BANKS' SPECIALIZATION AND PRIVATE INFORMATION

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Abstract

We document the geographical and sectoral specialization of banks' lending activities using comprehensive data on the universe of loans to corporate borrowers in Spain. Our analysis highlights how specific sources of specialization are more relevant for evaluating different types of borrowers. Specifically, loans to micro- and small firms exhibit reduced probabilities of default in local markets where banks specialize, whereas loans to medium-sized and large firms experience lower probabilities of default in sectors in which banks specialize. Crucially, we provide the first evidence of a direct link between bank specialization and better quality private information held by banks, by leveraging confidential data on banks' private risk assessments reported to regulators. We corroborate and benchmark our findings by comparing them to those obtained analyzing relationship lending, a well-established proxy for firm-specific private information.

Keywords: bank lending, bank specialization, financial stability, probability of default, private information.

JEL classification: D82, E58, G21, G32, L10.

Resumen

Este trabajo documenta la especialización geográfica y sectorial de la actividad crediticia de las entidades bancarias, a partir de datos exhaustivos sobre el universo de préstamos a empresas en España. El análisis muestra que distintas fuentes de especialización resultan relevantes según el tipo de prestatario. En particular, los préstamos a microempresas y pequeñas empresas presentan menores probabilidades de impago en mercados locales donde los bancos están especializados, mientras que los préstamos a empresas medianas y grandes registran menores probabilidades de impago en sectores en los que las entidades están especializadas. De modo decisivo, se aporta evidencia directa de la relación entre la especialización bancaria y una mayor calidad de la información privada de los bancos, utilizando datos confidenciales sobre las evaluaciones internas de riesgo que reportan a los supervisores. Los resultados se contrastan y contextualizan mediante su comparación con los obtenidos a partir del análisis del crédito relacional, una medida ampliamente utilizada de información privada específica de las relaciones banco-empresa.

Palabras clave: crédito bancario, especialización bancaria, estabilidad financiera, información privada, probabilidades de impago.

Códigos JEL: D82, E58, G21, G32, L10.

1 Introduction

A long-standing view in financial economics is that banks, by obtaining information, play a crucial role in screening and monitoring borrowers (Leland and Pyle, 1977; Diamond, 1984). Beyond non-transferable firm-specific information, lending to firms with shared characteristics can enable banks to learn and acquire information useful for evaluating similar firms. By disproportionately lending along certain dimensions, such as geographical markets and sectors, banks can specialize their lending activities (Loutskina and Strahan, 2011; Paravisini et al., 2023; Blickle et al., 2023). This specialization can help banks develop local market- or sector-specific expertise and skills, enhancing their ability to perform more accurate corporate risk assessments. Given that firms differ in the sources of information more relevant to assess their future performance and default, we argue that different types of specialization might be more relevant for different types of firms. In this paper, we provide evidence on the differential relevance of banks' local and sector specialization for the loan default of firms of different sizes, with a particular emphasis on local specialization as a less explored dimension of bank specialization. Importantly, we also provide the first direct link between specialization and enhanced banks' private information.

Our findings underscore the relevance of diverse forms of bank specialization for loan defaults across different types of firms. Specifically, we observe that loans granted to micro and small firms by banks specializing in their local markets exhibit lower probabilities of default, an effect not observed for medium and large firms. Conversely, loans granted to medium and large firms by banks specializing in their sector present lower probabilities of default, an effect not observed in micro and small firms. These results are in line with the varying nature of information needed to evaluate different types of firms. We link these differential loan default patterns to banks' information, providing direct evidence on the relationship between specialization and banks' private information. We lever regulatory information on banks' reported firms' probability of default (PD) and document that, for a given micro or small firm the predictive ability of locally specialized banks' PD surpasses that of non-locally specialized banks' PD. In contrast, for a given medium or large firm, sector-specialized banks' PD exhibit greater predictive ability compared to non-sectoral specialized banks' PD.

One key reason why private information obtained through local specialization may be more beneficial for banks in screening and monitoring smaller firms located in the same municipality is that these firms might be more susceptible to idiosyncratic local shocks or changes in the local competitive environment, given their plausible limited local diversification of activities, suppliers, and customers. Consequently, banks with local information

advantages can better anticipate and evaluate the effects of such type of shocks and changes may have on firms, which might be particularly relevant for the smaller ones. Additionally, since we use the firm's headquarter location—defined as its registered headquarter or where the management and direction of its activities are centralized—this municipality is more likely to be closely linked to the overall activity of micro and small firms. In contrast, sector specialization may be more beneficial for screening and monitoring larger firms within the same sector. These firms are likely to be more susceptible to sector-wide shocks, such as fluctuations in raw material prices or sector-specific regulatory adjustments. Additionally, any local shock might be easier to diversify given their exposure to multiple other markets.

To conduct our analyses, we use confidential data from the Spanish Credit Register (CIR) on the universe of Commercial and Industrial (C&I) loans granted in Spain by nearly 100 banks to over 700,000 active firms. This dataset enables us to observe the comprehensive set of loans extended to firms of all sizes in a bank-dependent economy, including micro and small firms, which are the backbone of several European economies. These firms constitute 95% of total non-financial firms in Spain and account for approximately 42% of total employment, according to the Integrated Directory of the Bank of Spain. As of June 2024, micro and small firms represent 39% of total outstanding lending in Spain.

We first document how banks specialize geographically across municipalities, what we refer to as local specialization, and also highlight its persistence over time.[1] Approximately 30% to 40% of their lending is concentrated in their top municipality and around 10% to 15% is focused in their second municipality. While these percentages are somewhat lower when measured using over-investment, defined as the excess specialization beyond what would be expected under full diversification, they remain comparable in magnitude.[2] We construct the specialization variable as the ratio of a bank's outstanding corporate lending in a given municipality and period to its total corporate lending in that period. To address concerns that this measure may be influenced by large exposures to individual firms, we

[1]Our primary definition of a local banking market in Spain is a municipality, which is also used in studies analyzing the competitive implications of mergers and acquisitions by the competent Spanish authority, the Comisión Nacional de los Mercados y la Competencia (CNMC). Additionally, we consider provinces as an alternative local market definition, as also used in these types of studies, and report in our robustness tests that our findings remain consistent. While the two measures of local specialization are highly correlated, Table A4 in the appendix shows that the negative relationship between local specialization in municipalities and loan default persists even after including bank-province-time fixed effects. These fixed effects account for both observable and unobservable time-varying factors specific to each bank-province pair, such as the degree of bank specialization in a given province. Although the statistical significance of the relationship is reduced under this specification, the effect remains.

[2]While our estimation strategy helps mitigate concerns regarding the size of the municipality or sector, we show in the Appendix that our results remain robust to changes in our definition of bank specialization. This includes considering excess specialization that directly accounts for the size of municipalities and sectors, among other specifications.

show in the Appendix that our results remain robust when excluding the focal firm from the specialization calculation. Similarly, banks specialize in specific sectors, with approximately 30% to 40% of their lending concentrated in their top sector and around 20% in their second sector. We categorize sectors using the 21 distinct classifications outlined by the statistical classification of economic activities in the European Community (NACE). Both local and sector specialization variables exhibit persistence over time, as evidenced by their high serial correlation.[3]

To illustrate the heterogeneity in banks' specialization across local markets, we examine a group of banks exhibiting high levels of over-investment—measured by local excess specialization—across various municipalities in Galicia, a region in northwestern Spain.[4] This group of banks has a degree of over-investment relative to the average of Spanish banks of 6.6% in Lugo, 3.9% in Pontevedra, and 1.7% in Redondela. This example illustrates that banks exhibit heterogeneous patterns of specialization across municipalities. Further specific examples and a detailed illustration of how banks specializes across sectors in Spain are discussed more extensively in Section 2.

We then present evidence on the relationship between the two dimensions of specialization, local markets and sectors, and loan default. We find that new loans granted to micro and small firms, which face greater financing constraints (Gertler and Gilchrist, 1994; Chodorow-Reich, 2014), are associated with lower probabilities of default in municipalities where the lending banks specialize locally. Conversely, new loans to medium and large firms exhibit lower probabilities of default in sectors where the lending banks specialize, consistent with the findings of Blickle et al. (2023). Specifically, our results estimate that a loan granted by a bank to a micro or small firm in its top municipality is 0.83 percentage points (p.p.) less likely to ever enter in default compared to other loans, while a loan to a medium or large firm in its top sector is 0.64 p.p. less likely to enter in default. Comparable economic magnitudes are observed when interpreting the results using over-investment, defined as excess specialization, with estimated reductions in default probabilities of 0.71 p.p. and 0.48 p.p., respectively.[5] These findings are economically relevant, given the average default rates of new loans in our sample: 1.7% for micro and small firms and 0.5% for medium and

[3]While sector specialization has been well-documented in prior research using U.S. data on loans larger than 1 million dollars (Blickle et al., 2023), potentially biased towards large firms, we contribute novel insights to the literature by documenting the relevance of local specialization and examining how the relationship between both dimensions of specialization and loan default varies with firm size

[4]Due to confidentiality reasons, as the data comes from the Spanish Credit Registry, we cannot disclose information about individual banks and must report information coming from a group of at least three banks.

[5]Due to the novelty of the findings regarding the relationship between banks' local specialization and the reduced default probabilities of new loans granted to micro and small firms, we present a comprehensive set of robustness tests for this result.

large firms. These estimates suggest that the nature of private information acquired through specialization—whether local or sectoral—may differ, thereby enhancing banks' ability to screen and monitor borrowers in ways that vary systematically with firm size.

To support our arguments regarding the nature of local specialization advantages, we explore sector heterogeneity by classifying sectors into three categories: non-tradable, tradable, and other, following the methodology of Mian et al. (2020). We find that the negative connection between local specialization and loan default among micro and small firms is prominent in over half of the sectors, including trade and retail and manufacturing, which together account for more than 60% of new loans during the period under consideration. Local-specific private information may be particularly useful for evaluating borrowers closely tied to local factors, such as those in non-tradable sectors like trade and repair. Interestingly, this relationship is also evident in the manufacturing sector, which is traditionally considered tradable, as well as in other sectors not classified within the primary categories. Conversely, this negative relationship between local specialization and loan default does not hold for medium and large firms in most sectors, suggesting that such private information held by banks is more relevant for evaluating micro and small borrowers, even in sectors not typically associated with local factors.[6]

Our analyses are subject to two concerns: the possibility that specialized and non-specialized banks might lend to different types of firms, and the presence of bank-specific factors such as overall lending advantages across various local markets or sectors. We mitigate these concerns by incorporating municipality-sector-size-time fixed effects, following the approach of Degryse et al. (2019), to compare the probabilities of default of new loans granted by banks with different degrees of specialization to similar firms. This also allows us to control for the size of the municipality and sector. Furthermore, we include bank-time fixed effects to compare the default probabilities of new loans granted by the same bank across different local markets or sectors where the bank has varying degrees of specialization. To account for additional potential omitted variables, we control for local and sector bank market power using market shares, plausible firm-specific information advantages using the length of previous bank-borrower relationships, and loan characteristics including the interest rate charged, loan size, whether the loan is collateralized, maturity, and loan type. While we conduct extensive robustness tests throughout the paper, which reinforce the reliability of our findings, we acknowledge that our results cannot be interpreted as causal due to the lack of exogenous variation in specialization, a common issue in the lending specialization

[6] Notably, the only sector where a negative and statistically significant association between local specialization and loan default is observed for medium and large firms is the other services sector, which had a relatively low number of new loans.

literature.

Next, we examine the connection between bank specialization and enhanced private information using confidential data on banks' private risk assessments reported to regulators.[7] While prior literature argues that banks possess lending advantages related to private information where they specialize, we provide the first direct evidence of this claim. We utilize the internal estimates of borrowers' PD reported by banks under the internal ratings-based (IRB) approach as a measure of banks' private information, following the methodology in Howes and Weitzner (2023) and Beyhaghi et al. (2024). Specifically, we focus on firms with outstanding loans from at least two banks assigning PDs within a given quarter. Given our previous results on the relevance of local specialization for micro and small firms, and sectoral specialization for medium and large firms, we evaluate the predictive accuracy of the PD assigned by the bank with the highest and lowest degree of local (sectoral) specialization. This evaluation is based on predicting one-year-ahead realized default for the same micro or small (medium or large) firm, by employing the area under the curve (AUC) (e.g., Iyer et al. (2016)).[8]

We find that PDs assigned by locally specialized banks discriminate better between defaulting and non-defaulting micro or small firms compared to PDs assigned by non-specialized banks. The AUC for the PD of the locally specialized bank is 83.38%, compared to 82.47% for the non-specialized bank. Given a randomly chosen ex-post defaulting and non-defaulting firm, the probability that the defaulting firm has a higher PD than the non-defaulting one is 0.91 p.p. higher for the locally specialized bank.[9] This difference is not only statistically significant at conventional levels but also economically important. An improvement of 0.01 in AUC is considered to be noteworthy in the credit scoring industry, as underscored by Iyer et al. (2016). Additionally, we show that sector specialization is linked to enhanced banks' private information when evaluating the credit risk of medium and large firms. Specifically, we estimate that, for a randomly selected pair of ex-post defaulting and non-defaulting firms, the probability that the sectorally specialized bank assigns a higher PD to the defaulting firm

[7] Internal estimates of PDs are available from the fourth quarter of 2021. Throughout this sample period, four major Spanish banks employed internal models to assess corporate risk. As of the second quarter of 2023, these banks accounted for approximately 68.2% of total outstanding lending and 66.4% of lending to micro and small firms. While these four major banks exhibit a lower degree of local and sector specialization compared to the full sample of banks, they still specialize their corporate lending activities both locally and sectorally. This is evidenced in Table A7 in the Appendix, where we compare the degree of local and sector specialization, using both our primary definition and the measure of excess (over-investment), across banks' top versus other municipalities and sectors.

[8] See Howes and Weitzner (2023) for further details on the application of AUC in measuring the discriminatory ability of binary outcomes, and more specifically in the context of internally estimated PDs and future realized defaults.

[9] In the Appendix, we provide evidence that this result holds to a series of robustness tests, including considering local specialization in provinces instead of municipalities as the relevant local market.

compared to the non-defaulting firm is 1.41 p.p. greater. Overall, these findings represent the first empirical evidence of improved banks' private information, using a direct measure of bank internal corporate risk assessment, linked to specialization.

Consistent with the notion that banks specializing in certain areas possess enhanced private information for screening and monitoring borrowers, we provide suggestive evidence supporting the credit supply associated with specialization. We utilize banks' requests for borrower information from the Credit Registry, which can be interpreted as loan applications (Jiménez et al., 2012). We attempt to control for loan demand by applying a within-firm estimation strategy, following a standard approach in the banking literature (Khwaja and Mian, 2008). However, we acknowledge that the underlying identifying assumption that loan demand for a given firm in a month is homogeneous across different banks might not hold in the context of bank specialization (Paravisini et al., 2023). While we control for time-varying bank-level factors and compare the likelihood of loan approval across applications submitted by the same firm in the same month to multiple banks with varying degrees of specialization, we interpret these findings as suggestive evidence due to potential remaining identification concerns. We find that an application made by a micro or small firm located in the bank's top municipality is approximately 4.3 p.p. more likely to be granted compared to other applications. Additionally, while statistical significance is not achieved at conventional levels for our preferred specification, we estimate that an application made by a medium or large firm in the bank's top sector is approximately 3.2 p.p. more likely to be granted compared to other applications.[10]

The results so far highlight the enhanced private information possessed by banks that specialize their lending activities and its plausible relationship with improved loan default probabilities. To further validate our findings, we replicate our analyses using relationship lending, proxied by the length of the relationship between banks and firms, as a well-known source of firm-specific private information for banks (Bharath et al., 2011; Claessens et al., 2024). Our analyses reveal that relationship lending is linked to reduced default probabilities of granted C&I loans, with this association being stronger for smaller firms. Moreover, comparing within the same micro or small firm, we find that banks with a longer relationship possess better private information, as their PDs have a superior predictive ability for one-year-ahead observed default compared to banks with a shorter relationship. However, this result is smaller in economic terms and not statistically significant at conventional levels for medium and large firms.[11] Lastly, when examining loan applications made by a firm

[10] In the Appendix, we show that the enhanced banks' loan supply linked to specialization does not seem to be reflected in higher interest rates on granted loans.

[11] A similar result is observed when using a firm's credit exposure to a bank as an alternative proxy for relationship lending, in line with Ongena et al. (2012) and Jiménez et al. (2022), among others.

within a month to banks with different relationship lengths, we find that applications to banks with longer relationships have a higher probability of being granted, with this effect being stronger for micro and small firms. These results enhance the validity of our findings on bank specialization and allow us to compare the benefits of enhanced private information in predicting defaults, derived from both sources. While the advantages of building a relationship with a specific firm may be more pronounced for smaller firms, transferable private information obtained through lending specialization is highly relevant, as it enables banks to evaluate multiple borrowers effectively.

The findings provided in this paper have relevant implications for the growing academic literature on the consequences and benefits of bank lending specialization. They enhance our understanding of how various dimensions of bank lending specialization impact credit risk based on firm size. Notably, the less explored dimension of local specialization is particularly relevant for smaller firms that likely face greater financing constraints. Crucially, this paper provides the first empirical evidence linking specialization to enhanced private information, utilizing confidential banks' internal credit risk assessments reported to regulators. Banks can leverage this private information to improve their screening and monitoring capabilities across multiple firms with shared characteristics, such as operating in the same local market. Consequently, these findings provide policymakers with valuable insights into the advantages of bank portfolio concentration across various dimensions, especially regarding loan defaults. Banks can leverage their improved private information during credit risk assessments to better manage and mitigate default risks.

1.1 Literature Review

Our article relates to three main strands of the literature. The first is the work on how banks specialize their lending activities in different dimensions and the lending implications associated with doing so (Degryse and Ongena, 2007; Blickle et al., 2023; Paravisini et al., 2023). Banks specialize locally and sectorally, but also in certain firm types, export markets, and collateral types (Blickle, 2022; Gopal, 2021; Duquerroy et al., 2022; Di and Pattison, 2023; Bonfim et al., 2023). Specialized banks seem to possess the capacity to offer more favorable loan conditions, including less restrictive covenants and lower spreads, and tend to invest more in information collection (Loutskina and Strahan, 2011; Berger et al., 2017b; Giometti et al., 2025). Moreover, specialization might also create spillovers into different lending markets, affect firm innovation, and reduce zombie lending (Chu et al., 2021; Degryse et al., 2024; De Jonghe et al., 2024).[12]

[12]For the implications of bank local and sector specialization and other market structure characteristics for the transmission of monetary policy or supply shocks to the economy, see Favara and Giannetti (2017),

If bank specialization is associated with enhanced expertise, technological development, or skills in evaluating projects within a particular local market or sector, as prior research has assumed (Paravisini et al., 2023; Blickle et al., 2023), banks may obtain a market- or sector-specific advantage where they specialize. We contribute to this literature by providing the first direct empirical evidence that specialization is related to banks' private information. Additionally, we show that the underlying private information related to local and sector specialization seems to have varying impacts on reducing C&I loan default probabilities and increasing loan supply, depending on firm size.

Our paper also relates to the literature on the special role of banks (Leland and Pyle, 1977; Diamond, 1984; Fama, 1985; Favara et al., 2021) and the production of private information. Banks produce information about borrowers at origination through the screening process (e.g., Agarwal and Hauswald (2010), Keys et al. (2010), Keys et al. (2012), Lisowsky et al. (2017), Hertzberg et al. (2018), Bedayo et al. (2020)) and over the life of the lending relationship due to their monitoring role (e.g., Mester et al. (2007), Cerqueiro et al. (2016), Gustafson et al. (2021), and Heitz et al. (2022)). Importantly, banks using the Internal Ratings-Based (IRB) approach employ their own models to estimate internal risk measures such as the PD (Behn et al., 2016; Dell'Ariccia et al., 2017; Berg and Koziol, 2017; Montes et al., 2018; Adelino et al., 2019; Beyhaghi et al., 2023).

These internal models require prior approval from supervisors. While prior research analyzing bank internal risk measures has reported some biases in these estimates (Begley et al., 2017; Plosser and Santos, 2018; Behn et al., 2022)), they are reported to regulators and have been used in recent research as direct measures of banks' private information (Howes and Weitzner, 2023; Beyhaghi et al., 2024).[13] These papers show that the quality of such assessments improves as local economic conditions deteriorate, and that changes in these assessments can predict firms' future outcomes, such as stock returns. To the best of our knowledge, we are the first to directly use banks' private information in the context of specialization to provide empirical evidence on the information advantages conferred by bank specialization. While Blickle et al. (2024) recently introduced a theoretical framework that concentrates on the private information banks gather from borrowers to analyze bank

Giannetti and Saidi (2019), De Jonghe et al. (2020), Giannetti and Jang (2021), Iyer et al. (2022), Izadi and Saadi (2023), Dursun-de Neef (2023), Casado and Martínez Miera (2024) and Ruzzier (2024), among others. For a discussion on the advantages and disadvantages of bank specialization, diversification, and portfolio overlap, with a focus on the ongoing debate regarding whether diversification strengthens or undermines bank stability, see Acharya et al. (2006), Goetz et al. (2013), Goetz et al. (2016), Aguirregabiria et al. (2016), Berger et al. (2017a), Cai et al. (2018), Chu et al. (2020), Doerr and Schaz (2021), Levine et al. (2021), and Gelman et al. (2023), among others.

[13] Qian et al. (2015), Nakamura and Roszbach (2018), and Becker et al. (2020) also utilize the internal risk estimates of banks, focusing on data from one or two specific banks.

lending specialization and borrower screening, no empirical evidence using a direct measure of banks' private information linked to the specialization benefits has been reported before.

Our paper also contributes to the literature on small versus large firms. Asymmetric information is presumable more pronounced for small firms, which rely more heavily on deposits and are generally less transparent. This makes them more susceptible to information frictions and more likely to experience credit supply constraints (Gertler and Gilchrist, 1994; Petersen and Rajan, 1994, 2002; Chodorow-Reich, 2014; Duygan-Bump et al., 2015; Chodorow-Reich et al., 2022).[14] We add to these works by providing evidence that the relationship between local or sector specialization and banks' private information, loan default, and loan supply varies by firm size. Local-specific information obtained through bank specialization appears to be particularly relevant for screening and monitoring micro and small firms, which face stronger financing constraints. In contrast, sector-specific information seems to be more important for medium and large firms.

Exacerbated information frictions observed in small business lending can also be alleviated by relationship lending (Berger and Udell, 1995; Ongena and Smith, 2001; Degryse and Ongena, 2005; Bolton et al., 2016; López-Espinosa et al., 2017; Puri et al., 2017). Puri et al. (2017) and Agarwal et al. (2018) provide evidence that relationship lending improves access to credit and reduces loan default probability. Additionally, Bharath et al. (2011) show that the benefits of relationship lending, particularly in terms of interest loan rates, are more relevant for small firms compared to large firms. We control for the effect of relationship lending in most of our analyses. Furthermore, our study contributes by providing evidence that relationship lending is associated with reduced loan default, enhanced banks' private information, and increased loan supply, with these effects being more pronounced for smaller firms. This empirical evidence, consistent with increased banks' private information related to relationship lending using banks' internal risk estimates, aligns with the novel findings in Claessens et al. (2024) using U.S. data, and provides further validity for our results on bank specialization.

The remainder of the paper is organized as follows. Section 2 describes the data, presents our measure of specialization, and documents how banks specialize locally and sectorally. Section 3 discusses our empirical specification and presents the results on loan default. In Section 4, we provide evidence on the link between banks' private information and specialization. Section 5 presents suggestive evidence on loan supply. Section 6 replicates prior findings using relationship lending to validate our results on specialization. Finally, Section 7 concludes.

[14] Previous studies have examined the differences in lending practices between small and large banks, see Cole et al. (2004) and Berger et al. (2005), among others.

2 Data

2.1 Data Sources & Summary Statistics

We primarily use confidential data from the Spanish Credit Register of the Banco de España (CIR). This dataset contains loan-level information granted by the universe of banks and firms operating in Spain. One of the main strengths of this data is its comprehensiveness, as it is not restricted to a subsample of banks or firms. This allows us to observe the lending behavior of institutions (banks and firms) of varying sizes. Our focus is on loans granted by domestic commercial banks, savings banks, and credit cooperatives, which account for approximately 95% of total outstanding lending as of the second quarter of 2024, to non-financial corporations.[15]

The dataset includes information on the default status of each loan, loan amount, interest rate charged, loan type, maturity, and whether the loan is collateralized. Our analysis primarily covers the period from the second quarter of 2018 to the second quarter of 2024, given the availability of the loan-level information and the interest rate charged on the loan, which is one of the main control variable used in the analysis. During the sample period, there are 97 active banks, including 35 commercial banks and 62 credit cooperatives, as well as 767,489 active non-financial firms.

Spain is a bank-dependent economy as highlighted by Jiménez et al. (2012) and Jiménez et al. (2014), among others, where micro and small firms constitute its backbone. As of the second quarter of 2024, micro and small firms represent 91% of the total number of firms (accounting for 39% of total outstanding lending), while medium and large firms make up 6% and 3% of the total number of firms (accounting for 17% and 44% of total outstanding lending), respectively.[16] Consistent with data from the Directorio Integrado del Banco de España (DIBE), micro and small firms correspond to 95% of active non-financial firms and 42% of total employment.

Table 1 presents summary statistics for new loans granted to both micro and small

[15] We exclude loans granted by non-depository institutions and foreign depository institutions, loans with multiple direct risk holders, and loans to firms operating in the financial and insurance sectors. Although mergers and acquisitions are not very relevant during our main sample period, we adjust for them by substituting the acquired entity with the acquirer at the beginning of the sample period.

[16] Firm size in the Spanish Credit Register is defined following the European Commission Recommendation (2003/361/EC) (Commission et al., 2003): Micro non-financial corporations have fewer than 10 employees and an annual turnover and/or annual total balance sheet not exceeding 2 million euros; small non-financial corporations, if not micro, have fewer than 50 employees and an annual turnover and/or total annual balance sheet not exceeding 10 million euros; medium non-financial corporations, if not small, have fewer than 250 employees and an annual turnover not exceeding 50 million euros and/or total annual balance sheet not exceeding 43 million euros; and large non-financial corporations are those that do not fall into the previous categories.

firms, as well as to medium and large firms. The unit of observation is at the loan level at origination. The average loan amount for new loans granted to micro and small firms is 49,000 euros, compared to 143,000 euros for medium and large firms. Both types of firms have a similar percentage of new loans secured by collateral (3%). However, micro and small firms have higher loan rates (4.1% versus 3.8%) and higher average maturity (6 quarters versus 3 quarters) compared to medium and large firms.

We define the variable loan default ($Default$) as a binary indicator that takes the value of 1 if the loan becomes non-performing at any point in the future, which is characterized as being overdue by 90 days or more. This status is tracked from the loan's origination until either its maturity or the end of our sample period, which concludes in the second quarter of 2024. We observe that new loans granted to micro and small firms face higher ex-post realized default (1.7% versus 0.5%) relative to those granted to medium and large firms. We compute the variable $RelLength$ as the number of quarters in which the bank-firm relationship has a positive amount of total outstanding lending, beginning from the first quarter of the year 2000. We observe that micro and small firms, when originating a new loan with a given bank, have an average relationship length of about 32 quarters, compared with 47 quarters for medium and large firms.

