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The Role of State Investment Banks for Renewable Energy Technologies in OECD Countries

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The role of state investment banks for renewable energy technologies in OECD countries*

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Abstract

To mitigate climate change, governments use various policy instruments to support low-carbon technologies. In many cases, state investment banks (SIBs) providing financing for renewable energy investments are part of the policy strategy. However, while the energy policy literature suggests that SIBs can absorb investment risks related to new technologies, mobilize private capital, and enable smaller-scale projects, it remains unclear whether their actual financing behavior is aligned with these expectations. Therefore, this paper assesses the predictors of SIB involvement in renewable energy financing deals in OECD countries by estimating a fixed-effects logit model for $N = 4,999$ transactions from 2004–2021. Our results indicate that the involvement of SIBs in a deal is significantly more likely for higher-risk technologies like offshore wind or biomass, and, in the case of solar photovoltaics, becomes less likely as domestic markets for the technology mature. For the first projects using a novel technology in a country, however, we find no evidence of higher SIB involvement, in contrast to other public sector lenders. In addition, SIB financing is less likely for smaller renewable energy deals, contrary to the literature's suggestions. We conclude by discussing the implications for policymakers regarding the use of SIBs to complement other climate policy instruments, for example with respect to mandates and guidelines for such institutions.

Keywords: Clean energy, de-risking, public finance, energy policy, state-owned banks.

JEL Codes: G21, H81, Q48, Q55.

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1 Introduction

Achieving the Paris Agreement targets will require investments in renewable energy (RE) technologies that substantially exceed current investment levels (IEA, 2021; Klaaßen & Steffen, 2023; McCollum et al., 2018). Given the scale of investment needs, mobilizing finance from the private sector is needed (IPCC, 2022). While economists typically consider a combination of carbon pricing and research subsidies as the optimal policy strategy to achieve this (Acemoglu et al., 2012), governments use a wide variety of RE support policies such as feed-in tariffs (FiTs) or portfolio standards (Abrell, Rausch, et al., 2019; Polzin et al., 2019). In a number of OECD countries, policymakers have also increasingly used state investment banks (SIBs), i.e., publicly capitalized financial institutions with independent day-to-day operations and a domestic focus, as part of their policy strategy to finance RE projects and the low-carbon transition in general (Campiglio, 2016; Cochran et al., 2014).[1] Public investment banks with a "green" lending mandate already exist in countries that represent over a third of the global gross domestic product (GDP) (Whitney et al., 2020), including jurisdictions that traditionally lean towards less government intervention like the UK or Australia (Geddes & Schmidt, 2020). Moreover, the United States have been holding consultations on whether to use USD 20 billion of the Inflation Reduction Act's Greenhouse Gas Reduction Fund to capitalize a national green bank (EFAB, 2022).[2] However, while the theoretical and empirical understanding of RE support policies, such as feed-in tariffs or portfolio standards, has greatly advanced over the past years (Abrell, Kosch, et al., 2019; Abrell, Rausch, et al., 2019; Kalkuhl et al., 2013; Reguant, 2019; Schmalensee, 2012), the prevalent use of SIBs for fostering the clean energy transition has received little attention.

Conceptual studies suggest that SIBs can provide financing to projects that are unable to source funds from the private sector, thus facilitating additional transactions (OECD, 2016, 2017). Furthermore, they can mobilize private financiers through signaling and further derisking, which allows commercial banks to gain experience with novel technologies (Geddes et al., 2018; Mazzucato & Penna, 2016; Mazzucato & Semieniuk, 2018; Waidelich et al., 2023). However, the potential deficiencies of state-owned banks, such as lower performance and politically distorted decision making, are well-known (Berger et al., 2005; Carvalho, 2014; La Porta et al., 2002) and can be exacerbated by changing economic contexts (Cassell, 2016), one example of which could be the clean energy transition. As a result, the

[1] While this paper uses the term state investment bank, other studies refer to such institutions as 'national development banks' (see for instance Torres and Zeidan, 2016; Zhang, 2020, 2022).

[2] The Greenhouse Gas Reduction Fund provides a total of USD 27 billion to the US EPA for mobilizing financing for clean energy and decarbonization projects—however, an estimated USD 7 billion would not be eligible for capitalizing a federal-level green bank (CGC, 2022).

actual financing behavior of SIBs regarding the energy transition might deviate considerably from the literature's recommendations, but it remains starkly understudied (Polzin et al., 2019). Existing studies either investigate the impact of public financing in general on RE investments (Cárdenas Rodríguez et al., 2015; Deleidi et al., 2020; Polzin et al., 2015) or assess how the involvement of public financial institutions affects bank syndicates, without considering energy technologies or SIBs in particular (Broccolini et al., 2021; Degl'Innocenti et al., 2022; Gurara et al., 2020).

Quantitative evidence on whether SIBs' financing activities align with theoretical rationales can guide policymakers who are considering designing a new, green SIB or adding RE financing to the mandates of existing institutions. Furthermore, such evidence can support future academic work on the theoretical role and causal impacts of public financial institutions for the clean energy transition, and technological change more generally. Therefore, this paper addresses the following research question:

RQ. *How does the financing behavior of SIBs with respect to RE technologies differ from that of private banks, and is that compatible with their intended role?*

To answer this question, we derive hypotheses regarding the optimal behavior of SIBs from the literature and test them by assessing the predictors of SIB involvement in debt-financing new RE projects in OECD countries. We focus on debt provision because it accounts for the majority of general SIB financing (Geddes et al., 2018; Mazzucato & Macfarlane, 2017). Furthermore, we limit our sample to OECD countries because, in developing countries, the primary role of SIBs (and other development finance institutions) is to compensate for the absence of deep and well-developed domestic credit markets, which is very different from the narrower role in countries with developed financial sectors (Torres & Zeidan, 2016). By estimating a fixed-effect logit model of SIB involvement on $N = 4,999$ transactions, we find that SIBs are more likely to appear in deals for higher-risk RE technologies such as offshore wind or biomass and waste. For solar photovoltaics (PV) plants, which exhibited a reduction in investment risks over the study period, SIBs become less likely to finance projects once the technology matures in the respective country, although this finding does not extend to other technologies. However, we do not find that SIBs are more likely to feature in the first debt-financing transactions for a novel technology in a country, indicating that unlike other public sector entities, they only play a limited role as first-movers for RE financing. Contrary to the literature's suggestion, SIBs are *less* likely to provide debt for small-sized RE transactions, whereas the evidence on whether they mobilize private sector lenders or crowd them out is not conclusive, but it favors the mobilization hypothesis. Overall, SIBs are involved in 11% of RE deals in our sample and account for nearly twice the lending activity of all other public sector entities combined, illustrating their significant role in financing the clean energy transition.

Our paper bridges previous empirical studies on public direct financing for RE technologies with sector-agnostic econometric assessments of public financial institutions in general. As part of the first strand, Polzin et al. (2015) regress the newly installed RE capacity in OECD countries on RE support policies in a fixed-effects model. They report positive impacts for FiTs, emission trading systems, and other policies—albeit heterogeneous between more and less mature technologies. However, their findings on the effect of public direct investment are inconclusive. Using a sample of over 5,000 deals in 87 countries, Cárdenas Rodríguez et al. (2015) regress private RE investment on deal-, project-, and organization-level characteristics as well as public policies. Due to the potential two-way causality between public and private financing provision, they estimate a simultaneous equation Tobit model and find mixed effects of the public on private investment. By contrast, Deleidi et al. (2020) assess the impact of public direct investment on private RE investment at the country level for 15 OECD countries as well as India and China and find a significant positive impact that exceeds the effect of other support policies, including FiTs. However, none of these papers analyze the role of public financial institutions or SIBs in particular.

Regarding the second literature strand, Broccolini et al. (2021) investigate the mobilization effects of multilateral development banks on syndicated loans in developing countries using fixed-effects regressions. They find that the presence of a development bank increases private financing inflows, syndicate sizes, and loan maturity. Similarly, Gurara et al. (2020) regress syndicated loan characteristics in developing countries on the presence of multilateral development banks in a fixed-effects model and report a positive association with loan pricing, maturity, and the propensity to service borrowers in high-risk countries. Degl'Innocenti et al. (2022) regress loan syndicate structure on the presence of development banks and report a lower syndicate concentration, particularly in times of financial turmoil, for financially constrained borrowers, and for green industries. These papers make important contributions regarding the role of public financial institutions, but they do not consider the energy sector or the technology risks involved. In addition, they either focus on developing countries, or they group SIBs together with distinctive public financial institutions such as public export credit agencies.[3]

By combining these two strands, our contribution to the literature is twofold. First, to the best of our knowledge we provide the first econometric assessment of SIBs' role in RE financ-

[3]These differences involve both mandates and instruments used. For example, commitments by public export credit agencies are dominated by short-term revolving credit for exporters (Berne Union, 2022), whereas SIBs deal overwhelmingly in medium- and long-term loans (Macfarlane & Mazzucato, 2018).

ing in high-income countries and the underlying drivers, thus advancing the understanding of SIBs as RE support policies. Second, we introduce the consideration of technology-specific risks and non-syndicated loans, which account for an important share of SIB lending (see Section 5), into empirical assessments of public financial institutions.

The remainder of the paper is structured as follows. Section 2 derives our research hypotheses while Sections 3–4 summarize the data and methodology, respectively. In Section 5, we present and discuss our findings and conclude with the overall implications for policy-making and research in Section 6.

2 Hypothesis development

We develop hypotheses on how SIBs *should* behave by taking into account two perspectives. First, given their institutional setup and financing activities, SIBs are actors in the (investment) banking market. Second, if governments use such institutions to induce RE investments specifically, SIBs can also be seen as energy policy instruments. Therefore, we build on theoretical insights and suggestions from financial economics as well as environmental economics and, more specifically, the literature on clean energy policies to derive four hypotheses on desirable financing behavior for SIBs.

2.1 Risk-bearing ability of SIBs

Compared to private sector actors, governments can distribute risks among a very large pool of taxpayers and hence incur lower costs of risk bearing (Arrow & Lind, 1970). SIBs are state-backed enterprises operating on a soft budget, i.e., without hard constraints in the case of financial distress (Kornai et al., 2003). Therefore, they inherit the national government's risk-bearing abilities and access to capital, whether they are directly capitalized by the state or raise funds on the capital markets themselves at government-like credit ratings (Cochran et al., 2014). In high-income countries, SIBs' investments overwhelmingly take the form of loans, whereas bonds, guarantees and equity investments account for minor portfolio shares (Macfarlane & Mazzucato, 2018). Unlike commercial banks, however, SIBs do not face the risk of deposit withdrawals (Diamond & Dybvig, 1983) and are not necessarily subject to the same regulatory scrutiny—for example, via capital requirements (D'Orazio & Popoyan, 2019). In addition, SIBs face lower pressure from return expectations compared to privately owned investment banks. Taken together, this allows them to provide financing below the market rate or to high-risk undertakings that provide societal benefits but may not be viable at the market rate, such as small and medium enterprises or infrastructure projects (Cochran et al., 2014; Stiglitz, 1993).

In RE financing, one of the key determinants of risk is technology, which is mirrored by substantial cost-of-capital differences between RE technologies (Steffen, 2020)[4]. These differences are partially driven by technology-inherent characteristics, such as different resource predictability between solar and wind or different shares of moving parts that introduce operational risks through wear-and-tear (Egli, 2020; Tietjen et al., 2016).[5] However, a key determinant of a power generation technology's risk-return profile is its position in the technology life cycle ranging from pilot and demonstration projects to large-scale diffusion (Wüstenhagen & Menichetti, 2012). In this life cycle, debt financing typically occurs at the deployment stage and facilitates the wide ramp-up of the technology by reducing financing costs (Grubb et al., 2021), first in the form of loans and, at a later stage, through public debt, such as bonds (Berger & Udell, 1998). This is because relatively immature technologies with a limited track record exhibit less attractive risk-return profiles for loan providers for various reasons.

First, technological developments, as well as evolutions in contract and regulatory structures, can significantly improve the risk-return structure as market shares increase (Egli, 2020; Grubb et al., 2021). Second, financiers first need to build up competencies to carry out credit screening and due diligence at low transaction costs for novel technologies with low deployment (Polzin, 2017). Path dependencies and lock-ins can exacerbate and perpetuate such disadvantages of immature technologies through increasing returns to scale (Arthur, 1989), sticky beliefs about risk-return profiles (Masini & Menichetti, 2012), or a belated pick-up by incumbents (Bürer & Wüstenhagen, 2009). As a result, increases in deployment typically reduce risk premiums and raise loan tenors through financial learning (Egli et al., 2018).

Against this background, there is a case for tailoring RE support policies to technology maturity (Cárdenas Rodríguez et al., 2015; Polzin et al., 2015). Several studies suggest that SIBs can leverage their risk-bearing ability to be *first movers* that build a track record for novel technologies and hence signal commercial viability to other lenders (Geddes & Schmidt, 2020; Geddes et al., 2018; OECD, 2016, 2017; Zhang, 2020). By absorbing high initial risks, SIBs have been described as 'creating markets' and fostering financial and technological innovation (Mazzucato & Penna, 2016; Mazzucato & Semieniuk, 2017).[6] From an economic

[4]Unlike for fossil fuel-based power plants, volatile fuel prices are hardly relevant for most RE technologies. To date, the electricity output from RE plants are typically also sold at a fixed price (either through government offtake or long-term power purchase agreements).

[5]For instance, offshore wind requires very large upfront investments and development cycles with high risks around construction and grid access, whereas biomass projects involve high feedstock risks since supply contract lengths are typically limited (Geddes et al., 2018).

[6]While this study focuses on SIBs, a similar link to innovation has been suggested for development

perspective, a publicly capitalized first mover can resolve the coordination failure between financiers to create a track record that spills over across the financial sector (Waidelich et al., 2023). Indeed, there is anecdotal evidence of SIBs financing lighthouse projects,[7] and the extant literature suggests that state-owned banks in general have been key for financing growth in high-risk technologies (Geddes et al., 2018; Mazzucato & Semieniuk, 2017, 2018). Therefore, we propose the following hypothesis:

Hypothesis 1. *SIBs are more likely to provide debt financing for projects that use a higher-risk technology compared to a lower-risk technology.*

However, a better risk-bearing ability does not imply that SIBs leverage this ability efficiently. Undue political influence and rent-seeking behavior can distort the decision-making of all state-owned banks (Carvalho, 2014), which have been found to slow down financial development (La Porta et al., 2002) and be less profitable than their private sector counterparts (Berger et al., 2005). Although these findings are often less pronounced in high-income countries (Micco et al., 2007), they suggest that state-owned banks taking higher credit risks can also be explained through mere inefficiencies and not through welfare-enhancing behavior. Moreover, as state-owned enterprises, SIBs are subject to principal-agent problems and have residual control rights that might lead to deviations from societal objectives (Shleifer & Vishny, 1994). Through their mandates, SIBs are typically required to fulfill multiple missions that are difficult to measure and weigh against each other, thus diffusing incentives for officials (Tirole, 1994). In particular, public employees can have weaker incentives to invest in innovative (and hence unproven) solutions because their personal upside in the case of success is lower than that of employees in the private sector (Hart et al., 1997; Steffen et al., 2022). Instead, career concerns might lead public employees to make more risk-averse decisions than are intended by their principals. Therefore, the state ownership literature paints a more pessimistic picture regarding Hypothesis 1 and highlights the importance of assessing this question empirically.

Importantly, whether a technology is high-risk or low-risk is not static over time. Since deployment increases the financial sector's experience with a technology, risk profiles can evolve significantly over time (Egli et al., 2018), particularly given the dynamic capacity growth for wind and solar PV in many jurisdictions (IRENA, 2022). However, while the private sector's willingness to finance projects using these technologies has increased in general, this evolution has not been homogeneous across countries. In the case of offshore wind, for instance,

finance institutions (Clò et al., 2022).

[7]For instance, the Australian CEFC set up the Clean Energy Innovation Fund (OECD, 2017), and the German KfW financed the country's first offshore park and targeted the technology through its Offshore Wind Energy Program (Geddes et al., 2018).

jurisdictions like the United Kingdom or Germany have matured to the extent that the necessity for SIB support has been questioned (Geddes et al., 2018)—whereas in other countries the technology's bankability remains limited without concessional finance. Therefore, unlike technological maturity, financial maturity is driven by *time-variant, country-specific factors*, such as the existence of credible support policies or financiers who are experienced with relevant technology and regulations (Polzin, 2017; Polzin et al., 2019). However, SIBs are typically required to provide only additional financing that cannot be sourced from the private sector (or only at prohibitive costs). If access to sufficiently cheap financing is provided for matured markets, then SIBs should move on to novel, less mature technologies (Geddes et al., 2018; OECD, 2016), which are more restricted by market opening challenges such as insufficient regulatory frameworks (Steffen et al., 2018). More generally, Torres and Zeidan (2016) argue that once domestic credit markets mature, SIBs should either turn towards indirect instruments, such as credit guarantees, and newly targeted borrowers—or be privatized. While Torres and Zeidan's argument focuses on the general development of the domestic banking sector, it can be applied equally to different technologies within the same jurisdiction if the availability of credit depends on their maturity.[8] Therefore, the literature suggests that it is socially beneficial if SIBs move counter to the technology's maturity cycle, which leads to the following hypothesis:

Hypothesis 2. *For the same RE technology, SIBs are more likely to provide debt financing at an early stage of low deployment levels and are less likely to provide financing at higher levels of deployment.*

Of course, overall technology risk and maturity are only one determinant of renewable energy finance. Project- or deal-specific characteristics can have an equal impact on financing conditions, with the size of companies and projects being an important factor (Steffen & Waidelich, 2022). Hence, SIBs and other public finance institutions are usually mandated to provide small and medium enterprise financing (Barbera et al., 2022). This is justified by the fact that such enterprises face constrained access to finance (Beck & Demirguc-Kunt, 2006) and are more vulnerable to credit crunches (Iyer et al., 2014). In general, smaller entities typically face higher financing costs (Fama & French, 1992), potentially due to less favorable risk profiles and higher transaction costs (van Dijk, 2011). Indeed, SIBs themselves report that their higher-risk loans, on average, feature smaller ticket sizes, which comes with lower profitability (EIB, 2022a). Such a transaction cost argument applies particularly to RE financing, where projects are often realized as special purpose vehicles with smaller

[8] An empirical example for such a step being the UK Green Investment Bank, which started operation as state investment bank in 2012 and was privatized in 2017.

ticket sizes vis-à-vis conventional power sources (Steffen, 2018). As a response, the literature suggests that SIBs should pool transactions deemed too small by commercial banks (Geddes & Schmidt, 2020) or finance them via on-lending through local financial institutions (Hall et al., 2016). This leads to the following hypothesis:

Hypothesis 3. *SIBs are more likely to be involved in deals with smaller ticket sizes.*

2.2 Mobilization and crowding-out of private banks

Most SIBs have a mandate to induce private capital and many institutions report how much external funds they mobilize (Macfarlane & Mazzucato, 2018; OECD, 2016, 2017). Aside from creating a track record as first movers (as discussed in the previous subsection), SIBs can vet projects and attract other financiers by signaling the project's commercial viability (Geddes et al., 2018). This enables the private sector to learn by co-investing through syndication (Degl'Innocenti et al., 2022; Geddes & Schmidt, 2020). As borrower and technology monitoring has public good properties (Stiglitz, 1993), SIBs can deliberately maximize opportunities for financial learning by attracting more lenders. Waidelich et al. (2023) show that SIBs' direct loan provision to emerging technologies becomes more cost-effective if more knowledge spills over to other (co-)lenders. Indeed, previous empirical studies on multilateral development banks and public financial institutions have found that their involvement correlates with larger and less concentrated syndicates (Broccolini et al., 2021; Degl'Innocenti et al., 2022). To determine whether these findings hold for SIB financing to RE projects, we propose the following hypotheses:

Hypothesis 4. *SIBs are more likely to engage in RE transactions with a higher number of private sector lenders.*

However, the extant literature also discusses the possibility of public financial institutions 'crowding out' the private sector— that is, *"public intervention directly [displacing] private investment by undertaking projects the private sector would have otherwise financed"* (OECD, 2016).[9] As SIB financing is below the market rate, commercial banks cannot compete with SIBs' loan terms and therefore risk being replaced by SIB lending, which can ultimately hamper the long-term development of domestic credit markets (Torres & Zeidan, 2016). *Ceteris paribus*, such a replacement of lenders would imply the same number of overall lenders and a *lower* number of non-SIB lenders on a transaction. Notably, many SIBs address these risks through on-lending via private sector financial institutions, through so-called "additionality checks" (Mazzucato & Macfarlane, 2017), or by limiting their financing

[9] For a critical discussion of this term in the context of SIB financing, see Deleidi et al. (2020).

provisions—for example, to 50% of overall project costs in the case of the European Investment Bank (EIB, 2022b). However, it remains an open question as to how effective these countermeasures are (OECD, 2016), with some studies suggesting a substitute relationship between private and public financing provision (Cárdenas Rodríguez et al., 2015).

