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Characteristics of Green Loan Users and the Green Policy Mix*

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Abstract

We analyse the usage of green loans under a public green loan program and document a positive link with borrower financial health. Green loan users have better credit ratings, higher sales growth, and lower leverage. The link remains stable in face of significantly changing conditions for green investments and heightened green policy uncertainty induced by changes in governments' green policy mix. Green loan users also exhibit better ex-post performance and lower default probability. The results imply that the screening undertaken by the lender matters for efficient green loan provision and highlight the important role of public loan programs in the green policy mix.

Keywords: Green loans; Public loan programs; Loan screening; Feed-in-Tariffs
JEL classification: G21, G28

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1. Introduction

Climate change is a major global challenge that requires concerted action to reduce greenhouse gas emissions and adapt to the impact of a changing climate (Paris Agreement 2015). Green finance plays a role in supporting these efforts by providing the necessary financial resources for investments into green technologies and infrastructure (Alharbi et al. 2023). Recent green initiatives (e.g. European 2018 Action Plan on Financing Sustainable Growth) have highlighted the need to support the uptake of green financing. Small and medium enterprises (SMEs) are seen as vital players for the sustainability transition, and increasing their access to sustainable finance opportunities has emerged as an important policy issue (e.g., EU 2021 Strategy for Financing the Transition to a Sustainable Economy). For SMEs that typically face constrained access to finance due to informational asymmetry, green loans, i.e., environmentally-focused loans, have become to represent an essential part in governments' green policy mix, often alongside other green policy interventions (e.g. subsidy schemes for green technology adoption).[1]

In recent years, an extant literature has emerged which examines the use of corporate green loans and the green lending behaviour of financial institutions.[2] However, there is paucity of research on SMEs' use of green loans. The present study goes some way toward filling this gap. Using a confidential loan-level dataset from a Japanese government-affiliated lender, we examine the type of SMEs that use green loans, and how their use of green loans is linked to financial performance, under changing green government policies. We choose as a setting a green SME loan program offered by the SME business unit of the Japan Finance Corporation (JFC), which is a large Japanese government-affiliated policy bank with a long history of providing loans to SMEs for environmental purposes.[3] The green SME loan program under investigation was initiated in 2010 as a part of a green policy mix to promote renewable energy production, which included the introduction of a feed-in-tariffs scheme to accelerate investment in renewable energy projects.

Unique to our study is that we examine SMEs' use of green loans over the course of this feed-in-tariffs scheme. Our sample period covers the full cycle of the scheme from its introduction

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[1] Green loans can be used to finance renewable energy project, support energy efficiency measures or fund other initiatives that focus on sustainability and environmental protection. Green loans typically have specific terms and conditions that are designed to encourage the borrower to use the funds for environmentally-friendly purposes. Examples of green loans include loans financing the installation of solar panels on commercial property, the development of renewable energy projects such as wind farms or hydroelectric power plants, or the promotion of energy efficiency of buildings. In recent years, principles such as the Green Loan Principles (LMA 2018) and Regulation 2020/852 (EU 2020) have established criteria for determining whether a loan qualifies as a green loan. Set out in the Loan Market Association's 'Green and Sustainable Lending Glossary of Terms' (LSTA 2021), a green loan is any type of loan instrument made available exclusively to finance or refinance, in whole or in part, new and/or existing eligible 'green projects' including renewable energy, energy efficiency, climate change adaptation and green buildings that meet regional, national or internationally recognised standards or certifications.

[2] See Akomea-Frimpong et al. (2022) for a review on products and determinants of green finance provided by banks, and De Haas (2023) for a review on studies on sustainable banking.

[3] See subsection 3.1 for the JFC and its units.

in 2012 to major reforms beginning from 2014 onwards. This allows us to observe how changing investment conditions for green technology is associated with green loan usage. During the early phase of the feed-in-tariffs scheme, the scheme provided for very favourable investment conditions and attracted a large influx of green investors. Some of these investors were high-risk investors in a sense that they lacked viable business plans for renewable energy production and would later struggle to survive (Chu and Takeuchi, 2022). A key objective of our study is to evaluate to what extent the pool of SME borrowers using the JFC public green loan program comprised high-risk green technology investors. As such, our study also reflects on the role of the JFC in screening green investors. We posit that the presence of an effective screening by the lender would be reflected in the characteristics of SMEs using a green loan, and their ex-post performance.

Our main data source is a confidential dataset maintained by the Japan Finance Corporation. The dataset comprises information about small and medium-sized firms in Japan which obtained loans (including green loans) from the SME business unit of the JFC. The unit records a number of characteristics for each of its borrowers, including the purpose of the loan, the borrowers' performance and financial risk as well as its location and industry. For each firm, the JFC also assigns an individual risk rating. For our analysis, the main variable of interest is a firm's use of a green loan at a given point in time. The granularity of the data allows us to examine in detail the characteristics of green loan users and how these evolve in light of changing investment opportunities under the feed-in-tariffs scheme. To our knowledge, this data set of corporate green loans is the most comprehensive to date and permits analysis at the level of the individual borrower and thereby provide some insights into the screening activity of the lender.

To investigate SMEs' use of green loans under changing investment conditions, our analysis comprises three parts. We begin our analysis by discussing some stylised characteristics pertaining to green loan users. Next, we estimate a probit model to examine the extent to which various firm-level characteristics (such as financial health) are linked to green loan usage and whether they vary across different phases of the feed-in-tariffs scheme. We complete our analysis with an examination of the ex-post performance of green loan users. Using a propensity score matching approach, we match SME green loan users with similar SME borrowers, and apply a difference-in-differences approach to compare the performance of the two groups of firms after loan origination.

By way of preview, we observe from the first part of our analysis that SMEs' use of green loans changes with investment conditions for green technologies. The number of green loan users increases when investment conditions are favourable under the feed-in-tariffs scheme (initial phase), and decline sharply when conditions deteriorate (reform phase). Our results also show that SMEs' use of green loans is more prevalent in industries where the physical environment (e.g.

buildings and land) is financially substantive to a firm's business. Firms in real estate and construction industries make up the largest share of green loan users. Green loan usage is also more prevalent in major economic centres such as Tokyo and Osaka.

Next, we find from the second part of our analysis that firm financial health (in terms of credit rating, indebtedness, profitability, and tangibility) is positively linked to green loan usage. Firms that have more growth potential, are better rated, less leveraged, and more tangible are more likely to use green loans. The positive link between firm financial health and green loan usage changes to some extent with underlying investment conditions. The link is stronger in the first years of the feed-in-tariff scheme, and weakens as investment conditions worsen after 2014. Notably, however, the link remains positive and does not turn negative under less favourable investment conditions.

Finally, the results from our ex-post examination suggest that green loan users perform well after obtaining a green loan relative to other SME borrowers. Specifically, we find that green loan users are more profitable, and are larger in size and have more tangible assets. Our results further indicate that green loan users had relatively better risk-ratings. This is also reflected in green loan users' being less likely to run a deficit or go bankrupt. Our results are robust to using different sets of SME borrowers for comparison.

The results from our analysis provide two key insights. First, the characteristics of green loan users remain fairly stable over time. That is, even in the wake of significantly changing conditions for green investments, green loan users continue to showcase overall good financial health characteristics. Second, this continuity is also reflected in green loan users' ex-post performance, which remains fairly stable throughout our sample period. As such, our results indicate that the green investors who borrowed funds from the JFC under the public green loan program were unlike the high-risk green investors that had entered the market for renewable energy production in the early phase of the feed-in-tariff scheme. Overall, our findings point to the presence of an effective screening process by the JFC and suggest that the screening function of government-affiliated lenders can play an important role in ensuring that favourable investment conditions created by government green policies are not met with excessive, unsustainable borrowing activity.