2.2 Measuring Specialization

Our primary measure of local specialization is calculated as the share of outstanding C&I lending granted by a given bank b in a municipality m in a quarter t, divided by the total outstanding C&I lending granted by bank b in a quarter t. This variable is defined in equation 1:

$$LocalSpec_{bmt} = \frac{A_{bmt}}{A_{bt}} \tag{1}$$

We also construct sector specialization following equation 1, using sectors instead of municipalities. This is calculated as the share of outstanding C&I lending granted by a given bank b in a sector i in a quarter t, divided by the total outstanding C&I lending granted by bank b in a quarter t. Our primary categorization of sectors follows the 21 distinct classifications outlined by the statistical classification of economic activities in the European Community (NACE), such as agriculture, forestry and fishing, mining and quarrying, trade and repair, and manufacturing. We exclude firms operating in the financial and insurance sector, thus retaining information from firms in 20 sectors.

These straightforward measures of specialization are utilized in most of our analyses. Our estimation strategy addresses significant issues related to these variables, such as the

potential influence of the size of the municipality or sector. Nevertheless, Table 4 shows that our finding on the relationship between the less-explored dimension of specialization, local specialization, and loan default remains robust across various measures of the specialization variable.

Some alternative measures are constructed in the spirit of prior research on bank lending specialization (Blickle et al., 2023; Paravisini et al., 2023). Excess specialization is calculated as the difference between the share of a bank in a municipality and the share a perfectly diversified bank would lend in the municipality, computing such share using the total outstanding C&I lending granted by all banks in the municipality over total lending across all municipalities in Spain. Specialization can also be computed using only outstanding lending granted to micro and small firms. Relative specialization is calculated as the ratio between the share of a bank in a municipality and the share a perfectly diversified bank would lend in the municipality, winsorized at the 1% level. Finally, specialization is also computed using the number instead of the amount of outstanding loans, excluding the specific firm from the specialization measure to avoid influence by relevant firms, using quartiles of the specialization variable per municipality to allow for nonlinearities, using a dummy variable for the top quartile per municipality to capture potential nonlinearities between banks highly specialized in a municipality versus the rest, and using a dummy variable for banks over the median degree of specialization within a municipality. Additionally, we use an alternative definition of a local market using provinces, a broader definition, instead of municipalities.

Lastly, we construct local (sector) market shares as the share of outstanding C&I lending granted by a given bank b in a municipality m (sector i) in a quarter t, divided by the total outstanding C&I lending granted by all banks in a given municipality m (sector i) and quarter t.

2.3 Documenting Specialization

We start by documenting that Spanish banks specialize locally, and this specialization remains persistent over time. Figure 1 shows the average unweighted and weighted degree of local specialization in the most important municipality (top municipality), the second most important municipality (second municipality), and all other municipalities. We observe that Spanish banks are highly specialized in their most important municipalities, having on average around 30% to 40% of their portfolio in their top municipality and around 10% to 15% in their second municipality, depending on whether the measure is volume-weighted. Furthermore, the average shares of local specialization in the top, second, and other municipalities remain relatively constant throughout the sample period, underscoring the persistence of

this variable over time. This persistence is further illustrated in Table A2 in the appendix, which shows the high serial correlation of this variable throughout the sample period.[17]

We also document how banks specialize in specific sectors and the persistence of this specialization over time. Figure 2 illustrates the average unweighted and weighted degrees of sector specialization in the most important sector (top sector), the second most important sector (second sector), and all other sectors. Specifically, banks allocate approximately 30% to 40% of their lending portfolio to their top sector and around 20% to their second sector, depending on whether the measure is volume-weighted. Similar to local specialization, the average shares in the top, second, and other sectors remain relatively constant throughout the sample period. This persistence is further evidenced by the high serial correlation of the variable, as shown in Table A2 in the appendix.

Table 2 presents the average, standard deviation, and various percentiles of the local and sector specialization variables for the top municipality and sector, as well as for all other municipalities and sectors. On average, banks allocate 39.6% (36.9%) of their total outstanding C&I lending to their top municipality (sector), compared to just 0.1% (4.6%) in the other municipalities (sectors) where they have at least one outstanding loan. These averages are used to interpret the results in Section 3.

Certain municipalities and sectors exhibit higher levels of economic activity, prompting banks to grant larger loan amounts in these areas. While our estimation strategy accounts for this, Table A1 and Figures A1 and A2 in the Appendix confirm that banks exhibit significant specialization in their top and second-ranked municipalities and sectors compared to others. This is shown using the measure of excess specialization, which captures over-investment relative to the average of Spanish banks, thereby accounting for the relative importance of these municipalities and sectors.

Given that local specialization is a relatively underexplored aspect of banks' lending practices, we utilize the excess specialization measure to illustrate how a group of Spanish banks specialize locally compared to the average. This serves as an example of this specialization dimension. Figure 3 presents the average degree of local specialization for a group of three banks, plotting the average specialization in each municipality during the second quarter of 2024.[18] We observe that this group of banks (group of banks 1) has a presence in 2,150 municipalities. Notably, this group exhibits a significant degree of over-investment, as measured by local excess specialization, compared to the average of Spanish banks across various municipalities in Galicia, the northwestern region of Spain. Specifically, the degree of local

[17] This high serial correlation is observed between contemporaneous local and sector specialization and their one-quarter, one-, two-, three-, and four-year lags, further highlighting their persistence over time.

[18] It is important to note that, as we compute the average specialization of a group of banks within municipalities, the sum of local specialization across municipalities for the group may not equal one.

excess specialization is 6.6% in Lugo, 5.1% in Vigo, 3.9% in Pontevedra, 1.7% in Redondela, and 1.3% in Chantada.[19]

Figure 4 provides a comprehensive view of the average local excess specialization of banks during the second quarter of 2024. This figure illustrates the average degree of local excess specialization for all Spanish banks across municipalities in Spain. During this period, Spanish banks had outstanding lending in approximately 5,700 out of a total of 8,132 municipalities.[20]

While sector specialization has been well-documented in the literature, we also illustrate this dimension by showing how the same group of banks specialize in certain sectors in Spain. Figure 5 presents the average degree of sector excess specialization during the second quarter of 2024.[21] We observe that this group of banks exhibits a high degree of over-investment, as measured by sector excess specialization, in the sectors of agriculture and fishing, real estate, and professional, scientific and technology. Specifically, the degrees of sector excess specialization are 7.5%, 4.1%, and 4%, respectively.[22] Lastly, Figure 6 provides a general overview of the average sector excess specialization of Spanish banks during the second quarter of 2024 across different sectors.[23]

3 Specialization and Loan Default

In this section, we explore the relationship between bank specialization and loan default. We begin by documenting how the relationship between local and sector specialization and loan default probability varies with firm size. Specifically, local specialization is linked to reduced loan default probabilities for micro and small firms, while sector specialization exhibits a similar relationship for medium and large firms. This novel evidence suggests that the nature of private information obtained through specialization is differentially beneficial for

[19] For further illustrative examples, see Figure A3 in the appendix, which uses a different group of banks (group of banks 2). Additionally, Figures A4 and A5 in the Appendix provide a closer look at Galicia and the Balearic Islands, facilitating a more direct comparison between these two groups of banks in these regions.

[20] Our findings underscore the importance of local specialization in relation to the default of loans to micro and small firms. Figure A6 in the Appendix shows the average degree of local excess specialization during the second quarter of 2024 across all municipalities in Spain, focusing exclusively on outstanding loans granted to micro and small firms.

[21] Similar to local excess specialization, the degrees of average sector excess specialization across sectors may not sum to one when computed for a group of banks.

[22] For an additional illustrative example, see Figure A7 in the appendix, which uses an alternative group of banks (group of banks 2).

[23] Our findings highlight the relevance of sector specialization for the loan default of medium and large firms. Figure A8 in the Appendix illustrates the average degree of sector excess specialization during the second quarter of 2024 across sectors, focusing exclusively on outstanding loans granted to medium and large firms.

screening and monitoring various types of borrowers. While the relationship between sector specialization and loan default has been previously examined, our findings offer novel insights by showing that the relevance of different specialization dimensions varies with firm size. In particular, we provide new evidence on the link between local specialization and default probabilities for micro and small firms, a relationship that has received limited attention in the literature. We further provide evidence on this relationship, showing that it remains robust across various specifications. Additionally, we explore the heterogeneity across sectors to reinforce the notion that this specific source of specialization is more relevant for smaller firms.

3.1 Baseline Empirical Specification

Banks may gain local market- or sector-specific private information through specialization, enhancing their expertise and skills in these local areas or sectors. This enhanced private information might help banks in their screening and monitoring roles, leading to lower loan default compared to banks with less specialization. Recent evidence in Blickle et al. (2023) supports this view, showing that sector specialization is related to reduced default using a sample of large loans, with a threshold over 1 million dollars, and the 40 largest stress-tested banks in the U.S. as a laboratory. We leverage comprehensive data from a bank-dependent economy, where small firms are the backbone, to explore how local and sector specialization affects loan default depending on firm size.

To investigate this relationship, we compare the default probabilities of new loans granted by banks to firms of different sizes located in municipalities and belonging to sectors where they specialize, relative to those in other municipalities and sectors. Our baseline empirical specification employs a linear probability model, which includes each loan only once at origination and constructs the dependent variable as a forward-looking indicator:

$$\begin{aligned} Default_{lbfmistT} =& \omega_{bt} + \alpha_{mist} + \beta_1 LocalSpec_{bm,t-1} + \beta_3 SectorSpec_{bi,t-1} + \\ & \Gamma Controls_{lbfmist} + \epsilon_{lbfmist}, \end{aligned} \tag{2}$$

where $Default_{lbfmisT}$ is the ex-post default status of a new loan l granted by bank b to firm f located in municipality m that belongs to sector i having a firm size s in quarter t. This status is computed using a forward-looking approach until the loan's maturity or the second quarter of 2024, denoted as T.[24] $LocalSpec_{bm,t-1}$ is the degree of local specialization

[24] To account for differences in default probabilities across loans with varying maturities and characteristics, we control for loan maturity at origination, among other factors. Additionally, to address concerns related

of bank b in municipality m in the prior quarter $t-1$, $SectorSpec_{bi,t-1}$ is the degree of sector specialization of bank b in sector i in the prior quarter $t-1$, and $Controls_{lbfmist}$ includes a set of bank-municipality, bank-sector, bank-firm, and loan level controls. ω_{bt} and α_{mist} are bank-time and municipality-sector-size-time fixed effects, respectively.

A key concern is that highly specialized banks might lend to different types of firms compared to less specialized banks. To address this, we use municipality-sector-size-time fixed effects (α_{mist}) and focus on new loans to firms in the same municipality, sector, and size during the same quarter, following the approach in Degryse et al. (2019). This allows us to compare loan default among similar firms served by banks with varying degrees of specialization.[25] Additionally, the inclusion of this set of fixed effects also control for the size of the municipality and the size of the sector, allowing our analyses to be capturing the differential effect of local and sector specialization across banks.

We incorporate bank-time fixed effects (ω_{bt}) to account for relevant time-variant bank heterogeneity, such as overall lending advantages or bank-wide shocks that might influence the reporting of defaulted loans. Additionally, our baseline specification includes a comprehensive set of controls ($Controls_{lbfmit}$). These controls encompass local and sector bank market shares to account for bank local and sector market power, and the duration of previous bank-borrower relationships (measured in quarters since the year 2000) to account for possible firm-specific informational advantages. We also include various loan characteristics, such as size, whether the loan is collateralized, interest rate, and maturity. We exclude observations with likely coding errors in loan interest rates or maturities, such as negative values or those beyond reasonable ranges. Finally, we control for loan type, differentiating between cash flow loans, asset-based loans, credit lines, trade finance, leasing, and other loans, similar to the approach of Ivashina et al. (2022).[26] In our main sample, which includes the full set of fixed effects, we analyze over 9 million new loans, with more than 5.7 million of these

to the right-censoring of the dependent variable, we conduct a robustness test showing that our results hold when restricting the sample to newly originated loans with maturities shorter than the final observation period in Table 4, ensuring that these loans are observed through maturity.

[25] We do not rely on a within-firm comparison (Khwaja and Mian, 2008) because such a comparison would capture the dynamics of which types of loans firms default on first, rather than focusing on defaults related to banks' private information in screening and monitoring borrowers. While this type of analysis could be interesting and would contribute to the existing work of Schäfer (2019), Morales-Avecedo (2016), and González et al. (2024), Baskaya et al. (2024), among others, it falls outside the scope of this article. Additionally, a within-firm comparison in this setup would require firms to originate at least two different loans in the same quarter with different banks. This requirement would restrict the analysis to firms that originate multiple loans within a given quarter, thereby excluding those that either borrow from only one bank or engage with multiple banks at different points in time. Given that our primary advantage and focus lie in leveraging information from small firms, using a within-firm comparison would potentially bias the analysis towards larger firms.

[26] We exclude overdrafts from our analysis because they represent a very specific type of loan that is often associated with disproportionately high interest rates.

granted to micro and small firms.

While we are able to account for time-variant bank heterogeneity, firm types, and a large set of controls, we acknowledge that causality cannot be definitively established when interpreting our results. Nonetheless, our results provide robust evidence of the beneficial relationship between bank specialization and loan default, particularly for smaller firms in specialized local markets.

3.2 Baseline Results

Table 3 presents the results for the baseline specification shown in equation 2, segmented by firm size.[27] Column (1) focuses on the full sample of firms and shows that new loans originated by banks with a high degree of local specialization in a municipality are less likely to default ex-post. Based on the data in Table 2, we estimate that a loan granted by a bank to a firm located in its top municipality is approximately 0.4 p.p. less likely to default ex-post compared to other loans, after controlling for bank-time and municipality-sector-size-time factors.[28] Thus, we compare loans originated by a bank to firms in its top municipality relative to both loans from the same bank and period in any other municipality and loans to firms in the same municipality, sector, size, and period but originated by banks for which the municipality is not the top one. Given that the average ex-post default probabilities for new loans originated and observed during our sample period is around 1.24%, loans in the top municipality are 32.26% less likely to default, highlighting the economic relevance of this effect. However, sector specialization does not show a statistically significant relationship with the default probabilities of loans when considering all firms.

Columns (2) and (3) examine the relationship between local and sector specialization and loan default for two subsamples of firms based on their size: micro and small firms, and medium and large firms. The results indicate that new loans originated by banks to micro and small firms in the municipalities where they are specialized are associated with a decreased probability of default. Conversely, new loans to medium and large firms in their specialized sectors exhibit lower default probabilities.

Specifically, a loan granted by a bank to a micro or small firm in its top municipality is 0.83 p.p. less likely to default, while a loan to a medium or large firm in its top sector is 0.64 p.p. less likely to default compared to other loans. Given that the average default rate for new loans in our sample is 1.7% for micro and small firms and 0.5% for medium and large

[27] In Table A3 of the Appendix, we present the results, including the control variables.

[28] This estimate is calculated by multiplying the coefficient (-0.0103) by the difference between the average local specialization in the top municipality (0.396) and the average in other municipalities (0.001): $-0.0103 * (0.396 - 0.001) = 0.004 = 0.4 p.p.$

firms, loans originated in the top municipality are 48.82% less likely to default, and loans in the top sector are 128% less likely to default. These findings underscore the economic significance of the relationship between local (sector) specialization and default probabilities for micro and small (medium and large) firms.

To provide further insights into the relationship between local and sector specialization and loan default, columns (4) to (7) examine this relationship across four subsamples of firms based on their size. The results indicate that the relationship between default and local (sector) specialization is most pronounced for micro (large) firms. Specifically, a loan granted by a bank to a micro firm in its top municipality is 0.84 p.p. less likely to default, while a loan to a large firm in its top sector is 1.21 p.p. less likely to default compared to other loans.

To visually illustrate these findings, Figure 7 presents the interpreted coefficients for loans originated in the top municipality or sector relative to other loans, along with the associated 95% confidence intervals. This visual representation highlights the extent and significance of the reduced loan default linked to local and sector specialization across different firm sizes.

Given that bank specialization is linked to enhanced private information where they operate strongly (as we will show in Section 4), banks can leverage this private information to develop local and sector-specific expertise and skills in evaluating borrowers. However, the nature of the private information obtained through specialization may vary. Local or sector-specific information might be more beneficial for screening and monitoring certain types of borrowers based on their size.

Firms, regardless of size, are subject to at least two types of shocks: those affecting their local area and those impacting their sector. Due to differences in local diversification of activities, suppliers, and customers, smaller firms may be more susceptible to changes in the local competitive environment or idiosyncratic local shocks. These shocks can affect the firms themselves or their suppliers and customers within the same municipality. Consequently, banks specializing in specific municipalities can gather valuable local-specific information, such as credit demand trends or early default signals across all firms within the same area. This information can be particularly useful for evaluating projects from micro and small firms, aligning with our empirical findings.

Furthermore, since we consider the registered headquarters or the location where the management and direction of activities are centralized as the firm's headquarters, this municipality is likely to be closely linked to the overall activity of micro and small firms. In Section 3.4, we explore the relationship between local specialization and loan default of micro and small firms across different sectors. This analysis provides further evidence and specific illustrative examples to enhance the interpretation of our results.

Conversely, sector-specific information obtained by banks, such as changes in raw material prices, sector-level regulatory adjustments, or shifts in household preferences related to products shared by the sector, might be more relevant for assessing projects from medium and large firms. Additionally, these firms may find it easier to diversify any local shocks due to their exposure to multiple other markets. This is also consistent with our empirical results, highlighting the differential utility of local and sector-specific information based on firm size.

3.3 Robustness

Since local specialization remains a relatively unexplored facet of banks' specialization, we provide in Table 4 the results from a comprehensive set of robustness tests examining the relationship between local specialization and loan default for micro and small firms.

Panel A explores the consistency of our results across different specifications of the specialization variable and the exclusion of sector specialization, sector market share, and local market shares as controls. First, we demonstrate that our findings remain robust when using various specifications of the specialization variable, addressing concerns that the specific construction of this variable might drive the results. Specifically, we compute the specialization variable as excess in column (1), relative in column (2), using only loans granted to micro and small firms in column (3), by the number of loans instead of the lending amount in column (4), and excluding loans granted to the specific firm in column (5).[29] These robustness tests also address concerns regarding the assumptions about the types of firms from which local-specific information is extracted and the influence of large credit exposures from specific firms.

Second, our results hold when excluding sector specialization and sector market shares in column (6), and when excluding sector specialization, sector market share, and local market share in column (7). This alleviates concerns that the observed relationship between loan default and local specialization is contingent on the inclusion of these potentially highly correlated controls.

Third, we examine the robustness of our results to nonlinearities in the relationship between local specialization and loan default by computing the local specialization variable as quartile dummies in column (8), as an indicator for the top quartile in column (9), and as an indicator for values greater than the median in column (10).

Panel B presents robustness tests for various dependent variables, sample periods, the use of drawn amounts, for a sample of loans without the right-censoring problem and an

[29] Some of these robustness tests are inspired by prior research on bank specialization (e.g., Blickle et al. (2023) and Paravisini et al. (2023), among others).

alternative specification of local markets. First, the results are consistent when computing loan default over one year in column (1) and when including doubtful loans as defaulted in column (2), addressing concerns related to the construction of the dependent variable.

Second, the results are robust when using only drawn amounts in column (3). This ensures that our findings are not only influenced by undrawn credit lines, which might behave differently. Third, restricting the sample to loans without public credit guarantees during the COVID-19 crisis does not alter the results, indicating that these findings are not driven by government interventions during this period.

Fourth, the results remain consistent when considering all outstanding loans in a given quarter, rather than only new loans, as shown in column (5). Fifth, the results are similar when focusing on banks that report PDs from their IRB models in column (6), for bank-firm relationships where the IRB PD is available from the fourth quarter of 2021 in column (7), and when including the initial PD as a control in column (8). These findings support the persistence of the relationship between local specialization and loan default when focusing on banks with IRB models. This is particularly relevant as we will further explore these reported PDs in Section 4 to provide direct evidence of banks' private information advantages related to specialization.

Sixth, restricting the sample to newly originated loans with maturities shorter than the final observation period does not alter the results, as shown in column (9). This approach mitigates concerns related to the right-censoring of the dependent variable as the dependent variable is fully observed through maturity. Lastly, our results remain robust when considering provinces as the relevant local banking market instead of municipalities, and when controlling for sector specialization and sector market shares using 2-digit NACE codes in column (10). To maintain consistency with our estimation strategy, we modify the set of fixed effects included in this robustness test by replacing municipality-sector-size-time fixed effects with province-sector-size-time fixed effects.[30] This result shows that our findings are not dependent on the specific definition of local banking markets used.

Table A4 in the Appendix also shows that the relationship between local specialization and loan default for micro and small firms holds across different specifications of the fixed effects included. Column (1) presents the results with bank-time, sector-time, and municipality-time fixed effects. Column (2) includes bank-time and sector-municipality-time fixed effects. Column (3), our preferred and most saturated empirical specification, explores the relationship with bank-time and municipality-sector-size-time fixed effects. Overall, the

[30] Table A4 in the appendix shows that, although statistical significance is reduced, the negative relationship between local specialization in municipalities and loan default remains robust even after controlling for bank-province-time fixed effects.

relationship between local specialization and loan default remains economically and statistically significant across these specifications.

3.4 Sector Heterogeneity

To strengthen the interpretation of our findings on the reduced probabilities of loan default for micro and small firms linked to local specialization, we investigate differences in this relationship across different sectors. To identify sectors more likely affected by local factors—where local-specific private information from banks might be particularly useful—we classify sectors into three categories: non-tradable, tradable, and other. This classification follows the framework used by Mian et al. (2020) in their international panel data set.[31]

Figure 8 presents the results for micro and small firms in sectors with at least 500 new loans originated during our sample period.[32] Among these sectors, eleven exhibit a negative relationship between local specialization and loan default, with six achieving statistical significance at the 5% level and one at the 10% level.[33] Six out of nine non-tradable sectors exhibit a negative relationship, suggesting that banks are better able to leverage locally specific private information when assessing borrowers in sectors where local conditions are likely to be more influential. However, statistical significance is only achieved for the water and sewerage, and trade and repair sectors.

Importantly, the trade and repair and the manufacturing sectors, which account for over 60% of new loans to micro and small firms during our sample period, exhibit a negative and statistically significant relationship at the 1% level between local specialization and loan default. As the trade and repair sector is classified as non-tradable, it is likely more influenced by local activity. Therefore, it is reasonable that local-specific private information acquired by banks specializing in a specific local area is highly valuable for evaluating micro and small firms in this sector.

To further illustrate this result, consider the following example where a bank specializing in the municipality of Alcobendas and the trade and repair sector. There are two firms headquartered in this municipality within this sector: a micro firm, which is an innovative company selling electric motorcycles, and a large firm, which is a prominent national company selling both cars and motorcycles, with a focus on electric variants and sales points across the

[31] This classification aligns with existing research suggesting that non-tradable sectors rely more heavily on local demand, while tradable sectors depend more on national or global demand (Mian and Sufi, 2014; Adelino et al., 2017; Müller and Verner, 2024; Li et al., 2024).

[32] Table A5 in the Appendix includes results for the full set of sectors, including extraterrestrial organizations and household activities.

[33] No sector exhibits a statistically significant positive relationship between local specialization and loan default among micro and small firms at conventional significance levels.

country. By concentrating its lending activities in Alcobendas, the bank can gather local-specific information that is particularly valuable for evaluating loans to the small retail firm. This includes insights into local economic conditions, commuting patterns, public bicycle service implementation, and local car pollution restrictions. Conversely, by specializing in the trade and repair sector, the bank can acquire sector-specific information relevant for assessing loans to the national company, including advancements in battery pollution efficiency, fluctuations in lithium-ion battery prices, and supply chain disruptions.

The negative relationship for micro and small manufacturing firms is also pronounced, despite the manufacturing sector being classified as tradable and traditionally not considered closely tied to local conditions. However, this relationship does not hold for medium and large firms, as reported in Table A6 in the Appendix. This aligns with the idea that local-specific private information held by banks in local markets where they specialize is useful for evaluating micro and small, but not medium and large borrowers. This differential relationship between micro and small versus medium and large firms is consistent across most sectors, including retail and trade, as well as sectors not classified in either category. These findings support the notion that local-specific private information acquired by banks is useful for screening and monitoring smaller firms, even in sectors traditionally considered less influenced by local factors and classified as tradable or other.

To rationalize this, consider a bank specializing in the municipality of Yecla and the manufacturing sector. In this municipality and sector, there are two firms: a micro firm manufacturing furniture and a large multinational company manufacturing furniture. By focusing its lending activities in Yecla, the bank can gather local-specific information particularly valuable for evaluating loans to the small manufacturing firm. This includes insights into changes in demand related to house construction, supply and prices, natural disasters affecting local production, increased competition from other local manufacturers or imported goods, and local economic downturns that can reduce consumer spending on non-essential items like furniture. Conversely, by specializing in the manufacturing sector, the bank can acquire sector-specific information more relevant for assessing loans to the multinational company, including technological advancements and innovations, fluctuations in raw material prices, supply chain interruptions, and changes in global economic conditions such as trade policies, tariffs, and international market dynamics. This differentiation in the utility of local versus sector-specific information aligns with our empirical results, explaining how specialization benefits banks in managing loans for firms of different sizes.

4 Specialization and Informational Advantages

The results above indicate that banks' local specialization is strongly associated with lower loan default probabilities for micro and small firms, while sector specialization is similarly associated with lower default probabilities for medium and large firms. Prior literature has highlighted the potential link between various dimensions of banks' lending specialization and enhanced private information (Paravisini et al., 2023; Blickle et al., 2023). However, direct evidence on this connection remains unexplored. To assess whether specialization is directly related to increased banks' private information where banks specialize, we utilize the reported PDs under the IRB approach as a measure of banks' private information, following recent works in the literature (Howes and Weitzner, 2023; Beyhaghi et al., 2024). Consistent with our previous findings, we then test whether PDs assigned by locally specialized banks outperform those of non-specialized banks in assessing the credit risk of micro and small firms. Similarly, we examine whether PDs assigned by sectorally specialized banks provide superior predictive accuracy for medium and large firms compared to those assigned by non-sectorally specialized banks.

Before examining the direct link between specialization and enhanced private information for banks, we document that even the IRB banks specialize their corporate lending activities both locally and sectorally in Spain. Table A7 in the Appendix presents the average, standard deviation, and various percentiles of the local and sector specialization variables for the top municipality and sector, as well as for all other municipalities and sectors, for our main specifications of the specialization variables and for excess specialization. On average, banks allocate 25.5% (20.6%) of their total outstanding C&I lending to their top municipality (sector), compared to around 0% (4.2%) in the other municipalities (sectors) where they have at least one outstanding loan. In terms of over-investment, as measured by excess specialization, banks over-invest on average 5.4% (4.3%) of their corporate portfolio to their top municipality (sector). While these percentages are smaller to those of Table 2 and Table A1 in the Appendix when considering the full sample of banks, they still exhibit the local and sector specialization of IRB banks.

To explore whether specialization directly relates to better private information, we focus on non-defaulted firms with positive outstanding lending from at least two different banks, each assigning its own internal PD to the firm within a given quarter.[34] We assess the

[34]We specifically focus on firms without defaulted loans in any given quarter, as these would uniformly have an assigned PD of 100%. We also limit our analysis to the period from the fourth quarter of 2021 to the second quarter of 2023. This timeframe allows us to observe the one-year-ahead realized defaults in all periods where internally estimated PDs are available. During this sample period, four Spanish banks assigned internal PDs to non-financial firms, accounting for approximately 68.2% of total outstanding lending to firms of all sizes and 66.4% of total outstanding lending for micro and small firms, as of the second quarter of

goodness of fit of both PDs reported by the bank with the highest and the bank with the lowest degree of local (sector) specialization to the same micro or small (medium or large) firm by comparing both predicted PDs with the one-year ahead realized default using the receiver operating characteristic (ROC) curve.