3 Data

To assess our hypotheses, we combine project-, transaction- and organization-level data from Bloomberg New Energy Finance (BNEF), the most comprehensive database for transaction-level information on RE asset finance. It features a wide range of variables such as project technology and capacity, or the different organizations involved as sponsors, debt providers, developers, or equipment providers. We consider all transactions that finance new-build power generation projects in OECD countries and that reached financial closing from 2004–2021.[10] As we aim to investigate the role of SIB *lending*, we exclude transactions that are purely financed through equity or for which the lender column in BNEF is empty.[11]

For all transactions, we merge the respective project information from BNEF based on matching files provided by Bloomberg and match organization information based on company names. For 9% of transactions that finance multiple RE projects, we merge the project with the highest project value or, if project values are missing, with the highest power generation capacity.[12] Following these steps, we arrive at an overall sample size of $N = 4,999$ transactions for onshore and offshore wind, solar PV, concentrated solar power (CSP), geothermal, biomass and waste, and small hydro over the period 2004–2021 in OECD member countries. As our interest is in studying the financing decisions of SIBs, we do not exclude deals for projects that were canceled after a financial close, which account for 0.6% of our sample. We combine this data with a variety of country-level information, such as GDP, technology shares in the national installed capacity, or technology-specific FiTs.

To identify SIBs in our sample, we start with the Global Database on Public Development Banks and Development Financing Institutions published by Peking University in collaboration with the French Development Agency (Xu & Marodon, 2021).[13] Specifically,

[10]For the years prior to 2004, BNEF does not offer the same detail of information, particularly on loan syndicate members.

[11]There are an additional 138 transactions (2.8% of the sample) for which the lender is simply stated as "Not Reported." In our main results, we code these transactions as not involving SIB lending since BNEF analysts should be able to find out lender information if SIBs feature in the syndicate, as they report on their activities. However, we display results if these transactions are instead excluded in Table 11 in Appendix B.

[12]Only 10 transactions in the sample finance projects that are either based in multiple countries or cover multiple RE technologies, which mitigates potential concerns about our matching strategy.

[13]To qualify for the database, an institution must i) be a stand-alone entity without a short-term specific goal, ii) use financial instruments as its primary product/service, iii) finance itself beyond regular bud-

we include all institutions i) based in an OECD country, ii) with a sub-national or national scope of operations, and iii) with a mandate that is either flexible or focuses on infrastructure, local government, or micro/small and medium enterprises.[14] Furthermore, we add the OECD-based state investment banks discussed in Macfarlane and Mazzucato (2018) and Geddes et al. (2018) including the European Investment Bank (EIB) because, while not a *national* investment bank, the EIB's loans are made predominantly within the EU—that is, domestically (EIB, 2022c). For the same reasons, we also include the North American Development Bank, which is capitalized by the US and Mexico (NADB, 2022), and the Nordic Investment Bank, which is capitalized by the Nordic and Baltic countries. Furthermore, we include further OECD-based state investment banks that meet the criteria specified above from Degl'Innocenti et al. (2022) and OECD (2017) if they are not covered by the previous sources.[15] Lastly, we add all subsidiaries of the identified SIBs in the BNEF Organizations database that i) show up on any RE transactions within our sample and ii) can be clearly identified as a financial sector company based on the company classification and abstracts in BNEF.

By collapsing the subsidiary activity to the SIB parent, we arrive at a list of 32 SIBs that provide debt financing for a total of 572 RE transactions in our OECD sample (11.4% of all transactions). A list of the individual institutions is displayed in Table 1.[16] In addition, Table 2 provides summary statistics on the key variables in our data set, which are explained in more detail in Appendix A.

get transfers, iv) have a public policy-oriented mandate, and v) have corporate strategies steered by the government (Xu & Marodon, 2021).

[14]This excludes mandate categories of the database that are not relevant to our research question (social housing, rural and agricultural development) or that apply to export credit agencies and development finance institutions whose financing activities lie primarily abroad (promoting exports and foreign trade, international financing of private sector development).

[15]This step effectively adds the Japanese Green Finance Organisation and the Italian Mediocredito Centrale, which account for four RE transactions in our sample.

[16]Since the UK GIB was sold to the private sector in August 2017, we only consider its activities as SIB lending up to July 2017.

Table 1: List of SIBs incl. in-sample lending activity

	Organization	Country	BNEF IDs	No. of transactions
1	Kreditanstalt fuer Wiederaufbau	Germany	3352, 31950, 503082, 53425	135
2	European Investment Bank	Luxembourg	538	133
3	BPIFrance SA	France	147133, 41599, 146361, 6700	47
4	Instituto de Credito Oficial	Spain	4259, 147751	39
5	Clean Energy Finance Corp	Australia	70222	37
6	Korea Development Bank/The	Korea (Republic)	38923, 539175, 593715, 601477	32
7	North American Development Bank	United States	1451	28
8	Nordic Investment Bank	Finland	20802	24
9	Development Bank of Japan Inc	Japan	724	21
10	UK Green Investment Bank Ltd	United Kingdom	569520, 36386	18
11	Nacional Financiera SNC	Mexico	16251	16
12	Turkiye Sinai Kalkinma Bankasi AS	Turkey	22365, 40512	15
13	Banobras	Mexico	11408	14
14	BNG Bank NV	Netherlands	151067	14
15	Japan Finance Corp	Japan	41811	10
16	NY Green Bank	United States	147083	9
17	Corp de Fomento de la Produccion	Chile	8474	8
18	Caisse des Depots et Consignations	France	3071, 45754, 795283	6
19	Banca del Mezzogiorno	Italy	11149, 628739	6
20	Nederlandse Waterschapsbank NV	Netherlands	81042	5
21	Cassa Depositi e Prestiti SpA	Italy	10748, 91142	4
22	Bank Gospodarstwa Krajowego	Poland	47021	2
23	Financiera de Desarrollo Nacional SA	Colombia	778777	2
24	Green Finance Organization	Japan	85954	2
25	MFB Magyar Fejlesztesi Bank Zrt	Hungary	147803	2
26	Scottish Investment Bank/The	United Kingdom	71610	2
27	Connecticut Green Bank	United States	16013	1
28	Development Bank of Wales Plc	United Kingdom	4310	1
29	Finnvera Oyj	Finland	569251	1
30	Korea Finance Corp	Korea (Republic)	41562	1
31	Landesbank Saar	Germany	365495	1
32	NO Burgschaften und Beteiligungen GmbH	Austria	802619	1

Table 2: Summary statistics

Statistic	N	Mean	St. Dev.	Min	Median	Max
I(SIB lending)	4,999	0.114	0.318	0	0	1
Closing year	4,999	2014.803	4.430	2004	2015	2021
Capacity (MW)	4,987	51.275	102.341	0.2	14.0	1,467.0
I(Cap. in 1st decile - onshore & PV only)	4,999	0.094	0.292	0	0	1
# of non-SIB lenders	4,999	1.746	1.937	0	1	29
# of sponsors	4,999	1.217	0.598	1	1	8
I(First-3 deal)	4,999	0.052	0.223	0	0	1
I(Term loan)	4,999	0.906	0.292	0	1	1
I(Any public sponsor)	4,874	0.056	0.230	0	0	1
I(Tech matured - onshore & PV only)	4,999	0.316	0.465	0	0	1
Feed-in tariff (2010 USD/kWh)	4,977	0.109	0.164	0.000	0.011	0.812
Real GDP PPP growth (%)	4,999	1.524	3.127	−14.839	2.005	25.176
CCPI Overall Score (0-100)	4,873	47.540	13.068	18.596	49.470	76.620
Long-term interest rate (%)	4,873	2.169	1.904	−0.511	2.064	22.497
Country Bank Z-score	4,999	18.694	8.728	0.017	16.603	43.060
Gov. expenditures (% of GDP)	4,999	18.774	3.445	10.336	19.412	26.732
Primary balance (% of GDP)	4,999	−2.481	3.499	−29.896	−2.242	15.461

Categorical variables denoted by I(...)

4 Methodology

To assess different predictors of SIB financing for RE projects, we estimate the following fixed-effects (FEs) logit model at the transaction level

$$
\begin{aligned}
ln\left(\frac{Pr(Y_{icta}=1|X)}{1-Pr(Y_{icta}=1|X)}\right) =&\beta_0\text{Tech}_a + \beta_1\text{I(Tech matured)}_{cta} + \beta_2\text{I(First-3 deal)}_{ica} + \\
&\beta_3\ln(\text{Capacity}_i) + \beta_4\text{I(Cap. in 1st decile)}_{ita} + \\
&\beta_5\text{NonSIBLenders}_i + X'_{icta}\gamma + \alpha_c + \delta_t + \epsilon_{icta}
\end{aligned} \tag{1}
$$

where Y_{icta} is a dummy variable indicating whether a transaction i in country c that closed in year t involved SIB lending. a denotes the RE technology financed by transaction i, with $Tech_a$ being the respective technology dummy. $I(Tech\ matured)_{cta}$ is a dummy indicating if the technology has reached financial maturity in country c and year t, while $I(First\text{-}3\ deal)_{ica}$ indicates if deal i featured among the first three transactions in country c to provide debt to technology a (for more detailed definitions, see below). $Capacity_i$ and $NonSIBLenders_i$ account for the total generation capacity financed by transaction i and the number of non-SIB lenders involved respectively, while $I(Cap.\ in\ 1st\ decile)_{ita}$ is a dummy indicating whether $Capacity_i$ falls within the first decile of all deals for the same technology a that closed in the same year t. X is a matrix of explanatory variables at the transaction- or country-level, while ϵ_{icta} denotes the error term. To control for additional confounders, Equation 1 also includes FEs at the country (α_c) and year level (δ_t) following Cárdenas Rodríguez et al. (2015).[17]

We rely on a categorical dependent variable because, for more than half of transactions with an SIB lender, the financing volume provided by the SIB is not available (see Appendix D). As our sample only involves closed debt-financed deals, using a logit model allows us to identify predictors that distinguish SIB-involving deals from those financed by other lenders in our sample, which are predominantly commercial banks and other private sector financial companies (78% and 12% of non-SIB lending activity, respectively; see Figure 14 in Appendix C).

To test if SIBs are more or less likely to appear in deals involving high-risk technologies (Hypothesis 1), we use onshore wind as the baseline for our $Tech$ dummy because it has historically been viewed as relatively low risk and mature (Cárdenas Rodríguez et al., 2015; Lehmann & Söderholm, 2018; Polzin et al., 2019; Polzin et al., 2015). Based on a literature

[17]For the Czech Republic, Latvia, New Zealand, Slovakia, Slovenia, and Switzerland, we do not observe any RE transactions involving SIB lending; hence, we omit 53 transactions in these countries which are perfectly separated by the respective country FE.

review of technology risks and levelized cost estimates, Mazzucato and Semieniuk (2018) classify onshore wind and small hydro as low risk, biomass and waste as low-to-medium risk, geothermal as medium risk, and CSP and offshore wind as high risk. Regarding solar PV, the authors suggest that the technology's risk has transitioned from high to low, in line with strong capacity growth over the last two decades (IRENA, 2022). Therefore, Hypothesis 1 implies higher involvement of SIBs in offshore wind, CSP, geothermal and biomass, compared to onshore wind and, potentially, solar PV.

To test whether higher market maturity predicts lower SIB involvement (Hypothesis 2), $I(Tech\ matured)_{cta}$ takes a value of 1 if the respective technology a accounts for at least 10% of the national installed capacity following the International Renewable Energy Agency IRENA (2022). The dummy is restricted to onshore wind and solar PV, which account for 91% of our sample, because the IRENA interviews informing the threshold were carried out only for solar PV and wind and because the sample size for the remaining technologies is too small to differentiate by country-specific market maturity. To assess whether SIBs enter the market particularly early compared to private banks, $I(First\text{-}3\ deal)_{ica}$ considers the first three deals following the definition of very early market-opening projects in Steffen et al. (2018). Regarding the hypothesized link between SIB lending and smaller ticket sizes (Hypothesis 3), we use the log-transformed deal capacity (net of technology FEs) as a proxy for transaction volumes since the monetary transaction volume is missing for 62% of our sample. Moreover, we include the first decile dummy $I(Cap.\ in\ 1st\ decile)_{ita}$ to allow for a specific effect of small deal size relative to other transactions for the same technology and closing year. The time-dependent threshold accounts for the fact that typical project sizes have evolved substantially for some technologies. Again, we define this more granular dummy variable only for onshore wind and solar PV due to sample size constraints for the remaining technologies.

Throughout our analyses, X features several control variables. First is the annual growth in real GDP (based on purchasing power parity) in country c and year t because SIBs often engage in counter-cyclical credit provision and therefore should be more likely to feature on deals during economic crises (D'Orazio & Popoyan, 2019; Levy Yeyati et al., 2004; Mazzucato & Penna, 2016).[18] Second, following Gurara et al. (2020), is a dummy indicating if the sponsor of transaction i is a public sector entity or publicly owned since SIBs are often mandated to finance public sector activities, which might differ in unobserved characteristics (Mazzucato & Macfarlane, 2017). Third, following Degl'Innocenti et al. (2022) and Gurara et al. (2020), is a dummy indicating if transaction i involved a term loan, which is the main

[18]Unlike previous studies (Deleidi et al., 2020; Polzin et al., 2015), we use GDP growth instead of absolute GDP to avoid spurious results resulting from the typical unit root in GDP time series (Greene, 2003).

financing instrument by many SIBs (Mazzucato & Semieniuk, 2017). Fourth is the inflation-adjusted FiT for technology a in country c and year t, which is a key RE support policy that has been shown to correlate with public RE financing provisions (Cárdenas Rodríguez et al., 2015).[19] Due to the potential link between SIB activity and GDP growth, which correlates strongly across OECD countries, we cluster standard errors at the year level and report results for alternative standard errors in Appendix B.

Despite the variety of controls and FEs, some issues remain, because of which our findings might not imply that SIBs deliberately target specific deal characteristics and outcomes. First, we observe only lenders for transactions that reached a financial close. If SIB involvement prevents a project from being canceled, as their de-risking role suggests, then variables that correlate positively (negatively) with cancelation risk, such as technology risk (number of non-SIB lenders), will correlate positively (negatively) with SIB involvement, even if SIBs did not target these characteristics. Second, SIBs might target high-risk projects that struggle to obtain commercial lenders, but once an SIB is involved, this could mobilize other debt providers.[20] Therefore, the estimated coefficient for the number of non-SIB lenders can be seen as the net effect of these aspects. However, we note that the hypotheses in Section 2 are not of a causal nature, and although for some variables our findings do not necessarily speak to what *caused* SIBs to engage, they control for most potential distortions in correlational patterns and thus are informative of SIBs' financing behavior with respect to RE.