Our study relates to several strands of literature. Our study contributes to an emerging literature on green debt. Much of this literature focuses on large corporate borrowers and their use of green bonds (e.g., Flammer 2021, Tang and Zhang 2020), syndicated green loans and sustainability-linked loans (e.g. Degryse et al., 2023; Dursun-de Neef et al. 2022; Loumioti et al., 2022) or both (e.g. Newton et al. 2022). Existing studies suggest that corporate characteristics are related to green debt use and generally observe a positive relation with characteristics such as size, profitability, environmental attitude, and environmental scores (e.g. Barbalau and Zeni, 2022; Cicchiello et al., 2022; Dursun-de Neef et al., 2022; Flammer, 2021). Yet, evidence for SMEs and their use of green debt is relatively scarce. Closest to our study is the paper by Accetturo et al. (2022) who find that bank credit availability drives green investments of SMEs that have abundant internal resources and are thus better equipped to finance capital-intensive investments in green technology. In contrast to Accetturo et al. (2022), our loan-level dataset allows us to directly observe whether a loan is for renewable energy investments or for other purposes.[4] Hence we can clearly distinguish between green loan users (users of renewable energy loans) and other SME borrowers. More generally, we depart from the existing literature in that we examine green loan user characteristics, and derive insights about the screening activity of the government-affiliated policy bank and its role in the green policy mix.[5]

Second, our study also relates to an extant literature that examines government green subsidy schemes and their impact on private green investments. Such schemes are subject to frequent adjustments as policy goals evolve or adapt, creating considerable uncertainty for investors and financial institutions (Neuhoff et al. 2022; Berg et al. 2013). There is ample evidence that private investors value schemes which provide a secure and predictable investment framework (for a review of the literature see Polzin et al., 2019). The literature also highlights that a better understanding of investors' financing and investment decisions in response to shifts in green policies is important for achieving more effective outcomes (e.g. Wang et al., 2021).[6] Our study adds to this literature by examining financial health characteristics of SME green loan users within a dynamically changing policy landscape. Our findings are in support of Polzin et al. (2019) which emphasise dynamics and uncertainty in the green policy mix and its implication for SMEs' green financing.

Finally, our study links to the extant literature on government-affiliated (state-owned) banks. Government-affiliated banks play an important role in banking sectors worldwide (La Porta et al. 2002), and there are many studies on, for example, their efficiency (e.g., La Porta et al. 2002; Sapienza, 2004; Dinç, 2005) and their role in mitigating credit constraint for SMEs (e.g., Behr et al. 2013, 2017, Micco and Panizza, 2006, Brei and Schclarek, 2013, Cull and Pería, 2013, Coleman and Feler, 2015). Within this literature an emerging strand focuses on government-affiliated *policy* banks (state-owned banks that are policy-oriented) and their role in the

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[4] Accetturo et al. (2022) indirectly derive information on SMEs use of bank credit by extracting information about SMEs' green investment activity from SMEs' annual report, rendering it difficult to isolate to whether and to what extent bank credit was indeed used for green technology investment.

[5] Studying bank relative to market-based green financing (e.g. green bonds), Newton et al. (2022) finds that green bank loans are better at shaping environmental (as well as social and governance) performance of corporate borrowers and suggest that the monitoring function performed by lender plays an important role.

[6] For instance, Werner and Scholtens (2017) document that increased policy uncertainty negatively affects investors' willingness to make green investments.

transformation process towards greener economies (Mazzucato 2015).[7] Government-affiliated policy banks have been shown to provide a large share of finance for renewable energy projects (Mazzucato and Penna, 2016; Mazzucato and Semieniuk, 2018). These banks can assist in mobilizing private capital for green technology investments by absorbing investment risks (Geddes et al., 2018) but may also be prone to lower performance and political influence (Berger et al., 2005; Carvalho, 2014; La Porta et al., 2002). Waidelich and Steffen (2023) further caution that the financing behaviour of government-affiliated policy banks may not necessarily align with government green policy goals, and provide evidence that these banks refrain from financing novel and small-scale green technology investments. We contribute to this strand of literature by highlighting the role of government-owned banks in performing the screening and monitoring of borrowers. [8] Our findings highlight the importance of government-affiliated banks in governments' green policy mix and call for further research on the screening and monitoring activities of government affiliated banks.

This paper proceeds as follows. In Section 2, we provide background information about Japan's feed-in-tariffs scheme and discuss our conceptual framework. Section 3 introduces our dataset in more detail, outlines our setting as well as our method. In Section 4, we report our results and Section 5 concludes.

2. Background and conceptual framework

In this section, we provide relevant background information related to feed-in-tariffs schemes. Specifically, we outline how feed-in-tariffs schemes work in general and discuss the specific characteristics of Japan's feed-in-tariff scheme that are relevant to our study. We then describe our conceptual framework.

2.1 Background

Renewable energy production is capital intensive at the initial stage of deployment of the underlying technology. This subjects investors to high up-front costs and makes renewable energy projects less economically viable than conventional energy projects. Feed-in-tariffs scheme are designed to financially support their investment in renewable energy production. Under feed-in-tariffs schemes, investors who wish to produce renewable energy (e.g. via solar panels) enter into a power purchase agreement with a utility provider. The agreement obliges the utility provider to purchase electric power (generated by the renewable energy device of the

[7] For a discussion of the role and scope of government-affiliated policy bank (also called *state investment banks* or *national development banks*) in the transformation process towards greener economies, see Mazzucato (2015). .

[8] For a discussion of the screening and monitoring role of banks and the underlying incentives see e.g. Diamond (1984) and Ramakrishnan and Thakor (1984).

investor) at a fixed price over a long-term period (e.g. 20 years). Utility providers in turn receive a renewable energy subsidy which is borne by the end users who are required to pay renewable energy surcharges. The ultimate aim of feed-in-tariffs is to advance the deployment of technology essential for the production of renewable energy by making investments in renewable energy production more attractive. For instance, when the technology, e.g. solar panels, gets more widely used, production becomes more scale-efficient and cost-effective so that prices of renewable energy technology eventually fall and in turn make investment in renewable energy production more attractive for investors.

Feed-in-tariffs schemes have been implemented in over 92 countries (as of 2021, REN21, 2022). In Japan, the scheme was introduced in 2012 shortly after the Fukushima nuclear disaster. The disaster had led to a shut-down of several nuclear reactors and a shift in the national stance on energy policies toward renewable energy sources. Over the period from 2012 to 2013, the feed-in-tariffs scheme offered investors relatively generous conditions promising good total profits, moderate annual returns on investment, and an adequate payback period (Muhammad-Sukki et al., 2014). This triggered a large influx of investments in renewable energy projects and helped advance the dissemination of renewable energy technology. The share of renewable electricity in the energy mix increased from 9% in 2011 to 15% in 2016 (Kimura, 2017).

Yet, Japan's feed-in-tariffs schemes was subject to a number of issues. Early on, concerns were raised that excessive purchase prices increased the burden for citizens and households (Tanaka et al., 2017b) who – as end consumers – bore the costs of the scheme. Government estimates suggested that for a standard household, electricity prices had risen by 0.5 JPY per kWh, or 150 JPY per month (approximately 1.9 USD). The scheme was also criticised by some for incentivising firms without viable renewable energy projects to enter the market for renewable energy production (Chu and Takeuchi, 2022). In order to secure a purchase price, renewable energy projects merely had to be registered but did not need to be operating. This lax approach to certification essentially lead to a large gap between operating and approved renewable energy capacity, and persisted until about 2017 when a tighter regulatory framework came into effect.

Moreover, with the entry of so-called mega solar power generators, issues around insufficient power grid capacity began to surface. In autumn 2014, Kyushu Electric Power, a major Japanese power firm, announced it would withhold all grid connection requests for solar power of more than 10kWh. Other Japanese power firms followed suit suspending renewable energy purchases in various prefectures. The Japanese Government responded with a major revision to the initial feed-in-tariffs scheme. Between 2014 to 2016, emergency measures were taken within the scope of the existing law, and were followed by a fundamental review of the existing feed-in-tariffs scheme leading to a substantial reduction in the purchase price. In 2017, major reforms came into effect including a bidding system, more stricter approval rules as well as changes to the purchasing party. These changes significantly impacted the production of renewable energy and related industries. Bankruptcies in industries related to renewable energy production steadily increased from 2014 onwards, with sharp upward trends in 2015 and 2016. As shown in **Table 1**, the increase in the number of bankruptcies was accompanied by a large increase in debt, suggesting that firms became overly leveraged.

For our analysis, we divided the feed-in-tariffs scheme period into three phases. These three phases are characterised by major policy shifts that had implications for renewable energy investment conditions. The first phase, which we refer to as the *boom phase*, spans the period from 2012 to 2013. The *boom* phase is marked by renewable energy projects promising a high business return and a low risk profile. Yet, an inadequately designed certification process, provided strong incentives for investors without viable prospects for producing renewable energy to enter the market and to secure options for highly profitable returns.