ROC analysis is useful for evaluating the performance of statistical models that classify outcomes into one of two categories, such as default in this case. Therefore, we compute the ROC curves by plotting the sensitivity (i.e., true positive rate) against 1-specificity (i.e., the false positive rate) at various threshold settings.[35] By using every possible value of the PD as thresholds, firms are classified based on their PDs. If a firm's PD exceeds a given threshold, it is classified as defaulted. Conversely, firms with PDs below the threshold are classified as non-defaulted. Then, the true positive ratio and the false positive ratio are computed and plotted, forming the ROC curve, from which the AUC can be interpreted as a measure of how well the PD discriminates ex-post realized default.

After computing and plotting the ROC curves for the PDs from both specialized and non-specialized banks, we calculate the two respective AUCs. The AUC ranges from zero to one, with higher values indicating superior predictive ability for default. For comparison, an AUC of 0.5 typically suggests that the prediction is no better than random chance. In this analysis, we focus on the difference between the AUCs derived from the reported PDs of specialized versus non-specialized banks. Consistent with our previous findings, we compare the AUCs generated by the reported PDs of locally specialized versus non-specialized banks for micro and small firms, and the AUCs generated by the reported PDs of sectorally specialized versus non-specialized banks for medium and large firms. Statistical significance for the difference in the prediction of PDs is determined using the DeLong test (DeLong et al., 1988) as in Iyer et al. (2016) and Howes and Weitzner (2023), among others.

Figure 9 provides evidence that banks possess better private information about micro and small firms located in municipalities where they specialize. Specifically, the AUC for the locally specialized bank is 83.38%, compared to 82.47% for the non-specialized bank. This indicates that, given a randomly chosen ex-post defaulting and non-defaulting firm,

2023. Figure A9 shows the distributions of both PD and the natural logarithm of PD. Figure A10 provides evidence supporting the usefulness of reported PDs in predicting future realized default by showing the positive relationship between PDs and observed default. To do so, we divide PDs into quartiles, show the average PD below each quartile, and illustrate their relationship to one-year ex-post realized default. We show a positive relationship between PDs and realized defaults.

[35] The true positive rate equals true positives divided by true positives plus false negatives. The false positive rate equals false positives divided by false positives plus true negatives. True positives are the bank-firm observations predicted as default that we observe ex-post default. False negatives are the bank-firm observations predicted as non-default that we observe ex-post default. False positives are the bank-firm observations predicted as default that we do not observe ex-post default. True negatives are the bank-firm observations predicted as non-default that we do not observe ex-post default.

the probability that the defaulting firm has a higher PD than the non-defaulting one is 0.91 p.p. higher for the specialized bank compared to the non-specialized bank. Therefore, while the estimated PDs from both banks contain substantial information about the one-year ex-post realized default probabilities of firms, this result suggests that the specialized bank has a higher probability of distinguishing default.[36] The difference between the two AUCs is statistically significant at the 1% level and is also economically meaningful. In the credit scoring industry, even an improvement of 0.01 in AUC is considered remarkable, as highlighted by Iyer et al. (2016).

Figure 10 provides evidence that banks possess better private information about medium and large firms within sectors where they specialize. We estimate that the AUC for sectorally specialized bank is 86.9%, compared to 85.49% for non-specialized bank. These results further indicate that while both PDs contain substantial information for evaluating ex-post default probabilities of medium and large firms, given a randomly chosen defaulting and non-defaulting firm, the probability that the defaulting firm has a higher PD than the non-default one is 1.41 p.p. higher for the specialized bank compared to the non-specialized bank. Therefore, sectorally specialized banks exhibit higher probability of distinguishing realized default of medium and large firms.[37] This difference between the AUCs is statistically significant at the 10% level.

As local specialization is a less explored dimension of banks' lending specialization, Table A8 consistently supports that the presence of enhanced banks' private information in local specialization for evaluating micro and small firms is robust across various specifications. Specifically, when we consider provinces as the relevant market for bank local specialization, we find similar results. Additionally, we construct the local specialization variable using only loans to micro and small firms, include doubtful loans in the computation of the one-year realized default, and incorporate bank-firm controls for both the specialized and non-specialized banks. These controls include local market share, sector specialization, sector market share, percentage of outstanding loan amount that is guaranteed, average interest rate, average maturity, log of total outstanding amount, and the length of the relationship.

[36] Columns (1) and (2) of Table A8 in the Appendix presents the results shown in the previous figure in a table format, facilitating easier comparison with a set of robustness tests presented in columns (3) to (10) in the same table.

[37] Figure A11 in the Appendix supports the robustness of banks' private information in sector specialization for medium and large firms when using 2-digit NACE codes instead of sectors.

5 Specialization and Loan Supply

The results so far support the idea that local and sector specialization are directly related to better private information for micro and small firms and medium and large firms, respectively. This enhanced private information may be a potential source of the decreased loan default probabilities associated with bank specialization for these different types of firms. If, as our previous results have shown, banks' lending specialization is linked to enhanced private information, it might also influence loan supply. In this section, we report some suggestive evidence in line with loan supply associated with these two sources of specialization.

To investigate this possibility, we examine loan application data. Crucially, in addition to originated loans, we can observe loan applications from the Spanish Credit Registry, allowing us to compare loan applications made by the same micro or small (medium or large) firm in a given month to banks with varying degrees of local (sector) specialization.[38] The identifying assumption that if at least one application is granted and another is not, the firm was requesting the same loan, i.e., homogeneous demand across banks (Khwaja and Mian, 2008; Jiménez et al., 2012), might not hold because firm demand could be bank and activity specific, especially in the context of specialization (Paravisini et al., 2023). Therefore, we interpret these results as suggestive evidence on the relationship between specialization and loan supply.

Consistent with our previous findings on the importance of local specialization for evaluating micro and small firms and sector specialization for medium and large firms, we estimate the following empirical specification for micro and small firms, and an equivalent specification for medium and large firms focusing on sector specialization:

$$\begin{aligned} LoanGranted_{abfmist} =& \omega_{bt} + \theta_{ft} + \beta_1 LocalSpec_{bm,t-1} + \\ & \Psi Controls_{bft} + \epsilon_{abfmist}, \end{aligned} \tag{3}$$

where $LoanGranted_{abfmit}$ equals one if the loan application a made by firm f located in municipality m that belongs to sector i having a firm size s at month t is approved by bank b in month t to $t+3$, and zero otherwise. $LocalSpec_{bm,t-1}$ is the degree of local specialization of bank b in municipality m in the prior quarter, and $Controls_{bft}$ includes the degree of

[38] We observe all information requests to the Credit Registry made by banks on borrowers. Following Jiménez et al. (2012), Jiménez et al. (2014), and Jiménez et al. (2017), among others, we interpret these requests as loan applications because banks can only request information from the Credit Registry if borrowers are asking for a loan. Additionally, as we cannot perfectly match loan applications to loan origination, we consider an application made in a given month to a given bank to be granted if a new loan for that bank-firm relationship exists from that month to three months later. Conversely, if there is an application for a bank-firm relationship and no new loan during the same period, we consider the application not granted.

sector specialization of bank b in sector i in the prior quarter and the duration in quarters from the year 2000 of previous relationships between bank b and firm f in the prior quarter. ω_{bt} and θ_{ft} are bank-time and firm-time fixed effects, respectively.[39] Similarly, for the results on loan supply to medium and large firms, we focus on sector specialization while controlling for local specialization.

The inclusion of firm-time fixed effects (θ_{ft}) allows us to effectively compare loan applications made by the same firm in a given month to banks with different degrees of local or sector specialization, where at least one of the applications is granted from that month to three months later and another is not. Additionally, we control for factors that may influence the construction of the specialization variables, such as the size of the municipality where the firm is located and the size of the sector the firm belongs to. Bank-time fixed effects (ω_{bt}) control for time-variant bank heterogeneity, such as bank-wide factors related to lending advantages in all municipalities or sectors, as explained in Section 3.

Table 5 presents the results on granted applications for micro and small firms. Column (1) shows that, among firms applying for loans in a given month to multiple banks with varying degrees of local specialization, the likelihood of loan approval is higher at banks with greater local specialization, even after controlling for sector specialization. We estimate that an application made by a firm located in the top municipality of the bank is approximately 8.1 p.p. more likely to be granted compared to other applications. This result is statistically significant at the 1% level.

Column (2) adds a control for the length of the relationship between firms and banks at the time of the loan application and shows that the result holds. Column (3) includes bank-time fixed effects, and column (4) is our preferred specification, where we control for sector specialization, relationship length, and bank-time fixed effects. While the result is reduced in economic terms when controlling for bank-wide factors, we estimate that an application made by a firm to the locally specialized bank is approximately 4.3 p.p. more likely to be granted compared to other applications, and it remains statistically significant at the 1% level.

Table 6 provides evidence of an increased probability of a loan application being granted by banks with a higher degree of sector specialization when focusing on medium and large firms. However, this evidence is weaker in statistical terms. Column (1) estimates that an application made by a firm to a sectoral specialized bank is approximately 4 p.p. more likely to be granted compared to other applications, while also controlling for local specialization. This result is statistically significant at the 5% level. Column (2) controls for relationship

[39] For simplicity, we employ linear probability models as extant research analyzing granted applications (Jiménez et al., 2012).

lending, and while the result is reduced in economic magnitude, it remains significant at the 10% level. Column (3) includes bank-time fixed effects, and the result lacks statistical significance at conventional levels. Finally, column (4) presents our preferred specification, including both bank-time fixed effects and the control for the length of the relationship. We estimate that a an application made by a firm to a sectorally specialized bank is approximately 3.2 p.p. more likely to be granted compared to other applications. However, this result does not achieve statistical significance at conventional levels.

As we have previously argued, local specialization is a less-explored dimension of banks' specialization. Therefore, we present further evidence in Table A9 in the Appendix that the suggestive evidence on loan supply for micro and small firms related to local specialization is robust across different specifications. Specifically, the most saturated specification, which includes bank-time fixed effects and controls for sector specialization and prior relationship length, holds when considering provinces as the relevant local market of specialization, computing the specialization variable using only micro and small firms, and considering applications granted if a new loan is observed for that bank-firm pair four or five months after the application.

Finally, Tables A10 and A11 in the Appendix compare the interest rates charged on new loans granted to micro and small firms based on the degree of bank local specialization, and the interest rates charged on new loans to medium and large firms based on the degree of bank sector specialization. Although the evidence is not statistically significant at conventional levels, it indicates a negative correlation between loan rates on newly originated loans for micro and small firms and local specialization, as well as for medium and large firms and sector specialization. This suggests that banks do not charge higher interest rates on new loans in areas or sectors where they specialize, aligning with the notion that specialization allows banks to offer slightly lower rates. This finding, combined with the results in Tables 5 and 6, suggests that banks' higher probabilities of granting loans to micro and small firms in municipalities where they specialize, and to medium and large firms in sectors where they specialize, are not associated with higher interest rates. This is consistent with the enhanced private information banks hold when specializing their lending activities in specific local markets or sectors.

6 Validation of Findings using Relationship Lending

In this section we aim to enhance the validity of our estimation strategy and results on specialization by replicating the analysis using relationship lending instead of specialization. This analysis serves as a benchmark for our findings on specialization but also enhances our

understanding of the relationship between relationship lending and banks' private information. Relationship lending, a bank-firm characteristic that has been extensively examined in the literature, is often considered a potential source of valuable information for banks. By exploring this link, our study contributes to the broader discussion on how banks leverage private information in their lending practices.

Existing literature indicates that relationship lending, whether through longer lending relationships or other types of products such as transaction accounts, reduces loan interest rates and default probabilities (Bharath et al., 2011; Puri et al., 2017). Additionally, novel research shows that through longer relationships, banks are able to extract enhanced private information about their borrowers (Claessens et al., 2024). Following our previous analyses, we first examine the relation between relationship lending and loan default across different firm sizes. We then focus on banks' internal risk assessments to explore whether relationship lending enables banks to obtain superior private information. Finally, we investigate whether relationship lending is associated with higher probabilities of loans being granted.

We estimate equation 2 and present the results in Table 7, which shows the relation between relationship lending and loan default for different firm sizes. Column (1) provides estimates for all firms, indicating that the length of the relationship between firms and banks is associated with a lower probability of default for new loans. Specifically, a loan granted by a bank to a firm with the longest relationship length is approximately 1.12 p.p. less likely to default compared to other loans, after controlling for bank-time and municipality-sector-size-time factors.[40]

Columns (2) and (3) show results for new loans granted to micro and small firms and to medium and large firms, respectively. While relationship lending is negatively associated with loan default, this relationship is stronger for smaller firms, consistent with smaller firms being more subject to informational frictions. A loan granted by a bank to a micro or small (medium or large) firm with the longest relationship length is approximately 1.43 (0.36) p.p. less likely to default compared to other loans. Columns (4) to (7) present results for firms of each sample size, with the strongest effect observed in new loans to micro firms, where a loan granted by a bank to a micro firm with the longest relationship length is approximately 2.16 p.p. less likely to default compared to other loans. Figure 11 visually illustrates the interpreted coefficients and 95% confidence intervals for new loans granted to firms of different sizes.[41]

[40] We compute relationship lending from the year 2000 and interpret this estimate using the difference in quarters between the average relationship length for the firm with the longest relationship for a given bank (82) and the average relationship length of other firms (25).

[41] Table A12 in the Appendix shows that the link between relationship lending and future loan default for new loans granted to micro and small firms holds across different specifications of fixed effects.

Figure 12 computes and plots the ROC curves for the PDs from both the bank with the longest and the bank with the shortest relationship length for a given micro or small firm or a given medium or large firm, replicating the approach used in Section 4. The results indicate that banks with longer lending relationships with a given firm possess better private information, as evidenced by a higher probability of correctly distinguishing between defaulting and non-defaulting firms. This result is stronger in economic terms and statistical significance for micro and small firms compared to medium and large firms, consistent with smaller firms being subject to more informational frictions. When evaluating micro and small firms, the AUC for the bank with the longest relationship is 84.1%, compared to 82.03% for the bank with the shortest relationship. The difference of 2.07 p.p. is statistically significant at the 1% level. However, when evaluating medium and large firms, the AUC for the bank with the longest relationship is 86.78%, compared to 86.09% for the bank with the shortest relationship. In this case, the difference of 0.69 p.p. is smaller in magnitude and not statistically significant at conventional levels.[42]

Table 8 examines the link between relationship lending and the granting of loan applications by estimating equation 3, with a focus on the effect of relationship length for both micro and small firms, as well as medium and large firms. Columns (1) and (3) show that loan applications made by a firm in a given month are more likely to be granted by banks with which the firm has a longer lending relationship both for micro and small firms and for medium and large firms. Columns (2) and (4) present the results for our preferred specification controlling for bank-wide factors. We estimate that an application made by a micro or small firm to the bank with the longest relationship length is approximately 37 p.p. more likely to be granted compared to other applications, while an application made by a medium or large firm is approximately 33 p.p. more likely to be granted compared to other applications. These results are statistically significant at the 1% level, being the economic magnitude slightly larger for micro and small firms. These findings are consistent with relationship lending being associated with higher probabilities of loan applications being granted.[43]

Using these results as a benchmark for our findings on local and sector specialization, our analysis suggests that the private informational advantages derived from relationship lending are larger in magnitude for micro and small firms compared to those obtained from local specialization. Conversely, for medium and large firms, the advantages from relationship

[42] Figure A12 in the Appendix shows that this result holds when using the credit exposure a firm has with a bank as an alternative measure of relationship lending (Jiménez et al., 2022).

[43] Table A13 in the Appendix provides evidence that banks charge lower interest rates on new loans granted to firms with longer relationship lengths, with its economic magnitude being again slightly larger for micro and small firms.

lending seem to be less pronounced relative to those from sector specialization. Nevertheless, the informational benefits gained through lending specialization can be valuable for screening and monitoring multiple borrowers, whereas those obtained through relationship lending tend to be borrower-specific. This further underscores the importance of local and sector specialization in accurately assessing the riskiness of borrowers.

Overall, these results indicate that banks enhance their non-transferable private information about specific borrowers through relationship lending, which is associated with decreased loan default and increased likelihood of granting loan applications, especially for smaller firms. This finding aligns with prior literature on the importance of relationship lending, validates our analyses of specialization in Sections 3, 4, and 5, and serves as a benchmark for our results on specialization.

7 Conclusion

In this paper, we examine the relationship between local and sector specialization and loan default, documenting how their relevance varies with firm size. Crucially we also establish the first direct evidence of enhanced banks' local or sector-specific private information linked to specialization. Using comprehensive data on all new loans granted by banks to firms in Spain from the second quarter of 2018 to the second quarter of 2024, we document how banks specialize locally in specific municipalities and sectorally in certain sectors. Specifically, we find that local specialization is associated with lower future loan default rates among micro and small firms, whereas sectoral specialization is more pertinent for medium and large firms. While we are cautious about establishing causality, our results are estimated controlling for firm types, local market and sector sizes, bank-wide factors such as overall bank informational advantages across all markets and sectors, and firm-specific information gathered through relationship lending.

Our findings have important implications for the literature on bank lending specialization and for studies emphasizing the differences between small and large firms. Banks can acquire enhanced local-specific private information by developing expertise and skills through specializing their lending activities in specific local markets. This informational advantage is particularly relevant for screening and monitoring smaller borrowers, who are more prone to information frictions and, due to the lower local diversification of their activities, suppliers, and customers, might also be more susceptible to idiosyncratic local shocks. Conversely, by specializing in specific sectors, banks might develop sector-specific private information that is particularly relevant for evaluating larger borrowers. These borrowers may be better able to diversify any local shocks due to their exposure to multiple local markets but might be

more susceptible to sector-wide shocks.

We use the reported PDs under the IRB approach as a measure of banks' private information about corporate borrowers' risk assessments (Howes and Weitzner, 2023; Claessens et al., 2024) to provide direct evidence of the link between enhanced private information and specialization. Consistent with our findings on the relevance of local specialization for micro and small firms, and sectoral specialization for medium and large firms, we show that internally estimated PDs from locally (sectoral) specialized banks are more informative and better differentiate between defaulting and non-defaulting micro and small (medium and large) firms. This insight is crucial for understanding the production of private information by banks, and to our knowledge, this is the first empirical study providing such evidence linked to specialization.

The paper also provides suggestive evidence that lending supply is related to lending specialization. By analyzing bank requests for borrower information recorded in the Spanish Credit Registry, which we interpret as loan applications, we investigate the likelihood of granting these applications using a within-firm comparison. Our findings indicate that loan applications by micro and small firms are more likely to be approved by banks with a higher degree of local specialization in the markets where these firms operate. Similarly, loan applications by medium and large firms have a higher probability of being granted by banks that are highly specialized in the firm's sector. Overall, our findings are valuable for policymakers aiming to comprehend the benefits of bank lending specialization and to understand banks' diversification decisions.

References

Acharya, Viral V., Iftekhar Hasan and Anthony Saunders. (2006). "Should banks be diversified? Evidence from individual bank loan portfolios". *The Journal of Business,* 79(3), pp. 1355-1412. https://doi.org/10.1086/500679

Adelino, Manuel, Igor Cunha and Miguel A. Ferreira. (2017). "The economic effects of public financing: Evidence from municipal bond ratings recalibration". *The Review of Financial Studies,* 30(9), pp. 3223-3268. https://doi.org/10.1093/rfs/hhx049

Adelino, Manuel, Ivan Ivanov and Michael Smolyansky. (2019). "Humans vs machines: Soft and hard information in corporate loan pricing". Available at SSRN 3596010. https://doi.org/10.2139/ssrn.3596010

Agarwal, Sumit, Souphala Chomsisengphet, Chunlin Liu, Changcheng Song and Nicholas S. Souleles. (2018). "Benefits of relationship banking: Evidence from consumer credit markets". *Journal of Monetary Economics,* 96, pp. 16-32. https://doi.org/10.1016/j.jmoneco.2018.02.005

Agarwal, Sumit, and Robert Hauswald. (2010). "Distance and private information in lending". *The Review of Financial Studies,* 23(7), pp. 2757-2788. https://doi.org/10.1093/rfs/hhq001

Aguirregabiria, Victor, Robert Clark and Hui Wang. (2016). "Diversification of geographic risk in retail bank networks: Evidence from bank expansion after the riegle-neal act". *The RAND Journal of Economics,* 47(3), pp. 529-572. https://doi.org/10.1111/1756-2171.12136

Baskaya, Soner, José Gutiérrez, José María Serena and Serafeim Tsoukas. (2024). "Bank supervision and non-performing loan cleansing". Documentos de Trabajo, 2428, Banco de España. https://doi.org/10.53479/37596

Becker, Bo, Marieke Bos and Kasper Roszbach. (2020). "Bad times, good credit". *Journal of Money, Credit and Banking,* 52(S1), pp. 107-142. https://doi.org/10.1111/jmcb.12736

Bedayo, Mikel, Gabriel Jiménez, José-Luis Peydró and Raquel Vegas Sánchez. (2020). "Screening and loan origination time: Lending standards, loan defaults and bank failures". Documentos de Trabajo, 2037, Banco de España. https://repositorio.bde.es/handle/123456789/14261

Begley, Taylor A., Amiyatosh Purnanandam and Kuncheng Zheng. (2017). "The strategic underreporting of bank risk". *The Review of Financial Studies,* 30(10), pp. 3376-3415. https://doi.org/10.1093/rfs/hhx036

Behn, Markus, Rainer Haselmann and Vikrant Vig. (2022). "The limits of model-based regulation". *The Journal of Finance*, 77(3), pp. 1635-1684. https://doi.org/10.1111/jofi.13124

Behn, Markus, Rainer Haselmann and Paul Wachtel. (2016). "Procyclical capital regulation and lending". *The Journal of Finance*, 71(2), pp. 919-956. https://doi.org/10.1111/jofi.12368

Berg, Tobias, and Philipp Koziol. (2017). "An analysis of the consistency of banks' internal ratings". *Journal of Banking and Finance*, 78, pp. 27-41. https://doi.org/10.1016/j.jbankfin.2017.01.013

Berger, Allen N., Sadok El Ghoul, Omrane Guedhami and Raluca A. Roman. (2017a). "Internationalization and bank risk". *Management Science*, 63(7), pp. 2283-2301. https://doi.org/10.1287/mnsc.2016.2422

Berger, Allen N., Nathan H Miller, Mitchell A. Petersen, Raghuram G. Rajan and Jeremy C. Stein. (2005). "Does function follow organizational form? Evidence from the lending practices of large and small banks". *Journal of Financial Economics*, 76(2), pp. 237-269. https://doi.org/10.1016/j.jfineco.2004.06.003

Berger, Allen N., and Gregory F. Udell. (1995). "Relationship lending and lines of credit in small firm finance". *Journal of Business*, pp. 351-381. https://doi.org/10.1086/296668

Berger, Philip G., Michael Minnis and Andrew Sutherland. (2017b). "Commercial lending concentration and bank expertise: Evidence from borrower financial statements". *Journal of Accounting and Economics*, 64(2-3), pp. 253-277. https://doi.org/10.1016/j.jacceco.2017.06.005

Beyhaghi, Mehdi, Cesare Fracassi and Gregory Weitzner. (2020). "Bank loan markups and adverse selection". Available at SSRN 3733932. https://doi.org/10.2139/ssrn.3733932

Beyhaghi, Mehdi, Cooper Howes and GregoryWeitzner. (2024). "The information advantage of banks: Evidence from their private credit assessments". https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4265161

Bharath, Sreedhar T., Sandeep Dahiya, Anthony Saunders and Anand Srinivasan. (2011). "Lending relationships and loan contract terms". *The Review of Financial Studies*, 24(4), pp. 1141-1203. https://doi.org/10.1093/rfs/hhp064

Blickle, Kristian. (2022). "Local banks, credit supply, and house prices". *Journal of Financial Economics*, 143(2), pp. 876-896. https://doi.org/10.1016/j.jfineco.2021.07.003

Blickle, Kristian, Zhiguo He, Jing Huang and Cecilia Parlatore. (2024). "Information-based pricing in specialized lending". Tech. rep., National Bureau of Economic Research. https://doi.org/10.3386/w32155

Blickle, Kristian, Cecilia Parlatore and Anthony Saunders. (2023). "Specialization in banking". Tech. rep., National Bureau of Economic Research. https://doi.org/10.3386/w31077

Bolton, Patrick, Xavier Freixas, Leonardo Gambacorta and Paolo Emilio Mistrulli. (2016). "Relationship and transaction lending in a crisis". *The Review of Financial Studies*, 29(10), pp. 2643-2676. https://doi.org/10.1093/rfs/hhw041

Bonfim, Diana, Ralph De Haas, Alexandra Matyunina and Steven Ongena. (2023). "Bank specialization in lending to new firms". https://matyunina.com/?page_id=432

Cai, Jian, Frederik Eidam, Anthony Saunders and Sascha Steffen. (2018). "Syndication, interconnectedness, and systemic risk". *Journal of Financial Stability*, 34, pp. 105-120. https://doi.org/10.1016/j.jfs.2017.12.005

Casado, Alejandro, and David Martínez Miera. (2024). "Local lending specialization and monetary policy". Documentos de Trabajo, 2440, Banco de España. https://doi.org/10.53479/37912

Cerqueiro, Geraldo, Steven Ongena and Kasper Roszbach. (2016). "Collateralization, bank loan rates, and monitoring". *The Journal of Finance*, 71(3), pp. 1295-1322. https://doi.org/10.1111/jofi.12214

Chodorow-Reich, Gabriel. (2014). "The employment effects of credit market disruptions: Firm-level evidence from the 2008-9 financial crisis". *The Quarterly Journal of Economics*, 129(1), pp. 1-59. https://doi.org/10.1093/qje/qjt031

Chodorow-Reich, Gabriel, Olivier Darmouni, Stephan Luck and Matthew Plosser. (2022). "Bank liquidity provision across the firm size distribution". *Journal of Financial Economics*, 144(3), pp. 908-932. https://doi.org/10.1016/j.jfineco.2021.06.035

Chu, Yongqiang, Saiying Deng and Cong Xia. (2020). "Bank geographic diversification and systemic risk". *The Review of Financial Studies*, 33(10), pp. 4811-4838. https://doi.org/10.1093/rfs/hhz148

Chu, Yongqiang, Zhanbing Xiao and Yuxiang Zheng. (2021). "The industry expertise channel of mortgage lending". Available at SSRN 3792629. https://doi.org/10.2139/ssrn.3792629

Claessens, Stijn, Steven Ongena and Teng Wang. (2024). ""If you don't know me by now...": Information collection by banks in lending to private firms". Swiss Finance Institute Research Paper, 23-01. https://doi.org/10.2139/ssrn.4323627

Cole, Rebel A., Lawrence G. Goldberg and Lawrence J. White. (2004). "Cookie cutter vs. character: The micro structure of small business lending by large and small banks". *Journal of Financial and Quantitative Analysis*, 39(2), pp. 227-251. https://doi.org/10.1017/S0022109000003057

Commission, EU, et al. (2003). "Recommendation 2003/361/ec of 6 may 2003 concerning the definition of micro, small and medium-sized enterprises". *Official Journal*, 20, p. 2003. https://eur-lex.europa.eu/eli/reco/2003/361/oj/eng

De Jonghe, Olivier, Hans Dewachter, Klaas Mulier, Steven Ongena and Glenn Schepens. (2020). "Some borrowers are more equal than others: Bank funding shocks and credit reallocation". *Review of Finance*, 24(1), pp. 1-43. https://doi.org/10.1093/rof/rfy040

De Jonghe, Olivier, Klaas Mulier and Ilia Samarin. (2024). "Bank specialization and zombie lending". *Management Science*. https://doi.org/10.1287/mnsc.2023.01437