5 Results

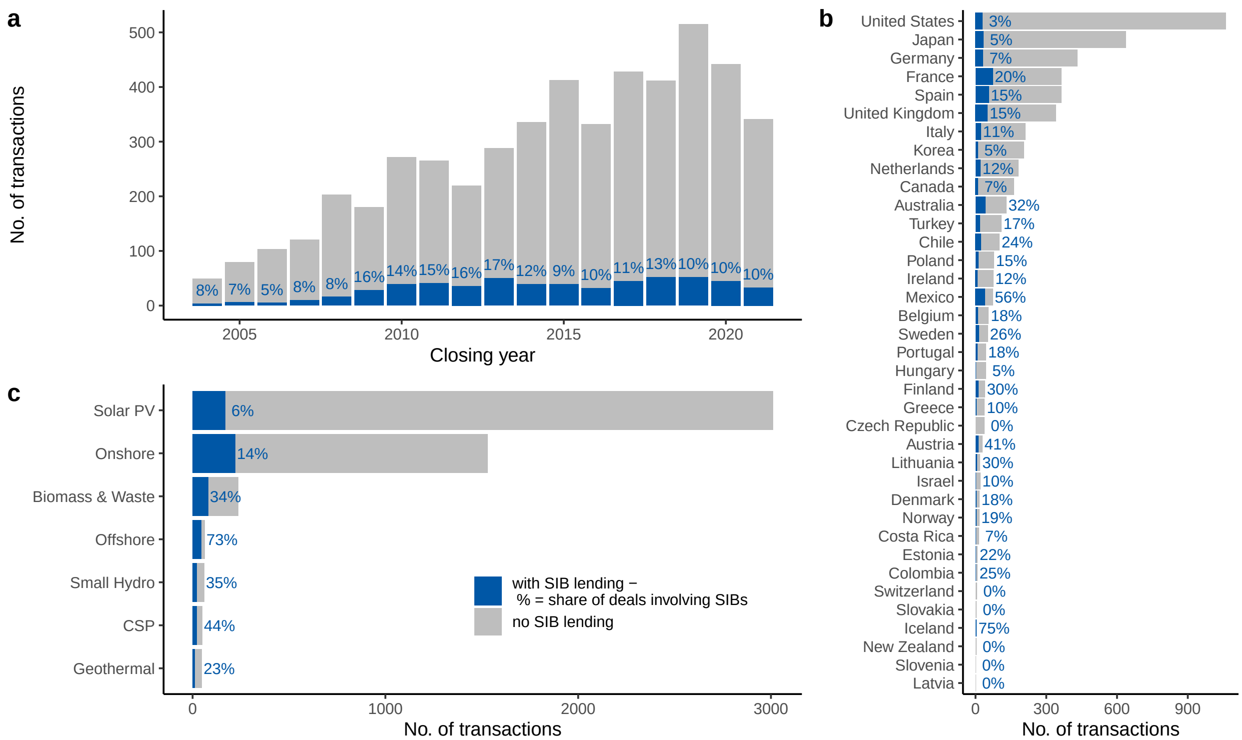
5.1 Descriptive statistics

Figure 1 displays how the transactions in our sample are distributed across different countries, years, and RE technologies, with the blue bars and value labels indicating the share of transactions that involved lending by at least one SIB. The annual number of RE deals in OECD countries increased from less than 100 in 2004 to 300–500 over the last few years. The share of transactions with SIB lending started relatively low at 5–8% from 2004–2008, then ramped up following the global financial crisis (14–17% from 2009–2013) and remained at 9–13% thereafter. Around 80% of transactions are located in the G7, Spain, South Korea, and the Netherlands, with SIB involvement varying significantly across countries.

[19] We use the FiT as the primary measure for RE policy support because it is a widespread policy measure across OECD countries with relatively strong evidence regarding private sector mobilization (Polzin et al., 2019).

[20] In addition, co-lending requirements in their mandate might also cause SIBs to prefer projects that already have a certain number of non-SIB lenders in place.

Figure 1: Sample composition by country, technology, and year



For instance, the US features a relatively low share of SIB involvement due to the lack of an SIB at the federal level, whereas in Australia and Mexico, SIBs are involved in at least one-third of the deals in our sample. Technology-wise, solar PV and onshore wind dominate the sample with 60% and 31% of transactions, respectively, followed by biomass and waste (5%), whereas the remaining technologies account for no more than 1% of transactions each. Solar PV and onshore wind also feature the lowest share of SIB involvement with 6% and 14%, respectively. By contrast, SIBs lent money to 73% of all offshore wind transactions, while their involvement in other RE technologies with small project numbers—such as small hydro, geothermal, biomass & waste, or CSP—ranged from 23–44%.

When comparing transactions with and without SIB lending through naive t-tests, the results in Table 3 show that the former are larger in terms of capacity (+58MW), involve more lenders and sponsors, and are more likely to involve a term loan and a public sponsor. More interestingly, SIB-financed deals are less likely to fall into the first decile of deal size in a given year, feature more often among the first three debt-financed transactions in a country for the technology in question and feature less in a matured market. In addition, the FiT for the technologies they finance is, on average, about 1 USD ct/kWh lower. Furthermore, countries and years in which an SIB-financed transaction takes place exhibit lower GDP growth (-0.2%-pts), higher long-term interest rates (+0.6%-pts), and lower stability of the banking sector, as evidenced by a lower banking system z-score. They also display higher levels of government expenditures but a lower budget deficit relative to GDP and perform better in climate change mitigation as measured by a higher CCPI score.

Table 3: Mean values by I(SIB lending) & t-tests

Variables	w/ SIB lending mean (s.e.)	w/o SIB lending mean (s.e.)	Diff.	t-stat
Closing year	2014.6 (4.2)	2014.8 (4.5)	-0.184	-0.99
Capacity (MW)	102.9 (152.9)	44.6 (91.8)	58.3	8.89
I(Cap. in 1st decile - onshore & PV only)	0.033 (0.18)	0.1 (0.3)	-0.0691	-7.88
# of non-SIB lenders	2.2 (3.5)	1.7 (1.6)	0.558	3.71
# of sponsors	1.5 (0.89)	1.2 (0.54)	0.272	7.15
I(First-3 deal)	0.13 (0.33)	0.043 (0.2)	0.0849	5.94
I(Term loan)	0.96 (0.2)	0.9 (0.3)	0.0612	6.52
I(Any public sponsor)	0.13 (0.34)	0.046 (0.21)	0.0834	5.7
I(Tech matured - onshore & PV only)	0.21 (0.41)	0.33 (0.47)	-0.122	-6.64
Feed-in tariff (2010 USD/kWh)	0.1 (0.15)	0.11 (0.17)	-0.0103	-1.5
Real GDP PPP growth (%)	1.3 (3.2)	1.5 (3.1)	-0.202	-1.41
CCPI Overall Score (0-100)	52.1 (11.1)	47 (13.2)	5.15	9.95
Long-term interest rate (%)	2.7 (2.3)	2.1 (1.8)	0.571	5.52
Country Bank Z-score	16.4 (7)	19 (8.9)	-2.6	-8.1
Gov. expenditures (% of GDP)	19.4 (3.8)	18.7 (3.4)	0.745	4.43
Primary balance (% of GDP)	-2.2 (3.4)	-2.5 (3.5)	0.356	2.37
Observations	572	4,427		

5.2 Regression results

Importantly, many of the correlations discussed in the previous section are driven by the heterogeneity of SIB activity across countries and RE technologies, as shown in Figure 1. For example, due to the large size of offshore wind deals, which finance a mean capacity of 362 MW per deal, they feature 7.7 non-SIB lenders on average compared to only 1.7 non-SIB lenders for the remaining technologies. To control for such confounders, Table 4 displays our main specification featuring the predictors discussed in Section 4 with and without country and year FEs (columns 1 and 2, respectively), with additional technology FEs (column 3) and for differentiating the IRENA-based market maturity dummy by individual technologies (column 4). As discussed in Section 4, Hypothesis 1 on technology risks implies that SIB involvement is more likely for offshore wind, biomass and waste, CSP, and geothermal compared to onshore wind and solar PV. Indeed, the coefficients for technology dummies confirm that relative to the baseline technology onshore wind, biomass and waste, CSP, and offshore deals are significantly more likely to involve SIB lending, whereas our coefficient with respect to geothermal is not significant at the 5% level. The effect is strongest for offshore wind, with the odds of SIB lending increasing by a factor of $e^{2.6} \approx 13.5$ for offshore compared to onshore wind, which corresponds to an average marginal effect of +40%-pts on the probability of SIB lending (see Figures 5–6 in Appendix B). Although small hydro is considered a low-risk technology, the respective coefficient indicates a significantly higher likelihood of SIB involvement as well. By contrast, solar PV deals are significantly *less* likely to involve SIB lending than onshore transactions. As a result, the difference of technology FEs vis-à-vis solar PV is also positive and significant at the 5% level for all technologies in the respective F-tests, including for geothermal.

Table 4: Regression results for the main specification

	I(SIB lending)			
	(1)	(2)	(3)	(4)
(Intercept)	-5.09***			
	(0.472)			
I(First-3 deal)	1.17***	1.01***	0.128	0.111
	(0.144)	(0.171)	(0.225)	(0.223)
ln(Capacity in MW)	0.528***	0.568***	0.474***	0.481***
	(0.053)	(0.056)	(0.060)	(0.060)
I(Cap. in 1st decile - onshore & PV only)	0.084	0.216	0.221	0.220
	(0.306)	(0.337)	(0.308)	(0.306)
# of non-SIB lenders	-0.039*	-0.007	-0.104***	-0.104***
	(0.019)	(0.019)	(0.029)	(0.030)
Real GDP PPP growth (%)	-0.029	-0.040	-0.031	-0.029
	(0.021)	(0.030)	(0.035)	(0.036)
Feed-in tariff (2010 USD/kWh)	0.651*	0.036	1.43***	1.27**
	(0.302)	(0.449)	(0.435)	(0.481)
I(Any public sponsor)	0.831***	0.555*	0.427†	0.433†
	(0.200)	(0.222)	(0.258)	(0.262)
I(Term loan)	1.33***	0.693*	0.788**	0.729**
	(0.268)	(0.275)	(0.274)	(0.262)
Tech = Biomass&Waste			1.45***	1.57***
			(0.275)	(0.278)
Tech = PV			-0.686***	-0.395†
			(0.168)	(0.220)
Tech = SmallHydro			1.42*	1.49*
			(0.690)	(0.689)
Tech = CSP			1.15**	1.39**
			(0.411)	(0.443)
Tech = Offshore			2.60***	2.74***
			(0.685)	(0.692)
Tech = Geothermal			0.799	0.878†
			(0.524)	(0.530)
I(Tech matured - onshore & PV only)			-0.365†	
			(0.219)	
I(Tech matured) × Tech = Onshore				0.038
				(0.309)
I(Tech matured) × Tech = PV				-0.854***
				(0.247)
Country FEs		Yes	Yes	Yes
Closing year FEs		Yes	Yes	Yes
Observations	4,841	4,797	4,797	4,797
Pseudo R^2	0.111	0.208	0.261	0.264
BIC	3,125.4	3,166.1	3,044.0	3,043.7

Clustered (Closing year) standard-errors in parentheses
No. of observations decreases due to missing values in regressors (column 1) as well as perfect separation by country FEs (columns 2–4), see Section 4
*Signif. Codes: ***: 0.001, **: 0.01, *: 0.05, †: 0.1*

With respect to the maturity cycle (Hypothesis 2), the coefficient of the IRENA-based market maturity dummy is negative but insignificant at the 5% level if we consider solar PV and wind together (column 3). However, the effect of market maturity is highly significant for solar PV if we differentiate by individual technologies in column 4, with the odds of SIB involvement decreasing by a factor of $e^{-0.854} \approx 0.43$ compared to a solar PV market classified as yet immature. With respect to the average marginal effect, this translates into a 6%-pts reduction in the probability of SIB lending (see Figure 6 in Appendix B). By contrast, the coefficient for onshore is insignificant, with a t-statistic well below 1. Interestingly, the p-value of the solar PV FE increases considerably to almost 10% in column 4, suggesting that the significantly lower likelihood of SIB lending for PV compared to onshore in column 3 is primarily driven by matured markets. Indeed, if we differentiate the maturity dummy's effect by country (see Figure 9 in Appendix B), the coefficient is significantly negative at the 5% level for Germany and Japan only—which are markets where solar PV obtained capacity shares of 10% relatively early in the first half of the 2010s (see Figure 15 in Appendix C).

Since our dependent variable is a dummy indicating SIB involvement, this finding could either stem from SIBs reducing their activities as markets mature, or from commercial banks ramping up their lending, which would also make it less likely to observe SIB involvement for a given deal. Therefore, Figure 2a displays the number of PV deals in the six largest markets that reached the maturity threshold in our sample period, with transactions involving SIBs marked in blue. In most markets, the overall deal activity *declines* after reaching market maturity, meaning that the decrease in SIB involvement shares results from an even stronger decline in SIB activity. Italy and Spain show the strongest reductions in PV deals after 2010, when fiscal pressures caused these countries to reduce their PV support policies—for example, by capping the overall spending for PV and retroactively cutting tariff rates in Italy (Karneyeva & Wüstenhagen, 2017).

Whether this means that SIBs reduce their lending activity for the technology depends on their mandate and scope of activities. Figure 2b displays the PV lending activities by the most active SIBs in the respective PV markets, which for Germany, France, Japan, and Korea is their national SIB and for Spain and Italy is the supranational European Investment Bank. Dashed vertical lines denote when the respective home market for PV reaches maturity, while blue (red) points represent deals inside (outside) the SIB's home market.[21] As displayed, the German Kreditanstalt fuer Wiederaufbau (KfW), by far the most active national SIB in our sample, has not decreased its PV activity overall. Instead, its geographic scope of

[21] The European Investment Bank's PV lending in our sample occurs entirely within current or, in the case of the UK, former EU member countries. Therefore, all these deals are classified as domestic. Since the bank does not have a single home market, no dashed line denoting PV market maturity is displayed.

activity has shifted abroad to less mature PV markets, such as Mexico, Chile, and Spain. Similarly, the Korean Development Bank is increasingly financing PV deals abroad, while the in-sample lending of the European Investment Bank has shifted away from markets like Germany or Italy, primarily toward Spain. All of these institutions have in common that their activities span a wide range of countries. Conversely, the Development Bank of Japan, which almost exclusively provides debt domestically, features no further PV transactions after 2015.[22]

Regarding the alleged first-mover role of SIBs, Table 4 suggests that SIBs are not significantly more likely to engage in the first three market-opening deals in a country that provide debt to the respective technology once we control for technology differences. Differentiating the market-opening dummy by technology does not affect this conclusion as the effect remains insignificant for all technologies except CSP (see Figure 11 in Appendix B), for which our sample comprises only 13 market-opening deals. Therefore, SIBs' first-mover role does not go significantly beyond the general targeting of high-risk technologies and, in the case of solar PV, a reaction to increasing market maturity. This poses the question of who else, if not SIBs, provides debt through market-opening deals in OECD countries. To answer this, we classify the lenders appearing on such deals based on their Bloomberg Industry Classification Standard and calculate the share of financial and non-financial private sector lenders as well as SIBs and other public sector lenders.

Figure 3b displays the results separately for solar PV, onshore wind, and the remaining technologies and reveals that most first-mover lenders remain commercial banks as well as other private sector financial companies—although the prevalence of these lenders increases considerably in subsequent deals. In contrast, public sector lenders account for 19%, 23%, and 33% of lender appearances in market-opening deals for solar PV, onshore wind, and other technologies, respectively—but only about half of these shares on subsequent deals. Importantly, however, this difference is not primarily driven by SIBs but by other public sector entities, such as export credit agencies and (subnational) governments. In addition, multilateral development banks are particularly important in the case of Latin American OECD new-joiners where financial markets are less developed, and both the World Bank (through its subsidiary IFC) and the Inter-American Development Bank have taken on first-mover roles. Notably, the activity of other public sector entities drops considerably for subsequent deals, illustrating that these institutions, unlike SIBs, appear to deliberately target market-opening deals through their lending. To assess potential heterogeneity between countries, we interact the market-opening dummy with country FEs (see Figure 12 in Appendix B) and

[22]The small, non-zero SIB involvement share for Japan from 2016–2020 are due to activities by Japan Finance Corp as well as lending abroad by the Korea Development Bank.

Figure 2: PV deals in main markets reaching maturity & PV financing of corresponding main SIBs

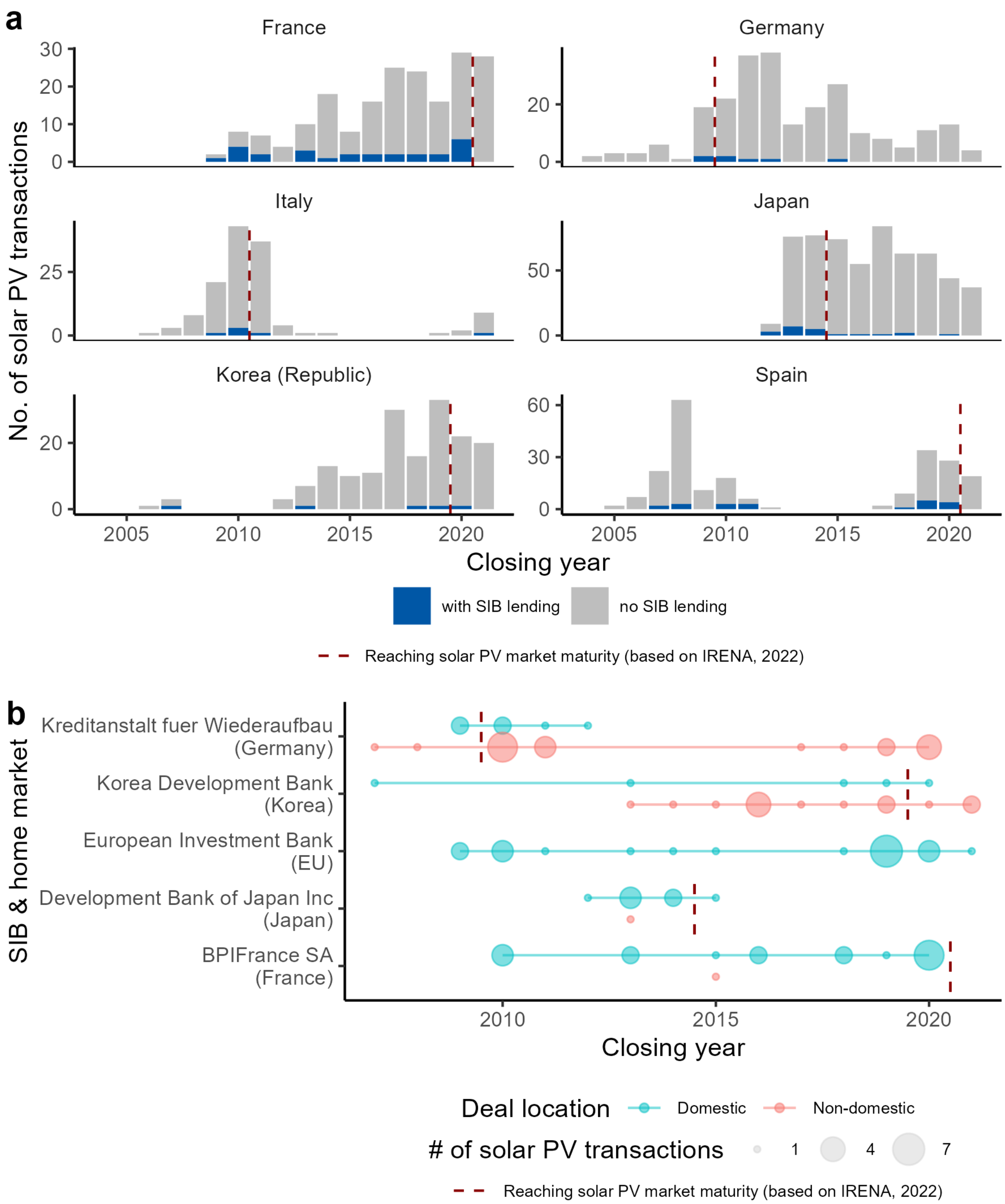
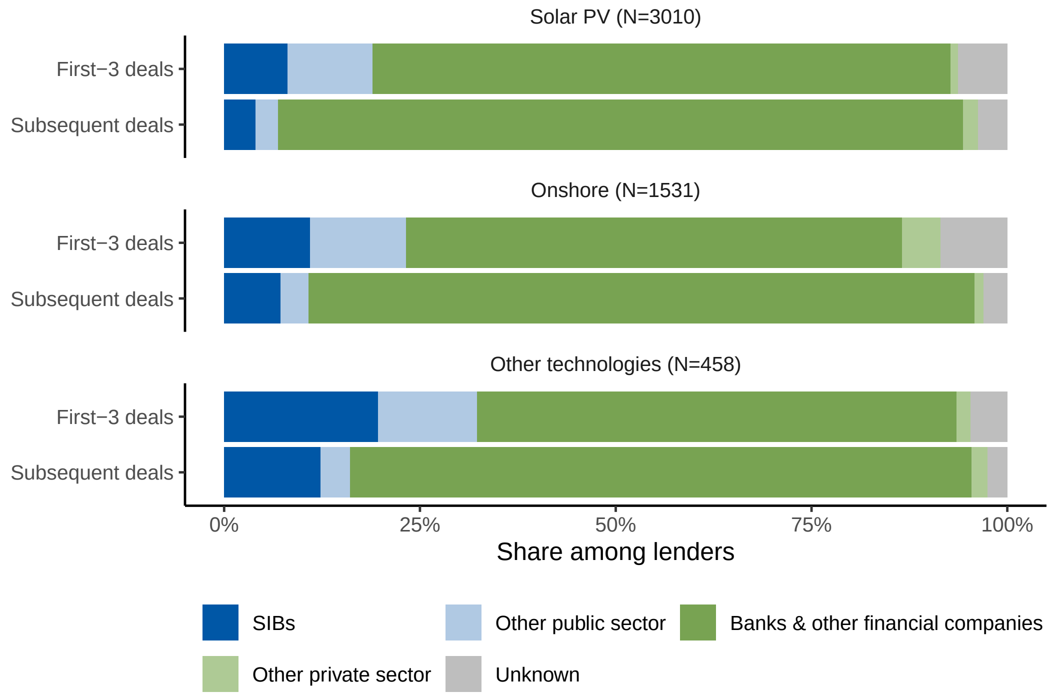