With the Kyushu Electric Shock in the latter half of fiscal year 2014, the *boom* phase came to an abrupt end and set off the second phase. This phase is characterised by the introduction of major reforms, eventually culminating in the revision of the legal framework.[9] We refer to this phase, from 2014 to 2016, as the *reform phase*. As major reforms were brought under way, the earnings outlook for firms wishing to enter the renewable energy market declined gradually and rendered excessive revenues of the earlier years increasingly unlikely. Moreover, concerns about grid access guarantees, variability in tariffs and reduced stability in the regulation induced higher levels of investment uncertainty. Thus the reform phase brought about a worsening in the risk-return profile.

The final and third phase, which we refer to as the *post-reform* phase, from 2017 until the end of our dataset, 2018, marks the end to Japan's feed-in-tariff schemes in its original form. During this phase, major reforms take effect and eventually lead to a bottoming out of investment conditions for renewable energy projects.

2.2 Conceptual framework and research questions

The above described changes to Japan's feed-in-tariffs scheme suggest that resultant changes to investment opportunities and conditions are likely to have a significant impact on the type of firms that choose to enter the market for renewable energy production. Polzin et al., (2019) show that the extent to which investors invest in renewable energy production depends on the design of the feed-in-tariffs scheme and its impact on the risk-return profile of renewable energy projects. For renewable energy projects, higher project risks translate directly into higher required returns because the renewable energy asset and its expected future cash flows are often the only collateral available to lenders. Shorter contract durations, more variability in tariff levels, as well as issues related to grid access are found to increase risk and lower returns, making investments in renewable energy less attractive for investors. Moreover, while long-term contract duration and high tariffs – as is common at earlier stages of feed-in-tariffs schemes - are attractive to investors, excessively generous feed-in-tariffs schemes have been shown to raise concerns about the sustainability of the regime and ultimately discourage investment (Polzin et al., 2019). We conjecture from these considerations that changes to the feed-in-tariffs scheme which alter conditions for renewable energy investment significantly have implications for investors' demand for green loan that finance renewable energy projects.

For the purpose of our study, we narrow our focus to a specific financial instrument - that is *green* loans. We examine green loan usage in a framework that emphasis factors related to the borrowing party of the loan contract (the investor) to play an important role for debt choices. [10]The literature on banking and corporate finance finds that firm characteristics such as larger firm size, older age, lower leverage, higher tangibility, longer bank-firm relationships as well as better credit quality, are positively linked to lower monitoring and funding costs, lower likelihood and costs of inefficient liquidation, as well as smaller incentives for firms to take actions harmful to the lender (e.g. Houston and James 1996; Kirshnaswami et al. 1999; Cantillo and Wright 2000; Denis and Mihov 2003; Altunbas et al., 2010). A number of studies investigate these attributes as determinants of green debt (bonds) choice and find evidence for a link between firm financial health and firms' choice of debt (Barbalau and Zeni, 2022; Cicchiello et al., 2022; Lin and Su, 2022).

For our analysis, we borrow from these insights and conjecture that major changes to the feed-in-tariffs scheme should be reflected in the link between firm financial health and green loan usage. That is, we expect that the pool of green loan users will comprise firms of better or poorer financial health depending on the investment conditions and incentives created by the feed-in-tariffs scheme. For instance, the *boom* phase with its many inadequately designed incentives potentially attracted a large number of renewable energy investors with unviable business prospects, making it more likely that the pool of green loan users would comprise these kind of firms. In contrast, the *reform* and *post-reform* phase are more likely to have attracted firms with better financial performance characteristics.

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[10] We consider the role of supply-side factors in firm's debt choice for our analysis to be relatively minor. This is because the JFC is a government-affiliated financial institution and not a private lender. The JFC is one of Japan's policy-implementing financial institutions, a joint stock company wholly owned by the government, whose lending schemes are defined by government policy. Loans are funded through Fiscal Investment and Loan Program (FILP), government-guaranteed bonds, FILP agency bonds, and government investments. Since sufficient budgets are secured, lending constraints due to a lack of resources are unlikely to be present. Thus, reluctance to lend and inadequate credit allocation due to insufficient capital, which is an issue typically observed in private financial institutions, might not occur and are unlikely to affect the availability of loans.

An important aspect disregarded by our discussion so far, is the role of the lender in her screening capacity. By screening loan applications, lenders subject applicants to a selection process whereby only those that are judged to be of acceptable creditworthiness are granted a loan. We posit that a screening process effective in distinguishing between creditworthy and uncreditworthy renewable energy investors would translate into a positive and fairly stable link between firm financial health and green loan usage over the course of the feed-in-tariffs scheme. In other words, we would expect an effective screening process to mitigate some of the design issues of the scheme and to prevent firms with unviable business prospects from obtaining a green loan.

From this discussion on borrowers' financial health versus the effectiveness of lenders' screening process, we derive two main research questions that our study seeks to answer. The first question pertains to changes in the feed-in-tariffs and the link between firm financial health and green loan usage. The second pertains to the screening effectiveness of the lender and the ex-post performance of green loan users. We formulate our questions as follows:

> *Question 1:* Do changes in investment conditions for renewable energy projects affect green loan usage?

> *Question 2:* To what extent does screening by the lender mitigate these effects?

3. Data and model specifications

In this section, we describe the source of our data, outline the rationale for choosing our control group, provide descriptive statistics for our sample, and discuss our model specifications.

3.1 Data source

We obtain confidential business data from the SME business unit of the Japan Finance Corporation (JFC).[11] For each loan, the JFC SME business unit (the JFC hereafter) records detailed information about the borrowing firm over a number of years after the origination of a loan.[12] The collected information comprises details about a firm's industry and headquarter location, size, sales growth, return on assets, operating deficit, default, equity funding (leverage), and

[11] The JFC is a public bank wholly owned by the Japanese government. The JFC has three business units, the Micro Business and Individual unit, the SME unit, and the Agriculture, Forestry, Fisheries and Food Business unit, which are successors of the three government-affiliated financial institutions before their merger in 2008. The SME business unit of the bank provides loans to small and medium-sized firms. Loans are issued for specific policy purposes such as environmental or energy related loans as well as loans for enterprise development, corporate revitalisation loans, safety net loans, and corporate restructuring loans.

[12] Notably, we only observe firms that were granted a loan but not those whose loan application was rejected.

tangibility. By transforming the dataset, we also obtain data on the length of the lender-borrower relationship between the firm and the JFC SME business unit, and firm age. We also observe borrower credit scores from an internal credit rating conducted by the JFC to make loan-granting decisions. These scores contain a soft, subjective assessment of borrower credit risk. To determine the credit risk, the JFC consults the availability of collateral, its type, and the personal guarantee of the borrower. Loans are not approved if conditions are judged to be unacceptable but are in general granted at the request of the borrower if the application satisfies the required criteria set out by the JFC (with risk-adjusted interest rates).

The JFC provides six policy driven loan programs, of which one comprises loans for environmental or energy related purposes. The other loan programs are: loans for enterprise development, corporate revitalisation loans, safety net loans, corporate restructuring loans and other loans. For our analysis, we focus on *non-fossil-energy* loans that fall under the category of environmental-or-energy-related-purpose loans, which the JFC offers for investments in environmental measures that utilize non-fossil energy sources such as solar energy, wind power, geothermal power, hydropower or biomass.[13] For the purpose of our study, we refer to non-fossil energy loans issued by the JFC as *green loans*. We choose the *green loan* terminology because the JFC non-fossil-energy loans are limited to financing green activities and therefore meet one of the key criteria that define a green loan under the Principles of Green Loans.

3.2 Choice of control group

To conduct our analysis of green loan usage and its link to firm characteristics, we need to make a decision as to the choice of the control group. That is, we need to decide with whom to compare the group of firms that use a green loan. Our choice is driven by evidence from the finance and banking literature which shows that a firm's decision to finance an investment with debt (i.e. by using a loan) and its decision from whom to borrow are not random.[14] This means that firms which choose to use external debt may be materially different from firms that do not choose (or need) to borrow funds. Thus, it is important to control for these dimensions when choosing a control group.