Degryse, Hans, Olivier De Jonghe, Leonardo Gambacorta and Cédric Huylebroek. (2024). "Bank specialization and corporate innovation". Tech. rep., NBB Working Paper. https://cepr.org/publications/dp19606

Degryse, Hans, Olivier De Jonghe, Sanja Jakovljević, Klaas Mulier and Glenn Schepens. (2019). "Identifying credit supply shocks with bank-firm data: Methods and applications". *Journal of Financial Intermediation*, 40, p. 100813. https://doi.org/10.1016/j.jfi.2019.01.004

Degryse, Hans, and Steven Ongena. (2005). "Distance, lending relationships, and competition". *The Journal of Finance*, 60(1), pp. 231-266. https://doi.org/10.1111/j.1540-6261.2005.00729.x

Degryse, Hans, and Steven Ongena. (2007). "The impact of competition on bank orientation". *Journal of Financial Intermediation*, 16(3), pp. 399-424. https://doi.org/10.1016/j.jfi.2007.03.002

Dell'Ariccia, Giovanni, Luc Laeven and Gustavo A. Suarez. (2017). "Bank leverage and monetary policy's risk-taking channel: Evidence from the United States". *The Journal of Finance*, 72(2), pp. 613-654. https://doi.org/10.1111/jofi.12467

DeLong, Elizabeth R., David M. DeLong and Daniel L. Clarke-Pearson. (1988). "Comparing the areas under two or more correlated receiver operating characteristic curves: A nonparametric approach". *Biometrics*, pp. 837-845. https://doi.org/10.2307/2531595

Di, Wenhua, and Nathaniel Pattison. (2023). "Industry specialization and small business lending". *Journal of Banking and Finance*, 149, p. 106797. https://doi.org/10.1016/j.jbankfin.2023.106797

Diamond, Douglas W. (1984). "Financial intermediation and delegated monitoring". *The Review of Economic Studies*, 51(3), pp. 393-414. https://doi.org/10.2307/2297430

Doerr, Sebastian, and Philipp Schaz. (2021). "Geographic diversification and bank lending during crises". *Journal of Financial Economics*, 140(3), pp. 768-788. https://doi.org/10.1016/j.jfineco.2021.02.004

Duquerroy, Anne, Clément Mazet-Sonilhac, Jean-Stéphane Mésonnier and Daniel Paravisini. (2022). "Bank local specialization". Banque de France Working Paper. https://sciencespo.hal.science/hal-03812807/

Dursun-de Neef, H. Özlem. (2023). "Bank specialization, mortgage lending and house prices". *Journal of Banking and Finance*, 151, p. 106836. https://doi.org/10.1016/j.jbankfin.2023.106836

Duygan-Bump, Burcu, Alexey Levkov and Judit Montoriol-Garriga. (2015). "Financing constraints and unemployment: Evidence from the great recession". *Journal of Monetary Economics*, 75, pp. 89-105. https://doi.org/10.1016/j.jmoneco.2014.12.011

Fama, Eugene F. (1985). "What's different about banks?". *Journal of Monetary Economics*, 15(1), pp. 29-39. https://doi.org/10.1016/0304-3932(85)90051-0

Favara, Giovanni, and Mariassunta Giannetti. (2017). "Forced asset sales and the concentration of outstanding debt: Evidence from the mortgage market". *The Journal of Finance*, 72(3), pp. 1081-1118. https://doi.org/10.1111/jofi.12494

Favara, Giovanni, Ivan Ivanov and Marcelo Rezende. (2021). "GSIB surcharges and bank lending: Evidence from US corporate loan data". *Journal of Financial Economics*, 142(3), pp. 1426-1443. https://doi.org/10.1016/j.jfineco.2021.06.026

Gelman, Michael, Itay Goldstein and Andrew MacKinlay. (2023). "Bank diversification and lending resiliency". Available at SSRN 4147790. https://doi.org/10.2139/ssrn.4147790

Gertler, Mark, and Simon Gilchrist. (1994). "Monetary policy, business cycles, and the behavior of small manufacturing firms". *The Quarterly Journal of Economics*, 109(2), pp. 309-340. https://doi.org/10.2307/2118465

Giannetti, Mariassunta, and Yeejin Jang. (2021). "Who lends before banking crises? Evidence from the international syndicated loan market". CEPR Discussion Paper, DP15737. https://doi.org/10.2139/ssrn.3739393

Giannetti, Mariassunta, and Farzad Saidi. (2019). "Shock propagation and banking structure". *The Review of Financial Studies*, 32(7), pp. 2499-2540. https://doi.org/10.1093/rfs/hhy135

Giometti, Marco, and Stefano Pietrosanti. (2022). "Bank specialization and the design of loan contracts". FDIC Center for Financial Research Working Paper, 2022-14. https://doi.org/10.2139/ssrn.4470135

Goetz, Martin R., Luc Laeven and Ross Levine. (2013). "Identifying the valuation effects and agency costs of corporate diversification: Evidence from the geographic diversification of us banks". *The Review of Financial Studies*, 26(7), pp. 1787-1823. https://doi.org/10.1093/rfs/hht021

Goetz, Martin R., Luc Laeven and Ross Levine. (2016). "Does the geographic expansion of banks reduce risk?". *Journal of Financial Economics*, 120(2), pp. 346-362. https://doi.org/10.1016/j.jfineco.2016.01.020

González, Francisco, José E. Gutiérrez and José María Serena. (2024). "Shadow seniority? Lending relationships and borrowers' selective default". Documentos de Trabajo, 2420, Banco de España. https://repositorio.bde.es/handle/123456789/36695

Gopal, Manasa. (2021). *How collateral affects small business lending: The role of lender specialization*. US Census Bureau, Center for Economic Studies. https://manasagopal23.github.io/files/jmp.pdf

Gustafson, Matthew T., Ivan T. Ivanov and Ralf R. Meisenzahl. (2021). "Bank monitoring: Evidence from syndicated loans". *Journal of Financial Economics*, 139(2), pp. 452-477. https://doi.org/10.1016/j.jfineco.2020.08.017

Heitz, Amanda, Christopher Martin and Alexander Ufier. (2022). "Bank monitoring with on-site inspections". FDIC Center for Financial Research Paper, 2022-09, 4197344. https://doi.org/10.2139/ssrn.4197344

Hertzberg, Andrew, Andres Liberman and Daniel Paravisini. (2018). "Screening on loan terms: Evidence from maturity choice in consumer credit". *The Review of Financial Studies*, 31(9), pp. 3532-3567. https://doi.org/10.1093/rfs/hhy024

Howes, Cooper, and Gregory Weitzner. (2023). "Bank information production over the business cycle". Available at SSRN 3934049. https://doi.org/10.2139/ssrn.3934049

Ivashina, Victoria, Luc Laeven and Enrique Moral-Benito. (2022). "Loan types and the bank lending channel". *Journal of Monetary Economics*, 126, pp. 171-187. https://doi.org/10.1016/j.jmoneco.2021.11.006

Iyer, Rajkamal, Asim Ijaz Khwaja, Erzo F. P. Luttmer and Kelly Shue. (2016). "Screening peers softly: Inferring the quality of small borrowers". *Management Science*, 62(6), pp. 1554-1577. https://doi.org/10.1287/mnsc.2015.2181

Iyer, Rajkamal, Sotirios Kokas, Alexander Michaelides and José-Luis Peydró. (2022). "Shock absorbers and transmitters: The dual facets of bank specialization". Available at SSRN 4180127. https://doi.org/10.2139/ssrn.4180127

Izadi, Mohammad, and Vahid Saadi. (2023). "Banking market structure and trade shocks". *Journal of Banking and Finance*, 153, p. 106884. https://doi.org/10.1016/j.jbankfin.2023.106884

Jiménez, Gabriel, Luc Laeven, David Martínez Miera and José-Luis Peydró. (2022). "Public guarantees, relationship lending and bank credit: Evidence from the COVID-19 crisis". CEPR Discussion Paper, DP17110. https://doi.org/10.2139/ssrn.4057530

Jiménez, Gabriel, Steven Ongena, José-Luis Peydró and Jesús Saurina. (2012). "Credit supply and monetary policy: Identifying the bank balance-sheet channel with loan applications". *American Economic Review*, 102(5), pp. 2301-2326. https://doi.org/10.1257/aer.102.5.2301

Jiménez, Gabriel, Steven Ongena, José-Luis Peydró and Jesús Saurina. (2014). "Hazardous times for monetary policy: What do twenty-three million bank loans say about the effects of monetary policy on credit risk-taking?". *Econometrica*, 82(2), pp. 463-505. https://doi.org/10.3982/ECTA10104

Jiménez, Gabriel, Steven Ongena, José-Luis Peydró and Jesús Saurina. (2017). "Macroprudential policy, countercyclical bank capital buffers, and credit supply: Evidence from the Spanish dynamic provisioning experiments". *Journal of Political Economy*, 125(6), pp. 2126-2177. https://doi.org/10.1086/694289

Keys, Benjamin J., Tanmoy Mukherjee, Amit Seru and Vikrant Vig. (2010). "Did securitization lead to lax screening? Evidence from subprime loans". *The Quarterly Journal of Economics*, 125(1), pp. 307-362. https://doi.org/10.1162/qjec.2010.125.1.307

Keys, Benjamin J., Amit Seru and Vikrant Vig. (2012). "Lender screening and the role of securitization: Evidence from prime and subprime mortgage markets". *The Review of Financial Studies*, 25(7), pp. 2071-2108. https://doi.org/10.1093/rfs/hhs059

Khwaja, Asim Ijaz, and Atif Mian. (2008). "Tracing the impact of bank liquidity shocks: Evidence from an emerging market". *American Economic Review*, 98(4), pp. 1413-1442. https://doi.org/10.1257/aer.98.4.1413

Leland, Hayne E., and David H. Pyle. (1977). "Informational asymmetries, financial structure, and financial intermediation". *The Journal of Finance*, 32(2), pp. 371-387. https://doi.org/10.2139/ssrn.4057530

Levine, Ross, Chen Lin and Wensi Xie. (2021). "Geographic diversification and banks' funding costs". *Management Science*, 67(5), pp. 2657-2678. https://doi.org/10.1287/mnsc.2020.3582

Li, Zhimin, Leslie Sheng Shen and Calvin Zhang. (2024). "Local effects of global capital flows: A China shock in the U.S. housing market". *The Review of Financial Studies*, 37(3), pp. 761-801. https://doi.org/10.1093/rfs/hhad067

Lisowsky, Petro, Michael Minnis and Andrew Sutherland. (2017). "Economic growth and financial statement verification". *Journal of Accounting Research*, 55(4), pp. 745-794. https://doi.org/10.1111/1475-679X.12165

López-Espinosa, Germán, Sergio Mayordomo and Antonio Moreno. (2017). "When does relationship lending start to pay?". *Journal of Financial Intermediation*, 31, pp. 16-29. https://doi.org/10.1016/j.jfi.2016.11.001

Loutskina, Elena, and Philip E. Strahan. (2011). "Informed and uninformed investment in housing: The downside of diversification". *The Review of Financial Studies*, 24(5), pp. 1447-1480. https://doi.org/10.1093/rfs/hhq142

Mester, Loretta J., Leonard I. Nakamura and Micheline Renault. (2007). "Transactions accounts and loan monitoring". *The Review of Financial Studies*, 20(3), pp. 529-556. https://doi.org/10.1093/rfs/hhl018

Mian, Atif, and Amir Sufi. (2014). "What explains the 2007-2009 drop in employment?". *Econometrica*, 82(6), pp. 2197-2223. https://doi.org/10.3982/ECTA10451

Mian, Atif, Amir Sufi and Emil Verner. (2020). "How does credit supply expansion affect the real economy? The productive capacity and household demand channels". *The Journal of Finance*, 75(2), pp. 949-994. https://doi.org/10.1111/jofi.12869

Montes, Carlos Pérez, Carlos Trucharte Artigas, María Elizabeth Cristófoli and Nadia Lavín San Segundo. (2018). "The impact of the IRB approach on the risk weights of European banks". *Journal of Financial Stability*, 39, pp. 147-166. https://doi.org/10.1016/j.jfs.2016.11.004

Morales-Avecedo, Paola. (2016). "Firms' strategic choice of loan delinquencies". Tech. rep., Sveriges Riksbank Working Paper Series. https://www.econstor.eu/bitstream/10419/157964/1/85932480X.pdf

Müller, Karsten, and Emil Verner. (2024). "Credit allocation and macroeconomic fluctuations". *Review of Economic Studies*, 91(6), pp. 3645-3676. https://doi.org/10.1093/restud/rdad112

Nakamura, Leonard I., and Kasper Roszbach. (2018). "Credit ratings, private information, and bank monitoring ability". *Journal of Financial Intermediation*, 36, pp. 58-73. https://doi.org/10.1016/j.jfi.2017.11.001

Ongena, Steven, and David C. Smith. (2001). "The duration of bank relationships". *Journal of Financial Economics*, 61(3), pp. 449-475. https://doi.org/10.1016/S0304-405X(01)00069-1

Ongena, Steven, Günseli Tümer-Alkan and Natalja V. Westernhagen. (2012). "Creditor concentration: An empirical investigation". *European Economic Review*, 56(4), pp. 830-847. https://doi.org/10.1016/j.euroecorev.2012.02.001

Paravisini, Daniel, Veronica Rappoport and Philipp Schnabl. (2023). "Specialization in bank lending: Evidence from exporting firms". *The Journal of Finance,* 78(4), pp. 2049-2085. https://doi.org/10.1111/jofi.13254

Petersen, Mitchell A., and Raghuram G. Rajan. (1994). "The benefits of lending relationships: Evidence from small business data". *The Journal of Finance,* 49(1), pp. 3-37. https://doi.org/10.1111/j.1540-6261.1994.tb04418.x

Petersen, Mitchell A., and Raghuram G. Rajan. (2002). "Does distance still matter? The information revolution in small business lending". *The Journal of Finance,* 57(6), pp. 2533-2570. https://doi.org/10.1111/1540-6261.00505

Plosser, Matthew C., and Joao A. C. Santos. (2018). "Banks' incentives and inconsistent risk models". *The Review of Financial Studies,* 31(6), pp. 2080-2112. https://doi.org/10.1093/rfs/hhy028

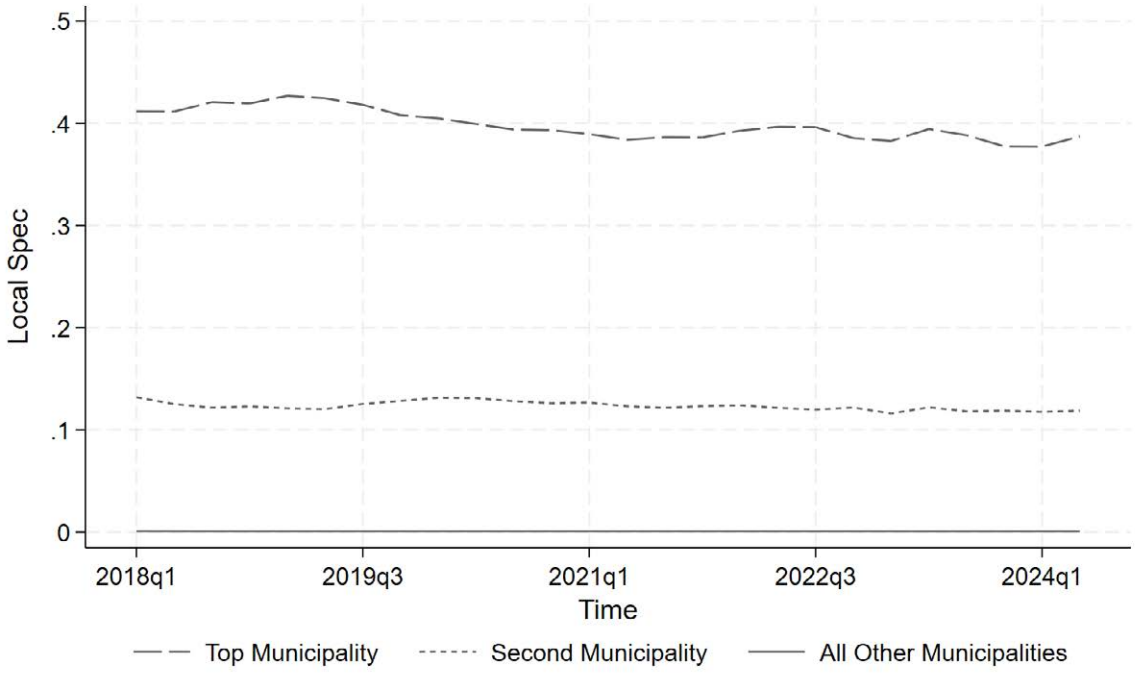
Puri, Manju, Jörg Rocholl and Sascha Steffen. (2017). "What do a million observations have to say about loan defaults? Opening the black box of relationships". *Journal of Financial Intermediation,* 31, pp. 1-15. https://doi.org/10.1016/j.jfi.2017.02.001

Qian, Jun, Philip E. Strahan and Zhishu Yang. (2015). "The impact of incentives and communication costs on information production and use: Evidence from bank lending". *The Journal of Finance,* 70(4), pp. 1457-1493. https://doi.org/10.1111/jofi.12251

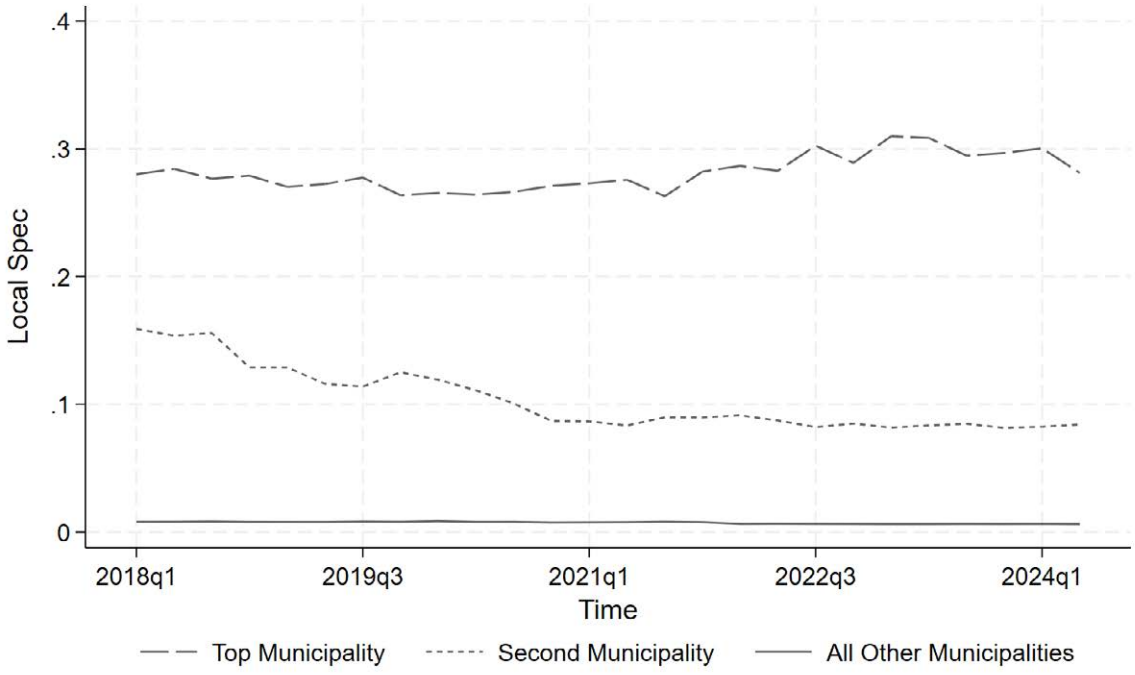
Ruzzier, Gianmarco. (2024). "Specialized banks and the transmission of monetary policy: Evidence from us syndicated loan market." https://www.gianmarcoruzzier.com/

Schäfer, Larissa. (2019). ""Forgive but not forget": The behavior of relationship banks when firms are in distress". *Review of Finance,* 23(6), pp. 1079-1114. https://doi.org/10.1093/rof/rfy031

Figure 1: Local Specialization



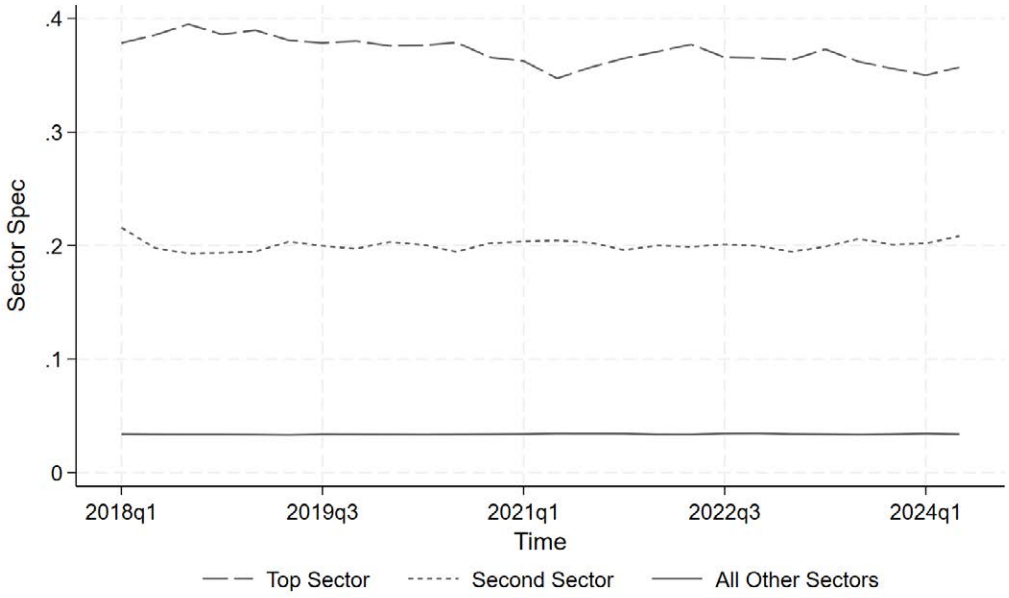
(a) Local Specialization (Volume Unweighted)



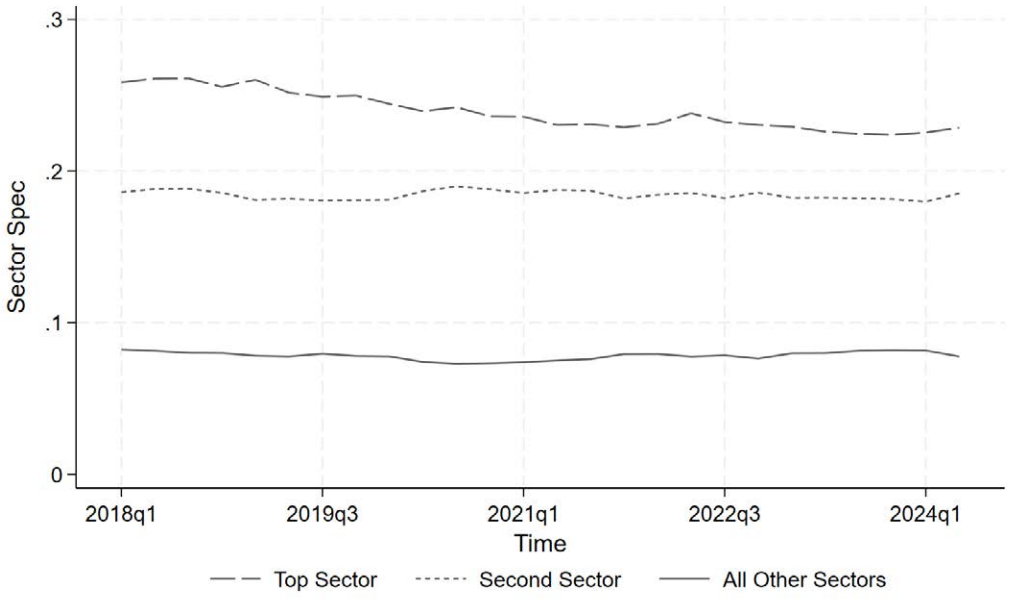
(b) Local Specialization (Volume Weighted)

Notes. This figure plots the degree of local specialization of banks in their top, second, and all other municipalities. Panel (a) presents the unweighted average local specialization. Panel (b) presents the weighted average local specialization using lending amounts as weights. The underlying data is from the Spanish Credit Registry.

Figure 2: Sector Specialization



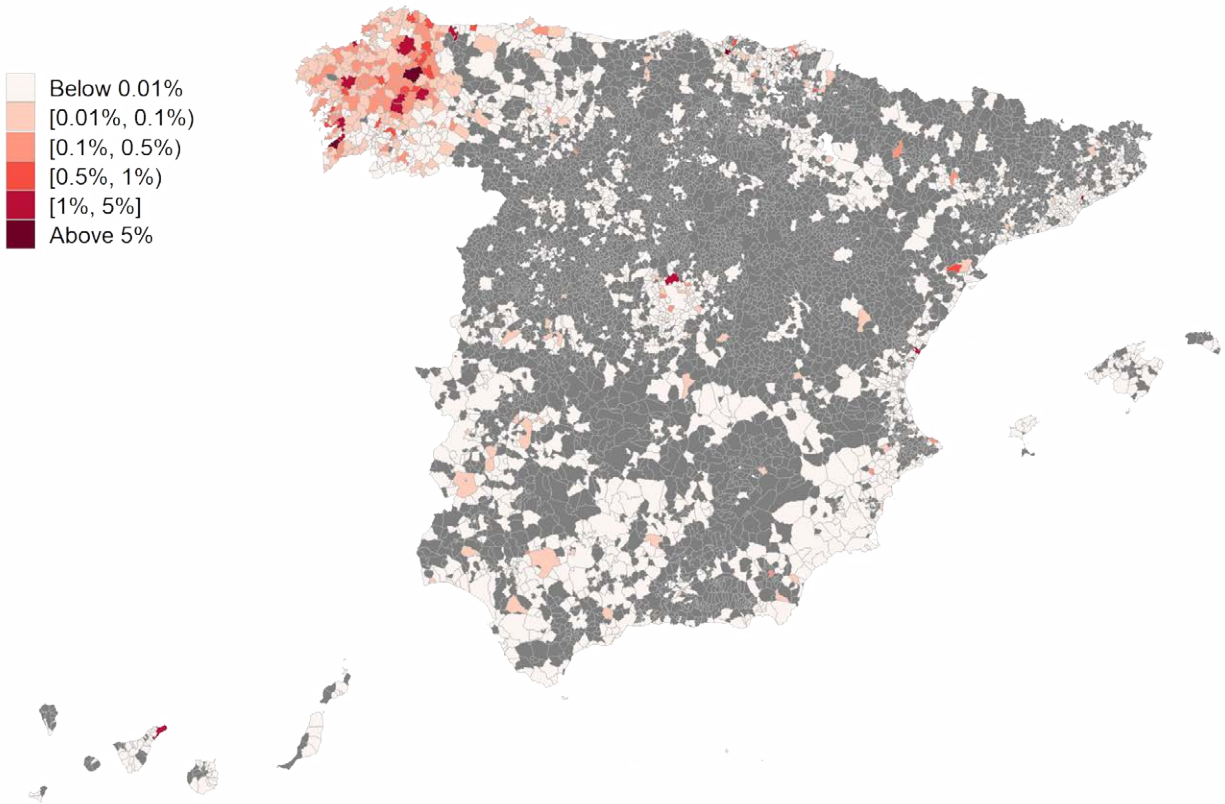
(a) Sector Specialization (Volume Unweighted)



(b) Sector Specialization (Volume Weighted)

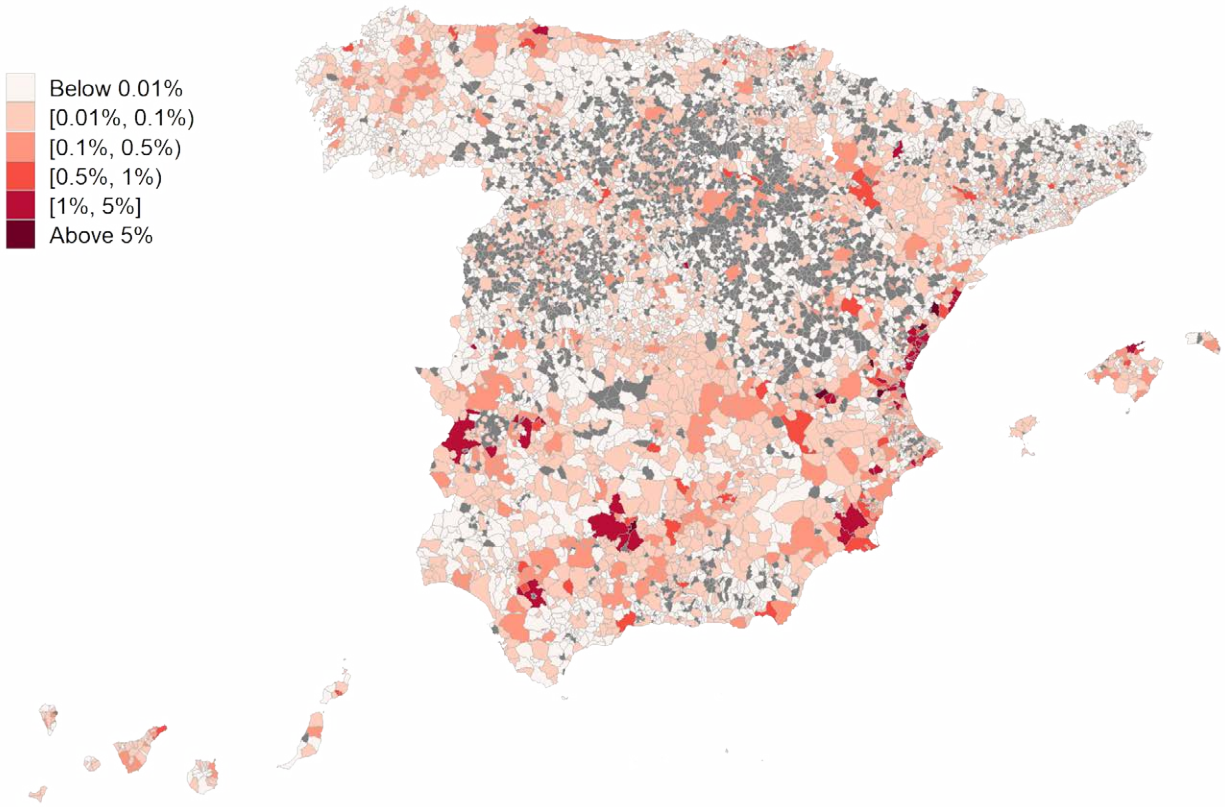
Notes. This figure plots the degree of sector specialization of banks in their top, second, and all other sectors. Panel (a) presents the unweighted average sector specialization. Panel (b) presents the weighted average sector specialization using lending amounts as weights. The underlying data is from the Spanish Credit Registry. The sample is from the third quarter of 2018 to the second quarter of 2024.