Figure 3: Involvement of SIBs and other lenders in market-opening and subsequent deals



find a significant positive correlation between market-opening and SIB lending at the 5% level only for Germany, where KfW has targeted RE relatively early (Geddes et al., 2018). By contrast, the only correlation that is significantly *negative* is for the UK, where the UK Green Investment Bank was launched in 2012 after most market-opening deals in our sample had already closed.

Regarding Hypothesis 3, the results in Table 4 show that SIBs are significantly more likely to be involved as lenders for *larger* transactions after controlling for technology FEs, with the odds of SIB lending increasing by 0.47% for every 1% increase in financed capacity (column 3). This finding is robust across all specifications in this paper and, for our main specification, corresponds to an average marginal effect of +0.3%-pts in the probability of SIB lending per 1MW increase in capacity (see Figure 5 in Appendix B). However, we find no evidence that a deal capacity that falls within the 1st decile of all transactions financing the same technology that closed in the same year affects the likelihood of SIB lending significantly. To explore this relationship further, Table 5 displays additional regression results for using a 2nd-order polynomial of deal capacity instead of the log-transformed value (columns 1–2) and for using bin dummies for all deciles, relative to the 6th decile as a baseline (columns 3–4). To explore the robustness of previous findings, Table 5 also displays the coefficients for all variables related to technology risk and maturity, but, for the sake of conciseness, omits coefficients for all further controls.

Similar to our main specification, the coefficients for the linear and squared capacity terms suggest a positive, concave relationship between deal size and the likelihood of SIB involvement. In addition, when using decile bins relative to the 6th decile, lower (higher) capacity deciles correlate with lower (higher) odds of SIB involvement although the respective coefficients are only statistically significant for the 1st decile as well as the 9th–10th deciles. Therefore, we conclude that, contrary to the literature's suggestions, a lower transaction size is, in general, significantly and robustly associated with a *reduced* likelihood of SIB lending. Importantly, the different ways of capturing size effects in the regression do not alter our previous conclusions regarding technology risk and maturity, as most technology FEs (except for geothermal) and the maturity dummy for PV remain economically and statistically significant. Similarly, SIB involvement is never significantly more likely for the first deals providing debt to a technology in a country.

Table 5: Additional specifications for size effects

	I(SIB lending)			
	(1)	(2)	(3)	(4)
Tech = Biomass&Waste	1.38***	1.49***	1.27**	1.39**
	(0.280)	(0.287)	(0.417)	(0.424)
Tech = PV	-0.949***	-0.683**	-1.32***	-1.07***
	(0.172)	(0.231)	(0.139)	(0.204)
Tech = SmallHydro	1.19†	1.26†	1.07	1.15
	(0.662)	(0.665)	(0.713)	(0.721)
Tech = CSP	1.17**	1.38**	1.46**	1.69**
	(0.417)	(0.463)	(0.489)	(0.527)
Tech = Offshore	2.46***	2.59***	3.32***	3.45***
	(0.671)	(0.682)	(0.843)	(0.850)
Tech = Geothermal	0.727	0.807	0.529	0.614
	(0.555)	(0.562)	(0.678)	(0.686)
I(Tech matured - onshore & PV only)	-0.329		-0.352	
	(0.234)		(0.221)	
I(Tech matured) × Tech = Onshore		0.048		0.0006
		(0.331)		(0.317)
I(Tech matured) × Tech = PV		-0.775**		-0.774***
		(0.271)		(0.233)
I(First-3 deal)	0.112	0.096	0.028	0.011
	(0.227)	(0.225)	(0.242)	(0.241)
Capacity (MW)	0.008***	0.008***		
	(0.001)	(0.001)		
Capacity (MW) square	$-5.88 \times 10^{-6***}$	$-5.98 \times 10^{-6***}$		
	(1.39×10^{-6})	(1.42×10^{-6})		
I(Cap. in 1st decile)	-0.426†	-0.435†		
	(0.237)	(0.237)		
Capacity decile = 1			-0.688*	-0.688*
			(0.303)	(0.297)
Capacity decile = 2			-0.320	-0.309
			(0.342)	(0.346)
Capacity decile = 3			-0.495	-0.485
			(0.317)	(0.314)
Capacity decile = 4			-0.492†	-0.484†
			(0.282)	(0.280)
Capacity decile = 5			-0.266	-0.235
			(0.400)	(0.398)
Capacity decile = 7			0.195	0.193
			(0.299)	(0.289)
Capacity decile = 8			0.276	0.305
			(0.322)	(0.320)
Capacity decile = 9			0.802***	0.813***
			(0.217)	(0.216)
Capacity decile = 10			1.30***	1.31***
			(0.224)	(0.224)
Further controls of main specification	Yes	Yes	Yes	Yes
Country FEs	Yes	Yes	Yes	Yes
Closing year FEs	Yes	Yes	Yes	Yes
Observations	4,797	4,797	4,797	4,797
Pseudo R^2	0.256	0.258	0.258	0.260
BIC	3,072.2	3,073.1	3,115.5	3,117.4

Clustered (Closing year) standard-errors in parentheses
All capacity decile dummies are applied only to onshore wind and solar PV
*Signif. Codes: ***: 0.001, **: 0.01, *: 0.05, †: 0.1*

Regarding the question of mobilizing private banks (Hypothesis 4), our main results in Table 4 seemingly suggest a significant negative correlation between the number of non-SIB lenders and SIB involvement (columns 3–4). However, this result is heavily driven by the fact that 188 deals have an SIB as the only lender. Since our sample only includes debt-financed transactions with at least one lender, having zero non-SIB lenders perfectly predicts our dependent variable, which can introduce a spurious negative correlation. To avoid this artefact, we subset our sample to transactions that have at least one non-SIB lender, such that our dependent variable indicates if at least one SIB featured as a *co-lender*—which addresses the question of mobilization more appropriately.

The results are presented in Table 6 and show that conditional on the presence of non-SIB lenders on a deal, a larger number of non-SIB lenders correlates positively with a higher likelihood of SIB lending, albeit not significantly at the 5% level for our main specification (columns 2–3). Interacting the number of non-SIB lenders with the technology FEs reveals that the effect is primarily driven by solar PV and offshore transactions (see Figure 13 in Appendix B). Overall, these findings favor the lender mobilization hypothesis over potential crowding-out concerns. This is in line with the mobilization effect of public financial institutions and multilateral development banks reported by previous, sector-agnostic studies (Broccolini et al., 2021; Degl'Innocenti et al., 2022), which consider only syndicated loans, similar to the subsample used in Table 6. However, we note that the relationship is not statistically significant and, in addition, cannot rule out that, for deals with SIBs as the only lender, some crowding-out could have occurred.

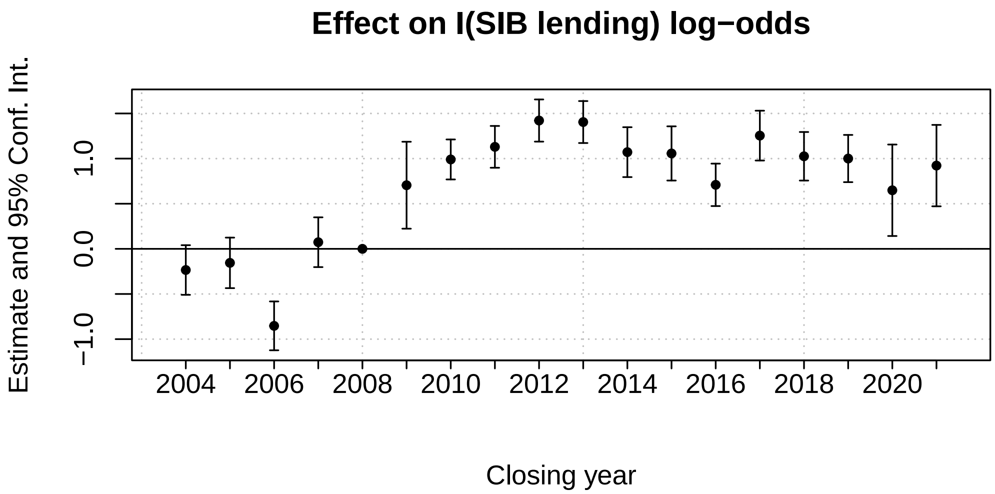
Regarding our previous conclusions regarding technology risk, market maturity, and size, we note that excluding solo-lending by SIBs reduces the statistical significance of several technology FEs with small sample sizes (offshore, CSP, small hydro). This is somewhat unsurprising since for these small-N technologies, omitting deals with SIBs as the only lender(s) removes over a quarter of all SIB-involving deals from our sample and reduces the overall number of deals by more than 10%. However, the offshore FE remains significant at the 10% level, and by contrast, both the magnitude and the significance of the market maturity dummy (column 3) increase relative to our main specification in Table 4 above. With respect to market-opening deals and size effects, our previous conclusions remain unaltered for this subsample.

Table 6: Regression results for lender mobilization

	I(SIB lending)		
	(1)	(2)	(3)
(Intercept)	-6.47***		
	(0.489)		
I(First-3 deal)	0.941***	0.164	0.160
	(0.148)	(0.267)	(0.265)
ln(Capacity in MW)	0.517***	0.535***	0.537***
	(0.062)	(0.081)	(0.082)
I(Cap. in 1st decile - onshore & PV only)	0.305	0.432	0.430
	(0.377)	(0.374)	(0.375)
# of non-SIB lenders	0.102***	0.066†	0.066†
	(0.020)	(0.035)	(0.035)
Real GDP PPP growth (%)	-0.019	-0.009	-0.008
	(0.022)	(0.036)	(0.036)
Feed-in tariff (2010 USD/kWh)	1.00**	1.87***	1.80**
	(0.361)	(0.538)	(0.578)
I(Any public sponsor)	0.558***	0.142	0.148
	(0.164)	(0.253)	(0.257)
I(Term loan)	2.02***	1.32***	1.29***
	(0.301)	(0.299)	(0.284)
Tech = Biomass&Waste		1.15***	1.19***
		(0.295)	(0.304)
Tech = PV		-1.03***	-0.903**
		(0.188)	(0.278)
Tech = SmallHydro		1.06	1.10
		(0.675)	(0.678)
Tech = CSP		0.459	0.577
		(0.485)	(0.541)
Tech = Offshore		1.21†	1.26†
		(0.633)	(0.648)
Tech = Geothermal		0.680	0.706
		(0.499)	(0.510)
I(Tech matured - onshore & PV only)		-0.479*	
		(0.200)	
I(Tech matured) × Tech = Onshore			-0.314
			(0.326)
I(Tech matured) × Tech = PV			-0.704**
			(0.219)
Country FEs		Yes	Yes
Closing year FEs		Yes	Yes
Observations	4,664	4,600	4,600
Pseudo R^2	0.138	0.284	0.284
BIC	2,321.9	2,354.8	2,362.1

Clustered (Closing year) standard-errors in parentheses
*Signif. Codes: ***: 0.001, **: 0.01, *: 0.05,* † : 0.1

Figure 4: Year FEs using the main specification (Table 4, Column 3)



While not directly relevant for *RE-specific* financing patterns, we note that the control variables included in our regressions are informative about other potential roles of SIBs suggested in the literature. First, our results provide no evidence that SIB lending is significantly more likely in years with lower GDP growth or higher banking sector instability (see Table 11 in Appendix B). Since business cycles correlate strongly across OECD countries,[23] this could, in theory, be driven by country and year FEs absorbing the identifying variation. However, the year FEs for the years of the global financial crisis or directly thereafter are not significantly higher compared to subsequent years if we estimate them explicitly, as Figure 4 illustrates. This suggests that countercyclical financing provision plays a less significant role in RE lending by SIBs, potentially because the number of RE transactions has shown little reaction to the global financial crisis (see Figure 1 above).

Moreover, our results suggest that SIB lending is somewhat more likely for projects sponsored by a public sector entity, which in our sample are primarily public utilities—although the coefficient is only significant at the 10% level. Interestingly, the significance of the corresponding dummy variable vanishes if we omit deals that feature an SIB as the only lender (Table 6) because solo lending by SIBs is disproportionately directed to public sector sponsors.[24] Furthermore, we find that the FiT level for a transaction's technology shows a significant positive correlation with the likelihood of SIB lending, which is particularly

[23]Regressing country-level GDP growth in our sample on year FEs alone yields an $R^2 = 0.13$, as shown in Table 15 in Appendix C.

[24]Among transactions with an SIB as the only lender, 16% of deals involve a public sector sponsor while this share amounts to only 12% for deals involving an SIB as a co-lender.

driven by onshore wind and solar PV transactions (see Figure 10 in Appendix B). This finding can be interpreted in multiple ways. First, it could indicate that the use of SIBs for RE financing correlates with more stringent levels of RE support policy in general. However, the significantly positive association remains unaltered if we include the CCPI as a measure of overall RE and climate policy performance, which itself is not significantly related to the likelihood of SIB lending in the presence of country FEs (see Table 11 in Appendix B). Second, the FiT variable could capture some variation related to market maturity since most OECD countries have reduced FiT levels as RE technologies become more cost-competitive (see Figure 16 in Appendix C). In this case, the positive association between FiT and SIB lending further corroborates our finding that, at least for solar PV, SIB lending is more likely at lower market maturity.

5.3 Robustness checks

To ensure that our results are robust, we deploy a wide battery of robustness checks. Regarding operationalization, alternative ticket size proxies, aside from log-transformed deal capacity, have already been discussed in the previous section. Furthermore, we apply the market maturity dummy to all RE technologies (instead of only onshore wind and solar PV), use the technology's share in the installed capacity as a continuous variable instead of the binary 10% threshold, and deploy separate technology fixed effects for early- and later-stage solar PV, following Mazzucato and Semieniuk (2018). Regarding the definition of market-opening deals, our main specification considers the first three deals, but we conduct robustness checks for 1, 5, 10, and 25 deals, respectively. We also explore including further control variables from the literature, such as government surplus and expenditures in percentage of GDP to measure the available fiscal space (Cárdenas Rodríguez et al., 2015), the bank z-score to measure distress of the domestic banking sector (Degl'Innocenti et al., 2022), the long-term interest rate (Deleidi et al., 2020; Polzin et al., 2015), the number of sponsors (Cárdenas Rodríguez et al., 2015), and the Climate Change Performance Index score to measure overall energy- and climate-related policy stringency. However, the coefficients for all these control variables are insignificant, while missing values for some countries further reduce our sample size—which is why we omit them in our main specification.

In addition, we explore more demanding specifications with technology and country-year FEs or with country and technology-year FEs, as well as standard errors clustered at the country level instead of the year level. Since noise in the FEs can contaminate our coefficient estimates due to the incidental parameter problem (Lancaster, 2000; Neyman & Scott, 1948), we further present results for dropping each FE group (country/year/technology) with fewer than 25 observations and for using the bias-corrected two-way FE estimator proposed by Fernández-Val and Weidner (2016). Moreover, we explore omitting observations for which BNEF data notes the lenders as "Not Reported" instead of coding them as not involving SIB debt-financing. To ensure that using a binary dependent variable does not drive our findings, we also extract SIB loan volumes from unstructured text information in BNEF and use the share of SIBs in a deal's total debt financing as an alternative fractional dependent variable with a suitable estimator (Papke & Wooldridge, 1996). However, this requires assumption-based imputation for almost 200 of our 572 deals involving an SIB.[25] Therefore, we deem this approach inferior to our logit model.

The results are displayed in Tables 8–14 in Appendix B and, for the alternative dependent variable, in Tables 17–18 in Appendix D. Regarding the effects of size and market maturity, our main findings—a significant and positive (negative) effect of deal size (PV market maturity)—are robust across all models under consideration. The same holds true for our main results on FEs for biomass and waste (significantly positive), offshore (significantly positive at the 5% level or, if deals with an SIB being the only lender are discarded, at the 10% level), and geothermal (insignificant). By contrast, the difference between solar PV, CSP, and small hydro vis-à-vis onshore wind is not consistently significant and neither is the weak positive association between SIB lending and the number of non-SIB lenders (if deals financed by SIBs alone are discarded). Therefore, we conclude that our main findings regarding size, PV market maturity, and technology risks for offshore wind as well as biomass and waste constitute strong evidence. By contrast, the findings on lender mobilization as well as on differences in SIB lending between onshore and the remaining technologies are less conclusive.