As we are interested in examining firm characteristics and financial health of green loan users, our choice falls to all firms that borrow from the JFC SME business unit and use loans other

[13] The non-fossil-energy loans are targeted at SMEs that aim to enter the power generation business but lack sufficient capital. Firms can borrow a maximum loan amount of 720million yen (5million USD) and are charged a base interest rate adjusted according to the underlying credit risk, loan maturity, and loan purpose. A key requirement imposed by the JFC for non-fossil-energy loans is that 100% of the loan proceeds are invested in eligible green activities. To verify the use of proceeds, the JFC conducts on-site inspections by visiting borrowers' locations to assess business and facility conditions and inspecting locations of solar panels and the timing of operations.

[14] For instance, Schwert (2017) shows that the formation of relationships between banks and borrower depends on borrower and bank financial health.

than the non-fossil energy loans. We believe that our control group is suitable because it comprises firms with the following characteristics. Firms are SMEs from Japan; and are funded externally under a public loan scheme program offered by the same lender (in this case the JFC); have successfully applied for and obtained a loan. Choosing firms that meet these characteristics helps ensuring comparability with green loan users because firms have similar underlying characteristics in terms of origin, lender, as well as use of external finance. **Table 2** depicts a conceptual categorization of our sample firms. Our sample consists of firms which use a green loan from JFC (1a) and of firms that use other JFC loans (2a). Due to data limitations, we are unable to extend our comparison to non-JFC borrowers, such as firms comprised in group (1b) and (2b). Comparison with these other non-users would provide further insight into green loan usage, in particular, if our group of non-users (2a) is materially different from other non-users.

After eliminating observations with missing information (all variables), our final sample comprises 96135 SMEs that obtained a loan from the JFC at one point during the period from 2012 to 2018.[15] A total of 2962 of these firms received a non-fossil-energy loan. We refer to this group of firms as *green loan users* or *users* hereafter. The remaining 93173 firms make up our control group. These firms received loans from the JFC other than non-fossil-energy loans. We refer to these firms as *non-users* or *control* firms.

Table 3 compares the distribution of employee size and industry of our control firms with firms in the Economic Census. The Economic Census provides the most comprehensive corporate statistics in Japan allowing us to map the composition of firms in our control group in reference to the "average" Japanese firm. Notably, firms in our control group do not comprise firms that are very small or are active in agriculture and fishery. This is because we use data from the JFC SME Business unit which excludes microbusinesses and firms in agriculture and fishery industries (these are dealt with by the JFC Micro Business and Individual unit and the JFC Agriculture, Forestry, Fisheries and Food Business unit). Furthermore, firms in our control group are also relatively more dominant in the manufacturing industry. We attribute this to the fact that the loan programs offered by the JFC predominantly provide funds for equipment.

3.3 Summary statistics

Figure 1 shows the number of green loan users over the period from 2010 to 2018. The number increases sharply with the introduction of the feed-in-tariffs scheme in 2012. In 2014, the trend peaks and is followed by a drastic decline. In the years between 2014 and 2018, green loans showcase a much more moderate take up. For reference, we also report the number of non-users. The trend in this number is relatively stable until about 2012, and we notice a slight

[15] The number of observations before the elimination was 106050.

downward trend thereafter. Notably, the number of non-users does not mirror the drastic increase in green loan users around 2012, suggesting that favourable investment conditions such as those created by the feed-in-tariffs scheme may potentially drive interest in green loans.

Next, we examine green loan users by industry and location. **Table 4** provides a breakdown of green loan users by industries (Panel A) and location (Panel B). In Panel A, industries are partitioned according to those as recorded by the JFC. As can be seen, green loan users are more common in industries related to real estate and construction, with about 15% and 11% of users from these industries. Panel B provides a breakdown by location (prefecture level). As is shown, green loan users are especially prevalent in major economic regions such as Kanto, Kansai, and Kyushu. The prefectures Osaka (8.7%), Fukuoka (7.7%) and Tokyo (7.3%) that comprise large urban conglomerates with sizable real estate and constructions activity, showcase a large number of green loan users.

Table 5 provides a description and definition of the variables that serves as indicators for firm characteristics. As measures of firm financial health, we use indicators that in the literature on corporate finance and banking, and more recently on green debt choice, have been found to be linked to firms' debt usage. These include leverage, profitability, tangibility, and size. (Houston and James 1996; Kirshnaswami et al. 1999; Cantillo and Wright 2000; Denis and Mihov 2003; Altunbas et al., 2010; Lin and Su, 2022; Barbalau and Zeni, 2022; Flanner 2021). We also include non-financial characteristics that the literature associates with firm debt choice, such as age and borrower-lender relationship attributes. We present summary statistics separately for green loan users and non-users in **Table 6.** The reported mean values show that green loan users have on average better credit ratings, are less leveraged and demonstrate better performance in terms of return on assets and sales growth relative to non-users. Notably, green loan users are also slightly younger and have shorter relationship with the lender. Users and non-users show little differences in terms of size and tangibility. Difference-in-means tests, reported in the last column of the table, confirm that the observed differences between the two group are also of statistical significance. **Figure 2** shows the year-by-year distribution of green loan users and non-users with respect to their credit rating. The plots show that the distribution of the control group does not change. The distribution of users of green loans shifts from favourable to less favourable credit ratings from 2012 to 2015. However, the shifts are not drastic, and the distribution does not change afterwards.

3.4 Methodology

This section explains our empirical framework. Our empirical analysis comprises two parts. In the first part, we use a multivariate analysis to examine the link between firm financial health and the usage of green loans. Our focus is hereby on examining changes across the three phases of the feed-in-tariffs scheme. In the second part, we compare the ex-post performance of green loan users and non-users.

3.4.1 Usage of green loans

The first part of our analysis examines the link between firm characteristics and green loan usage. To investigate this link, we use a probit model and estimate the following equation:

$$Pr\left(Green\ Loan_{i,t} = 1\right) = f\left(\alpha_0 + \alpha_1 X_{i,t-1} + \alpha_2 X_{i,t} + \epsilon_{i,t}\right) \quad (1)$$

where i $(= 1, \dots, N)$ is the firm (N is the number of firms), t $(= 2012, \dots, 2018)$ is the index representing the year. $Green\ Loan_{i,t}$ is a variable that is equal to the value of one if a firm uses a green loan and zero otherwise. $Pr(\cdot)$ is the probability that $Green\ Loan_{i,t}$ takes the value of one, the function f represents the cumulative distribution function of the standard normal distribution. The main test variables are $X_{i,t}$ and $X_{i,t-1}$ which comprise the following six financial health attributes *Rating,* and *Leverage, ROA, Tangibility, Size,* and *Sales_growth*, as well as two other firm attributes *Age, and Borrower-Lender-Relationship* respectively. Our empirical approach uses lagged test variables for *Leverage, ROA, Tangibility, Size,* and *Sales growth* to mitigate endogeneity concerns arising from reverse causality.[16]

To analyse the link between firm financial health and green loan usage across various phases of the feed-in-tariffs scheme, we also use a specification whereby we interact our main test variables with period dummies that take the value of one in the respective period, and zero otherwise. As outlined in Section 2, we distinguish between three different periods - *boom* (2012-2013), *reform* (2014-2016), and the *post-reform* phase (2017-2018).[17] Because interaction terms in probit models may not adequately measure marginal effects (Ai and Norton 2003), we use an OLS estimation by assuming a linear function for f. Our model also comprises industry and prefecture fixed effects to account for time-invariant differences across industry and location. We also include period dummies. The final term $\epsilon_{i,t}$ is an error term.

3.4.2 Ex-post performance

The second part of our analysis examines firms' ex-post performance – the performance after firms have obtained a green loan from the JFC. To begin with, we measure a firm's change in performance relative to the year of the loan origination. We calculate the change as follows:

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[16] See Table 3 for variable definitions.
[17] Unreported results indicate that the main conclusion does not change even if we replace these period dummies with year dummies.

$$\Delta Y_{t+k} = Y_{t+k} - Y_t \text{ with } k = 1,2,3.$$

Y denotes the performance indicator and t denotes the year when the loan was originated. We take the difference between the value of Y in the year the loan was made (year t) and the values of Y one, two, and three years later ($Y_{t+1}, Y_{t+2}, Y_{t+3}$). We then transform our green loan usage data from calendar time to event time by designating the year when the firm obtained the green loan (year of loan origination) as time zero. We track the change in firm performance for three periods after the loan origination year.

