan amount provided to all firms in TSE1\&2 in year } t \text{ by bank } j} \times \text{Post}$
CB-Bank Exposure	$\frac{\sum \text{Loan amount provided to CBEligible firms in year } t \text{ by bank } j}{\sum \text{Loan amount provided to all firms in TSE1\&2 in year } t \text{ by bank } j} \times \text{Post}$
<i>Control variables</i>	
Bank Deposit ratio	Deposits/ Total assets
Bank CAR	Capital adequacy ratio
Bank Profitability	Log(Interest income – Interest expenses)
Firm variables	
<i>Outcome variables</i>	
Loan ratio	(Short-term loans + Long-term loans)/Total assets
Interest	Interest expenses*100/ (ST loans + LT loans)
Firm ROA	Operating income/ Total assets
<i>Treatment variables</i>	
ETF-Firm Exposure	Equals one if the average of ETF-Bank Exposure of firm i 's top three main banks in 2011-2018 is above the mean value
CB-Firm Exposure	Equals one if the average of CB-Bank Exposure of firm i 's top three main banks in 2011-2018 is above the mean value
<i>Firm characteristics</i>	
Firm tangibility	Average of "Firm's property, plant, and equipment/Total assets" in 2009-2010
Firm size	Average of "Log(Total assets)" in 2009-2010
Firm profitability	Average of "EBITDA/Total assets" in 2009-2010
Firm age	Average of "Log(1+ Firm age)" in 2009-2010

Table 2. Summary statistics**A. Bank variables**

Variable	Obs.	Mean	SD	Min	Max
Bank Loan ratio	1,121	0.6372	0.0900	0.2891	0.8938
Bank Securities ratio	1,115	0.2509	0.0792	0.0000	0.4861
Bank Investment ratio	1,121	0.0109	0.0044	0.0000	0.0313
Bank ROA	1,121	0.0125	0.0033	0.0029	0.0285
ETF-Bank Exposure (Post period)	976	0.1438	0.2011	0	0.9932
CB-Bank Exposure (Post period)	976	0.3183	0.3186	0	1
Bank Deposit ratio	1,121	0.8495	0.1081	0.2146	0.9568
Bank CAR	1,156	11.3263	2.5045	6.02	21.14
Bank Profitability	1,121	10.4308	1.0659	8.2900	14.4429

B. Public firm variables

	ETF-Firm Exposure = 0		ETF-Firm Exposure = 1		P-value (t-test)
	Obs.	Mean	Obs.	Mean	
Loan ratio	98	0.1531	134	0.1241	0.0372
Firm tangibility	106	0.3678	150	0.3178	0.0297
Firm size	106	9.4909	150	9.7118	0.0399
Firm profitability	104	-0.0184	149	0.0047	0.1026
Firm age	116	3.8735	154	4.0014	0.0936
	CB-Firm Exposure = 0		CB-Firm Exposure = 1		P-value (t-test)
	Obs.	Mean	Obs.	Mean	
Loan ratio	388	0.1272	417	0.1065	0.0010
Firm tangibility	432	0.3360	491	0.2953	0.0004
Firm size	432	10.3929	491	10.6150	0.0048
Firm profitability	419	0.0102	478	0.0219	0.0074
Firm age	451	3.8947	504	3.9098	0.7304

C. Private firm variables

	ETF-Firm Exposure = 0		ETF-Firm Exposure = 1		P-value (t-test)
	Obs.	Mean	Obs.	Mean	
Loan ratio	93,070	0.6015	112,054	0.6148	0.0000
Interest	88,920	2.5746	106,223	2.6350	0.0000
Firm ROA	110,432	-0.0267	137,919	-0.0258	0.1698
Firm tangibility	109,280	0.2836	135,429	0.2604	0.0000
Firm size	110,442	11.8997	137,927	12.7074	0.0000
Firm profitability	104,429	-0.0183	124,356	-0.0409	0.2540
Firm age	110,442	3.1744	137,927	3.1961	0.0000
	CB-Firm Exposure = 0		CB-Firm Exposure = 1		P-value (t-test)
	Obs.	Mean	Obs.	Mean	
Loan ratio	87,302	0.6100	117,822	0.6079	0.4384
Interest	83,536	2.5546	111,607	2.6471	0.0000
Firm ROA	102,644	-0.0254	145,707	-0.0268	0.0428
Firm tangibility	101,591	0.2822	143,118	0.2626	0.0000
Firm size	102,652	12.0622	145,717	12.2068	0.0000
Firm profitability	96,753	-0.0373	132,032	-0.0256	0.5580
Firm age	102,652	3.1943	145,717	3.1809	0.0000