6 Conclusion

This paper examines the financing behavior of SIBs with respect to RE technologies relative to commercial banks and how this behavior is compatible with the role of these institutions suggested by the academic literature. By considering debt-financed RE transactions in OECD countries, our results provide strong evidence that SIB financing activities are significantly more likely to involve higher-risk technologies compared to other lenders, which could be explained either by deliberate targeting or by SIBs reducing cancelation risks through their (technology-agnostic) involvement. In the case of solar PV, the likelihood of SIB financing decreases for markets reaching maturity, as SIBs reduce their lending activities or shift them toward foreign markets if their mandates allow for it. By contrast, we find no

[25] A more detailed description of missing values and the imputation process can be found in Appendix D.

evidence of similar maturity-related patterns for onshore wind. A potential reason for this is the somewhat less dynamic market growth for onshore over our sample period (see Figure 15 in Appendix C), which could limit both the identifying variation net of FEs that our research design can leverage and the likelihood that either SIBs or private sector lenders proactively revise their financing behavior.

While the flip side of maturity-related patterns is that SIBs are more likely to act as debt providers in immature PV markets, we find no clear evidence that SIBs are significantly more involved in a country's *very first* debt financing deals for a novel technology. Such first-mover roles are instead taken over by other public sector entities, with a particular role for export credit agencies and multilateral development banks in less-developed OECD member countries. However, maturity-related patterns of SIB financing in general seem to be very jurisdiction dependent, which might reconcile our findings with previous, qualitative studies on selected SIBs acting as first movers for RE financing. Beyond technology risk and maturity, in contrast to the literature's suggestions, SIBs are more likely to finance *larger* RE transactions, which could result from politically influenced decision making towards more prominent deals, or from the incentives of SIB managers and staff being misaligned with the policy objective of enabling smaller-scale (but more laborious and potentially less profitable) RE projects.

Regarding the question of mobilizing private banks, we find that SIBs often operate as sole lenders, particularly for projects sponsored by public sector entities. In a co-lending role, however, the presence of an SIB in a transaction correlates with higher syndicate sizes—a finding that aligns with previous studies on public financial institutions but is not consistent across all robustness checks. Therefore, the question of whether and to what extent SIBs mobilize other lenders in RE financing remains an important avenue for future research with more causality-focused research designs. Lastly, stringent RE policy support in the form of feed-in tariffs robustly predicts SIB involvement, hinting at either a complementary use of policy measures or at further maturity-related financing patterns. Conversely, the general countercyclical financing behavior of SIBs seems to play a limited role in RE financing.

Taken together, our results reveal that SIBs do indeed leverage their risk-bearing abilities to foster riskier RE technologies in immature markets but do not seem to prioritize first-mover roles or the financing of smaller assets. These findings are immediately relevant for policymakers who are considering revising an SIB's mandate or establishing a new institution, such as the potential capitalization of a US green bank through the Greenhouse Gas Reduction Fund. Given our results, decision makers in such situations should place a particular emphasis on deliberately targeting smaller-scale deals, ensuring that the SIB's mandate and guidelines are effective in that regard if enabling smaller RE projects is a policy objective. Furthermore, policymakers should mandate or incentivize SIBs to withdraw from sufficiently mature technologies—for example, by setting clear guidelines for additionality. In addition, our results illustrate that empirical relationships in RE financing are strongly moderated by technology differences. This highlights the importance of a high technological resolution when assessing energy financing and can inform future empirical research to avoid spurious findings.

However, there are several limitations to the findings presented here that lend to further research. First, our results speak to correlational patterns rather than to the causal determinants of SIB financing activities. While our empirical method allows to identify significant and important effects across SIBs, it should not be seen to substitute causal analysis of individual banks' project patterns in their precise context. Second, while this paper disentangles SIBs' financing patterns from other public financial institutions, we treat SIBs as a homogeneous group of institutions and do not explore and compare the mandates of different SIBs in more detail. Third, while our research design implicitly compares SIBs to non-SIB lenders, we do not carry out comprehensive comparisons with other types of public financial institutions, such as development finance institutions or export credit agencies, to explore how SIBs' financing patterns and roles differ from those of other state-owned institutions.

To advance our understanding of SIBs as an RE support policies, future research should leverage the specifics of SIB mandates to explore how different legal stipulations translate into financing patterns and, ultimately, deployment outcomes. Another avenue for research would be to empirically assess the RE financing behavior of state-owned export credit agencies or development finance institutions, to highlight similarities and differences with public financial institutions whose focus lies abroad. This would not only provide additional context for the findings presented here but could also guide policymakers further on how to channel SIBs and public finance in general, to complement other policy instruments in fostering the clean energy transition.

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A Variable definitions

Table 7: Variable definitions & data sources

Variable	**Description & Source**
I(SIB lending)	Dummy indicating if there is at least one SIB among lead and syndicated debt providers for transaction i in the BNEF Asset Finance database
Closing year	The year in which transaction i reached financial close in the BNEF Asset Finance database
Country	The country of transaction i in the BNEF Asset Finance database
Technology	The RE technology deployed by the project financed through transaction i based on the (Sub-)Sector variables in the BNEF Renewable Energy Projects database. We use the Subsector variable to differentiate between onshore and offshore wind, as well as between solar PV and CSP. For multi-project transactions, we select the primary project based on the largest project cost of, if unavailable, capacity (see Section 4)
Capacity (MW)	The total generation capacity financed through transaction i in the BNEF Asset Finance database, i.e., the sum of project capacities if a transaction finances multiple RE projects
I(Cap. in 1st decile)	Dummy indicating if the generation capacity financed through transaction i falls into the smallest decile across all deals with the same Technology and Closing year. Applied to onshore wind and solar PV deals only
# of non-SIB lenders	The number of lead and syndicated debt providers for transaction i in the BNEF Asset Finance database that are not SIBs
# of sponsors	The number of sponsors for transaction i in the BNEF Asset Finance database
I(First-k deal)	Dummy indicating if transaction i was one of the first k debt-financed deals, based on the closing date, with the same Technology in the same Country in the BNEF Asset Finance database. For calculating this variable, we also consider years prior to 2004
I(Term loan)	Dummy indicating if the Financing Type column in the BNEF Asset Finance database for transaction i includes the category "Term loan"
I(Any public sponsor)	Dummy indicating if at least one sponsor for transaction i is a public-sector organization. Public-sector organizations are classified based on the BICS classification scheme in the Bloomberg Terminal or, if this information is not available, on the "Public Sector" category in the Subactivity variable in the BNEF Organizations database. All identified SIBs are also coded as public sector entities
I(Tech matured)	Dummy indicating if the transaction's Technology accounts for at least 10% of the national installed capacity in the transaction's Country and Closing year, following IRENA (2022). Capacity values are extracted through the IRENASTAT Online Data Query Tool for the variable *Installed electricity capacity by country/area (MW) by Country/area, Technology, Grid connection and Year* and, for each technology, summed up across on-grid and off-grid capacities. Applied to onshore wind and solar PV deals only
Feed-in tariff (2010 USD/kWh)	The mean feed-in tariff for a transaction's Technology in a transaction's Country and Closing year according to the OECD.Stat database (variable FIT_USD). The raw OECD values in current USD are deflated to 2010 USD using the US CPI provided by the World Bank's World Development Indicators database. If a transaction's Technology in our data is "Biomass & Waste", we apply the OECD feed-in tariff value for biomass. As there is no CSP tariff in the OECD data, we apply the solar PV FiT to CSP deals
Real GDP PPP growth (in %)	Year-on-year annual growth rate in real GDP PPP from the World Bank's World Development Indicators database in a transaction's Country and Closing year
CCPI Overall Score (0-100)	Climate Change Performance Index score (Burck et al., 2021) of a transaction's Country in its Closing year
Long-term interest rate (%)	Long-term interest rate in a transaction's Country and Closing year according to the OECD.Stat database (variable IRLTLT01)
Country Bank Z-score	The banking system z-score in a transaction's Country and Closing year. Values are taken from the World Bank's Global Financial Development Database
Gov. expenditures (% of GDP)	General government final consumption expenditure in a transaction's Country and Closing year according to the World Bank World Development Indicators database (variable NE.CON.GOVT.ZS)
Primary balance (% of GDP)	The primary balance of the government in the transaction's Country and Closing year according to the Cross-Country Database of Fiscal Space (Kose et al., 2022) (variable pby)

B Robustness checks, marginal effects and effect heterogeneity

B.1 Robustness checks for main results

Table 9 displays results if we use alternative approaches to operationalize market maturity: for our main approach as displayed in Table 4 (1), for using differentiated solar PV dummies for before and from 2010 on following Mazzucato and Semieniuk (2018) (2),[26] for applying the IRENA-based market maturity dummy to all technologies in our sample based on a maturity threshold of 10% (3), for applying the market maturity dummy to all technologies but further interacting this with the technology FE (4), for using the continuous share in national installed capacity instead of the dummy based on the 10% threshold (5), for interacting the share in national installed capacity with the solar PV, onshore and offshore FEs (6).

Table 10 presents results for our main specification (Table 4, column 3) when using an alternative numbers of first deals in defining a market-opening deal. The model in column 2 for First-3 corresponds to our main specification.

Table 11 displays the results for our main specification including the interaction term between the market maturity dummy and the individual technologies under several approaches; for our main approach as displayed in Table 4 (1), for clustering at the country level instead of the closing year level (2), for using country-year FEs instead of separate country and year FEs (3), for using technology-year FEs instead of separate technology and year FEs (4), for adding the additional control variables discussed in Section 4 (5), and for excluding transactions for which BNEF lists the lender as "Not Reported" which we code as not including SIB lending under our main approach as laid out in Section 3 (6). Except for column (2), all results are based on standard errors clustered at the closing year level.

Table 12 displays the results for subsetting our sample to deals that involve at least one non-SIB lender (Table 6, column 3) under the same alternative approaches as used in Table 11.

[26] The table does not include the interaction term between the maturity dummy and PV before 2010 because there is no country in our sample for which solar PV accounted for at least 10% of national capacity before 2010.

Table 8: Main specification results with standard errors clustered at the country level

	I(SIB lending)			
	(1)	(2)	(3)	(4)
(Intercept)	-5.09***			
	(0.416)			
ln(Capacity in MW)	0.528***	0.568***	0.474***	0.481***
	(0.093)	(0.081)	(0.083)	(0.082)
I(Cap. in 1st decile - onshore & PV only)	0.084	0.216	0.221	0.220
	(0.288)	(0.323)	(0.350)	(0.350)
# of non-SIB lenders	-0.039	-0.007	-0.104*	-0.104*
	(0.044)	(0.036)	(0.042)	(0.043)
Real GDP PPP growth (%)	-0.029†	-0.040	-0.031	-0.029
	(0.017)	(0.035)	(0.040)	(0.040)
Feed-in tariff (2010 USD/kWh)	0.651	0.036	1.43*	1.27†
	(0.766)	(0.723)	(0.615)	(0.668)
I(Any public sponsor)	0.831***	0.555**	0.427*	0.433*
	(0.251)	(0.197)	(0.216)	(0.219)
I(Term loan)	1.33***	0.693***	0.788***	0.729***
	(0.197)	(0.207)	(0.190)	(0.192)
I(First-3 deal)	1.17***	1.01***	0.128	0.111
	(0.233)	(0.264)	(0.201)	(0.192)
Tech = Biomass&Waste			1.45***	1.57***
			(0.271)	(0.278)
Tech = PV			-0.686***	-0.395†
			(0.152)	(0.216)
Tech = SmallHydro			1.42***	1.49***
			(0.311)	(0.287)
Tech = CSP			1.15**	1.39***
			(0.368)	(0.361)
Tech = Offshore			2.60***	2.74***
			(0.594)	(0.614)
Tech = Geothermal			0.799**	0.878**
			(0.308)	(0.304)
I(Tech matured - onshore & PV only)			-0.365*	
			(0.167)	
I(Tech matured) × Tech = Onshore				0.038
				(0.206)
I(Tech matured) × Tech = PV				-0.854**
				(0.260)
Country FEs		Yes	Yes	Yes
Closing year FEs		Yes	Yes	Yes
Observations	4,841	4,797	4,797	4,797
Pseudo R^2	0.111	0.208	0.261	0.264
BIC	3,125.4	3,166.1	3,044.0	3,043.7

Clustered (Country) standard-errors in parentheses
*Signif. Codes: ***: 0.001, **: 0.01, *: 0.05,* † : 0.1

Table 9: Robustness check for alternative measures of market maturity

	I(SIB lending)					
	(1)	(2)	(3)	(4)	(5)	(6)
ln(Capacity in MW)	0.481***	0.480***	0.474***	0.477***	0.473***	0.479***
	(0.060)	(0.061)	(0.060)	(0.060)	(0.060)	(0.062)
I(Cap. in 1st decile - onshore & PV only)	0.220	0.218	0.225	0.199	0.226	0.210
	(0.306)	(0.306)	(0.308)	(0.303)	(0.306)	(0.305)
# of non-SIB lenders	-0.104***	-0.104***	-0.103***	-0.101***	-0.102***	-0.105***
	(0.030)	(0.030)	(0.030)	(0.030)	(0.030)	(0.030)
Real GDP PPP growth (%)	-0.029	-0.029	-0.032	-0.031	-0.035	-0.034
	(0.036)	(0.036)	(0.035)	(0.036)	(0.035)	(0.035)
Feed-in tariff (2010 USD/kWh)	1.27**	1.30*	1.44***	1.38**	1.43**	0.937†
	(0.481)	(0.534)	(0.433)	(0.499)	(0.434)	(0.480)
I(Any public sponsor)	0.433†	0.433†	0.425	0.470†	0.422†	0.437
	(0.262)	(0.262)	(0.259)	(0.257)	(0.256)	(0.267)
I(Term loan)	0.729**	0.729**	0.782**	0.792**	0.778**	0.716**
	(0.262)	(0.262)	(0.274)	(0.275)	(0.270)	(0.261)
I(First-3 deal)	0.111	0.111	0.126	0.158	0.129	0.091
	(0.223)	(0.223)	(0.226)	(0.221)	(0.227)	(0.226)
Tech = Biomass&Waste	1.57***	1.57***	1.51***	1.41***	1.51***	1.59***
	(0.278)	(0.278)	(0.266)	(0.314)	(0.273)	(0.305)
Tech = PV	-0.395†		-0.675***	-0.451*	-0.681***	0.012
	(0.220)		(0.166)	(0.224)	(0.169)	(0.292)
Tech = SmallHydro	1.49*	1.49*	1.67*	1.48*	1.80*	1.57*
	(0.689)	(0.690)	(0.701)	(0.689)	(0.737)	(0.724)
Tech = CSP	1.39**	1.38**	1.18**	1.34**	1.16**	1.50**
	(0.443)	(0.457)	(0.407)	(0.442)	(0.414)	(0.479)
Tech = Offshore	2.74***	2.74***	2.67***	2.66***	2.67***	2.73***
	(0.692)	(0.692)	(0.675)	(0.696)	(0.687)	(0.716)
Tech = Geothermal	0.878†	0.879†	0.839	0.659	0.816	0.894
	(0.530)	(0.529)	(0.525)	(0.486)	(0.558)	(0.597)
I(Tech matured) × Tech = Onshore	0.038	0.037				
	(0.309)	(0.312)				
I(Tech matured) × Tech = PV	-0.854***					
	(0.247)					
Tech = PVbefore2010		-0.452				
		(0.440)				
Tech = PVfrom2010on		-0.394†				
		(0.220)				
I(Tech matured) × Tech = PVfrom2010on		-0.858***				
		(0.245)				
I(Tech matured - all technologies)			-0.247			
			(0.213)			
I(Tech matured) × Tech = Onshore				0.032		
				(0.312)		
I(Tech matured) × Tech = Biomass&Waste				1.97**		
				(0.741)		
I(Tech matured) × Tech = PV				-0.860***		
				(0.248)		
I(Tech matured) × Tech = Offshore				-0.623		
				(0.586)		
I(Tech matured) × Tech = Geothermal				28.1***		
				(0.693)		
Tech share in nat. capacity					-0.011	
					(0.013)	
Tech share in nat. capacity × Tech = Onshore						0.003
						(0.023)
Tech share in nat. capacity × Tech = PV						-0.078***
						(0.012)
Country FEs	Yes	Yes	Yes	Yes	Yes	Yes
Closing year FEs	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4,797	4,797	4,797	4,797	4,797	4,797
Pseudo R^2	0.264	0.264	0.260	0.268	0.260	0.265
BIC	3,043.7	3,052.1	3,046.9	3,056.7	3,048.7	3,040.9

Clustered (Closing year) standard-errors in parentheses
*Signif. Codes: ***: 0.001, **: 0.01, *: 0.05,* † : 0.1

Table 10: Main specification - using different # of first deals in the country providing debt to a given technology (k)

	I(SIB lending)				
	(1)	(2)	(3)	(4)	(5)
ln(Capacity in MW)	0.473***	0.474***	0.474***	0.475***	0.473***
	(0.061)	(0.060)	(0.060)	(0.061)	(0.060)
I(Cap. in 1st decile - onshore & PV only)	0.219	0.221	0.215	0.201	0.218
	(0.308)	(0.308)	(0.309)	(0.301)	(0.305)
# of non-SIB lenders	-0.105***	-0.104***	-0.102***	-0.105***	-0.105***
	(0.029)	(0.029)	(0.029)	(0.029)	(0.029)
Real GDP PPP growth (%)	-0.030	-0.031	-0.034	-0.033	-0.030
	(0.035)	(0.035)	(0.036)	(0.035)	(0.035)
Feed-in tariff (2010 USD/kWh)	1.42**	1.43***	1.45***	1.36**	1.42***
	(0.438)	(0.435)	(0.439)	(0.431)	(0.404)
I(Any public sponsor)	0.426	0.427†	0.420	0.411	0.429†
	(0.259)	(0.258)	(0.257)	(0.261)	(0.260)
I(Term loan)	0.783**	0.788**	0.796**	0.806**	0.781**
	(0.273)	(0.274)	(0.272)	(0.281)	(0.272)
Tech = Biomass&Waste	1.47***	1.45***	1.38***	1.31***	1.48***
	(0.262)	(0.275)	(0.281)	(0.285)	(0.285)
Tech = PV	-0.682***	-0.686***	-0.701***	-0.705***	-0.682***
	(0.167)	(0.168)	(0.169)	(0.167)	(0.166)
Tech = SmallHydro	1.42*	1.42*	1.41*	1.36*	1.43*
	(0.683)	(0.690)	(0.694)	(0.652)	(0.683)
Tech = CSP	1.16**	1.15**	1.10**	1.08**	1.18**
	(0.417)	(0.411)	(0.401)	(0.387)	(0.401)
Tech = Offshore	2.64***	2.60***	2.48***	2.37***	2.67***
	(0.672)	(0.685)	(0.676)	(0.638)	(0.652)
Tech = Geothermal	0.826	0.799	0.682	0.550	0.841†
	(0.511)	(0.524)	(0.564)	(0.515)	(0.500)
I(Tech matured - onshore & PV only)	-0.368†	-0.365†	-0.352	-0.317	-0.369†
	(0.221)	(0.219)	(0.221)	(0.223)	(0.212)
I(First-1 deal)	0.074				
	(0.379)				
I(First-3 deal)		0.128			
		(0.225)			
I(First-5 deal)			0.310		
			(0.253)		
I(First-10 deal)				0.401	
				(0.245)	
I(First-25 deal)					-0.006
					(0.188)
Country FEs	Yes	Yes	Yes	Yes	Yes
Closing year FEs	Yes	Yes	Yes	Yes	Yes
Observations	4,797	4,797	4,797	4,797	4,797
Pseudo R^2	0.261	0.261	0.262	0.263	0.261
BIC	3,044.2	3,044.0	3,041.9	3,039.2	3,044.3