Figure 3: Local Excess Specialization in Spain for a Group of Banks



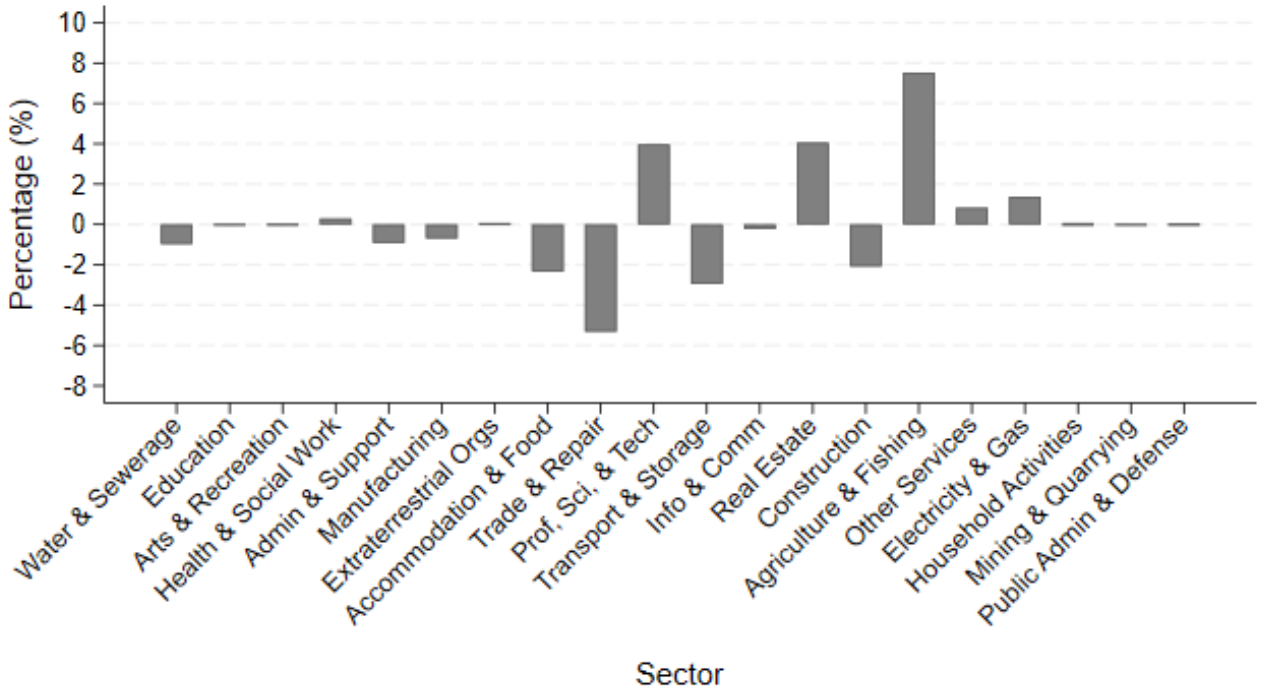
Notes. This map illustrates banks' local excess specialization across Spanish municipalities for a group of three banks (group of banks 1). Local specialization is averaged within municipalities for the three banks and presented as a percentage (%). Municipalities colored in grey indicate areas where no headquartered firms have outstanding loans with any of the banks in the group. The underlying data is from the Spanish Credit Registry. The sample is from the second quarter of 2024.

Figure 4: Average Local Excess Specialization in Spain



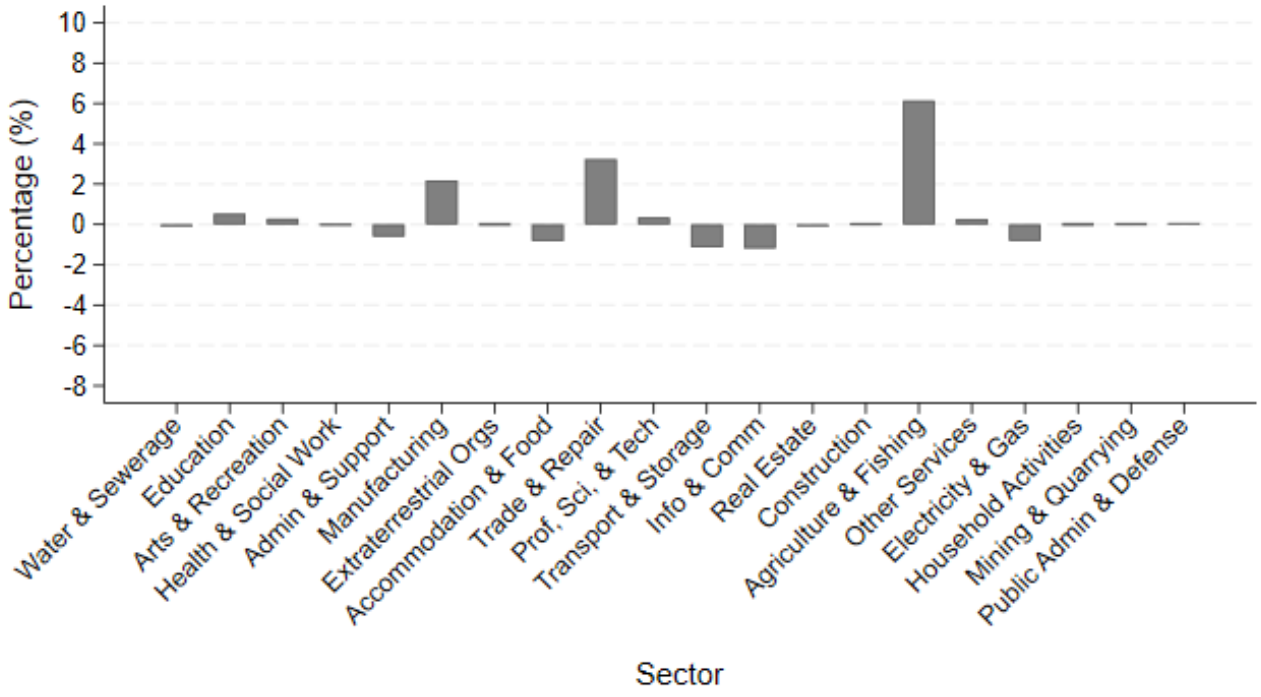
Notes. This map displays the average local excess specialization of banks across Spanish municipalities, presented as a percentage (%). Municipalities colored in grey indicate areas without headquartered firms having outstanding loans. The underlying data is from the Spanish Credit Registry. The sample is from the second quarter of 2024.

Figure 5: Sector Excess Specialization for a Group of Banks



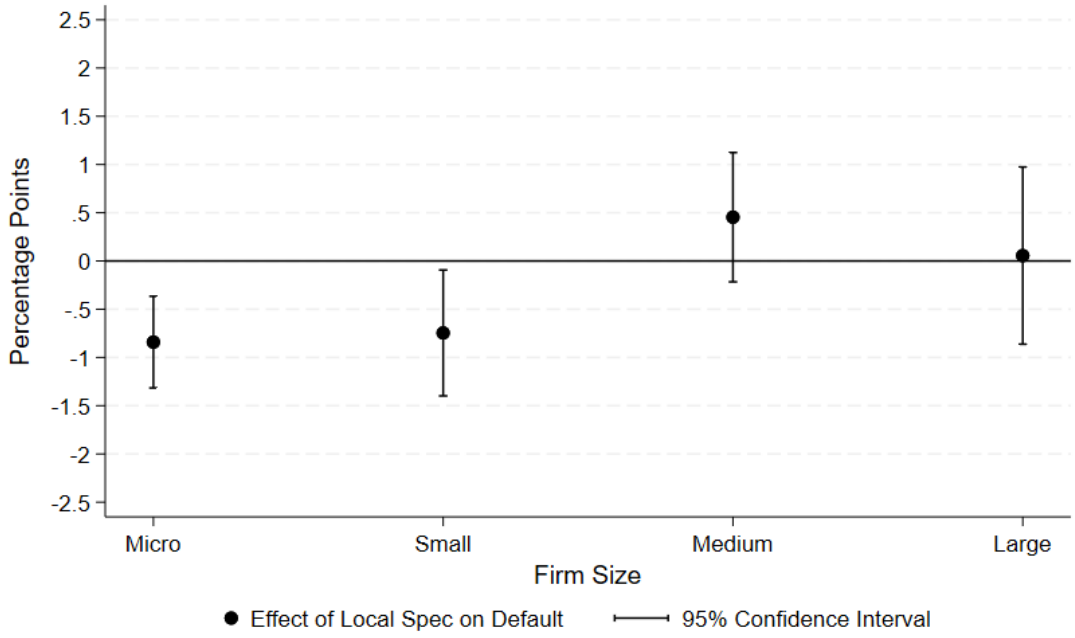
Notes. This figure illustrates banks' sector excess specialization across sectors for a group of three banks (group of banks 1). Sector excess specialization is averaged within sectors for the three banks and presented as a percentage (%). The underlying data is from the Spanish Credit Registry. The sample is from the second quarter of 2024.

Figure 6: Average Sector Excess Specialization

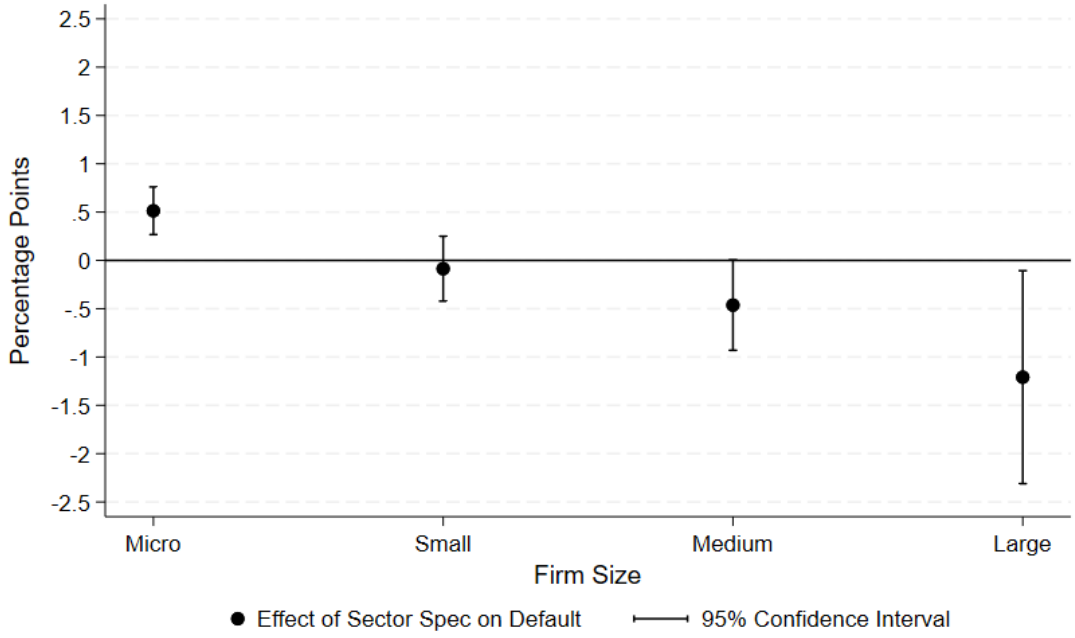


Notes. This figure displays the average sector excess specialization of banks across sectors, presented as a percentage (%). The underlying data is from the Spanish Credit Registry. The sample is from the second quarter of 2024.

Figure 7: Specialization, Loan Default, and Firm Size: Interpreted Coefficients



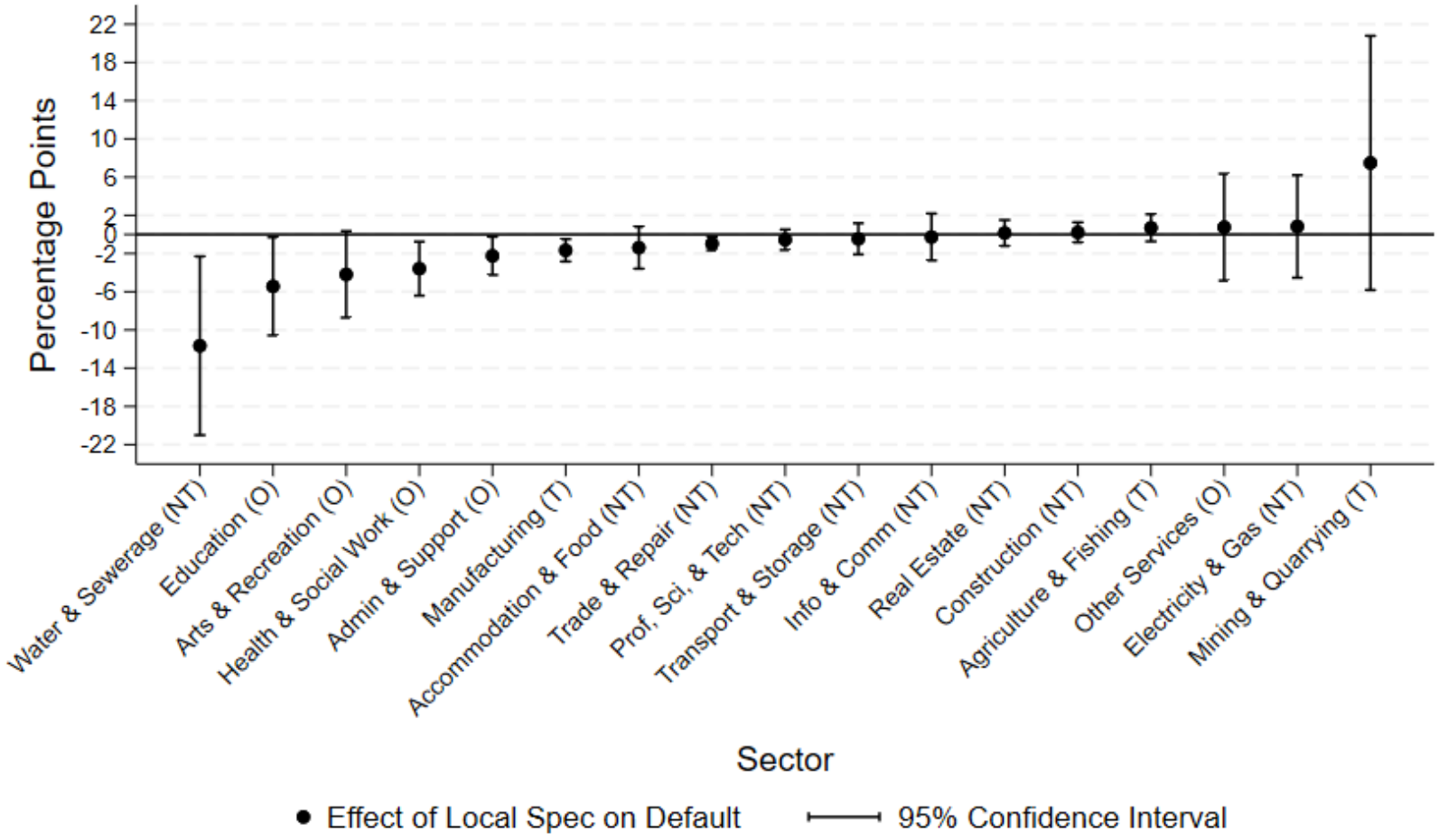
(a) Local Specialization



(b) Sector Specialization

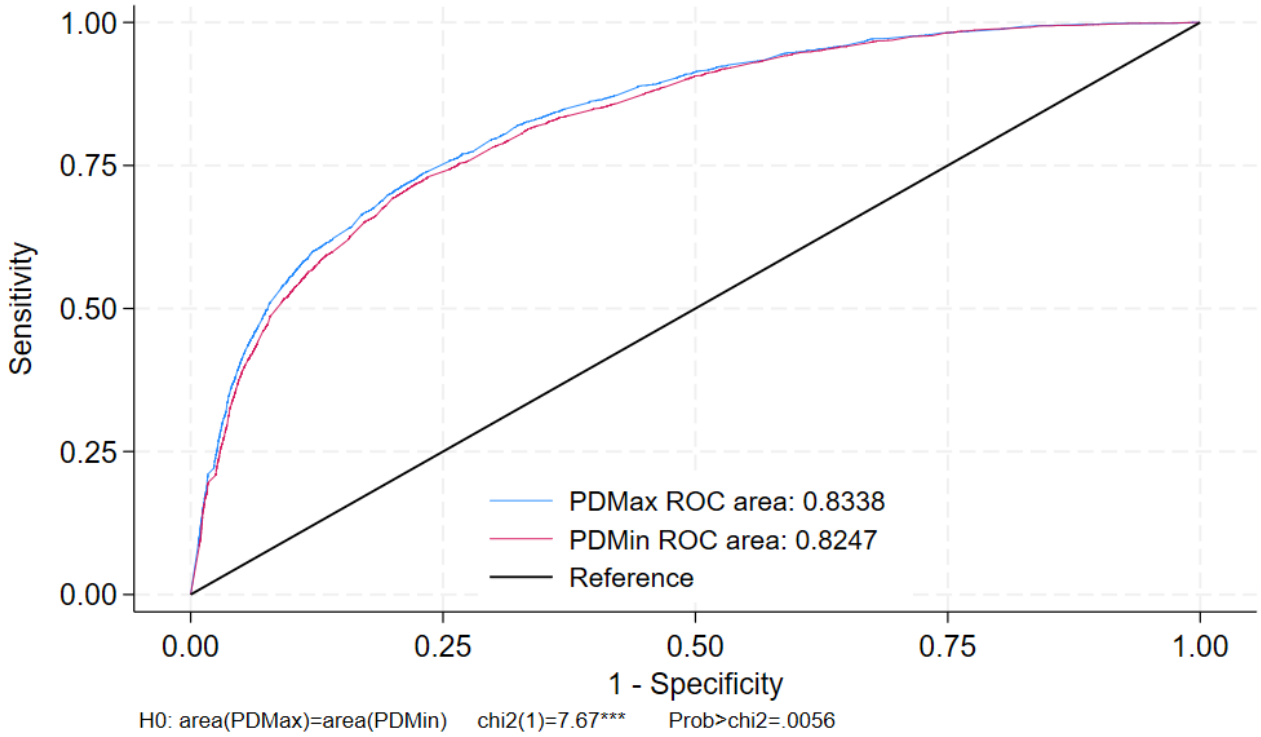
Notes. This figure shows the relationship between banks' local and sector specialization and loan default for loans granted to firms in the banks' top municipality or sector compared to other municipalities or sectors, depending on firm size. Panel (a) presents the results for local specialization. Panel (b) presents the results for sector specialization. The estimates and statistical significance (95% confidence intervals) are assessed by multiplying the estimated coefficients presented in Table 3 by the difference between the average local specialization in the top municipality or sector and the average in other municipalities or sectors presented in Table 2. The underlying data is from the Spanish Credit Registry. The sample is from the third quarter of 2018 to the second quarter of 2024.

Figure 8: Local Specialization, Loan Default, and Micro-Small Firms: Across Sectors



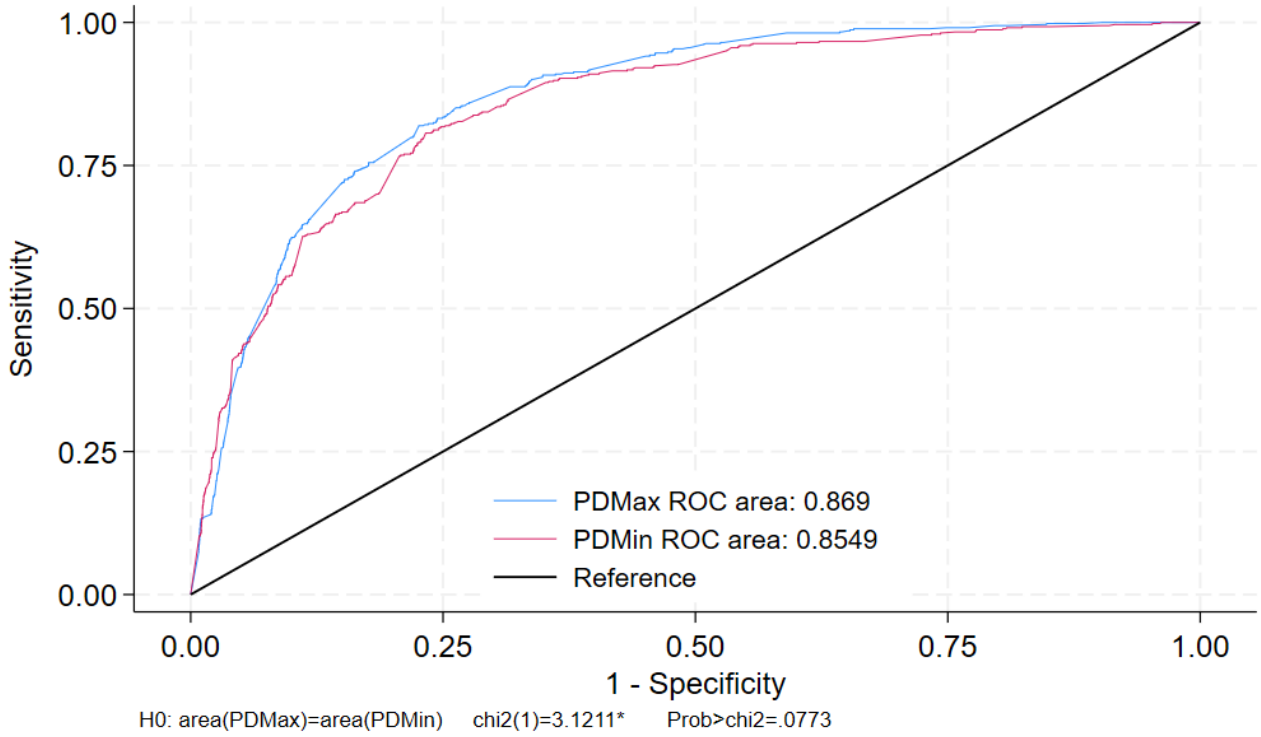
Notes. This figure shows the relationship between banks' local specialization and loan default for loans granted to micro and small firms in the banks' top municipality compared to other municipalities, across different sectors. The estimates and statistical significance (95% confidence intervals) are assessed by multiplying the estimated coefficients presented in Table A5 in the Appendix by the difference between the average local specialization in the top municipality and the average in other municipalities presented in Table 2. We classify sectors into three categories: non-tradable (NT), tradable (T), and other (O), following the methodology of Mian et al. (2020) in their international panel data. The underlying data is from the Spanish Credit Registry. The sample is from the third quarter of 2018 to the second quarter of 2024.

Figure 9: Local Specialization, Private Information, and Micro-Small Firms



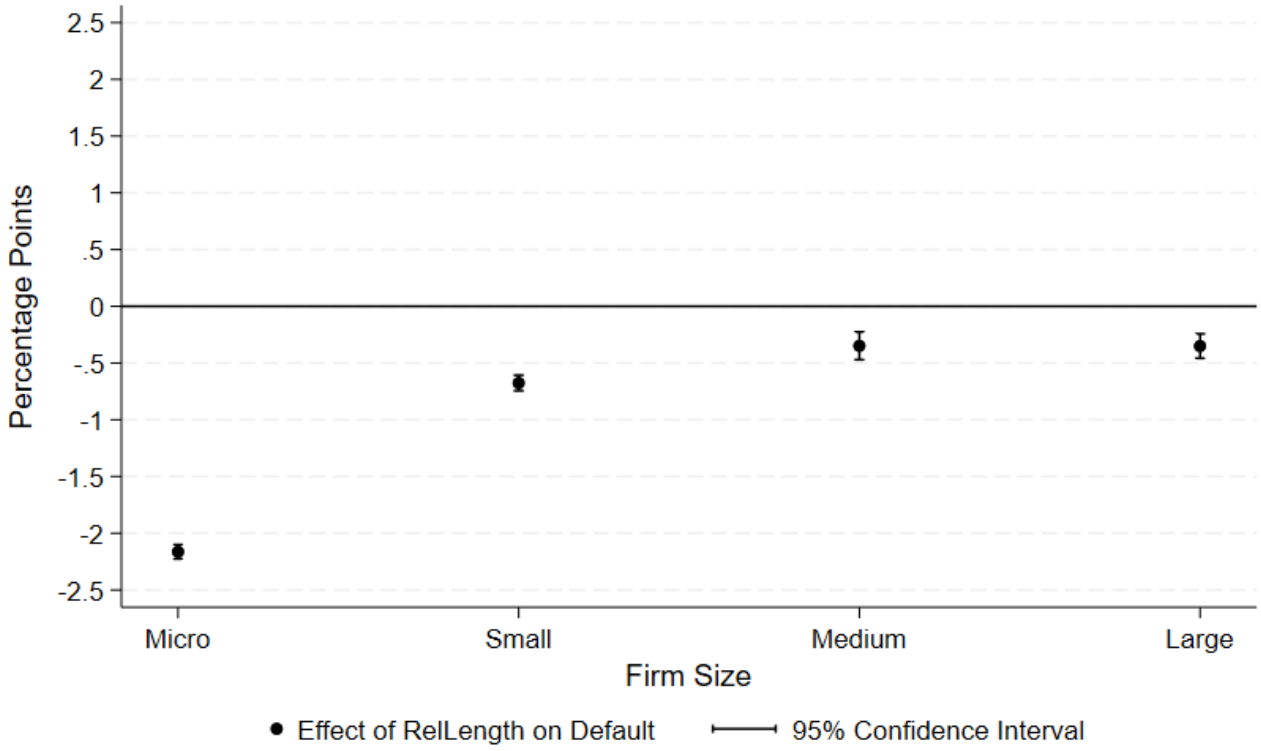
Notes. This figure shows the predictive accuracy of the internally estimated PD by banks with the highest and lowest local specialization for predicting realized default in micro and small firms, using the area under the receiver operating curve (AUC). The x-axis plots sensitivity (true positive rate). The y-axis plots 1-specificity (false positive rate). The blue and red ROC curves represent the PD from banks with the highest and lowest local specialization, respectively. The AUCs measure how well each PD discriminates ex-post realized default. A statistical test estimates if the difference between the AUCs is significant at conventional levels. The straight black line, with an AUC of 0.5, suggests a prediction no better than random. The data are from the Spanish Credit Registry. The sample is from the fourth quarter of 2021 to the second quarter of 2024. *** indicates significance at the 0.01 level.