Table 3. Spillover of BOJ ETF purchases on banks: FEM

	(1)	(2)	(3)	(4)
	Bank	Bank	Bank	Bank
	Loan ratio	Securities ratio	Investment ratio	ROA
ETF-Bank Exposure	-0.0282*** (0.0100)	0.0090 (0.0161)	-0.0017*** (0.0005)	-0.0041*** (0.0009)
Bank Deposit ratio	0.3915*** (0.0561)	-0.0954 (0.0621)	0.0185*** (0.0038)	0.0257*** (0.0064)
Bank CAR	-0.0067*** (0.0013)	0.0061*** (0.0019)	-0.0000 (0.0001)	0.0001 (0.0001)
Bank Profitability	0.0324* (0.0169)	0.0511 (0.0308)	0.0023** (0.0011)	
Constant term	0.0468 (0.1766)	-0.2717 (0.2838)	-0.0283** (0.0131)	-0.0105* (0.0056)
Number of observations	1,112	1,106	1,112	1,112
R-squared (within)	0.3213	0.0556	0.2677	0.3228

* p<0.1, ** p<0.05, *** p<0.01. Figures in parentheses are cluster-robust standard errors.

Table 4. Spillover of BOJ CB purchases on banks: FEM

	(1)	(2)	(3)	(4)
	Bank	Bank	Bank	Bank
	Loan ratio	Securities ratio	Investment ratio	ROA
CB-Bank Exposure	-0.0138*** (0.0050)	0.0205*** (0.0055)	-0.0012*** (0.0002)	-0.0017*** (0.0003)
Bank Deposit ratio	0.3915*** (0.0567)	-0.0898 (0.0647)	0.0184*** (0.0037)	0.0254*** (0.0069)
Bank CAR	-0.0068*** (0.0012)	0.0053*** (0.0019)	0.0000 (0.0001)	0.0001 (0.0001)
Bank Profitability	0.0294* (0.0172)	0.0545* (0.0318)	0.0020* (0.0011)	
Constant term	0.0785 (0.1796)	-0.3080 (0.2945)	-0.0256** (0.0129)	-0.0101* (0.0060)
Number of observations	1,112	1,106	1,112	1,112
R-squared (within)	0.3212	0.0731	0.2867	0.3061

* p<0.1, ** p<0.05, *** p<0.01. Figures in parentheses are cluster-robust standard errors.

Table 5. Spillover of BOJ purchases on non-targeted public firms: PSM-DID

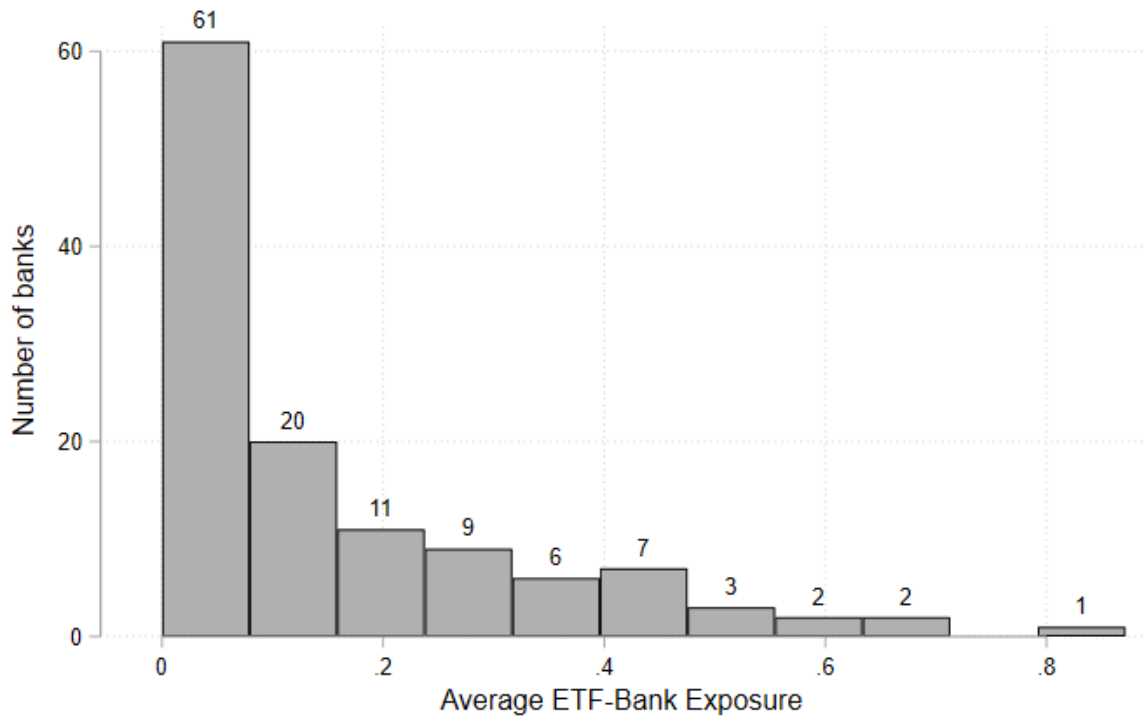
Outcome variable	ETF purchases		CB purchases	
	ATE	P-value	ATE	P-value
Δ Log (Loan Amount)	0.0637	0.616	0.0135	0.816
Δ Loan ratio	0.0130	0.336	0.0049	0.410
Obs.	227		758	