Clustered (Closing year) standard-errors in parentheses
*Signif. Codes: ***: 0.001, **: 0.01, *: 0.05, †: 0.1*

Table 11: Robustness check for the main specification (market maturity interacted with individual technologies)

	I(SIB lending)					
	(1)	(2)	(3)	(4)	(5)	(6)
ln(Capacity in MW)	0.481***	0.481***	0.581***	0.515***	0.468***	0.517***
	(0.060)	(0.082)	(0.071)	(0.058)	(0.069)	(0.069)
I(Cap. in 1st decile - onshore & PV only)	0.220	0.220	0.351	0.282	0.228	0.266
	(0.306)	(0.350)	(0.260)	(0.298)	(0.303)	(0.313)
# of non-SIB lenders	-0.104***	-0.104*	-0.126**	-0.112*	-0.104***	-0.148***
	(0.030)	(0.043)	(0.040)	(0.048)	(0.032)	(0.030)
Real GDP PPP growth (%)	-0.029	-0.029		-0.024	-0.033	-0.024
	(0.036)	(0.040)		(0.034)	(0.036)	(0.037)
Feed-in tariff (2010 USD/kWh)	1.27**	1.27†	1.12	1.58*	1.37**	1.29**
	(0.481)	(0.668)	(0.865)	(0.704)	(0.527)	(0.491)
I(Any public sponsor)	0.433†	0.433*	0.230	0.447	0.544*	0.485†
	(0.262)	(0.219)	(0.299)	(0.298)	(0.265)	(0.277)
I(Term loan)	0.729**	0.729***	0.675*	0.694*	0.634*	0.742**
	(0.262)	(0.192)	(0.305)	(0.280)	(0.270)	(0.259)
I(First-3 deal)	0.111	0.111	-0.210	-0.092	0.232	-0.014
	(0.223)	(0.192)	(0.422)	(0.308)	(0.239)	(0.230)
Tech = Biomass&Waste	1.57***	1.57***	1.76***		1.65***	1.71***
	(0.278)	(0.278)	(0.392)		(0.294)	(0.260)
Tech = PV	-0.395†	-0.395†	-0.385		-0.284	-0.393†
	(0.220)	(0.216)	(0.282)		(0.240)	(0.226)
Tech = SmallHydro	1.49*	1.49***	1.67*		0.823	1.58*
	(0.689)	(0.287)	(0.808)		(0.675)	(0.738)
Tech = CSP	1.39**	1.39***	1.25†		1.33**	1.71***
	(0.443)	(0.361)	(0.709)		(0.475)	(0.510)
Tech = Offshore	2.74***	2.74***	3.20**		2.75***	3.46***
	(0.692)	(0.614)	(1.19)		(0.727)	(0.546)
Tech = Geothermal	0.878†	0.878**	1.08†		0.601	0.898†
	(0.530)	(0.304)	(0.635)		(0.684)	(0.523)
I(Tech matured) × Tech = Onshore	0.038	0.038	0.009	-0.213	0.090	0.022
	(0.309)	(0.206)	(0.389)	(0.438)	(0.333)	(0.298)
I(Tech matured) × Tech = PV	-0.854***	-0.854**	-1.03**	-0.780**	-1.03***	-0.871**
	(0.247)	(0.260)	(0.396)	(0.292)	(0.271)	(0.267)
# of sponsors					0.008	
					(0.070)	
CCPI Overall Score (0-100)					-0.004	
					(0.011)	
Long-term interest rate (%)					-0.046	
					(0.050)	
Country Bank Z-score					0.008	
					(0.032)	
Gov. expenditures (% of GDP)					-0.130	
					(0.135)	
Primary balance (% of GDP)					-0.036	
					(0.040)	
Country FEs	Yes	Yes		Yes	Yes	Yes
Closing year FEs	Yes	Yes			Yes	Yes
Country-Closing year FEs			Yes			
Tech-Closing year FEs				Yes		
Observations	4,797	4,797	3,760	4,697	4,583	4,662
Pseudo R^2	0.264	0.264	0.305	0.278	0.269	0.276
BIC	3,043.7	3,043.7	3,767.6	3,335.7	2,867.7	2,976.3

*Signif. Codes: ***: 0.001, **: 0.01, *: 0.05,* † : 0.1

Table 12: Robustness check for the main specification (market maturity interacted with individual technologies)

	I(SIB lending)					
	(1)	(2)	(3)	(4)	(5)	(6)
ln(Capacity in MW)	0.537***	0.537***	0.641***	0.593***	0.532***	0.581***
	(0.082)	(0.097)	(0.111)	(0.087)	(0.092)	(0.094)
I(Cap. in 1st decile - onshore & PV only)	0.430	0.430	0.600	0.542	0.442	0.491
	(0.375)	(0.406)	(0.400)	(0.385)	(0.363)	(0.390)
# of non-SIB lenders	0.066†	0.066	0.069	0.065†	0.057	0.029
	(0.035)	(0.041)	(0.046)	(0.037)	(0.036)	(0.034)
Real GDP PPP growth (%)	-0.008	-0.008		-0.008	-0.014	-0.002
	(0.036)	(0.042)		(0.029)	(0.036)	(0.037)
Feed-in tariff (2010 USD/kWh)	1.80**	1.80**	2.28†	1.63†	1.97**	1.76**
	(0.578)	(0.623)	(1.21)	(0.989)	(0.719)	(0.583)
I(Any public sponsor)	0.148	0.148	0.009	0.160	0.241	0.171
	(0.257)	(0.248)	(0.293)	(0.287)	(0.270)	(0.271)
I(Term loan)	1.29***	1.29***	1.47***	1.28***	1.18***	1.30***
	(0.284)	(0.275)	(0.425)	(0.272)	(0.313)	(0.271)
I(First-3 deal)	0.160	0.160	0.088	-0.134	0.275	0.049
	(0.265)	(0.281)	(0.431)	(0.386)	(0.292)	(0.285)
Tech = Biomass&Waste	1.19***	1.19***	1.50***		1.28***	1.34***
	(0.304)	(0.352)	(0.445)		(0.324)	(0.304)
Tech = PV	-0.903**	-0.903***	-0.961*		-0.791**	-0.882**
	(0.278)	(0.199)	(0.393)		(0.286)	(0.283)
Tech = SmallHydro	1.10	1.10*	1.58†		0.197	1.18
	(0.678)	(0.490)	(0.890)		(0.989)	(0.724)
Tech = CSP	0.577	0.577	-0.009		0.402	0.832
	(0.541)	(0.396)	(0.827)		(0.593)	(0.572)
Tech = Offshore	1.26†	1.26*	1.57		1.24†	1.80***
	(0.648)	(0.508)	(1.11)		(0.709)	(0.447)
Tech = Geothermal	0.706	0.706†	0.928		0.546	0.733
	(0.510)	(0.390)	(0.636)		(0.814)	(0.499)
I(Tech matured) × Tech = Onshore	-0.314	-0.314	-0.424	-0.505	-0.305	-0.315
	(0.326)	(0.251)	(0.407)	(0.440)	(0.349)	(0.320)
I(Tech matured) × Tech = PV	-0.704**	-0.704*	-0.749*	-0.713*	-0.886***	-0.712**
	(0.219)	(0.309)	(0.339)	(0.314)	(0.208)	(0.240)
# of sponsors					0.041	
					(0.098)	
CCPI Overall Score (0-100)					-0.010	
					(0.016)	
Long-term interest rate (%)					-0.071	
					(0.071)	
Country Bank Z-score					0.010	
					(0.043)	
Gov. expenditures (% of GDP)					-0.189	
					(0.165)	
Primary balance (% of GDP)					-0.107*	
					(0.051)	
Country FEs	Yes	Yes		Yes	Yes	Yes
Closing year FEs	Yes	Yes			Yes	Yes
Country-Closing year FEs			Yes			
Tech-Closing year FEs				Yes		
Observations	4,600	4,600	3,149	4,496	4,407	4,466
Pseudo R^2	0.284	0.284	0.338	0.305	0.291	0.292
BIC	2,362.1	2,362.1	2,868.9	2,627.2	2,237.9	2,324.7

*Signif. Codes: ***: 0.001, **: 0.01, *: 0.05,* † : 0.1

Table 13: Main specification results using the bias-corrected FE estimator by Fernández-Val & Weidner (2016)

	Main	Main	Excl. solo-lending	Excl. solo-lending
ln(Capacity in MW)	0.466^{***}	0.472^{***}	0.526^{***}	0.527^{***}
	(0.057)	(0.058)	(0.077)	(0.078)
I(Cap. in 1st decile - onshore & PV only)	0.214	0.214	0.421	0.419
	(0.295)	(0.293)	(0.357)	(0.358)
# of non-SIB lenders	-0.101^{***}	-0.101^{***}	$0.064^{\dagger}$	$0.064^{\dagger}$
	(0.028)	(0.029)	(0.034)	(0.034)
Real GDP PPP growth (%)	−0.030	−0.029	−0.008	−0.007
	(0.034)	(0.035)	(0.034)	(0.035)
Feed-in tariff (2010 USD/kWh)	1.412^{***}	1.255^{**}	1.833^{***}	1.764^{**}
	(0.418)	(0.462)	(0.513)	(0.551)
I(Any public sponsor)	$0.413^{\dagger}$	$0.418^{\dagger}$	0.141	0.147
	(0.249)	(0.253)	(0.244)	(0.247)
I(Term loan)	0.773^{**}	0.714^{**}	1.291^{***}	1.266^{***}
	(0.261)	(0.250)	(0.285)	(0.270)
I(First-3 deal)	0.121	0.104	0.151	0.148
	(0.216)	(0.215)	(0.256)	(0.255)
Tech = Biomass&Waste	1.419^{***}	1.539^{***}	1.124^{***}	1.169^{***}
	(0.266)	(0.269)	(0.285)	(0.294)
Tech = PV	-0.681^{***}	$-0.393^{\dagger}$	-1.020^{***}	-0.891^{***}
	(0.163)	(0.213)	(0.180)	(0.268)
Tech = SmallHydro	1.380^{*}	1.456^{*}	1.030	1.062
	(0.670)	(0.669)	(0.652)	(0.655)
Tech = CSP	1.113^{**}	1.350^{**}	0.432	0.549
	(0.391)	(0.422)	(0.459)	(0.515)
Tech = Offshore	2.519^{***}	2.651^{***}	$1.166^{\dagger}$	1.216^{*}
	(0.646)	(0.652)	(0.599)	(0.614)
Tech = Geothermal	0.790	$0.867^{\dagger}$	0.676	0.700
	(0.505)	(0.511)	(0.482)	(0.492)
I(Tech matured - onshore & PV only)	$-0.364^{\dagger}$		-0.473^{*}	
	(0.211)		(0.193)	
I(Tech matured) × Tech = PV		-0.849^{***}		-0.700^{***}
		(0.239)		(0.212)
I(Tech matured) × Tech = Onshore		0.034		−0.308
		(0.298)		(0.316)
Country FEs	Yes	Yes	Yes	Yes
Closing year FEs	Yes	Yes	Yes	Yes
Observations	4797	4797	4600	4600

$^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$; $^{\dagger}p < 0.1$

Table 14: Main specification results excl. countries with less than 25 obs. (Colombia, Costa Rica, Denmark, Estonia, Iceland, Israel, Latvia, Lithuania, New Zealand, Norway, Slovakia, Slovenia, Switzerland)

	I(SIB lending)			
	(1)	(2)	(3)	(4)
ln(Capacity in MW)	0.467***	0.473***	0.532***	0.534***
	(0.061)	(0.061)	(0.082)	(0.082)
I(Cap. in 1st decile - onshore & PV only)	0.211	0.210	0.420	0.419
	(0.313)	(0.311)	(0.377)	(0.378)
# of non-SIB lenders	-0.094**	-0.094**	0.069*	0.068*
	(0.029)	(0.030)	(0.035)	(0.035)
Real GDP PPP growth (%)	-0.028	-0.026	-0.009	-0.008
	(0.038)	(0.039)	(0.036)	(0.037)
Feed-in tariff (2010 USD/kWh)	1.53***	1.39**	1.96***	1.89***
	(0.419)	(0.466)	(0.516)	(0.555)
I(Any public sponsor)	0.394	0.402	0.129	0.135
	(0.274)	(0.279)	(0.252)	(0.256)
I(Term loan)	0.713**	0.658*	1.29***	1.27***
	(0.269)	(0.259)	(0.306)	(0.291)
I(First-3 deal)	0.112	0.092	0.198	0.192
	(0.254)	(0.256)	(0.282)	(0.282)
Tech = Biomass&Waste	1.38***	1.50***	1.12***	1.16***
	(0.277)	(0.280)	(0.297)	(0.305)
Tech = PV	-0.711***	-0.438*	-1.05***	-0.923***
	(0.165)	(0.212)	(0.182)	(0.270)
Tech = SmallHydro	1.34†	1.41†	1.04	1.07
	(0.763)	(0.759)	(0.683)	(0.685)
Tech = CSP	0.918*	1.15**	0.190	0.309
	(0.380)	(0.409)	(0.431)	(0.491)
Tech = Offshore	2.45***	2.58***	1.17†	1.22†
	(0.695)	(0.700)	(0.636)	(0.649)
Tech = Geothermal	0.598	0.676	0.512	0.540
	(0.482)	(0.487)	(0.486)	(0.494)
I(Tech matured - onshore & PV only)	-0.416†		-0.495*	
	(0.217)		(0.199)	
I(Tech matured) × Tech = Onshore		-0.033		-0.333
		(0.302)		(0.321)
I(Tech matured) × Tech = PV		-0.872***		-0.714**
		(0.248)		(0.221)
Country FEs	Yes	Yes	Yes	Yes
Closing year FEs	Yes	Yes	Yes	Yes
Observations	4,716	4,716	4,553	4,553
Pseudo R^2	0.254	0.256	0.284	0.285
BIC	2,944.0	2,944.7	2,297.2	2,304.6

Clustered (Closing year) standard-errors in parentheses
*Signif. Codes: ***: 0.001, **: 0.01, *: 0.05,* † : 0.1

B.2 Average marginal effects

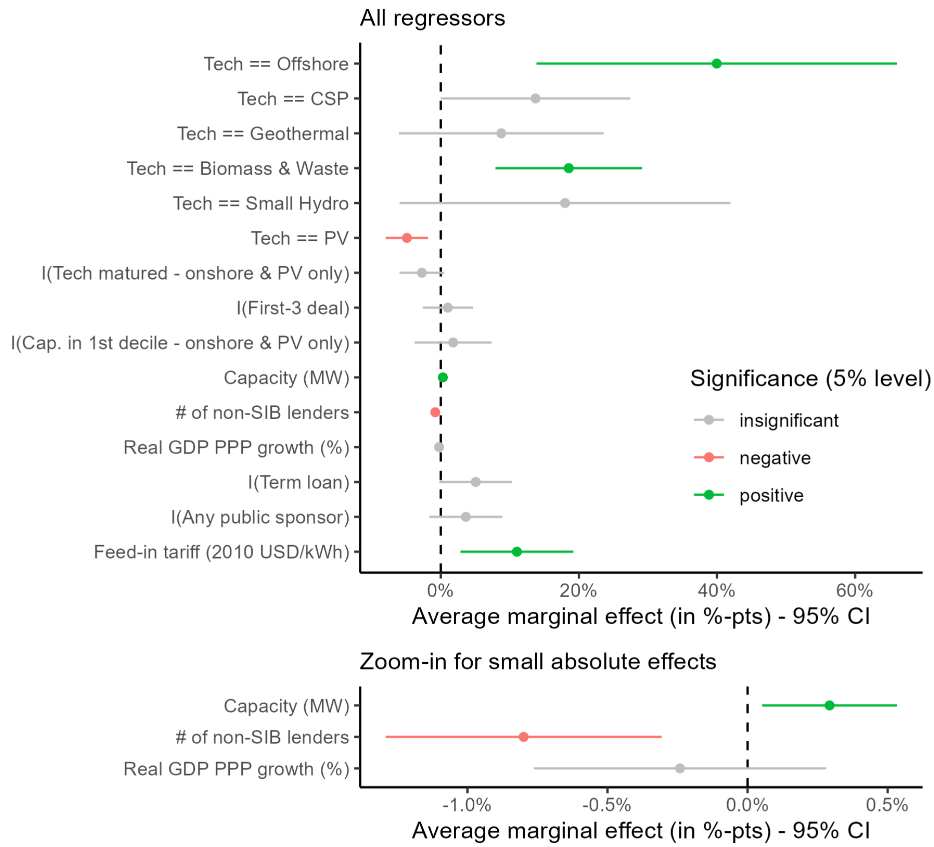


Figure 5: Average marginal effects for our main specification (Table 4, column 3)