We use the following performance indicators: *Rating,* and *Leverage, ROA, Tangibility, Size,* and *Sales_growth.* We also use two proxies for firm failure: *default*, a dummy which is equal to one if a firm is bankrupt and zero otherwise, and *deficit*, a dummy variable which is equal to one if a firm has negative operating income and zero otherwise. The dummy variables *default* and *deficit* are based on information from internal ratings (*Rating*) provided by the JFC.[18]

On the basis of our six performance measures, we then compare the ex-post performance of users and non-users. To determine whether users and non-users differ in their performance, we use a propensity score matching approach in combination with a difference-in-differences estimation.[19] We match users and non-users one-on-one using a nearest neighbour matching approach. The propensity score matching is performed on the basis of the six performance measures and ensures that we use firms for comparison with similar initial characteristics at time zero. The difference-in-differences estimation allows us to compare the changes in performance over time between the two groups. To determine the propensity score we use the same variables and settings as in the probit model described above. On the basis of the estimated propensity score, we select firms from each group with equal or highly similar scores. Using our sample of matched firms, we then estimate the average treatment effect (ATE). The ATE captures here the extent to which the use of a green loan (relative to another type of loan) is associated with good or bad performance following the year of the loan origination.

4. Results and discussion

In this section, we report and discuss the results from estimating the probit and OLS model for the usage of green loans, and the difference-in-differences model with propensity score matching for the ex-post performance.

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[18] See Table 3 for variable definitions.

[19] Propensity score matching creates pairs of users and non-users with ex-ante similar characteristics. Comparing firms with different ex-ante characteristics may risk capturing differences in performance that are merely the result of a difference in underlying firm characteristics before using green loans.

4.1 Usage of green loans

In this section we first present the empirical results for the link between firm characteristics and green loan usage. **Table 7, Column (1)** reports the results from estimating the probit model with a dummy variable indicating green loan usage as the dependent variable. The coefficients for the test variables *Rating, Leverage, and Relationship* are negative and statistically significant. This indicates that green loan users have better ratings and are less leveraged while having shorter relationships with the lender. Furthermore, the coefficient for sales growth is positive and statistically significant, suggesting that firms with better growth potential use green loans. For ROA, and age, the coefficients are positive but not statistically significant while for size, the coefficient is positive yet only weakly statistically significant. Overall, the results suggest that green loan usage is determined by firm financial health characteristics. Firms with better credit ratings and growth potentials and lower leverage are found to be more likely to use green loans.

By introducing period dummies and switching to OLS estimation, we next examine how the link between firm financial health and green loan usage evolves over the course of the feed-in-tariffs scheme. **Table 7 Column (2)** reports the results. As for the *boom* phase (2012-2013), we observe that green loan users are of better financial health. The coefficients indicate that green loan users have higher ratings, lower leverage, higher profitability, and higher growth potential. Yet we also observe that green loan users are less tangible. We also observe that firms are older and have shorter borrower-lender relationships. As for the *reform* (2014-2016) and *post reform* (2017-2018) phase, we observe that fewer financial health attributes remain statistically significant. The loss in statistical significance indicates that the link between firm financial health and green loan usage is less strong. During the *reform* phase, green loan users continue to have better credit ratings and higher sales growth, but are not more likely to have lowerleverage. For the *post-reform* phase, we find that firms continue to be of higher profitability, have higher tangibility. They also tend to be younger and to have a shorter borrower-lender relationship.

Overall, the results suggest that green users continue to be of somewhat better financial health in the face of worsening investment conditions for green technologies. That is, although reforms to the feed-in-tariffs scheme gradually made investments in renewable energy projects less lucrative for investors from 2014 onwards, this did not markedly affect the determinants of green loan usage. Overall, our results suggest that firms using green loans continued to be of better financial health than non-users notwithstanding a decline in investment conditions for renewable energy projects.

What might explain the fairly stable link between firm financial health and green loan usage in the context of major reforms to the feed-in-tariffs scheme? On plausible explanation could related to our choice of SMEs used for comparison. For instance, if non-users are inherently of poorer financial health (while green loan users are healthy), then this could bias our results towards a positive link between firm financial health and green loan usage. A key assumption underlying our comparison of green loan users and non-users is that non-users constitute a suitable control group. However, certain categories of loans offered by the JFC are targeted at firms that do not (or cannot) borrow under normal business conditions, such as firms affected by natural disasters or start-ups, or firms obtaining revitalization support. In this case, users and non-users would be materially different types of borrowers violating our assumption and potentially biasing our results.

To investigate the extent to which the choice of our control group drives our results, we re-estimate our probit and OLS model using an alternative *limited* sample of firms by excluding from our original control group the following set of firms. First, we exclude firms using loans for projects such as industrial waste treatment or pollution control measures, to ensure that the group of non-users comprises only firms that borrow for reasons other than engagement in environmental activities. We also exclude firms that borrow under non-regular business conditions. These include firms borrowing loans for new enterprise development, safety-net loans and loans for corporate revitalization measures, or loans targeted at start-ups. We also exclude firms borrowing loans in order to alleviate liquidity issues, or firms damaged by natural disasters. We conjecture that if substantially different risk criteria are used to evaluate applications for those types of loans, then these firms may not be suitable controls. Excluding firms with above described characteristics from the control group results in 23,483 non-green loan users, a loss of about 75% among the control group .

Table 8 reports the results from estimating the probit and OLS model with the *limited* sample. The results from the probit model (Column 1) indicate that green loan users are better rated, while financial health measures such as profitability, growth potential, or low leverage are not statistically significant. When considering results from the OLS model with interaction terms, we observe that during the *boom* phase, green loan users are better rated, but less tangible, smaller in size, older, and with a shorter lender-borrower relationship. During the *reform* and *post-reform* phases, green loan users are more leveraged than non-users, but the effect of tangibility flips across the phases. Overall, the results based on the *limited* sample indicate that the link between firm financial health and green loan usage is potentially less strong than suggested by our initial results, but do not change the above conclusion.

On balance, our results provide an answer to our first research questions pertaining to whether changes in the feed-in-tariffs scheme affect green loan usage. We find that the link between firm financial health and green loan usage become less strong in the face of worsening investment conditions. However, there is no indication that the link turns negative. Green loan usage continues to be positively associated with firm financial health over the course of the sample period. In this sense, our findings substantiate the narrative that the group of green loan users was spared an influx of the kind of poorly performing firms that had entered the market for renewable energy in large numbers to benefit from overly favourable investment conditions during the early phase of the feed-in-tariffs scheme.

4.2 Ex-post performance

Table 9 Panel A reports the result from estimating the difference-in-differences model with propensity score matching. The average treatment effect (ATE) for ROA, tangibility, and size is positive and statistically significant; These positive ATEs indicate that ROA, tangibility and assets of green loan users increased after obtaining a green loan. We also find that ratings improved ex-post; the negative ATE indicates that ratings for green loan users were better than for non-users. As for sales growth and leverage, we observe no statistically significant effects. Looking at the indicator for default, we find that green loan users are less likely to default; The ATE is statistically significant and negative, and although it is close to zero, it is economically significant because of the low default rate on average. Finally, we also find that green loan users are less likely to run a deficit. Overall the estimates suggest that the ex-post performance of green loan users is better relative to non-users. Users are more profitable, grow in size, have a more tangible asset base, and are less likely to default or run a deficit.[20]

Table 9 Panel B reports the results for the *limited* sample (see Section 4.1 for a description of the sample). We observe again a positive and statistically significant ATE for ROA and tangibility suggesting that green loan users are more profitable and tangible after obtaining green loans. We also observe a positive and statistically significant ATE for leverage indicating that green loan users are more indebted relative to non-users. Yet, indicators such as default and deficit again suggest that a higher leverage is not correlated with a higher likelihood for default and deficit for green loan users. We also find that green loan users have better credit ratings ex post. Overall, the results reported in Panel B are not materially different from those reported in Panel A. This alleviates concerns that the composition of the sample and choice of control group firms drives our results.