Table 6. Spillover of BOJ purchases on private firms: PSM-DID

Outcome variable	ETF purchases		CB purchases	
	ATE	P-value	ATE	P-value
Δ Log (Loan Amount)	0.0318***	0.000	0.0099**	0.022
Δ Loan ratio	0.0080***	0.000	0.0036*	0.100
Δ Interest	-0.0286**	0.013	-0.0219**	0.058
Δ Firm ROA	-0.0011	0.136	-0.0053	0.218
Obs. (approx.)	159,699		159,704	

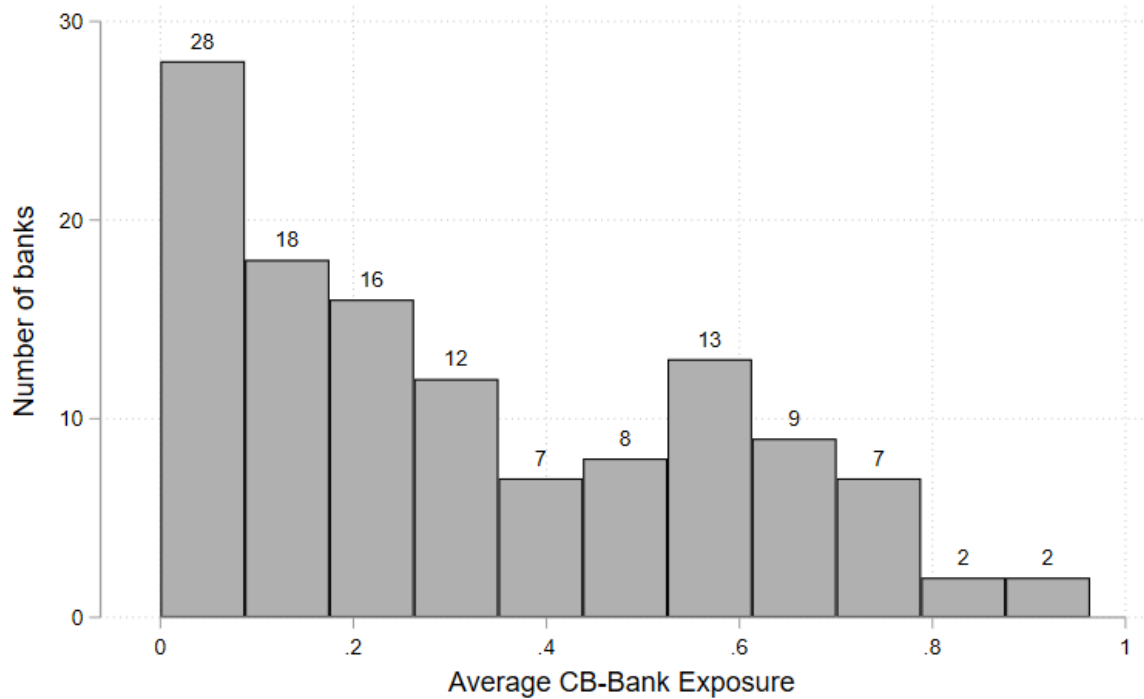
Figure 1. Average value of Bank Exposure variables from 2011 to 2018