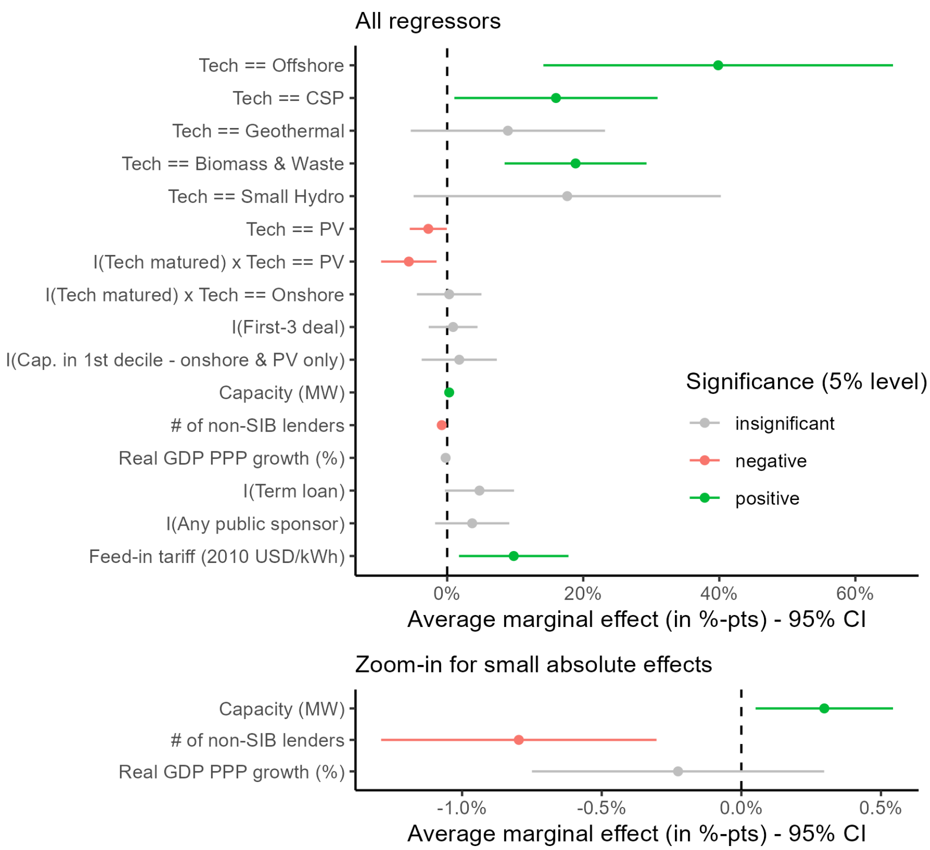


Figure 6: Average marginal effects for our main specification interacting technology FEs with technology maturity (Table 4, column 4)

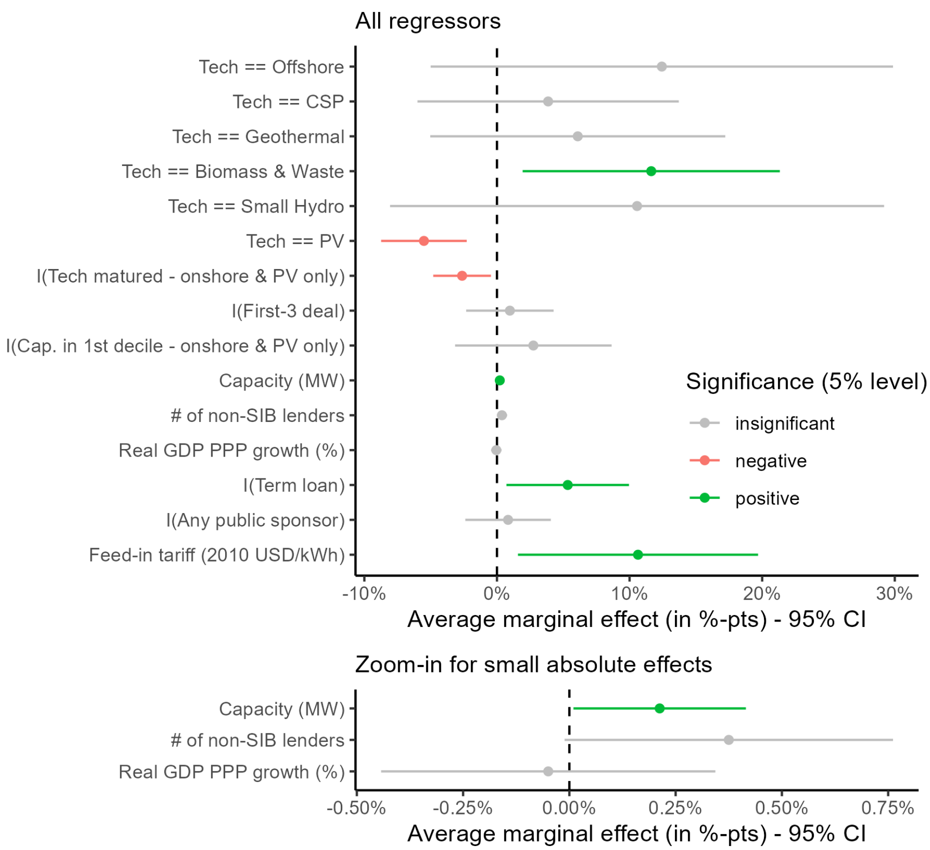


Figure 7: Average marginal effects for our main specification if deals with SIBs as the only lender(s) are omitted (Table 6, column 2)

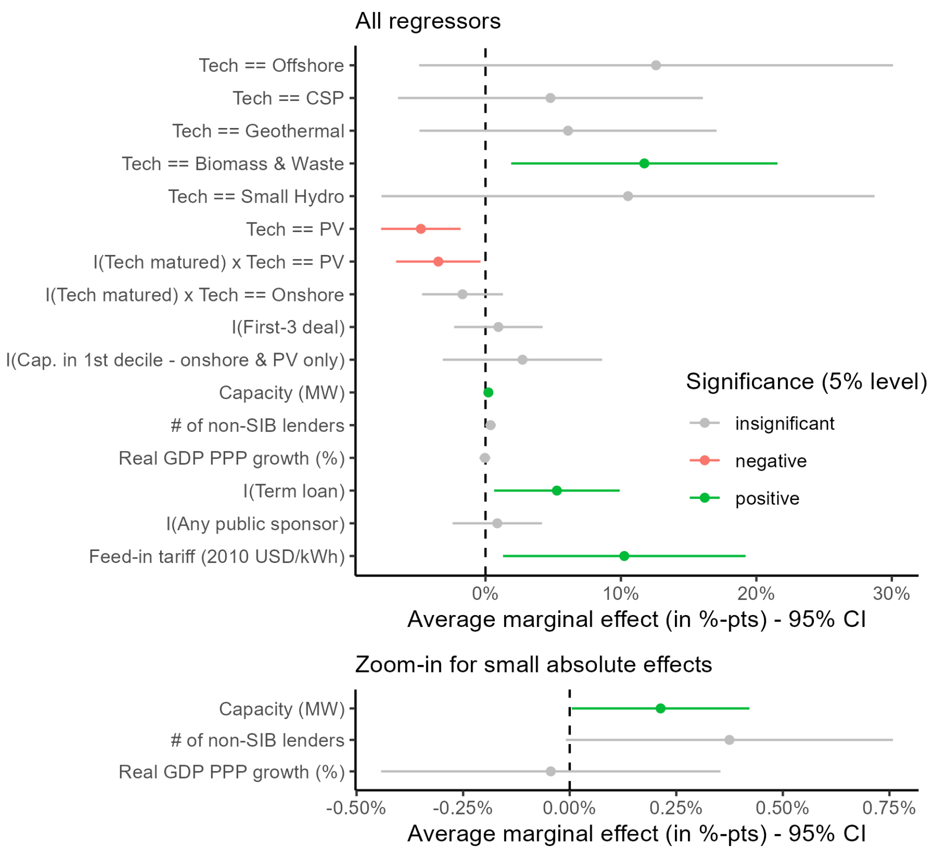


Figure 8: Average marginal effects for our main specification interacting technology FEs with technology maturity if deals with SIBs as the only lender(s) are omitted (Table 6, column 3)

B.3 Effect heterogeneity

Note that for all interaction terms displayed in this section, we omit all terms that would result in perfect separation.

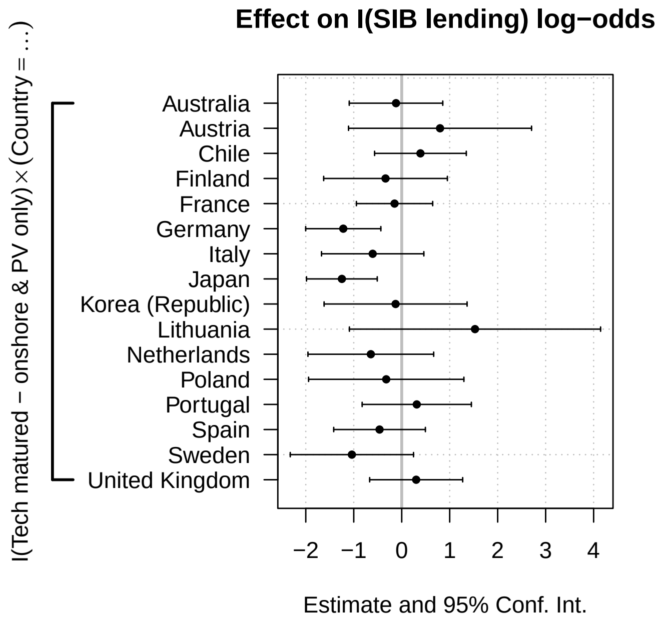


Figure 9: Impact of the maturity dummy (for wind and solar PV only) by country using the specification in Table 4, column 3

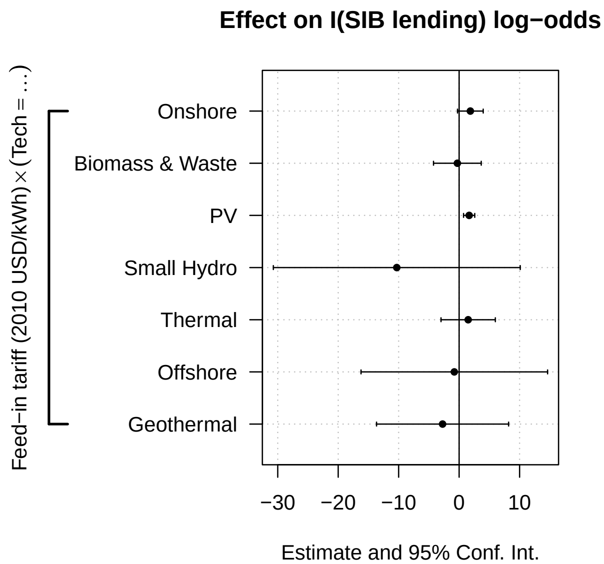


Figure 10: Impact of the feed-in tariff on I(SIB lending) by RE technology using the specification in Table 4, column 3

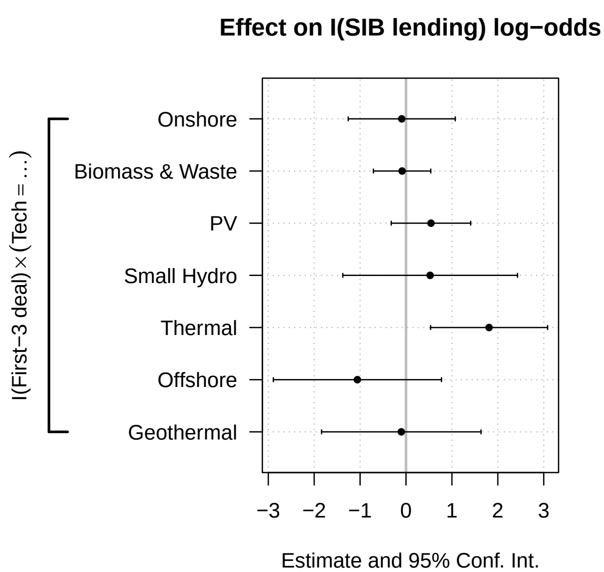


Figure 11: Effect of I(First-3 deal) differentiated by technology using the specification in Table 4, column 3

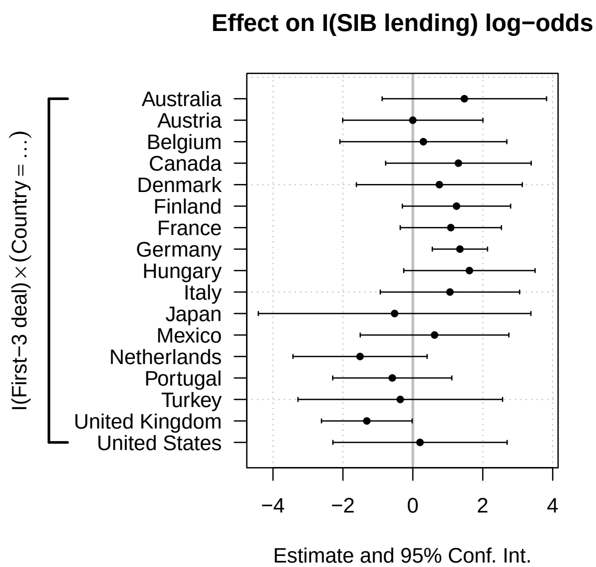


Figure 12: Effect of I(First-3 deal) differentiated by country using the specification in Table 4, column 3

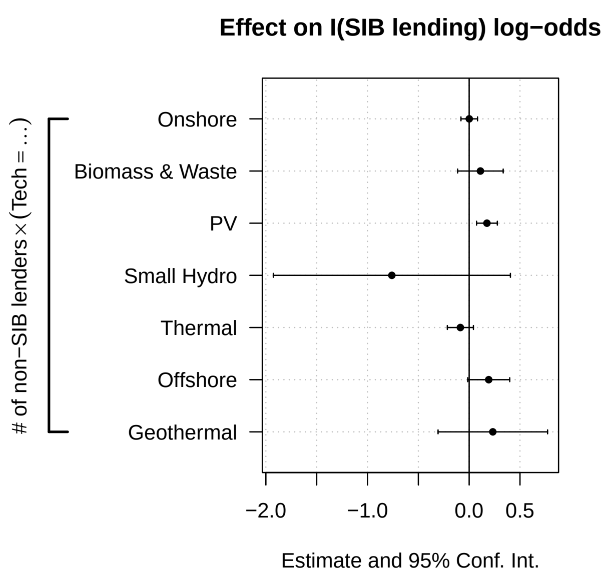


Figure 13: Coefficient for number of non-SIB lenders differentiated by technology using the specification in Table 4, column 3

C Additional visualizations and tables

Table 15: Regressing GDP growth on year FEs

	Real GDP PPP growth (%) (1)
Closing year = 2004	3.71***
	(0.670)
Closing year = 2005	3.08***
	(0.692)
Closing year = 2006	4.17***
	(0.615)
Closing year = 2007	4.48***
	(0.571)
Closing year = 2009	-4.07***
	(0.525)
Closing year = 2010	3.03***
	(0.525)
Closing year = 2011	3.00***
	(0.516)
Closing year = 2012	1.01†
	(0.547)
Closing year = 2013	1.42**
	(0.536)
Closing year = 2014	2.52***
	(0.536)
Closing year = 2015	3.25***
	(0.559)
Closing year = 2016	2.35***
	(0.516)
Closing year = 2017	3.13***
	(0.506)
Closing year = 2018	2.82***
	(0.497)
Closing year = 2019	2.00***
	(0.489)
Closing year = 2020	-4.35***
	(0.536)
Closing year = 2021	6.26***
	(0.536)
Observations	435
Pseudo R^2	0.127
BIC	2,163.4

IID standard-errors in parentheses
*Signif. Codes: ***: 0.001, **: 0.01, *: 0.05, †: 0.1*

Table 16: Regressing SIB lending on dummy indicating missing values in key regressors (FiT, financed generation capacity, public sector sponsor)

	I(SIB lending)
	(1)
(Intercept)	-2.05***
	(0.063)
has_missingnessTRUE	0.177
	(0.298)
Observations	4,999
Pseudo R^2	0.0001
BIC	3,572.4

Clustered (Closing year) standard-errors in parentheses
*Signif. Codes: ***: 0.001, **: 0.01, *: 0.05, †: 0.1*

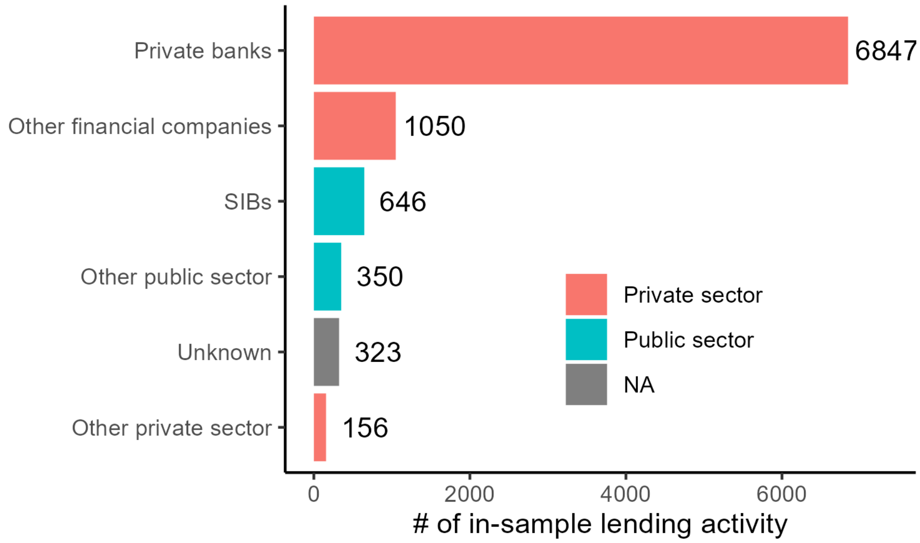


Figure 14: In-sample deal activity by lender type.
Note: Displayed numbers count the # of lender appearances of all organizations that fall into the respective category.