Having excluded potential bias from our choice of control group (using the *limited* sample), we are left with two non-mutually excluding explanations for why green loan users demonstrate good ex-post performance. First, it may be that the investment in renewable energy

[20] We also perform our ex-post performance analysis for each of the three phases of the feed-in-tariffs scheme (results unreported, available upon request). Although we find in some specifications smaller sales growth and a larger loan ratio of green loan users, the whole period results are qualitatively unchanged (with some deterioration in later periods). These results indicate that in spite of the drastic change in the investment environment, the ex-post performance of green loan users is on balance not inferior to non-users.

production (financed by the loan) paid off and helped improving firms' performance metrics. For instance, firms may have benefited from generous purchase prices driving down their energy costs. Additionally, the installation of technological equipment for the production of renewable energy may have translated into a more tangible and even larger asset base, explaining the increase in tangibility and size ex-post. Alternatively, the good ex-post performance of green loan users may also be in part attributable to effective screening by the lender that allowed selecting high-performing firms. That is, with a screening process effective in preventing high-risk firms with unviable business prospects from obtaining a green loan, the pool of JFC green loan users should not comprise this type of high-risk borrowers because those firms would have been unable to pass the loan application by the JFC.[21] As such, the results provide an answer to our second research question pertaining to the role of green loan lenders and suggest that the screening capacity of the lenders can potentially counteract negative incentives set by inadequately designed policies.

5. Conclusion

Green loans play an important role in the transition to a more climate-friendly economy by providing funding for investments in new promising technologies. In this study, we analyse the usage of green loans, its determinants and implication for users. Specifically, we examine the usage of green loans by small- and medium-sized firms under a public loan scheme provided by the Japan Finance Corporation. We use as a setting the green loan program of the Japan Finance Corporation under the feed-in-tariff scheme. For our analysis, we make use of reform-induced changes to investment conditions for renewable energy projects, to better understand what factors determine green loan usage.

Our results suggest that green loan usage is positively linked to firm financial health. Green loan users are more likely to have better credit ratings, higher sales growth, and are less leveraged compared to firms not using green loans—attributes that the finance literature typically associates with large public borrowers. Changes in investment conditions triggered by reforms and shocks related to the feed-in-tariffs scheme did not materially affect the link between green loan usage and firm financial health. Our study also uncovers that green loan users perform on average better and are less likely to default or run a deficit in the years following the loan issuance. We attribute these findings in part to the screening activity by the lender.

Overall our results are inconsistent with the notion that our group of green loan users comprises the kind of problematic firms that had rushed in large numbers into the market for

[21] Of course, we cannot rule out that such firms may have refrained from applying for a green loan from the JFC. In the absence of loan application data we are unable to confirm these, but such a discouragement (self-selection) might also be considered as an outcome of effective screening.

renewable energy production during the early phase of the feed-in-tariffs scheme. As such, our results suggest that green loan lenders play an important role in their screening capacity. By screening out firms with unviable business prospects, lenders may lessen the impact of negative incentives set by an inadequately designed feed-in-tariffs scheme.

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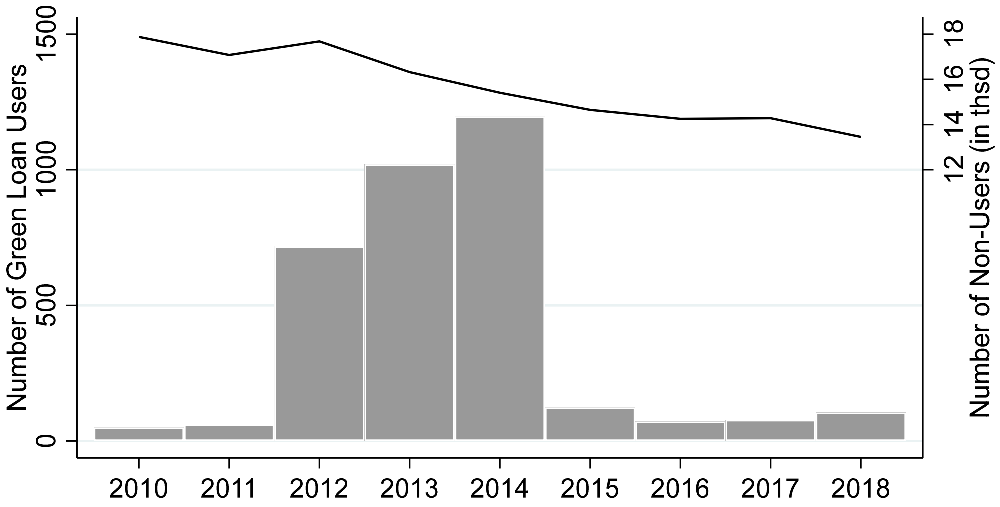
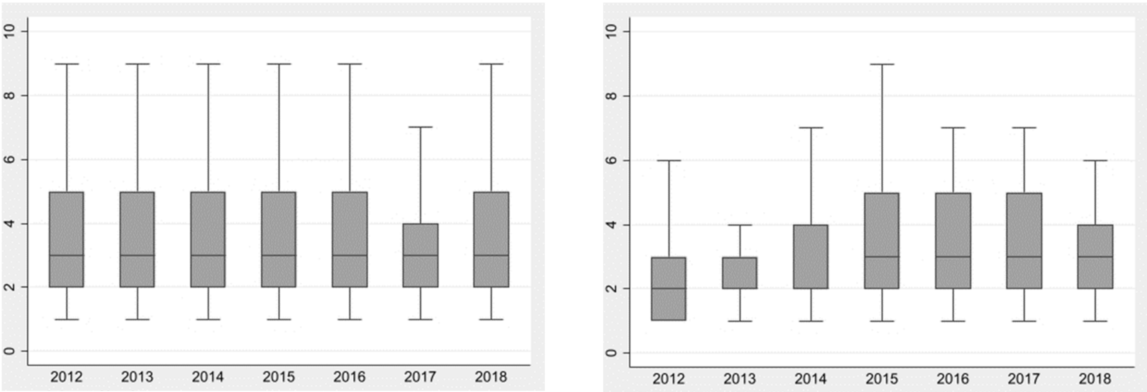
Figures and Tables

Figure 1 | Number of firms using JFC green loans from 2010 to 2018



This figure shows the number of firms in our sample by loan usage. The bars show the number of green loan users (LHS; green loan users = users of JFC SME loans classified as non-fossil energy loans) and the line shows the number of non-users (RHS; non-users = users of JFC SME loans other than non-fossil energy loans) for the period from 2010 to 2018.

Figure 2 | Year-by-year credit rating distribution



This figures shows the year-by-year credit rating (scores 1-10) of non-users (LHS) and users of green loans (RHS) for the sample period 2012-2018.

Table 1 | Bankruptcies

Year	Number of cases	Previous year change (%)	Debt (Mill.Yen)	Previous year change (%)
2006	2			
2007	4	100.0	1,762	8290.5
2008	6	50.0	16,475	835.0
2009	11	83.3	2,776	-83.2
2010	5	-54.4	345	-87.6
2011	12	140.0	3,788	998.0
2012	19	58.3	4,896	29.3
2013	16	-15.8	4,723	-3.5
2014	20	25.0	4,327	-8.4
2015	38	90.0	9,307	115.1
2016	67	76.3	33,328	258.1
2017	88	31.3	30,246	-9.2
2018	95	8.0	24,013	-20.6
2019	74	-22.1	21,234	-11.6
2020	84	13.5	23,957	12.8
Total	*541*		*181,198*	

This table reports the number of bankruptcies and total liabilities for firms related to solar-energy technology. Bankruptcy is defined as legal liquidation with debts of 10million yen and more. Solar-related firms include firms whose main business is related to solar power generation systems such as sales and installation, manufacturing, and consulting, as well as subsidiaries of solar-related firms whose main business is different from solar-technology. Source: "Number of Bankruptcies and Total Liabilities" (Teikoku Databank 2021).

Table 2 | Sample composition

	a) Public loan scheme borrowers	b) Others
1) Renewable energy investors (firms)	(1a) Green loan users = Users of JFC renewable energy loans	(1b) Non-users = Firms investing in renewable energy AND *not* using JFC loans
2) Other investors (firms)	(2a) Non-users = Users of *other* JFC loans	(2b) Non-users = Firms *not* investing in renewable energy AND *not* using JFC loans
	REGRESSION SAMPLE	

This table provides a schematic of the control group used for comparison of green loan users. The sample used in this study comprises firms in group 1a and 2a.