Figure 10: Sector Specialization, Private Information, and Medium-Large Firms



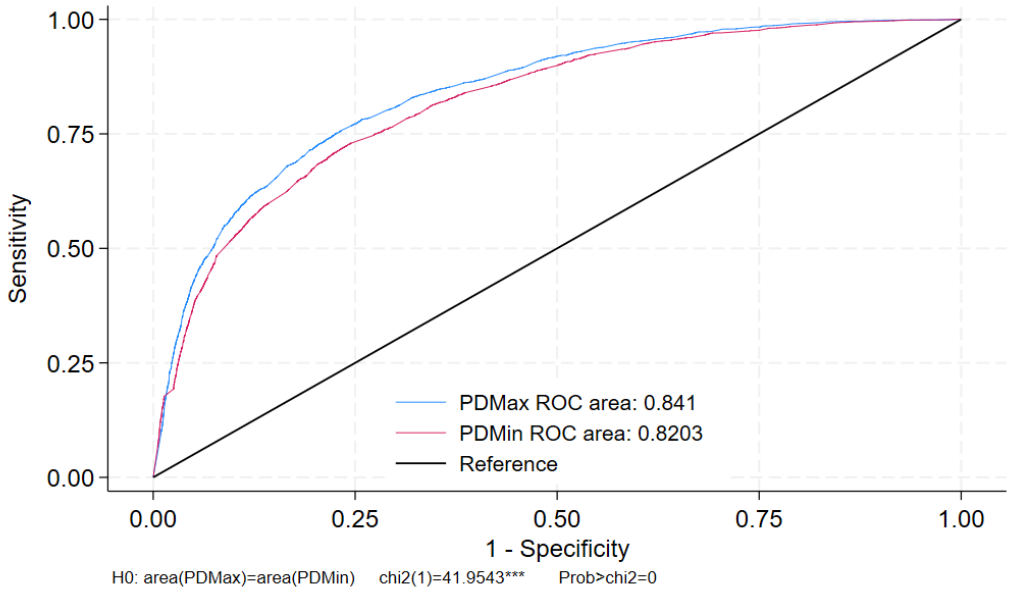
Notes. This figure shows the predictive accuracy of the internally estimated PD by banks with the highest and lowest sector specialization for predicting realized default in medium and large firms, using the area under the receiver operating curve (AUC). The x-axis plots sensitivity (true positive rate). The y-axis plots 1-specificity (false positive rate). The blue and red ROC curves represent the PD from banks with the highest and lowest sector specialization, respectively. The AUCs measure how well each PD discriminates ex-post realized default. A statistical test estimates if the difference between the AUCs is significant at conventional levels. The straight black line, with an AUC of 0.5, suggests a prediction no better than random. The data are from the Spanish Credit Registry. The sample is from the fourth quarter of 2021 to the second quarter of 2024. * indicates significance at the 0.1 level.

Figure 11: Relationship Lending, Loan Default, and Firm Size: Interpreted Coefficients

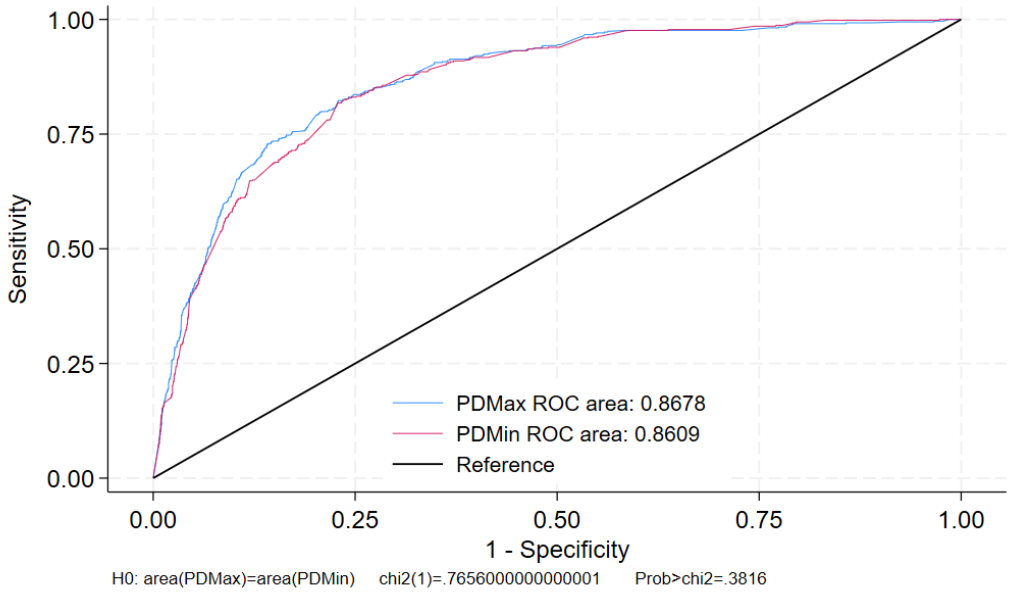


Notes. This figure shows the association between relationship lending and loan default for loans granted to firms with the longest relationship length for a given bank compared to the average relationship length of other firms, depending on firm size. The estimates and statistical significance (95% confidence intervals) are assessed by multiplying the estimated coefficients presented in Table 7 by the difference between the average relationship length for the firm with the longest relationship (82) and the average for other firms (25). The underlying data is from the Spanish Credit Registry. The sample is from the third quarter of 2018 to the second quarter of 2024.

Figure 12: Relationship Lending and Private Information



(a) Micro-Small Firms



(b) Medium-Large Firms

Notes. This figure shows the predictive accuracy of the internally estimated PD by banks with the highest and lowest relationship length for predicting realized default for both micro and small firms and medium and large firms, using the area under the receiver operating curve (AUC). Panel (a) presents the results for micro and small firms. Panel (b) presents the results for medium and large firms. The x-axis plots sensitivity (true positive rate). The y-axis plots 1-specificity (false positive rate). The blue and red ROC curves represent the PD from banks with the highest and lowest relationship length, respectively. The AUCs measure how well each PD discriminates ex-post realized default. A statistical test estimates if the difference between the AUCs is significant at conventional levels. The straight black line, with an AUC of 0.5, suggests a prediction no better than random. The data are from the Spanish Credit Registry. The sample is from the fourth quarter of 2021 to the second quarter of 2024. *** indicates significance at the 0.01 level.

Table 1: Summary Statistics

	Micro & Small Firms						Medium & Large Firms					
	N	mean	p25	p50	p75	sd	N	mean	p25	p50	p75	sd
Amount (thousand €)	5,955,692	48.753	3.175	12.000	35.000	454.399	3,705,853	143.063	0.648	6.935	36.707	6,915.424
Amount (log)	5,955,692	2.308	1.155	2.485	3.555	1.849	3,705,853	1.629	-0.434	1.937	3.603	2.744
Interest Rate (%)	5,955,692	4.065	2.180	3.659	5.640	2.438	3,705,853	3.814	1.789	4.000	5.580	2.199
Maturity (remaining quarters)	5,955,692	5.561	1	1	4	9.460	3,705,853	2.693	1	1	2	6.111
Secured	5,955,692	0.030	0	0	0	0.171	3,705,853	0.030	0	0	0	0.170
Default	5,955,692	0.017	0	0	0	0.128	3,705,853	0.005	0	0	0	0.069
RelLength (quarters)	5,955,692	32.382	10	24	51	27.130	3,705,853	46.942	25	42	72	27.464
Local Spec	5,939,099	0.029	0.000	0.001	0.009	0.074	3,697,362	0.034	0.001	0.003	0.020	0.075
Local MktSh	5,939,099	0.175	0.080	0.166	0.248	0.120	3,697,362	0.128	0.055	0.106	0.174	0.104
Sector Spec	5,955,524	0.144	0.078	0.163	0.186	0.080	3,705,760	0.153	0.102	0.167	0.185	0.090
Sector MktSh	5,955,524	0.137	0.042	0.153	0.216	0.091	3,705,760	0.097	0.050	0.065	0.156	0.078

Notes. This table presents summary statistics at the loan level for the period from the third quarter of 2018 to the second quarter of 2024. The data are reported quarterly. Loans are counted only at their origination. Amount is the total committed exposure of the granted loans. Interest rate is the rate charged for the loan. Maturity is the remaining maturity in quarters of the loan. Secured is an indicator that takes the value of 1 if the loan is collateralized, and 0 otherwise. Default is an indicator that takes the value of 1 if the loan enters in default after its origination, defined as being overdue by 90 days or more, and 0 otherwise. RelLength is the number of quarters where the bank-firm relationship has a positive amount of total outstanding lending, starting from the first quarter of the year 2000. Local Spec is the degree of local specialization of a given bank in a municipality and quarter, as defined in equation 1. Local MktSh is the bank's local market share in a given municipality and quarter. Sector Spec is the degree of sector specialization of a given bank in a sector and quarter. Sector MktSh is the bank's sector market share in a given sector and quarter. The statistics are split based on whether a loan is granted to a micro and small firm or to a medium or large firm. The data are from the Spanish Credit Registry.

Table 2: Summary Statistics of Local and Sector Specialization

	Top municipality or sector					All other municipalities or sectors				
Specialization type	mean	p25	p50	p75	sd	mean	p25	p50	p75	sd
Local Spec (municipality)	0.396	0.191	0.329	0.575	0.249	0.001	0.000	0.000	0.000	0.008
Sector Spec (20 sectors)	0.369	0.252	0.312	0.423	0.177	0.046	0.006	0.019	0.060	0.061

Notes. This table presents summary statistics for the local specialization and sector specialization measures. The variables are defined in Table 1. The statistics for both specialization measures are divided based on whether the municipality or sector is the top municipality or sector. The top municipality is defined as the municipality where a given bank has its highest degree of local specialization. The top sector is the sector where a given bank has its highest degree of sector specialization. The data are from the Spanish Credit Registry.

Table 3: Specialization, Loan Default, and Firm Size

	Default						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Local Spec	-0.0103***	-0.0210***	0.0109	-0.0213***	-0.0189**	0.0115	0.00142
	(0.00395)	(0.00500)	(0.00672)	(0.00613)	(0.00842)	(0.00865)	(0.0119)
Sector Spec	0.00214	0.0100***	-0.0198***	0.0159***	-0.00267	-0.0143*	-0.0374**
	(0.00260)	(0.00303)	(0.00682)	(0.00389)	(0.00531)	(0.00739)	(0.0174)
Observations	9,350,812	5,717,604	3,633,052	2,868,821	2,848,603	1,842,658	1,790,200
R-squared	0.204	0.180	0.337	0.158	0.229	0.325	0.370
Bank-Quarter FE	Y	Y	Y	Y	Y	Y	Y
MIST FE	Y	Y	Y	Y	Y	Y	Y
Controls	Y	Y	Y	Y	Y	Y	Y
Cluster s.e.	Firm-Quarter	Firm-Quarter	Firm-Quarter	Firm-Quarter	Firm-Quarter	Firm-Quarter	Firm-Quarter
Sample of firms	All	MicroSmall	MedLarge	Micro	Small	Medium	Large

Notes. This table estimates the relationship between banks' local and sector specialization and loan default for firms of different sizes. The data are at the loan level, focusing on the first observation of a loan at the time it is granted, from the third quarter of 2018 to the second quarter of 2024. Default is an indicator that takes the value of 1 if the loan enters in default after its origination. Column (1) includes all firms, regardless of size. Column (2) focuses on micro and small firms, while Column (3) focuses on medium and large firms. Columns (4) to (7) further break down the analysis by micro, small, medium, and large firms, respectively. MIST includes the set of municipality-sector-size-time fixed effects. The other variables are defined in Table 1. The data are from the Spanish Credit Registry. Fixed effects are denoted at the bottom of the table. Standard errors are clustered by firm-quarter. *, **, *** indicate significance at the 0.1, 0.05, and 0.01 levels, respectively.

Table 4: Local Specialization, Loan Default, and Micro-Small Firms: Robustness

	Default									
	Excess	Relative	Spec MicroSmall	Number	Spec Without Firm	No Sector	No Sector MktSh	Quartiles	Top	Spec > Median
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Panel A: Specialization measures and controls										
Local Spec	-0.0210***	-1.89e-05***	-0.0172***	-0.0109*	-0.0155***	-0.0207***	-0.0296***			
	(0.00500)	(5.55e-06)	(0.00479)	(0.00570)	(0.00505)	(0.00500)	(0.00486)			
Local Spec d4								-0.00775***	-0.00209***	
								(0.000850)	(0.000389)	
Local Spec d3								-0.00577***		
								(0.000756)		
Local Spec d2								-0.00458***		
								(0.000731)		
Local Spec d34										-0.00179***
										(0.000324)
Observations	5,717,604	5,717,604	5,713,151	5,717,604	5,072,579	5,717,709	5,717,709	5,717,604	5,717,604	5,717,604
R-squared	0.180	0.180	0.180	0.180	0.199	0.180	0.180	0.180	0.180	0.180
Bank-Quarter FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
MIST FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Controls	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Cluster s.e.	Firm-Quarter	Firm-Quarter	Firm-Quarter	Firm-Quarter	Firm-Quarter	Firm-Quarter	Firm-Quarter	Firm-Quarter	Firm-Quarter	Firm-Quarter
Sample of firms	MicroSmall	MicroSmall	MicroSmall	MicroSmall	MicroSmall	MicroSmall	MicroSmall	MicroSmall	MicroSmall	MicroSmall
Period	2018q3-2024q2	2018q3-2024q2	2018q3-2024q2	2018q3-2024q2	2018q3-2024q2	2018q3-2024q2	2018q3-2024q2	2018q3-2024q2	2018q3-2024q2	2018q3-2024q2

	Default									
	Default1y	Defaultdud	Drawn	No ICOs	Not Only New	PD Banks	PD Banks	PD Banks	No right-censored	Province&NACE2d
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Panel B: Dependent variables, sample, drawn amount and locality										
Local Spec	-0.0159***	-0.0119*	-0.0198***	-0.0151***	-0.0165***	-0.0329***	-0.0737***	-0.0939***	-0.0206***	-0.0149***
	(0.00445)	(0.00644)	(0.00538)	(0.00466)	(0.00239)	(0.0230)	(0.0235)	(0.0317)	(0.00631)	(0.00253)
PD								0.0774***		
								(0.0049)		
Observations	5,717,604	5,717,604	5,512,399	4,942,859	30,294,492	3,629,117	1,516,440	1,516,440	4,461,621	5,951,659
R-squared	0.204	0.193	0.181	0.188	0.117	0.173	0.236	0.242	0.218	0.047
Bank-Quarter FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
MIST FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	N
PIST FE	N	N	N	N	N	N	N	N	N	Y
Controls	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Cluster s.e.	Firm-Quarter	Firm-Quarter	Firm-Quarter	Firm-Quarter	Firm-Quarter	Firm-Quarter	Firm-Quarter	Firm-Quarter	Firm-Quarter	Firm-Quarter
Sample of firms	MicroSmall	MicroSmall	MicroSmall	MicroSmall	MicroSmall	MicroSmall	MicroSmall	MicroSmall	MicroSmall	MicroSmall
Period	2018q3-2024q2	2018q3-2024q2	2018q3-2024q2	2018q3-2024q2	2018q3-2024q2	2018q3-2024q2	2021q4-2023q2	2021q4-2023q2	2018q3-2024q1	2018q3-2024q2

Notes. This table examines the robustness of the relationship between local specialization and loan default for micro and small firms. Panel A and B report results for different specification of the specialization variable, included controls, dependent variables, sample periods, and local market and sector definition. The variables are defined in Tables 1 and 3. The data are sourced from the Spanish Credit Registry. Fixed effects are indicated at the bottom of the table. Standard errors are clustered by firm-quarter. *, *** denote significance at the 0.1 and 0.01 levels, respectively.

Table 5: Local Specialization, Loan Supply, and Micro-Small Firms

	LoanGranted			
	(1)	(2)	(3)	(4)
Local Spec	0.204***	0.160***	0.0861**	0.109***
	(0.0348)	(0.0338)	(0.0425)	(0.0419)
Observations	200,031	200,031	198,810	198,810
R-squared	0.506	0.532	0.548	0.560
Bank-Month FE	N	N	Y	Y
Firm-Month FE	Y	Y	Y	Y
Controls	Y	Y	Y	Y
Control RelLength	N	Y	N	Y
Cluster s.e.	Firm-Month	Firm-Month	Firm-Month	Firm-Month
Sample of firms	MicroSmall	MicroSmall	MicroSmall	MicroSmall
Period	2018m9-2024m6	2018m9-2024m6	2018m9-2024m6	2018m9-2024m6

Notes. This table examines the relationship between local specialization and loan supply for micro and small firms. The analysis is conducted at the application level. The data cover from September 2018 to June 2024. LoanGranted is an indicator that takes the value of 1 if the loan application is approved within three months of the application. Column (1) includes firm-month fixed effects and controls for local market share, sector specialization, and sector market share, and column (2) adds a control for the length of prior firm-bank relationships. Column (3) includes firm-month and bank-month fixed effects, and controls for local market share, sector specialization, and sector market share, with column (4) adding a control for the length of prior firm-bank relationships. The variables are defined in Table 1. The data are sourced from the Spanish Credit Registry. Fixed effects are indicated at the bottom of the table. Standard errors are clustered by firm-month. **, *** denote significance at the 0.05, and 0.01 levels, respectively.

Table 6: Sector Specialization, Loan Supply, and Medium-Large Firms

	LoanGranted			
	(1)	(2)	(3)	(4)
Sector Spec	0.125**	0.0969*	0.117	0.0994
	(0.0583)	(0.0561)	(0.0775)	(0.0762)
Observations	38,669	38,669	37,337	37,337
R-squared	0.534	0.572	0.628	0.642
Bank-Month FE	N	N	Y	Y
Firm-Month FE	Y	Y	Y	Y
Controls	Y	Y	Y	Y
Control RelLength	N	Y	N	Y
Cluster s.e.	Firm-Month	Firm-Month	Firm-Month	Firm-Month
Sample of firms	MediumLarge	MediumLarge	MediumLarge	MediumLarge
Period	2018m9-2024m6	2018m9-2024m6	2018m9-2024m6	2018m9-2024m6

Notes. This table examines the relationship between sector specialization and loan supply for medium and large firms. The analysis is conducted at the application level. The data cover from September 2018 to June 2024. LoanGranted is an indicator that takes the value of 1 if the loan application is approved within three months of the application. Column (1) includes firm-month fixed effects and controls for sector market share, local specialization, and local market share, and column (2) adds a control for the length of prior firm-bank relationships. Column (3) includes firm-month and bank-month fixed effects, and controls for sector market share, local specialization, and local market share, with column (4) adding a control for the length of prior firm-bank relationships. The variables are defined in Table 1. The data are sourced from the Spanish Credit Registry. Fixed effects are indicated at the bottom of the table. Standard errors are clustered by firm-month. *, ** denote significance at the 0.1, and 0.05 levels, respectively.

Table 7: Relationship Lending, Loan Default, and Firm Size

	Default						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
RelLength	-0.000197***	-0.000250***	-6.37e-05***	-0.000379***	-0.000118***	-6.11e-05***	-6.14e-05***
	(3.66e-06)	(4.12e-06)	(7.49e-06)	(5.61e-06)	(6.15e-06)	(1.10e-05)	(9.61e-06)
Observations	9,350,812	5,717,604	3,633,052	2,868,821	2,848,603	1,842,658	1,790,200
R-squared	0.204	0.180	0.337	0.158	0.229	0.325	0.370
Bank-Quarter FE	Y	Y	Y	Y	Y	Y	Y
MIST FE	Y	Y	Y	Y	Y	Y	Y
Controls	Y	Y	Y	Y	Y	Y	Y
Cluster s.e.	Firm-Quarter	Firm-Quarter	Firm-Quarter	Firm-Quarter	Firm-Quarter	Firm-Quarter	Firm-Quarter
Sample of firms	All	MicroSmall	MedLarge	Micro	Small	Medium	Large

Notes. This table examines the association between relationship lending and loan default for firms of different sizes. The data are at the loan level, focusing on the first observation of a loan at the time it is granted, from the third quarter of 2018 to the second quarter of 2024. Default is an indicator that takes the value of 1 if the loan enters in default after its origination. Column (1) includes all firms, regardless of size. Column (2) focuses on micro and small firms, while Column (3) focuses on medium and large firms. Columns (4) to (7) further break down the analysis by micro, small, medium, and large firms, respectively. The variables are defined in Tables 1 and 3. The data are from the Spanish Credit Registry. Fixed effects are denoted at the bottom of the table. Standard errors are clustered by firm-quarter. *** indicates significance at the 0.01 level.

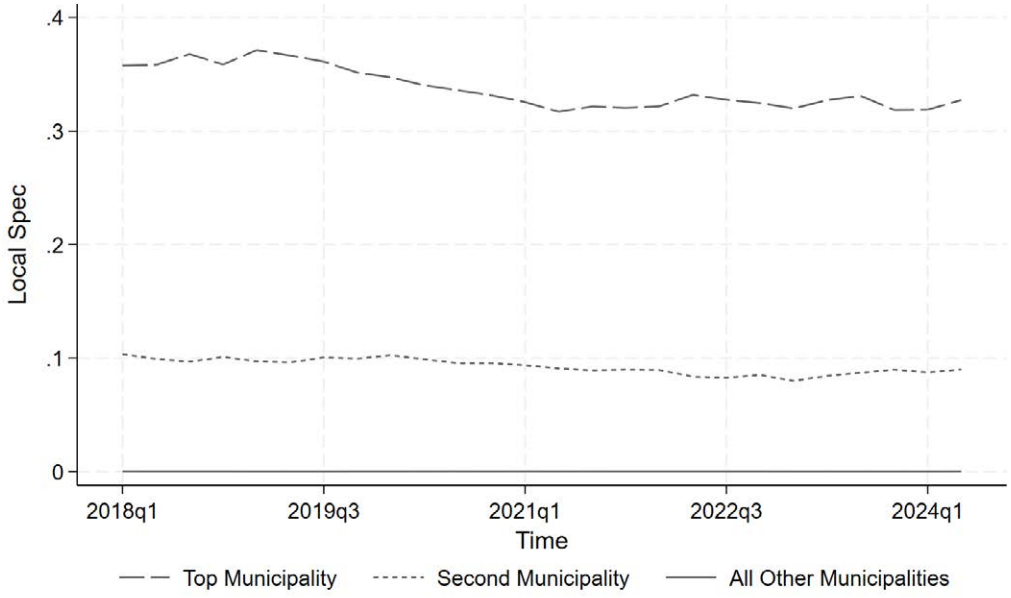
Table 8: Relationship Lending and Loan Supply

	LoanGranted			
	(1)	(2)	(3)	(4)
RelLength	0.00825***	0.00650***	0.00809***	0.00582***
	(0.000106)	(0.000119)	(0.000195)	(0.000235)
Observations	200,031	198,810	38,669	37,337
R-squared	0.532	0.560	0.572	0.642
Bank-Month FE	N	Y	N	Y
Firm-Month FE	Y	Y	Y	Y
Controls	Y	Y	Y	Y
Cluster s.e.	Firm-Month	Firm-Month	Firm-Month	Firm-Month
Sample of firms	MicroSmall	MicroSmall	MedLarge	MedLarge
Period	2018m9-2024m6	2018m9-2024m6	2018m9-2024m6	2018m9-2024m6

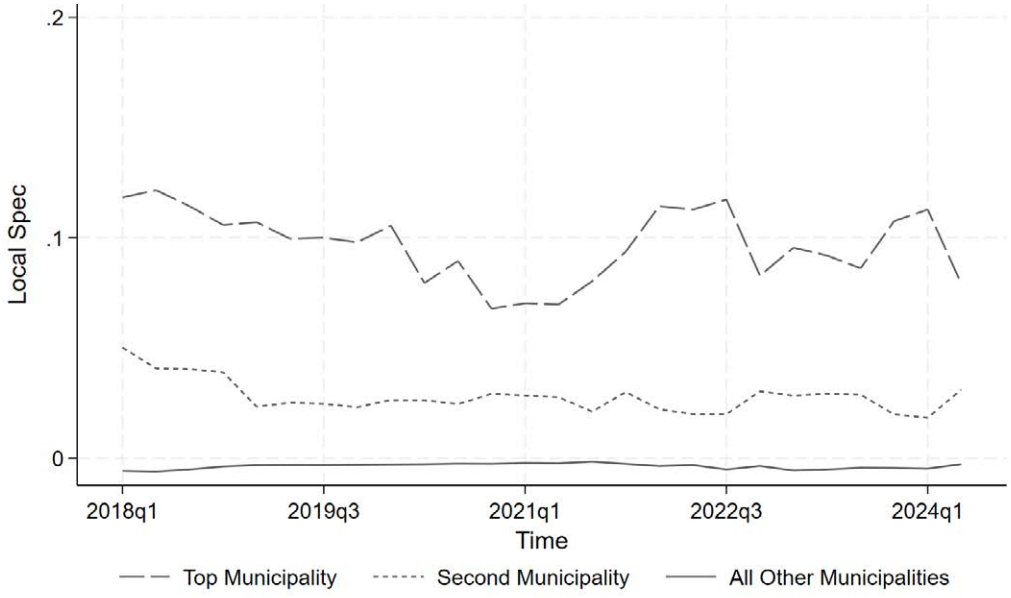
Notes. This table examines the association between relationship lending and loan supply for micro and small firms and for medium and large firms. The analysis is conducted at the application level. The data cover from September 2018 to June 2024. LoanGranted is an indicator that takes the value of 1 if the loan application is approved within three months of the application. Columns (1) and (3) include firm-month fixed effects and controls for local and sector specialization, and local and sector market shares. Columns (2) and (4) add bank-month fixed effects. The variables are defined in Table 1. The data are sourced from the Spanish Credit Registry. Fixed effects are indicated at the bottom of the table. Standard errors are clustered by firm-month. *** denotes significance at the 0.01 level.