(a) Banks' exposure to the BOJ's ETF purchases



Period: 2011-2018. Total number of banks: 122

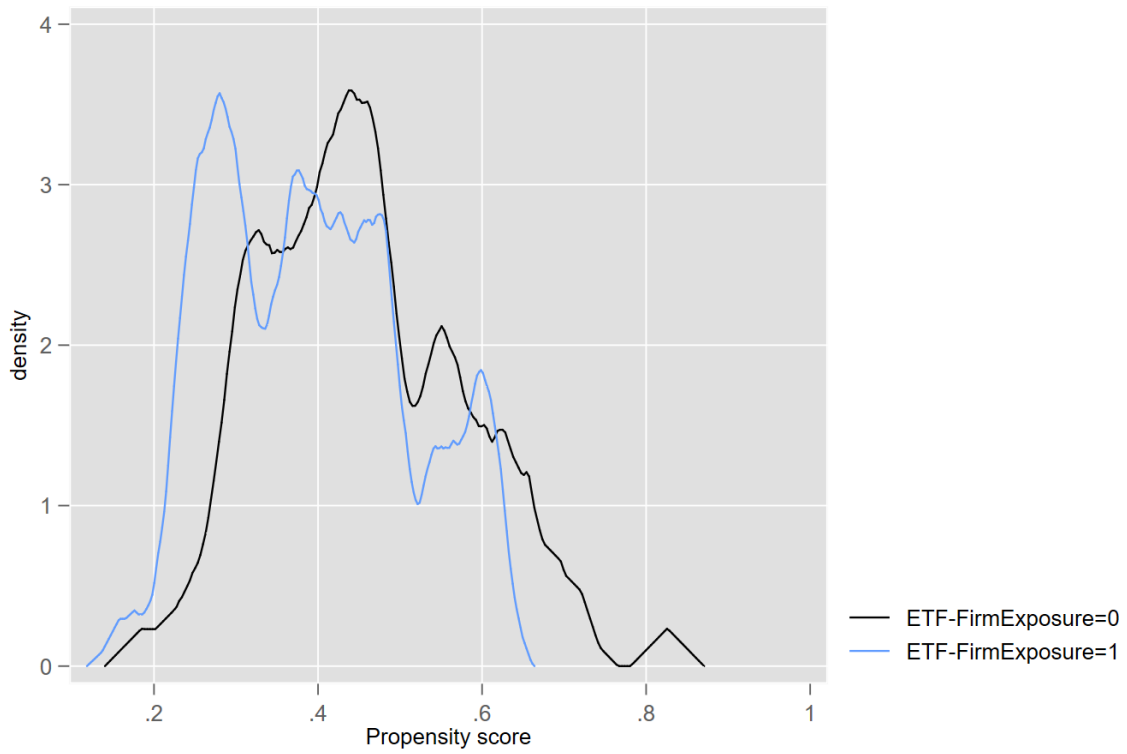
(b) Banks' exposure to the BOJ's CB purchases



Period: 2011-2018. Total number of banks: 122

Figure 1. Spillovers of BOJ purchases on public firms - Testing for overlap assumption