Table 3 | Control group composition

	Economic Census						Regression sample (non-green-loan users)					
	2012		2014		2016		2012		2014		2016	
Total	4128215	100%	4098284	100%	3856457	100%	16458	100%	13841	100%	12274	100%
Number of Employees												
0-4	3136695	76%	3046806	74%	2853123	74%	675	4%	453	3%	2385	19%
5-9	455675	11%	469759	11%	448946	12%	1020	6%	751	5%	501	4%
10-19	258599	6%	279724	7%	261652	7%	2188	13%	1703	12%	1229	10%
20-29	94115	2%	100912	2%	96176	2%	2045	12%	1599	12%	1158	9%
30-49	73561	2%	80820	2%	77774	2%	2989	18%	2533	18%	1949	16%
50-99	56039	1%	61311	1%	59249	2%	3570	22%	2918	21%	2467	20%
100-299	37636	1%	41490	1%	41474	1%	2703	16%	2261	16%	1976	16%
300-	15895	0%	17462	0%	18063	0%	1268	8%	1623	12%	609	5%
Industry												
Agriculture/Fishery/Mining	26382	1%	28165	1%	27368	1%	32	0%	30	0%	26	0%
Construction	468199	11%	456312	11%	431736	11%	1157	8%	995	8%	816	7%
Manufacturing	434130	11%	417932	10%	384781	10%	7535	49%	6402	49%	5863	51%
Utilities*	46199	1%	47525	1%	44672	1%	1520	10%	1310	10%	1244	11%
Wholesale/ Retail trade	930073	23%	907857	22%	842182	22%	3655	24%	2910	23%	2450	21%
Finance/Insurance	32419	1%	32200	1%	29439	1%	8	0%	3	0%	5	0%
Real estate	329449	8%	322573	8%	302835	8%	576	4%	500	4%	444	4%
Services	1785581	43%	1810866	44%	1724636	45%	886	6%	786	6%	631	6%

This table shows average characteristics of non-green loan users (firms in the control group) by size (number of employees) and industry relative to firms included in the Japan Economic Census for the year 2012, 2014, 2016.

* Electricity, Gas, Heat supply and Water/Telecommunications/Transport and postal activities

Table 4 | Distribution by industry and location

Panel A : Industry	
Real estate	15.0%
Wholesale trade	10.4%
Other services	8.6%
Electricity, gas and water supply	7.7%
Transport and postal services	7.5%
Retail trade	6.8%
Metal product manufacturing	4.6%
General-purpose, production and commercial machinery	4.1%
Foodstuff manufacturing industry	3.1%
Petroleum and coal products	2.5%
Wood and wood products manufacturing	2.5%
Manufacture of ceramic and stone products	2.4%
Accommodation and food services	1.7%
Textile industry	1.7%
Printing and related industries	1.5%
Steel industry	1.4%
Transport equipment manufacturing	1.4%
Electrical and information and communication machinery	1.4%
Pulp, paper and paper products	1.1%
Chemical industry	0.9%
Information and communications industry	0.8%
Agriculture, forestry and fisheries	0.7%
Other manufacturing	0.7%
Non-ferrous metals manufacturing	0.4%
Mining, quarrying and gravel mining	0.1%
Finance and insurance	0.1%

Panel B : Location			
Hokkaido	3.0%	Osaka	8.7%
		Hyogo	3.8%
Miyagi	2.1%	Mie	1.4%
Fukushima	1.1%	Nara	1.3%
Aomori	0.9%	Shiga	0.9%
Iwate	0.8%	Wakayama	0.9%
Akita	0.5%	Kyoto	0.7%
Yamagata	0.3%		
		Hiroshima	2.7%
Tokyo	7.3%	Okayama	2.0%
Tochigi	3.7%	Yamaguchi	1.9%
Gunma	3.0%	Shimane	0.8%
Saitama	2.5%	Tottori	0.5%
Kanagawa	2.0%		
Ibaraki	2.0%	Kagawa	2.7%
Chiba	1.6%	Ehime	1.9%
		Tokushima	1.2%
Aichi	5.4%	Kochi	0.9%
Shizuoka	4.1%		
Nagano	2.2%	Fukuoka	7.7%
Gifu	2.1%	Oita	2.7%
Ishikawa	1.2%	Kumamoto	2.2%
Yamanashi	1.0%	Miyazaki	1.7%
Toyama	1.0%	Saga	1.5%
Niigata	0.7%	Nagasaki	1.5%
Fukui	0.6%	Kagoshima	1.0%

This table shows the distribution of green loan users by industry (Panel A) and location (Panel B).
Values are in percent and show the share of green loan users in respective industry/location to total green loan users.

Table 5 | Variable definitions

Variable name	Definition	Comment
Rating	JFC's internal credit rating of the borrower in period *t* used for loan granting decision and determining loan terms.	A lower value indicates a higher rating, while a higher value indicates a poorer rating.
Leverage	Total amount of short- and long-term debt divided by total assets in period *t-1.*	This variable captures borrowers' indebtedness
ROA	The return on assets using operating income in period *t-1*.	This variable reflects borrower profitability and is an indicator for capacity to service debt.
Tangibility	The amount of tangible fixed assets divided by total assets in period *t-1*.	This indicator serves as a proxy for the level of collateral that a borrower can provide as a guarantee for a loan.
Size	The natural logarithm of total assets in period *t-1*.	This variable reflects the likelihood that a firm going bankrupt (smaller firms are more likely to do so than large firms).
Sales Growth	Year-over-year sales growth rate in period *t-1*.	This variable captures firms' growth potential
Age	Borrower age calculated as the difference between the year of establishment and the year of the data entry.[22]	This variable captures firms' age
Relation	Duration (year) of a lender-borrower relationship defined as the difference (in years) between the year in which the first loan from JFC was used by firm *i* and the year in which the said loan was used. (Due to the data availability on first loans, the maximum value for this variable is 22).	This variable proxies for the length of a firm's relationship with the JFC
Default	A dummy which is equal to one if a firm is bankrupt and zero otherwise (based on Rating) in period *t-1*.	
Deficit	A dummy variable which is equal to one if firm has negative operating income and zero otherwise (based on Rating) in period *t-1*.	

This table provides the definitions of variables used in the analysis.

[22] We remove observations with a calculated firm age greater than 1000 from the sample. For values of zero, we add one when taking the logarithm.

Table 6 | Summary statistics

	Green loan users					Non-users					
Variable	Obs	Mean	Std.Dev.	Min	Max	Obs	Mean	Std.Dev.	Min	Max	Difference
Green loan user	2,962	1	0	1	1	93,173	0	0	0	0	
Rating	2,962	2.739	1.602	1	9	93,173	3.313	1.900	1	12	-0.574***
Leverage $_{(t-1)}$	2,962	0.514	0.317	0	5.088	93,173	0.560	0.349	0	54.900	-0.046***
ROA$_{(t-1)}$`	2,962	0.040	0.100	-2.471	2.810	93,173	0.025	0.100	-17.9	11	0.015***
Tangibility$_{(t-1)}$`	2,962	0.067	0.108	0	0.856	93,173	0.067	0.093	0	0.974	0.000
Size$_{(t-1)}$ (in million yen)	2,962	1796.807	2806.624	2	48311	93,173	1865.251	2946.148	0	153436	-68.444
Sales growth$_{(t-1)}$	2,962	0.744	0.208	0	6.199	93,173	0.717	0.132	0	7.788	0.026***
Age	2,962	47.369	28.882	1	326	93,173	52.696	32.305	1	707	-5.327***
Relation	2,962	8.364	7.310	0	22	93,173	11.654	7.316	0	22	-3.289***

This table reports the descriptive statistics for the variables defined in Table 3. Summary statistics are for the sample period 2012-2018. Results from difference-in-means test are reported in the last column.