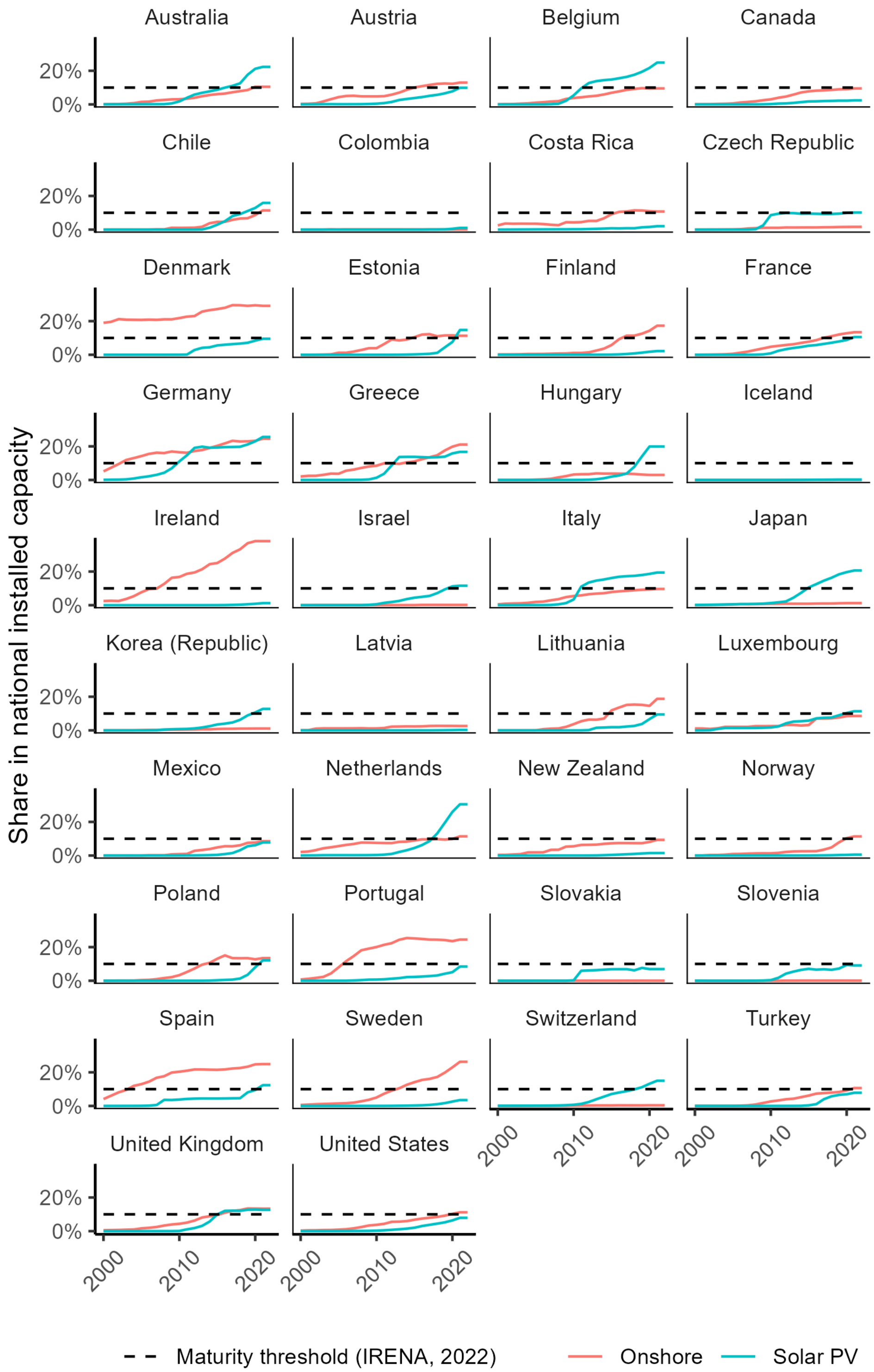


Figure 15: Capacity shares for onshore wind and solar PV using IRENA data

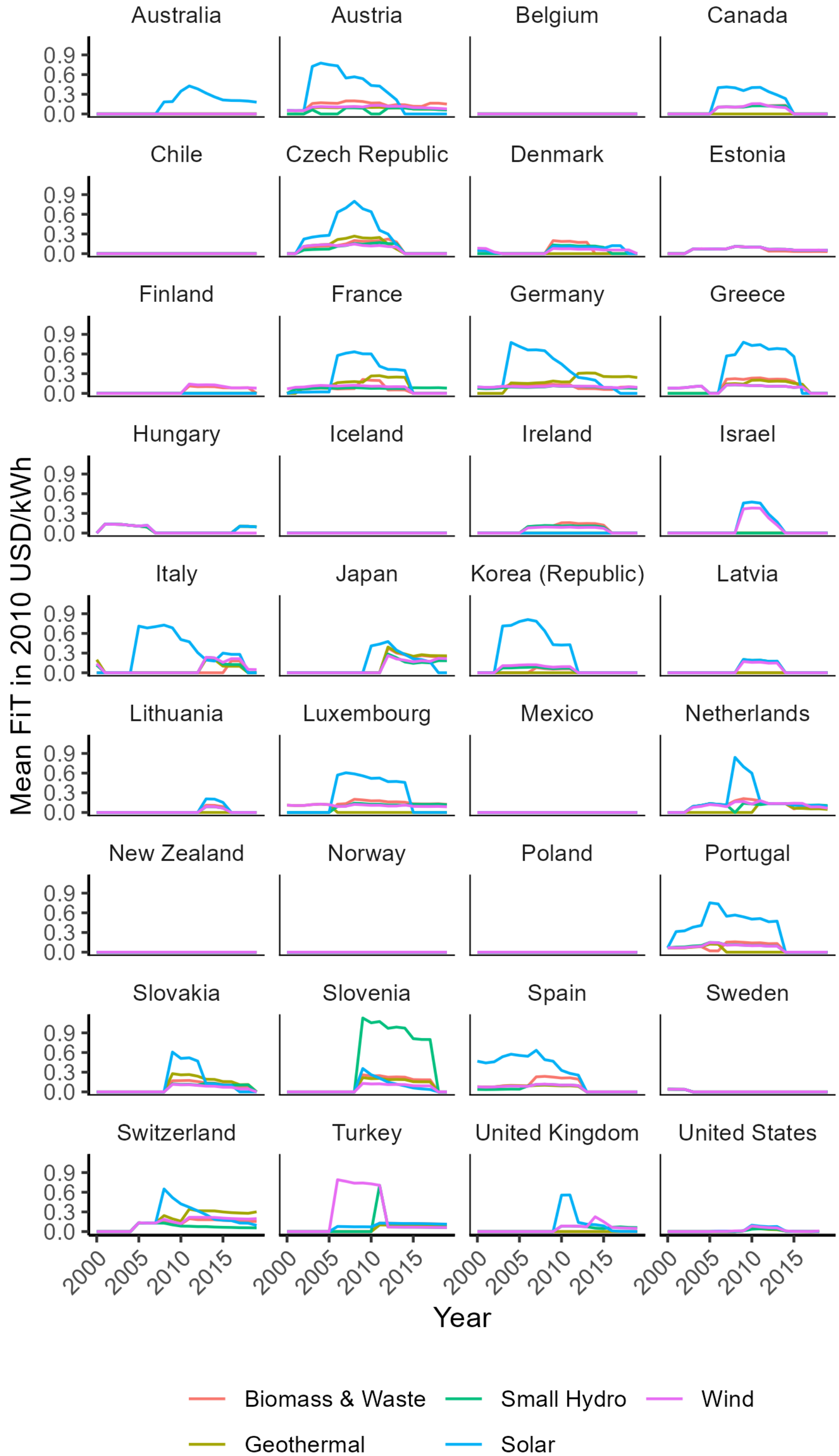
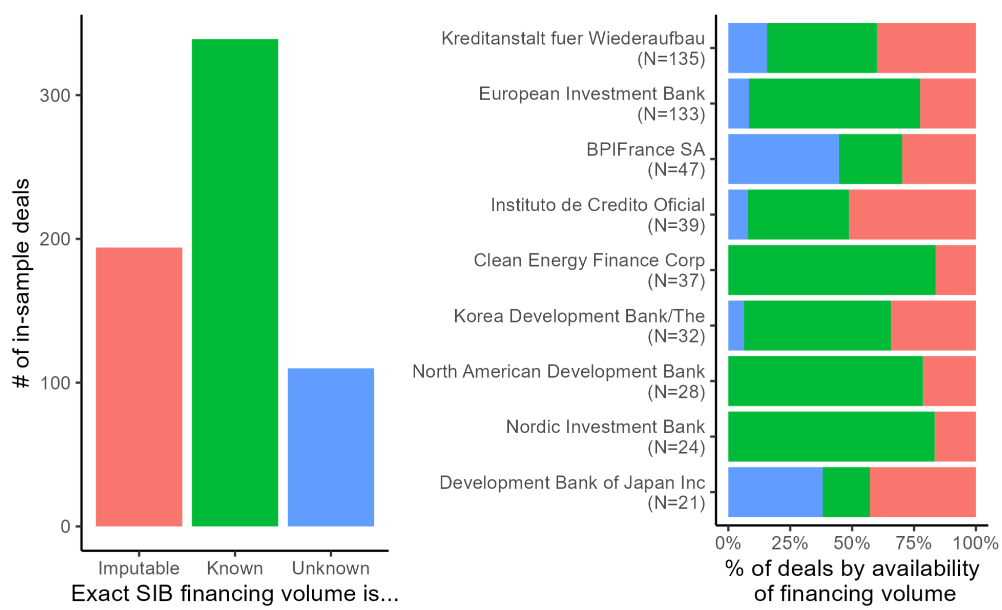


Figure 16: Feed-in tariffs in OECD countries (no data available for Colombia and Costa Rica)

D Imputation & analysis of SIB loan volumes

While the BNEF database does not contain variables on the loan volumes by individual lenders, it features text descriptions for each deal which, in some cases, allow to derive how much money was provided by the SIB(s) involved. Even where this is not the case, it is possible to impute the SIB loan financing by allocating the total debt volume, if available, equally across the different lenders involved. Where the total debt volume is unknown, no such imputation can be carried out. Figure 17 displays the number of deals based on whether SIB financing volumes can be derived from the data, can be imputed, or remain unknown—for the overall data and for the ten most active SIBs in our sample. Volumes are known for more than half of the sample, while the share of deals with volumes that cannot even be imputed is less than 20%.

Figure 17: Availability of information on debt-financing volumes provided by SIBs



To investigate how appropriate allocating total debt equally across lenders is, Figure 18 displays such a "hypothetical share of SIBs" against their actual share based on the deals for which SIB loan volumes are known including OLS regression lines, distinguishing between the European Investment Bank (EIB) and other SIBs. This is because the EIB typically accounts for a much higher share compared to the simple $1/N$ assumption. For the remaining SIBs, the assumption is more accurate, although, on average, SIBs account for a higher share. Therefore, we conclude that the $1/N$ assumption is a rather conservative approach to impute SIB financing volumes—however, the significant variation in Figure 18 shows that such simplifying assumptions are likely to introduce considerable distortions into the regression analysis.

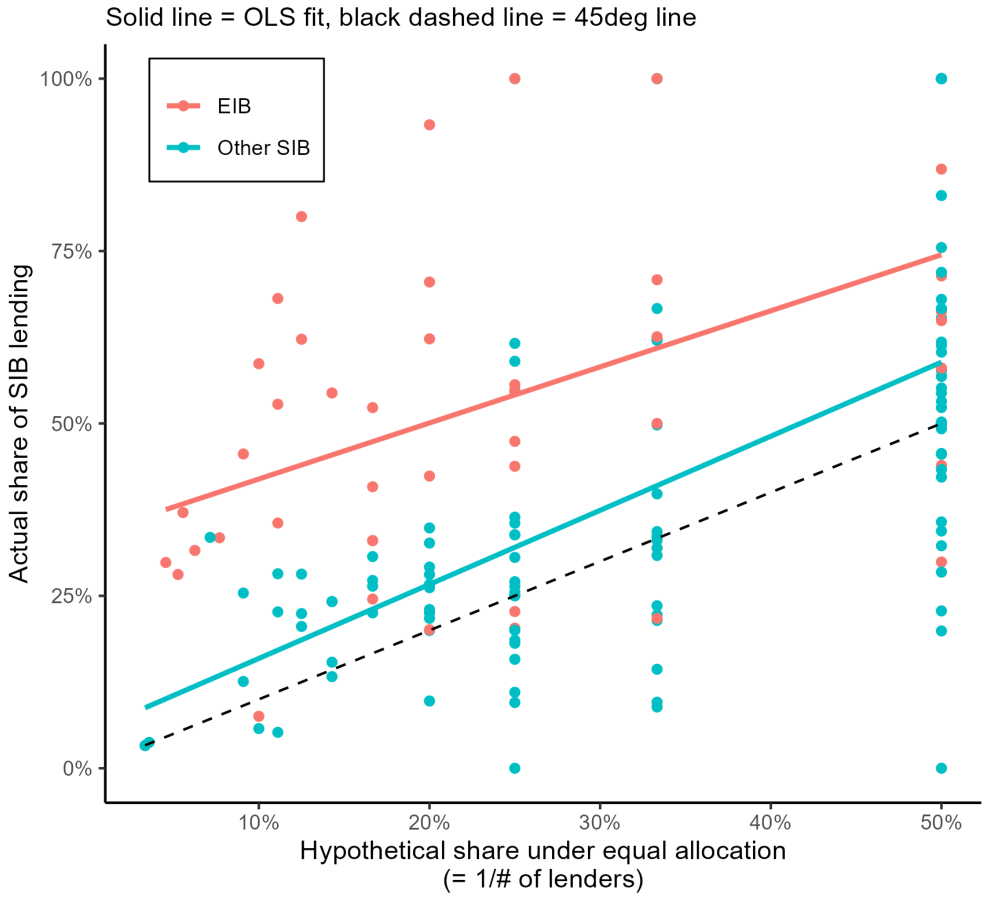


Figure 18: Actual SIB shares versus hypothetical shares under equal allocation across lenders

Instead of analysing the categorical variable of whether a deal involved SIB lending, the derived SIB loan volumes can be used to analyze if findings differ if we use the share of SIB lending in the total debt provided (on a scale between 0–1) as an alternative dependent variable. Table 17 displays the results from our main Table 4 if we instead regress SIBs' lending share in a model for fractional dependent variables suggested by Papke and Wooldridge (1996), imputing the dependent variable with $1/N$ for all SIB-involving deals for which the exact SIB loan volume is not known. Table 18 shows the results for the same regressions if we instead omit all SIB-involving deals for which SIB loan volumes are not known and which would require imputation.

Table 17: Regression results for the share of SIB lending in total debt (fractional response), imputing unknown shares with 1/(# of lenders)

	SIB share in total debt (0-1)			
	(1)	(2)	(3)	(4)
(Intercept)	-4.28***			
	(0.513)			
ln(Capacity in MW)	0.572***	0.539***	0.430***	0.438***
	(0.051)	(0.054)	(0.050)	(0.051)
I(Cap. in 1st decile - onshore & PV only)	-0.096	-0.040	-0.063	-0.075
	(0.304)	(0.331)	(0.306)	(0.302)
# of non-SIB lenders	-0.850***	-0.749***	-0.793***	-0.788***
	(0.158)	(0.141)	(0.124)	(0.125)
Real GDP PPP growth (%)	-0.019	-0.024	-0.027	-0.024
	(0.022)	(0.029)	(0.032)	(0.032)
Feed-in tariff (2010 USD/kWh)	0.308	-0.651	0.846	0.605
	(0.370)	(0.529)	(0.555)	(0.578)
I(Any public sponsor)	0.843***	0.717***	0.587*	0.600*
	(0.214)	(0.205)	(0.250)	(0.259)
I(Term loan)	0.927**	0.562†	0.573†	0.486
	(0.287)	(0.307)	(0.310)	(0.299)
I(First-3 deal)	1.21***	0.962***	0.083	0.061
	(0.185)	(0.190)	(0.266)	(0.263)
Tech = Biomass&Waste			1.27***	1.45***
			(0.295)	(0.291)
Tech = PV			-0.526**	-0.114
			(0.189)	(0.205)
Tech = SmallHydro			1.35*	1.48*
			(0.568)	(0.576)
Tech = CSP			1.36**	1.62***
			(0.444)	(0.452)
Tech = Offshore			3.22***	3.42***
			(0.944)	(0.933)
Tech = Geothermal			0.967†	1.08†
			(0.575)	(0.580)
I(Tech matured - onshore & PV only)			-0.232	
			(0.193)	
I(Tech matured) × Tech = Onshore				0.358
				(0.279)
I(Tech matured) × Tech = PV				-0.915***
				(0.258)
Country FEs		Yes	Yes	Yes
Closing year FEs		Yes	Yes	Yes
Observations	4,841	4,797	4,797	4,797
Pseudo R^2	0.402	0.447	0.474	0.477
BIC	1,482.8	1,754.1	1,751.3	1,751.6

Clustered (Closing year) standard-errors in parentheses
*Signif. Codes: ***: 0.001, **: 0.01, *: 0.05,* † : 0.1

Table 18: Regression results for the share of SIB lending in total debt (fractional response), omitting deals with unknown SIB share

	SIB share in total debt (0-1)			
	(1)	(2)	(3)	(4)
(Intercept)	-4.96***			
	(0.801)			
ln(Capacity in MW)	0.703***	0.676***	0.553***	0.560***
	(0.077)	(0.087)	(0.097)	(0.096)
I(Cap. in 1st decile - onshore & PV only)	-0.198	-0.135	-0.070	-0.074
	(0.457)	(0.506)	(0.473)	(0.464)
# of non-SIB lenders	-1.09***	-0.909***	-0.900***	-0.901***
	(0.242)	(0.201)	(0.180)	(0.182)
Real GDP PPP growth (%)	-0.022	-0.017	-0.036	-0.034
	(0.028)	(0.044)	(0.045)	(0.046)
Feed-in tariff (2010 USD/kWh)	0.373	-1.27	0.775	0.707
	(0.621)	(0.856)	(1.02)	(1.05)
I(Any public sponsor)	0.611**	0.580**	0.429	0.449
	(0.219)	(0.214)	(0.300)	(0.310)
I(Term loan)	0.915*	0.510	0.519	0.457
	(0.456)	(0.470)	(0.480)	(0.478)
I(First-3 deal)	1.46***	1.04***	0.133	0.117
	(0.218)	(0.219)	(0.316)	(0.313)
Tech = Biomass&Waste			1.63***	1.77***
			(0.329)	(0.320)
Tech = PV			-0.609**	-0.311
			(0.209)	(0.240)
Tech = SmallHydro			1.46*	1.56*
			(0.665)	(0.677)
Tech = CSP			1.18*	1.35*
			(0.558)	(0.551)
Tech = Offshore			3.44***	3.60***
			(0.974)	(0.977)
Tech = Geothermal			1.25†	1.34†
			(0.754)	(0.760)
I(Tech matured - onshore & PV only)			-0.128	
			(0.253)	
I(Tech matured) × Tech = Onshore				0.277
				(0.319)
I(Tech matured) × Tech = PV				-0.650*
				(0.327)
Country FEs		Yes	Yes	Yes
Closing year FEs		Yes	Yes	Yes
Observations	4,573	4,476	4,476	4,476
Pseudo R^2	0.327	0.404	0.441	0.444
BIC	1,144.9	1,378.9	1,378.7	1,383.4

Clustered (Closing year) standard-errors in parentheses
*Signif. Codes: ***: 0.001, **: 0.01, *: 0.05,* † : 0.1

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