A Appendix

Figure A1: Local Specialization (Excess)



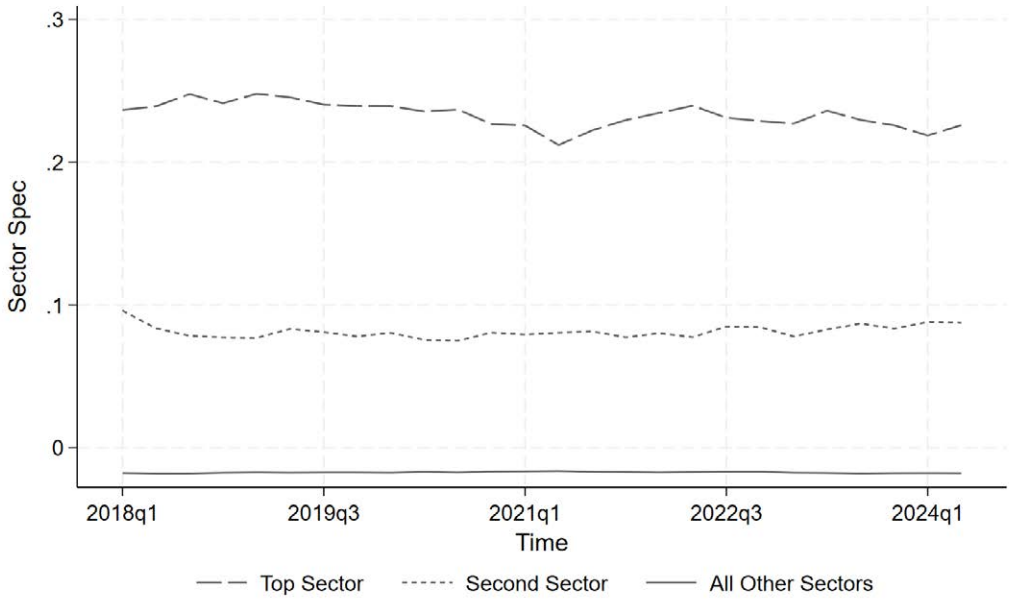
(a) Local Specialization (Excess & Volume Unweighted)



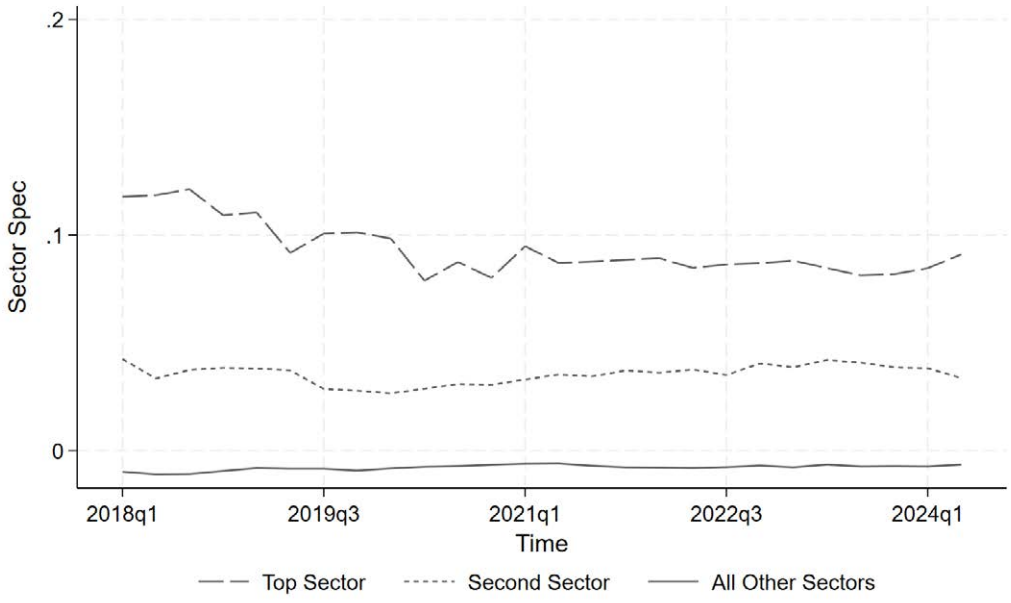
(b) Local Specialization (Excess & Volume Weighted)

Notes. This figure plots the degree of local excess specialization of banks in their top, second, and all other municipalities, using excess specialization as an alternative specification of the variable. Panel (a) presents the unweighted average local excess specialization. Panel (b) presents the weighted average local excess specialization using lending amounts as weights. The underlying data is from the Spanish Credit Registry. The sample is from the third quarter of 2018 to the second quarter of 2024.

Figure A2: Sector Specialization (Excess)



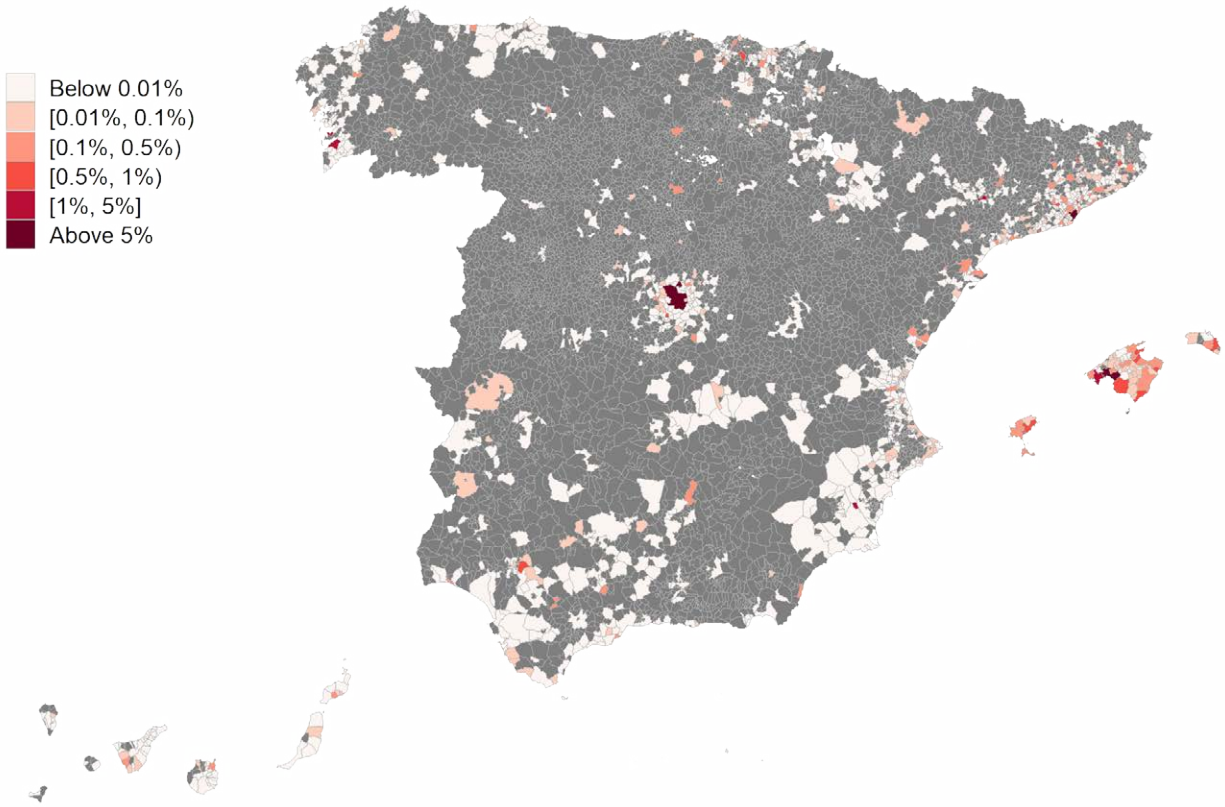
(a) Sector Specialization (Excess & Volume Unweighted)



(b) Sector Specialization (Excess & Volume Weighted)

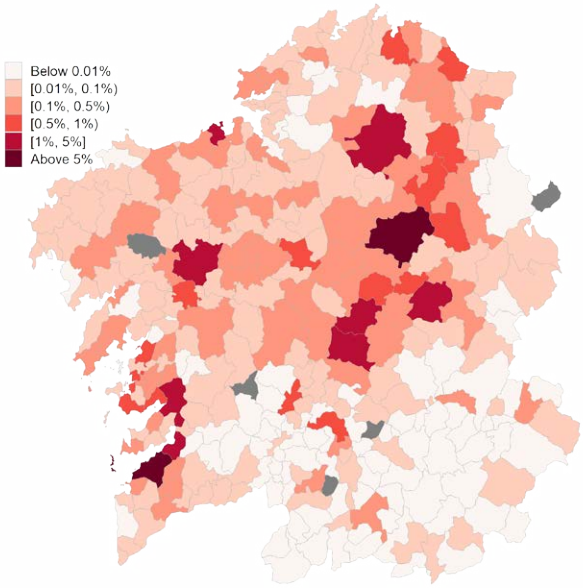
Notes. This figure plots the degree of sector excess specialization of banks in their top, second, and all other sector, using excess specialization as an alternative specification of the variable. Panel (a) presents the unweighted average sector excess specialization. Panel (b) presents the weighted average sector excess specialization using lending amounts as weights. The underlying data is from the Spanish Credit Registry. The sample is from the third quarter of 2018 to the second quarter of 2024.

Figure A3: Local Excess Specialization in Spain for a Different Group of Banks

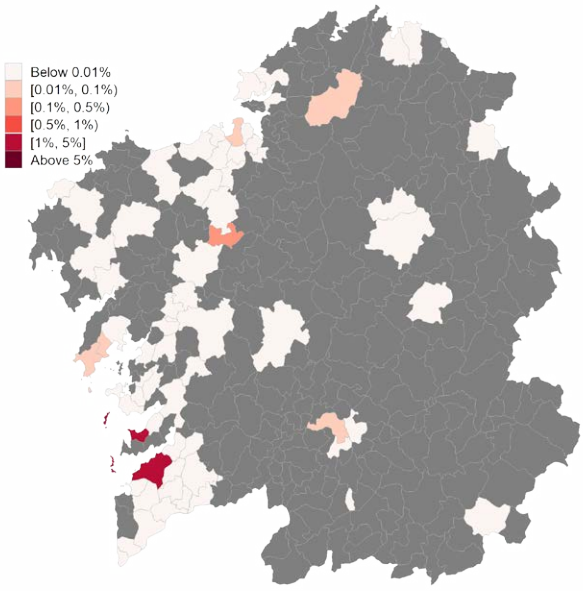


Notes. This map illustrates banks' local excess specialization across Spanish municipalities for a different group of three banks (group of banks 2). Local excess specialization is averaged within municipalities for the three banks and presented as a percentage (%). Municipalities colored in grey indicate areas where no headquartered firms have outstanding loans with any of the banks in the group. The underlying data is from the Spanish Credit Registry. The sample is from the second quarter of 2024.

Figure A4: Local Excess Specialization in Galicia and Two Groups of Banks



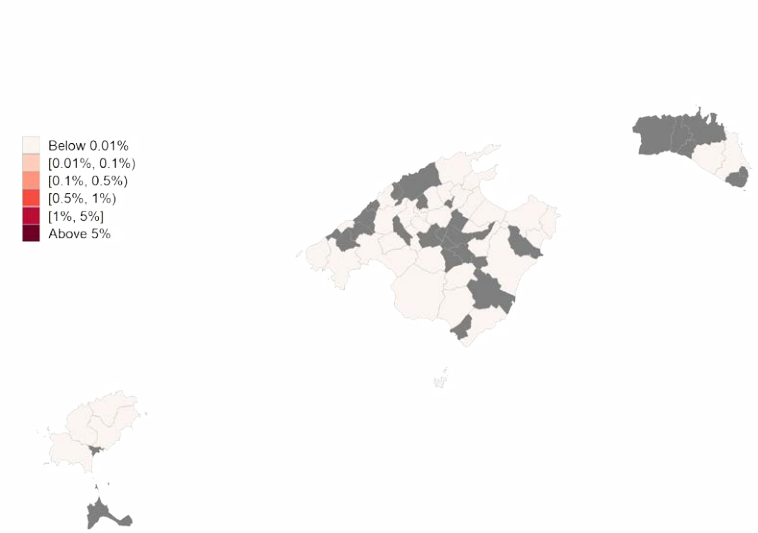
(a) Group of banks 1



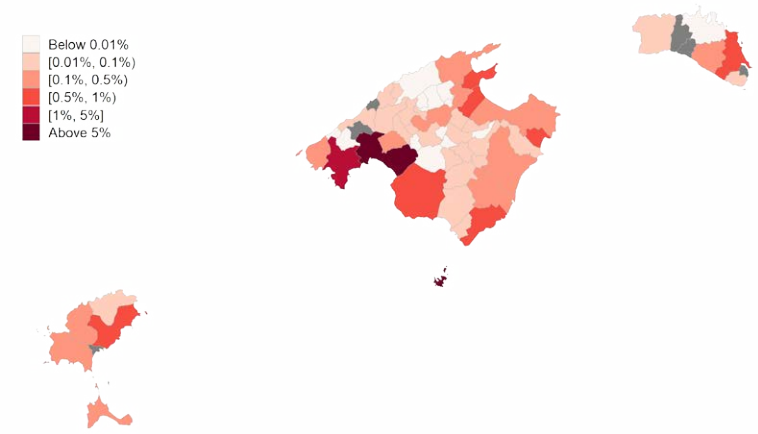
(b) Group of banks 2

Notes. These maps illustrate banks' local specialization across municipalities in Galicia for the two groups of banks, each consisting of three banks. Local excess specialization is averaged within municipalities for each group and presented as a percentage (%). Panels (a) and (b) display the maps for groups 1 and 2, respectively. Municipalities colored in grey indicate areas without headquartered firms having outstanding loans. The underlying data is from the Spanish Credit Registry. The sample is from the second quarter of 2024.

Figure A5: Local Excess Specialization in the Balearic Islands and Two Groups of Banks



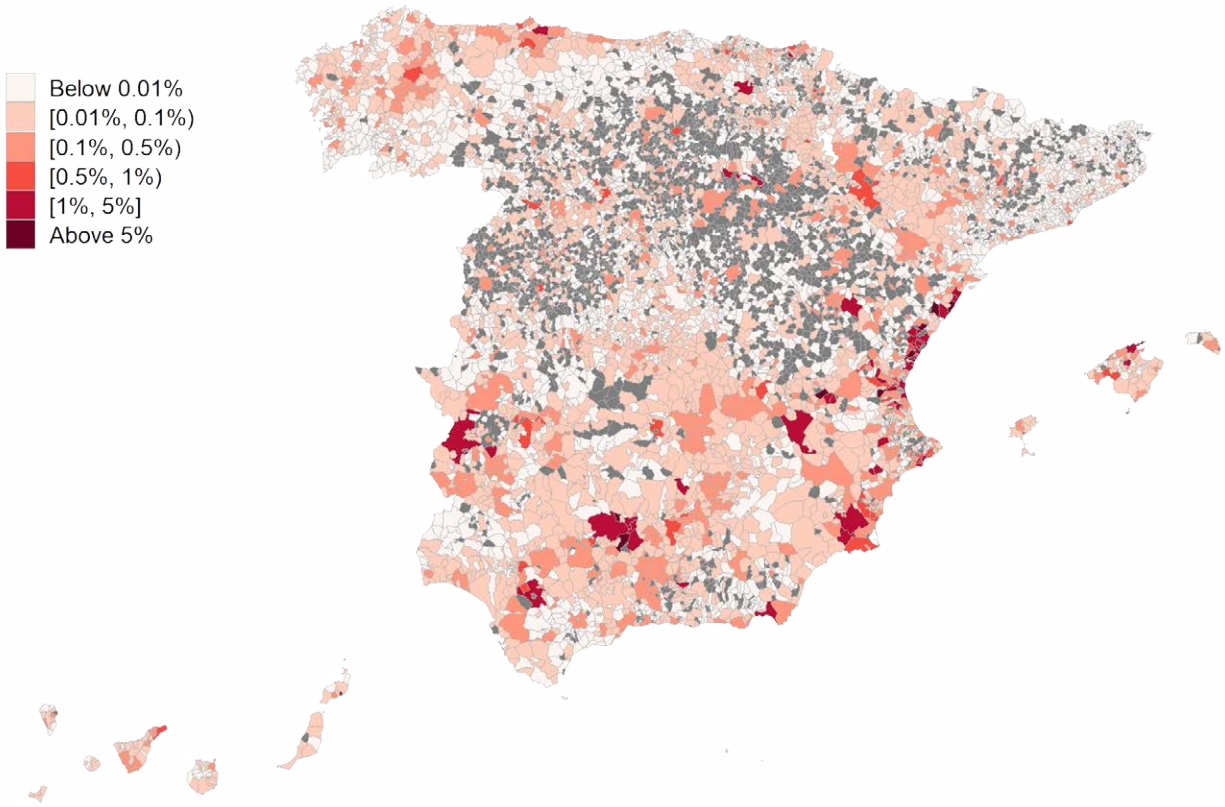
(a) Group of banks 1



(b) Group of banks 2

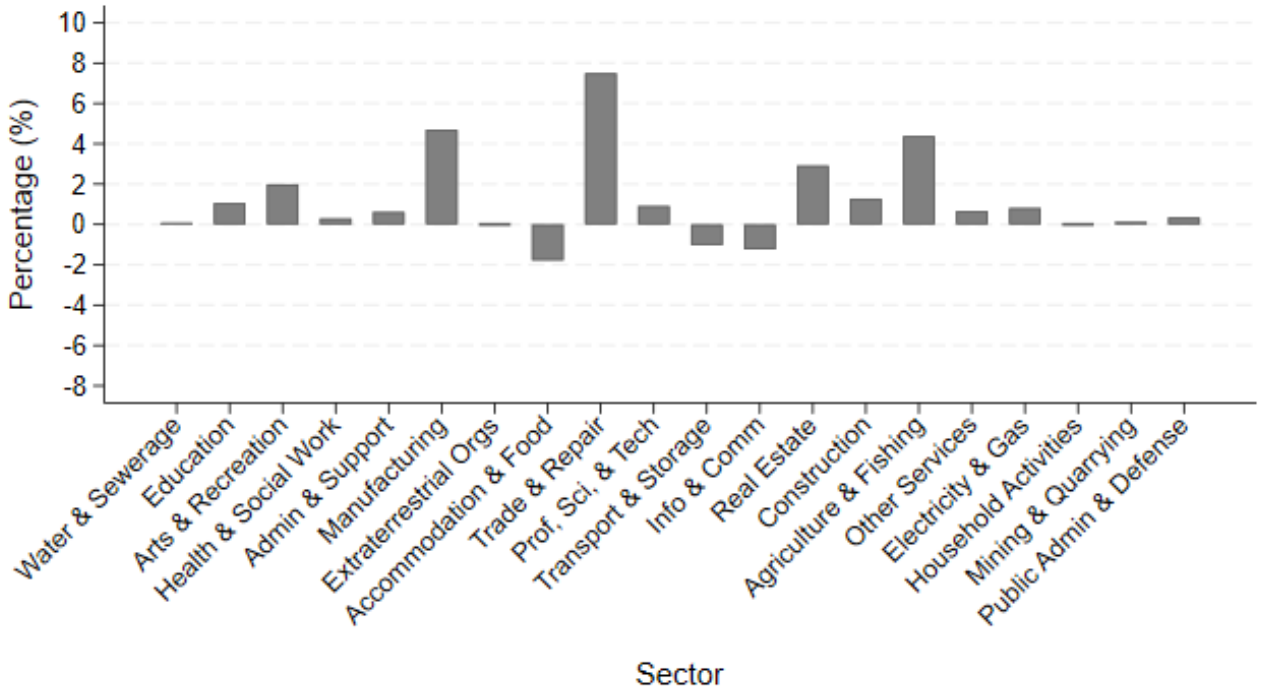
Notes. These maps illustrate banks' local excess specialization across municipalities in the Balearic Islands for the two groups of banks, each consisting of three banks. Local excess specialization is averaged within municipalities for each group and presented as a percentage (%). Panels (a) and (b) display the maps for groups 1 and 2, respectively. Municipalities colored in grey indicate areas without headquartered firms having outstanding loans. The underlying data is from the Spanish Credit Registry. The sample is from the second quarter of 2024.

Figure A6: Average Local Excess Specialization in Spain: Micro-Small Firms



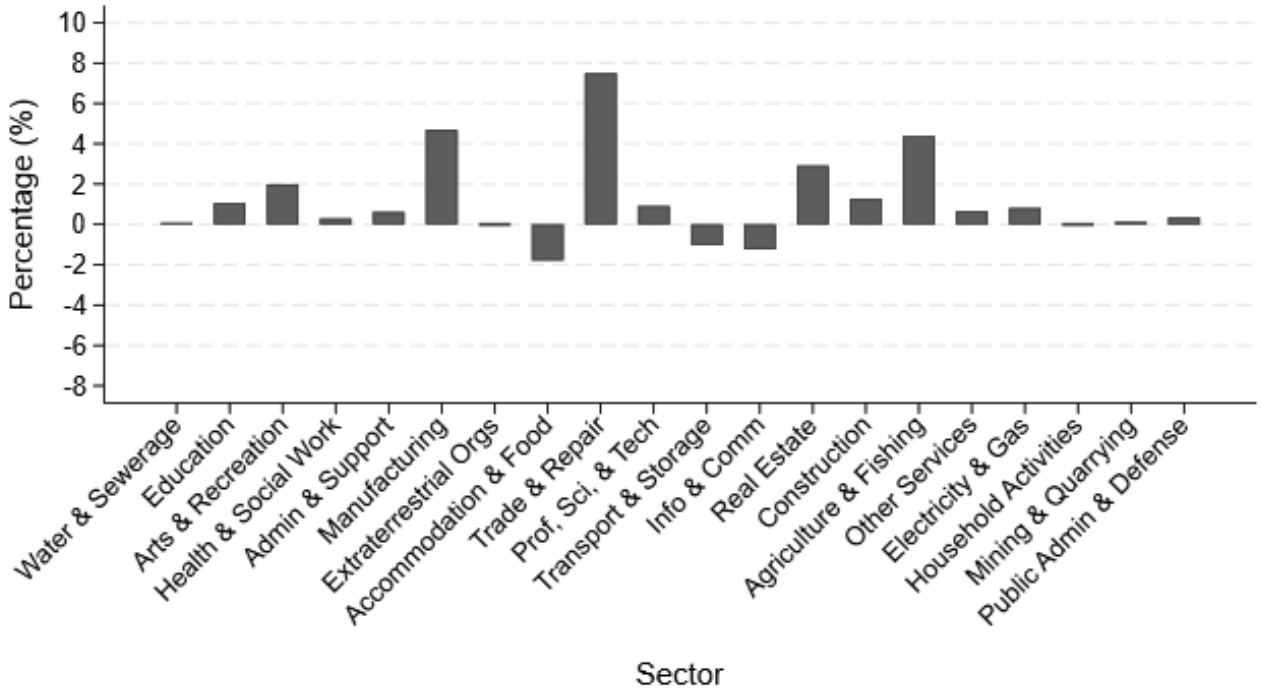
Notes. This map displays the average local excess specialization of banks across Spanish municipalities, presented as a percentage (%), based on lending to micro and small firms. Municipalities colored in grey indicate areas without headquartered firms having outstanding loans. The underlying data is from the Spanish Credit Registry. The sample is from the second quarter of 2024.

Figure A7: Sector Excess Specialization for a Different Group of Banks



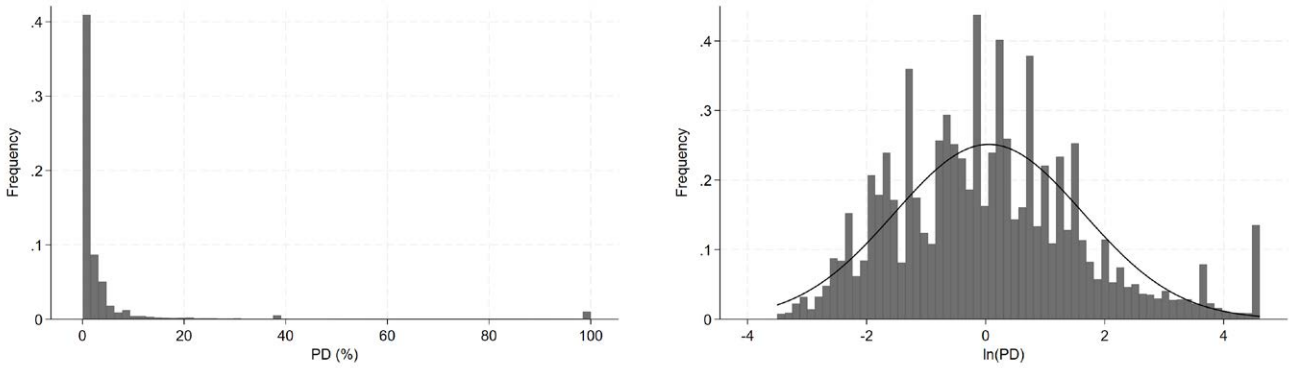
Notes. This figure displays the average sector excess specialization for a different group of three banks (group of banks 2). Sector excess specialization is averaged within sectors for the three banks and presented as a percentage (%). The underlying data is from the Spanish Credit Registry. The sample is from the second quarter of 2024.

Figure A8: Average Sector Excess Specialization: Medium-Large Firms



Notes. This figure displays the average sector excess specialization of banks across sectors, presented as a percentage (%), based on lending to medium and large firms. The underlying data is from the Spanish Credit Registry. The sample is from the second quarter of 2024.