Table 7 | Green loan usage and financial health

(1) Whole period (*Probit*)		(2) Interaction with period dummies (*OLS*)	
Test variable	Regression results	Test variable	Regression results
X_i = Rating	-0.1085***	X_i * 2012_13	-0.0102***
	(0.0064)		(0.0006)
		X_i * 2014_16	-0.0046***
			(0.0004)
		X_i * 2017_18	-0.0004
			(0.0003)
X_i = Leverage	-0.1139***	X_i * 2012_13	-0.0188***
	(0.0405)		(0.0037)
		X_i * 2014_16	0.0000
			(0.0040)
		X_i * 2017_18	0.0016
			(0.0022)
X_i = ROA	0.2453	X_i * 2012_13	0.0369***
	(0.1566)		(0.0128)
		X_i * 2014_16	0.0125
			(0.0140)
		X_i * 2017_18	0.0346**
			(0.0151)
X_i = Tangibility	-0.0362	X_i * 2012_13	-0.0413***
	(0.1071)		(0.0123)
		X_i * 2014_16	-0.0169
			(0.0109)
		X_i * 2017_18	0.0286**
			(0.0116)
X_i = Size	0.0155*	X_i * 2012_13	-0.0014
	(0.0082)		(0.0012)
		X_i * 2014_16	0.0002
			(0.0009)
		X_i * 2017_18	-0.0002
			(0.0005)
X_i = Sales growth	0.2147***	X_i * 2012_13	0.0202*
	(0.0484)		(0.0113)
		X_i * 2014_16	0.0298***
			(0.0096)
		X_i * 2017_18	-0.0053
			(0.0077)
X_i = Age	0.0102	X_i * 2012_13	0.0102***
	(0.0153)		(0.0020)
		X_i * 2014_16	0.0021
			(0.0016)
		X_i * 2017_18	-0.0036***
			(0.0012)
X_i = Relationship	-0.1707***	X_i * 2012_13	-0.0144***
	(0.0093)		(0.0015)
		X_i * 2014_16	-0.0174***
			(0.0013)
		X_i * 2017_18	-0.0028***
			(0.0010)
Constant	Yes		Yes
Year effects	Yes		Yes
Prefecture FE	Yes		Yes
Industry FE	Yes		Yes
Observations	96,135		96,135
R-squared (OLS)			0.0545

This table reports the results from the probit estimation as well the results from the OLS estimation. The outcome variable is a dummy variable that is equal to one if a firm uses a green loan, and zero otherwise. The test variables include *Rating, Leverage, ROA, Tangibility, Size, Sales growth, Age,* and *Relationship.* For detailed definitions and summary statistics see Table 3. Robust standard errors are reported in parentheses. ***, **, *, indicate significance at the 1%, 5%, and 10% level respectively.

Table 8 | Limited sample: Green loan usage and financial health

(1) Whole period (*Probit*)		(2) Interaction with period dummies (*OLS*)	
Test variable	Regression results	Test variable	Regression results
X_i = Rating	-0.0498***	X_i * 2012_13	-0.0191***
	(0.0083)		(0.0025)
		X_i * 2014_16	-0.0021
			(0.0019)
		X_i * 2017_18	-0.0031*
			(0.0017)
X_i = Leverage	0.0483	X_i * 2012_13	-0.0134
	(0.0453)		(0.0131)
		X_i * 2014_16	0.0398***
			(0.0131)
		X_i * 2017_18	0.0340***
			(0.0127)
X_i = ROA	-0.0373	X_i * 2012_13	-0.0490
	(0.1476)		(0.0405)
		X_i * 2014_16	0.0248
			(0.0479)
		X_i * 2017_18	0.1555**
			(0.0698)
X_i = Tangibility	-0.4940***	X_i * 2012_13	-0.2720***
	(0.1396)		(0.0400)
		X_i * 2014_16	-0.1313***
			(0.0310)
		X_i * 2017_18	0.1323***
			(0.0414)
X_i = Size	-0.0079	X_i * 2012_13	-0.0085**
	(0.0103)		(0.0036)
		X_i * 2014_16	-0.0012
			(0.0026)
		X_i * 2017_18	-0.0046**
			(0.0020)
X_i = Sales growth	0.0953	X_i * 2012_13	0.0167
	(0.0651)		(0.0278)
		X_i * 2014_16	0.0259
			(0.0234)
		X_i * 2017_18	-0.0213
			(0.0200)
X_i = Age	0.0713***	X_i * 2012_13	0.0371***
	(0.0197)		(0.0063)
		X_i * 2014_16	0.0153***
			(0.0049)
		X_i * 2017_18	-0.0060
			(0.0047)
X_i = Relationship	-0.1546***	X_i * 2012_13	-0.0263***
	(0.0120)		(0.0044)
		X_i * 2014_16	-0.0417***
			(0.0037)
		X_i * 2017_18	-0.0015
			(0.0041)
Constant	Yes		Yes
Year effects	Yes		Yes
Prefecture FE	Yes		Yes
Industry FE	Yes		Yes
Observations	26,445		26,445
R-squared (OLS)			0.1329

This table reports the results from the probit estimation (Column 1) as well the results from the OLS estimation (Column 2) for the *limited* sample excluding non-users borrowing loans for projects related to environmental activities, loans for new enterprise development, safety-net loans and loans for corporate revitalization measures, and loans targeted at start-ups and new businesses. The outcome variable is a dummy variable that is equal to one if a firm uses a green loan, and zero otherwise. The test variables include *Rating, Leverage, ROA, Tangibility, Size, Sales growth, Age,* and *Relationship.* For detailed definitions and summary statistics see Table 3. Robust standard errors reported in parentheses. ***, **, *, indicate significance at the 1%, 5%, and 10% level respectively.

Table 9 | Ex-post performance analysis

PANEL A	Rating				Leverage				ROA			
	ATE	p-value	Mean	N	ATE	p-value	Mean	N	ATE	p-value	Mean	N
$t+1$	-0.079	0.155	0.121	2946	0.009	0.271	0.035	2857	0.014	0.221	-0.002	2857
$t+2$	-0.224	0.000***	0.103	2916	0.001	0.941	0.024	2828	0.008	0.097*	0.007	2828
$t+3$	-0.301	0.000	0.070	2805	-0.009	0.557	0.003	2704	0.008	0.048**	0.006	2704
	Tangibility				Size				Sales growth			
	ATE	p-value	Mean	N	ATE	p-value	Mean	N	ATE	p-value	Mean	N
$t+1$	0.017	0.000***	0.027	2857	29585005.4	0.080*	134413824.0	2857	0.000	0.962	0.003	2854
$t+2$	0.021	0.000***	0.028	2828	65254992.7	0.037**	258706892.0	2828	-0.007	0.293	-0.029	2786
$t+3$	0.023	0.000***	0.031	2704	79572578.3	0.003***	377577146.0	2704	-0.005	0.461	-0.037	2662
	Default				Deficit							
	ATE	p-value	Mean	N	ATE	p-value	Mean	N				
$t+1$	-0.003	0.000***	0.000	2,946	-0.051	0.011**	0.002	2857				
$t+2$	-0.004	0.000***	0.001	2,916	-0.100	0.000***	-0.068	2828				
$t+3$	-0.006	0.000***	0.001	2,805	-0.112	0.000***	-0.105	2704				

PANEL B	Rating				Leverage				ROA			
	ATE	p-value	Mean	N	ATE	p-value	Mean	N	ATE	p-value	Mean	N
$t+1$	-0.051	0.146	0.121	2,946	0.014	0.001***	0.035	2857	0.004	0.148	-0.002	2857
$t+2$	-0.133	0.001***	0.103	2,916	0.012	0.004***	0.024	2828	0.008	0.000***	0.007	2828
$t+3$	-0.149	0.001***	0.070	2,805	-0.002	0.799	0.003	2704	0.007	0.001***	0.006	2704
	Tangibility				Size				Sales growth			
	ATE	p-value	Mean	N	ATE	p-value	Mean	N	ATE	p-value	Mean	N
$t+1$	0.015	0.000***	0.027	2,857	6837915.3	0.652	134413824.0	2857	-0.004	0.386	0.003	2854
$t+2$	0.017	0.000***	0.028	2,828	-7190509.7	0.738	258706892.0	2828	-0.003	0.403	-0.029	2786
$t+3$	0.018	0.000***	0.031	2,704	34141986.3	0.368	377577146.0	2704	-0.004	0.374	-0.037	2662
	Default				Deficit							
	ATE	p-value	Mean	N	ATE	p-value	Mean	N				
$t+1$	-0.002	0.000***	0.000	2,946	-0.020	0.191	0.002	2857				
$t+2$	-0.003	0.000***	0.001	2,916	-0.063	0.000***	-0.068	2828				
$t+3$	-0.003	0.000***	0.001	2,805	-0.100	0.000***	-0.105	2704				

This table reports the results from estimating a difference-in-differences model with matching. Panel A is based on the sample comprising all control firms for matching. Panel B sample comprises a limited group of control firms for matching. The matching method is the propensity score matching. $t + k$ indicates the k^{th} year after obtaining a loan. Variables are defined in Table 3. ***, **, *, indicate significance at the 1%, 5%, and 10% level respectively.