(a) The BOJ's ETF purchases



(b) The BOJ's CB purchases

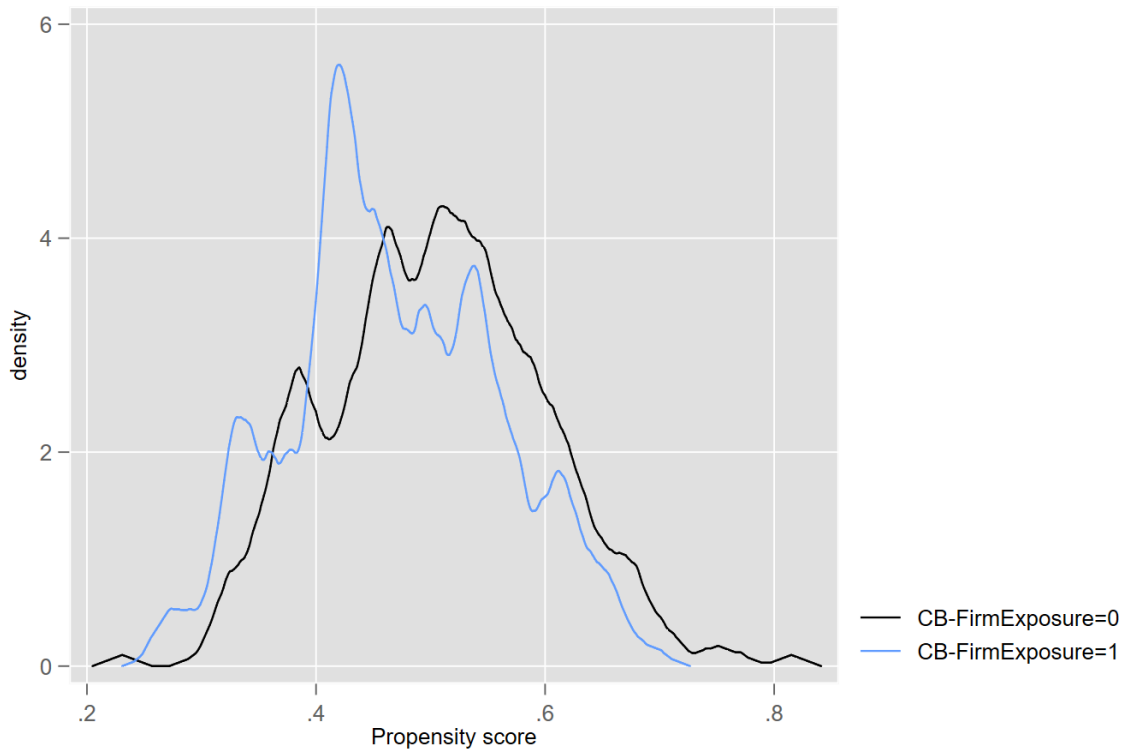
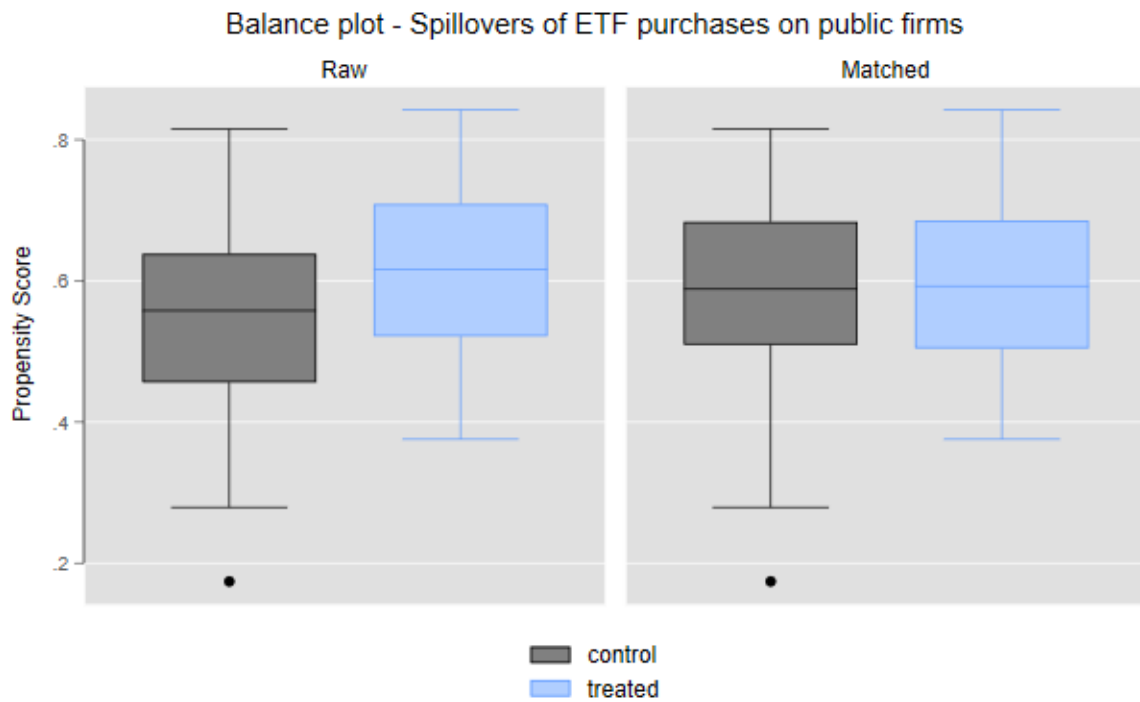


Figure 3. Spillovers of BOJ purchases on public firms – Covariate balance box

(a) The BOJ's ETF purchases



(b) The BOJ's CB purchases