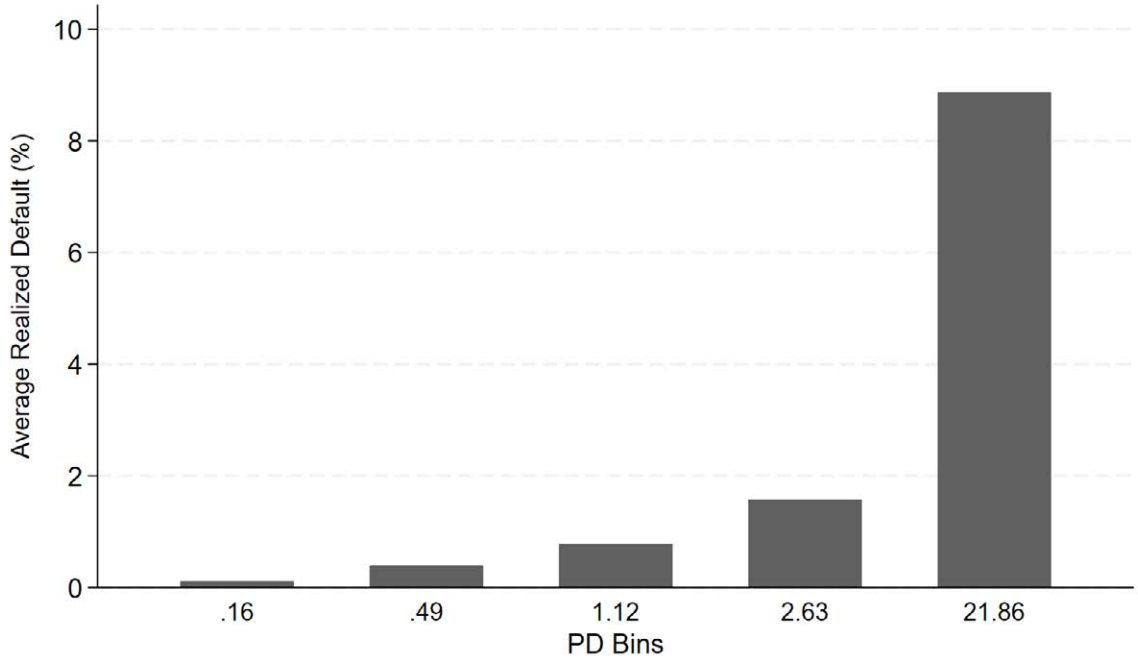
Figure A9: Frequency Distributions of PD and ln(PD)



(a) PD **(b)** LnPD

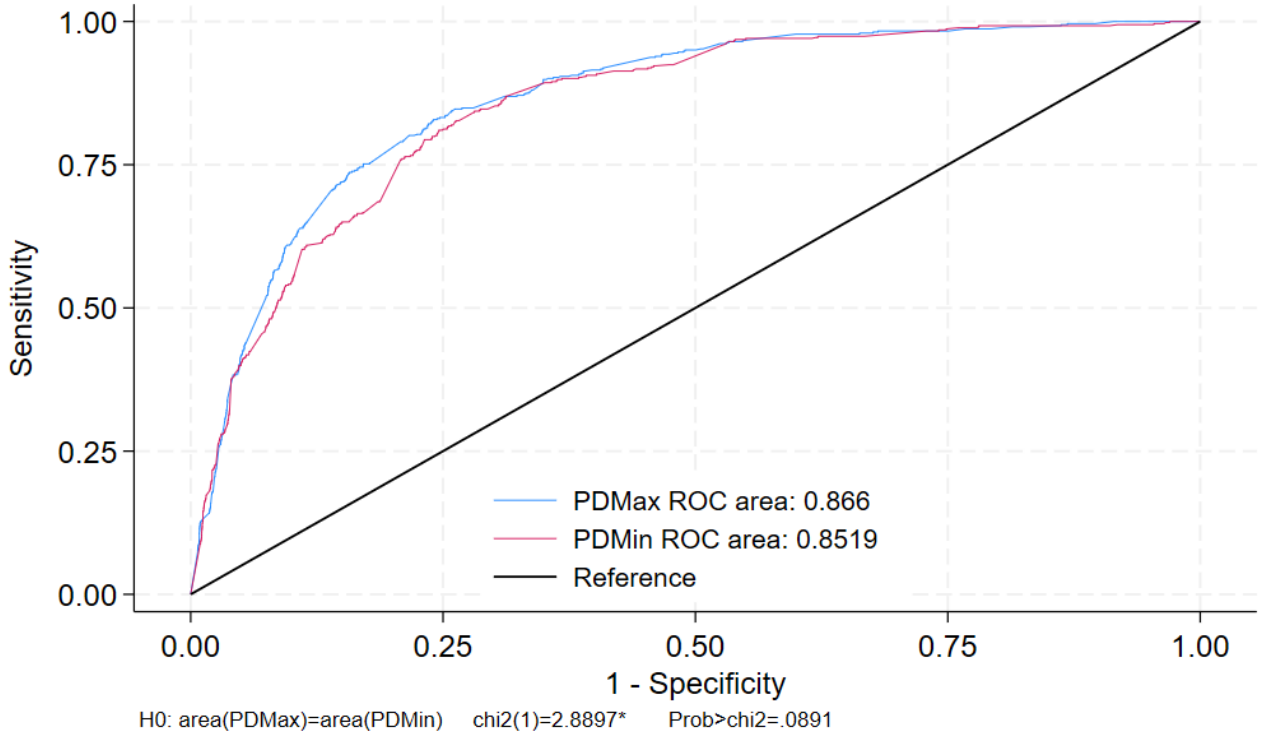
Notes. This figure plots the frequency distributions of the internally estimated PD and natural logarithm of PD. Panel (a) shows the graph for PD. Panel (b) shows the graph for the natural logarithm of PD. The underlying data is from the Spanish Credit Registry. The sample is from the fourth quarter of 2021 to the second quarter of 2024.

Figure A10: Realized Default Rates and Internally Estimated PD Quintiles



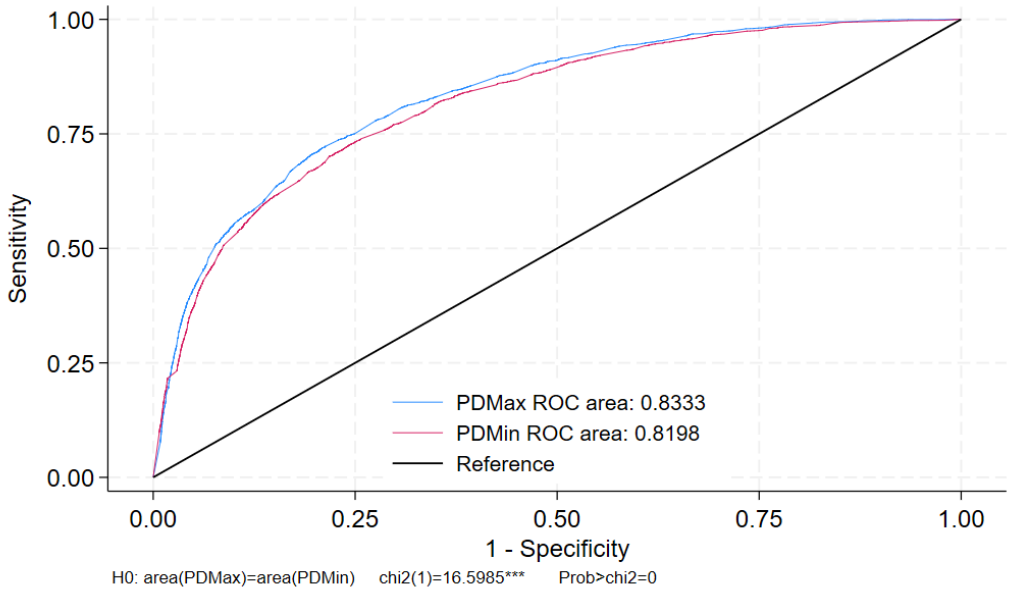
Notes. This figure shows the average realized default rates across internally estimated PD Quintiles. The y-axis presents the average default rate as a percentage (%), and the x-axis presents the average internally estimated PD within each quintile. The underlying data is from the Spanish Credit Registry. The sample is from the fourth quarter of 2021 to the second quarter of 2024.

Figure A11: Sector Specialization, Private Information, and Medium-Large Firms: 2-digit NACE

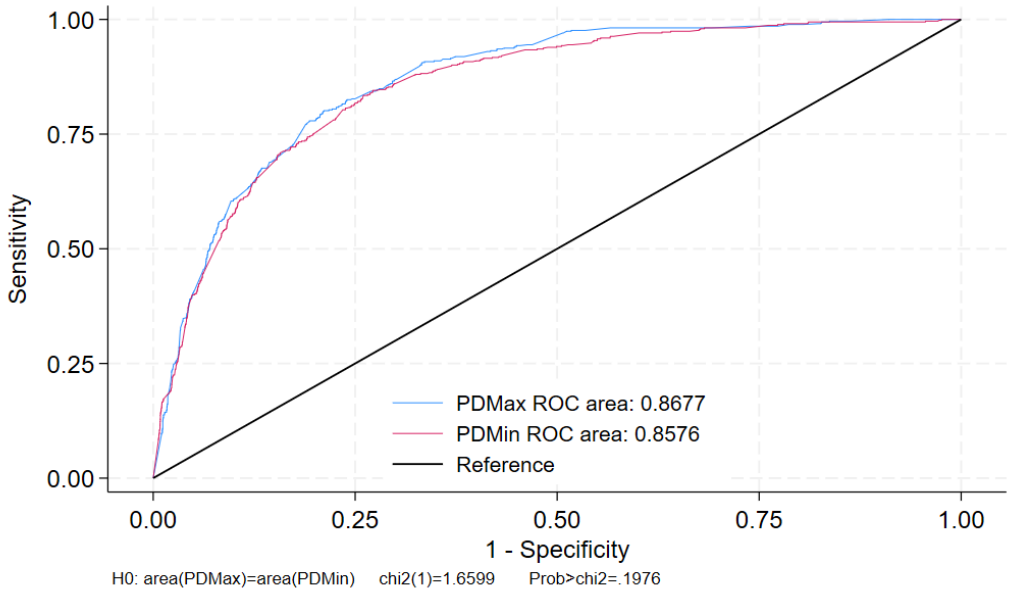


Notes. This figure illustrates the predictive accuracy of the internally estimated PDs by banks with the highest and lowest sector specialization, using 2-digit NACE codes for sector definition, in predicting realized defaults in medium and large firms. The area under the receiver operating characteristic curve (AUC) is used for this evaluation. The y-axis plots 1-specificity (false positive rate). The blue and red ROC curves represent the PD from banks with the highest and lowest sector specialization, respectively. The AUCs measure how well each PD discriminates ex-post realized default. A statistical test estimates if the difference between the AUCs is significant at conventional levels. The straight black line, with an AUC of 0.5, suggests a prediction no better than random. The data are from the Spanish Credit Registry. The sample is from the fourth quarter of 2021 to the second quarter of 2024. * indicates significance at the 0.1 level.

Figure A12: Relationship Share and Private Information



(a) Micro-Small Firms



(b) Medium-Large Firms

Notes. This figure shows the predictive accuracy of the internally estimated PD by banks with the highest and lowest relationship share for predicting realized default for both micro and small firms and medium and large firms, using the area under the receiver operating curve (AUC). Panel (a) presents the results for micro and small firms. Panel (b) presents the results for medium and large firms. The x-axis plots sensitivity (true positive rate). The y-axis plots 1-specificity (false positive rate). The blue and red ROC curves represent the PD from banks with the highest and lowest relationship length, respectively. The AUCs measure how well each PD discriminates ex-post realized default. A statistical test estimates if the difference between the AUCs is significant at conventional levels. The straight black line, with an AUC of 0.5, suggests a prediction no better than random. The data are from the Spanish Credit Registry. The sample is from the fourth quarter of 2021 to the second quarter of 2024. *** indicates significance at the 0.01 level.

Table A1: Summary Statistics of Excess Local and Sector Specialization

	Top municipality or industry					All other municipalities or industries				
Specialization type	mean	p25	p50	p75	sd	mean	p25	p50	p75	sd
Local Excess Spec (municipality)	0.336	0.130	0.250	0.538	0.259	0.000	0.000	0.000	0.000	0.001
Sector Excess Spec (20 sectors)	0.231	0.116	0.172	0.290	0.178	-0.010	-0.029	-0.006	0.002	0.046

Notes. This table presents summary statistics for the excess local specialization and excess sector specialization measures. Excess local and excess sector specialization are computed in the spirit of Blickle et al. (2023) as the difference between the share of a bank in a municipality or sector and the share a perfectly diversified bank would lend in the municipality or sector. The statistics for both excess specialization measures are divided based on whether the municipality or sector is the top municipality or sector. The top municipality is defined as the municipality where a given bank has its highest degree of excess local specialization. The top sector is the sector where a given bank has its highest degree of excess sector specialization. The data are from the Spanish Credit Registry.

Table A2: Serial Correlation Local and Sector Specialization

	Local Spec				
	(1)	(2)	(3)	(4)	(5)
Panel A: Local Specialization					
Local Spec t-1	0.981***				
	(0.00345)				
Local Spec t-4		0.947***			
		(0.0102)			
Local Spec t-8			0.909***		
			(0.0174)		
Local Spec t-12				0.883***	
				(0.0243)	
Local Spec t-16					0.864***
					(0.0310)
Observations	1,104,438	913,671	697,025	502,421	322,856
R-squared	0.971	0.926	0.886	0.853	0.832
Quarter FE	Y	Y	Y	Y	Y
Cluster s.e.	Bank-Local	Bank-Local	Bank-Local	Bank-Local	Bank-Local
	Sector Spec				
	(1)	(2)	(3)	(4)	(5)
Panel B: Sector Specialization					
Sector Spec t-1	0.971***				
	(0.00394)				
Sector Spec t-4		0.922***			
		(0.0117)			
Sector Spec t-8			0.866***		
			(0.0199)		
Sector Spec t-12				0.835***	
				(0.0260)	
Sector Spec t-16					0.812***
					(0.0330)
Observations	33,524	28,528	22,430	16,595	10,907
R-squared	0.947	0.850	0.766	0.716	0.682
Quarter FE	Y	Y	Y	Y	Y
Cluster s.e.	Bank-Sector	Bank-Sector	Bank-Sector	Bank-Sector	Bank-Sector

Notes. This table presents the serial correlation of the local and sector specialization measures. The data are from the third quarter of 2018 to the second quarter of 2024 at the bank-local-quarter level in panel A and at the bank-sector-quarter level in panel B. The variables are defined in Table 1. The data are from the Spanish Credit Registry. Fixed effects are denoted at the bottom of the table. Standard errors are clustered by bank-local in panel A and bank-sector in panel B. *** indicates significance at the 0.01 level.

Table A3: Specialization, Loan Default, and Firm Size: Reporting Controls

	Default						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Local Spec	-0.0103***	-0.0210***	0.0109	-0.0213***	-0.0189**	0.0115	0.00142
	(0.00395)	(0.00500)	(0.00672)	(0.00613)	(0.00842)	(0.00865)	(0.0119)
Local MktSh	-0.00809***	-0.0105***	-3.91e-05	-0.0139***	-0.00844***	-0.00401	0.00797**
	(0.00115)	(0.00136)	(0.00203)	(0.00184)	(0.00205)	(0.00252)	(0.00335)
Sector Spec	0.00214	0.0100***	-0.0198***	0.0159***	-0.00267	-0.0143*	-0.0374**
	(0.00260)	(0.00303)	(0.00682)	(0.00389)	(0.00531)	(0.00739)	(0.0174)
Sector MktSh	0.00660	-0.00299	0.0354**	-0.00845	0.0141	0.0676***	-0.0145
	(0.00540)	(0.00559)	(0.0173)	(0.00659)	(0.0107)	(0.0237)	(0.0200)
Secured	0.00183	0.00324**	-0.00212	0.00146	0.00707***	0.000153	-0.00453***
	(0.00125)	(0.00159)	(0.00135)	(0.00200)	(0.00260)	(0.00221)	(0.00148)
RelLength	-0.000197***	-0.000250***	-6.37e-05***	-0.000379***	-0.000118***	-6.11e-05***	-6.14e-05***
	(3.66e-06)	(4.12e-06)	(7.49e-06)	(5.61e-06)	(6.15e-06)	(1.10e-05)	(9.61e-06)
Amount	-8.72e-05*	-0.000221***	-7.89e-05	-3.14e-05	-0.000361***	0.000172	-0.000313***
	(4.75e-05)	(8.17e-05)	(5.60e-05)	(0.000111)	(0.000116)	(0.000122)	(4.83e-05)
Interest rate	0.00181***	0.00185***	0.00182***	0.00189***	0.00188***	0.00171***	0.00200***
	(5.03e-05)	(5.49e-05)	(0.000139)	(6.76e-05)	(9.47e-05)	(0.000152)	(0.000291)
ProductType2	-0.0291***	-0.0402***	-0.00661***	-0.0552***	-0.0228***	-0.00626**	-0.00701***
	(0.00135)	(0.00169)	(0.00164)	(0.00216)	(0.00274)	(0.00254)	(0.00211)
ProductType3	0.00101***	0.00101***	0.00158**	-0.000715*	0.00325***	0.00250***	-0.000439
	(0.000270)	(0.000313)	(0.000640)	(0.000380)	(0.000530)	(0.000963)	(0.000944)
ProductType4	-0.00253***	-0.00311***	-0.00226***	-0.00434***	-0.00219***	-0.00246***	-0.00290***
	(0.000402)	(0.000564)	(0.000564)	(0.000965)	(0.000691)	(0.000761)	(0.000967)
ProductType5	-0.0124***	-0.0146***	-0.00527***	-0.0162***	-0.0125***	-0.00426***	-0.00787***
	(0.000476)	(0.000560)	(0.000867)	(0.000836)	(0.000712)	(0.00105)	(0.00152)
Maturity	0.00113***	0.00130***	0.000565***	0.00142***	0.00113***	0.000630***	0.000417***
	(1.25e-05)	(1.48e-05)	(2.44e-05)	(1.85e-05)	(2.58e-05)	(3.21e-05)	(3.63e-05)
Observations	9,350,812	5,717,604	3,633,052	2,868,821	2,848,603	1,842,658	1,790,200
R-squared	0.204	0.180	0.337	0.158	0.229	0.325	0.370
Bank-Quarter FE	Y	Y	Y	Y	Y	Y	Y
MIST FE	Y	Y	Y	Y	Y	Y	Y
Cluster s.e.	Firm-Quarter	Firm-Quarter	Firm-Quarter	Firm-Quarter	Firm-Quarter	Firm-Quarter	Firm-Quarter
Sample of firms	All	MicroSmall	MedLarge	Micro	Small	Medium	Large

Notes. This table estimates the relationship between banks' local and sector specialization and loan default for firms of different sizes reporting the coefficients for the controls. The data are at the loan level, focusing on the first observation of a loan at the time it is granted, from the third quarter of 2018 to the second quarter of 2024. Default is an indicator that takes the value of 1 if the loan enters in default after its origination. Column (1) includes all firms, regardless of size. Column (2) focuses on micro and small firms, while Column (3) focuses on medium and large firms. Columns (4) to (7) further break down the analysis by micro, small, medium, and large firms, respectively. Product types are classified similarly to the approach in Ivashina et al. (2022). ProductType1 represents cash flow loans and is the omitted category. ProductType2, ProductType3, ProductType4, and ProductType5 represent asset-based loans, credit lines, trade finance, and leasing, respectively. The other variables are defined in Tables 1 and 3. The data are from the Spanish Credit Registry. Fixed effects are denoted at the bottom of the table. Standard errors are clustered by firm-quarter. *, **, *** indicate significance at the 0.1, 0.05, and 0.01 levels, respectively.

Table A4: Local Specialization, Loan Default, and Micro-Small Firms

	Default				
	(1)	(2)	(3)	(4)	(5)
Local Spec	-0.0155***	-0.0198***	-0.0210***	-0.00800	
	(0.00455)	(0.00490)	(0.00500)	(0.00537)	
Local Spec d4					-0.00536***
					(0.000930)
Local Spec d3					-0.00445***
					(0.000826)
Local Spec d2					-0.00400***
					(0.000800)
Observations	5,921,551	5,783,376	5,717,604	5,714,426	5,714,426
R-squared	0.065	0.144	0.180	0.189	0.189
Bank-Quarter FE	Y	Y	Y	N	N
Bank-Province-Quarter FE	N	N	N	Y	Y
MT FE	Y	N	N	N	N
IT FE	Y	N	N	N	N
MIT FE	N	Y	N	N	N
MIST FE	N	N	Y	Y	Y
Controls	Y	Y	Y	Y	Y
Cluster s.e.	Firm-Quarter	Firm-Quarter	Firm-Quarter	Firm-Quarter	Firm-Quarter
Sample of firms	MicroSmall	MicroSmall	MicroSmall	MicroSmall	MicroSmall
Period	2018q3-2024q2	2018q3-2024q2	2018q3-2024q2	2018q3-2024q2	2018q3-2024q2

Notes. This table estimates the relationship between banks' local specialization and loan default for micro and small firms with different sets of fixed effects. The data are at the loan level, focusing on the first observation of a loan at the time it is granted, from the third quarter of 2018 to the second quarter of 2024. Default is an indicator that takes the value of 1 if the loan enters in default after its origination. Column (1) includes bank-quarter, municipality-quarter, and sector-quarter fixed effects. Column (2) includes bank-quarter and municipality-sector-quarter fixed effects. Column (3) includes bank-quarter and municipality-sector-size-quarter fixed effects. Columns (4) and (5) include bank-province-quarter and municipality-sector-size-quarter fixed effects. The variables are defined in Tables 1 and 3. The data are from the Spanish Credit Registry. Fixed effects are denoted at the bottom of the table. Standard errors are clustered by firm-quarter. *** indicates significance at the 0.01 level.

Table A5: Local Specialization, Loan Default, and Micro-Small Firms Across Sectors

	Default									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Local Spec	-0.295**	-0.138**	-0.106*	-0.0907**	-0.0569**	-0.0421***	-0.0413	-0.0351	-0.0245***	-0.0142
	(0.121)	(0.0663)	(0.0584)	(0.0365)	(0.0258)	(0.0152)	(0.328)	(0.0284)	(0.00897)	(0.0138)
Observations	18,654	37,025	42,425	61,893	152,951	1,149,108	212	208,115	2,431,291	308,269
R-squared	0.468	0.272	0.254	0.199	0.233	0.208	0.577	0.173	0.126	0.157
Bank-Quarter FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
MIST FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Cluster s.e.	Firm-Quarter	Firm-Quarter	Firm-Quarter	Firm-Quarter	Firm-Quarter	Firm-Quarter	Firm-Quarter	Firm-Quarter	Firm-Quarter	Firm-Quarter
Sample of firms	MicroSmall	MicroSmall	MicroSmall	MicroSmall	MicroSmall	MicroSmall	MicroSmall	MicroSmall	MicroSmall	MicroSmall
Sector	Water & Sewerage	Education	Arts & Recreation	Health & Social Work	Admin & Support	Manufacturing	Extraterrestrial Orgs	Accomodation & Food	Trade & Repair	Prof, Sci, & Tech
Sector Type	NT	O	O	O	O	T	O	NT	NT	NT

	Default								
	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)
Local Spec	-0.0117	-0.00689	0.00379	0.00538	0.0175	0.0190	0.0211	0.178	0.189
	(0.0211)	(0.0317)	(0.0175)	(0.0135)	(0.0184)	(0.0722)	(0.0693)	(0.307)	(0.172)
Observations	318,753	106,597	103,574	551,234	146,553	53,735	12,750	226	10,083
R-squared	0.270	0.191	0.171	0.211	0.319	0.345	0.439	0.542	0.614
Bank-Quarter FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
MIST FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Cluster s.e.	Firm-Quarter	Firm-Quarter	Firm-Quarter	Firm-Quarter	Firm-Quarter	Firm-Quarter	Firm-Quarter	Firm-Quarter	Firm-Quarter
Sample of firms	MicroSmall	MicroSmall	MicroSmall	MicroSmall	MicroSmall	MicroSmall	MicroSmall	MicroSmall	MicroSmall
Sector	Transport & Storage	Info & Comm	Real Estate	Construction	Agriculture & Fishing	Other Services	Electricity & Gas	Household Activities	Mining & Quarr
Sector Type	NT	NT	NT	NT	T	O	NT	O	T

Notes. This table estimates the relationship between banks' local specialization and loan default for micro and small firms across different sectors. The data are at the loan level, focusing on the first observation of a loan at the time it is granted, from the third quarter of 2018 to the second quarter of 2024. Default is an indicator that takes the value of 1 if the loan enters in default after its origination. Columns (1) to (19) present the results for water & sewerage, education, arts & recreation, health & social work, admin & support, manufacturing, extraterrestrial orgs, accommodation & food, trade & repair, professional, scientific & technical, transport & storage, information & communication, real estate, construction, agriculture & fishing, other services, electricity & gas, household activities, and mining & quarrying, respectively. The variables are defined in Tables 1 and 3. The data are from the Spanish Credit Registry. Fixed effects are denoted at the bottom of the table. Standard errors are clustered by firm-quarter. *, **, *** indicate significance at the 0.1, 0.05, and 0.01 levels, respectively.

Table A6: Local Specialization, Loan Default, and Medium-Large Firms Across Sectors

	Default								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Local Spec	0.0442	0.0495	0.205**	-0.0889	0.0788	0.0141*	0.0318	0.00584	0.0139
	(0.0695)	(0.0406)	(0.0894)	(0.0572)	(0.0538)	(0.00823)	(0.0607)	(0.00856)	(0.0285)
Observations	27,256	9,387	8,465	34,752	230,496	967,517	69,358	1,467,494	78,630
R-squared	0.736	0.434	0.446	0.359	0.368	0.319	0.357	0.338	0.238
Bank-Quarter FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
MIST FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Cluster s.e.	Firm-Quarter	Firm-Quarter	Firm-Quarter	Firm-Quarter	Firm-Quarter	Firm-Quarter	Firm-Quarter	Firm-Quarter	Firm-Quarter
Sample of firms	MedLarge	MedLarge	MedLarge	MedLarge	MedLarge	MedLarge	MedLarge	MedLarge	MedLarge
Sector	Water & Sewerage	Education	Arts & Recreation	Health & Social Work	Admin & Support	Manufacturing	Accomodation & Food	Trade & Repair	Prof, Sci, & Tech
Sector Type	NT	O	O	O	O	T	NT	NT	NT

	Default							
	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
Local Spec	-0.00326	0.0868*	-0.0284	0.0617	-0.0402	-0.253**	-0.0181	-0.0731
	(0.0185)	(0.0466)	(0.0720)	(0.0461)	(0.0358)	(0.128)	(0.0125)	(0.263)
Observations	163,139	53,038	13,122	386,211	49,459	7,672	57,632	6,016
R-squared	0.435	0.308	0.334	0.439	0.438	0.396	0.403	0.651
Bank-Quarter FE	Y	Y	Y	Y	Y	Y	Y	Y
MIST FE	Y	Y	Y	Y	Y	Y	Y	Y
Cluster s.e.	Firm-Quarter	Firm-Quarter	Firm-Quarter	Firm-Quarter	Firm-Quarter	Firm-Quarter	Firm-Quarter	Firm-Quarter
Sample of firms	MedLarge	MedLarge	MedLarge	MedLarge	MedLarge	MedLarge	MedLarge	MedLarge
Sector	Transport & Storage	Info & Comm	Real Estate	Construction	Agriculture & Fishing	Other Services	Electricity & Gas	Mining & Quarr
Sector Type	NT	NT	NT	NT	T	O	NT	T

Notes. This table estimates the relationship between banks' local specialization and loan default for medium and large firms across different sectors. The data are at the loan level, focusing on the first observation of a loan at the time it is granted, from the third quarter of 2018 to the second quarter of 2024. Default is an indicator that takes the value of 1 if the loan enters in default after its origination. Columns (1) to (17) present the results for water & sewerage, education, arts & recreation, health & social work, admin & support, manufacturing, accommodation & food, trade & repair, professional, scientific & technical, transport & storage, information & communication, real estate, construction, agriculture & fishing, other services, electricity & gas, and mining & quarrying, respectively. The variables are defined in Tables 1 and 3. The data are from the Spanish Credit Registry. Fixed effects are denoted at the bottom of the table. Standard errors are clustered by firm-quarter. *, ** indicate significance at the 0.1 and 0.05 levels, respectively.

Table A7: Summary Statistics of Local and Sector Specialization: IRB Banks

	Top municipality or sector					All other municipalities or sectors				
Specialization type	mean	p25	p50	p75	sd	mean	p25	p50	p75	sd
Local Spec (municipality)	0.255	0.231	0.254	0.276	0.044	0.000	0.000	0.000	0.000	0.002
Sector Spec (20 sectors)	0.206	0.183	0.196	0.226	0.031	0.042	0.006	0.022	0.062	0.049
Local Excess Spec (municipality)	0.054	0.020	0.038	0.079	0.044	0.000	0.000	0.000	0.000	0.001
Sector Excess Spec (20 sectors)	0.043	0.020	0.031	0.043	0.033	-0.002	-0.004	0.000	0.002	0.011

Notes. This table presents summary statistics on the local and sector specialization measures for IRB banks. The variables are defined in Table 1 and Table A1 in the Appendix. The statistics for the specialization measures are divided based on whether the municipality or sector is the top municipality or sector. The top municipality is defined as the municipality where a given bank has its highest degree of local specialization. The top sector is the sector where a given bank has its highest degree of sector specialization. The data are from the Spanish Credit Registry.

Table A8: Local Specialization, Private Information, and Micro-Small Firms: Robustness

	Default1y									
	Main		Province		Spec MicroSmall		Defaultdud1y		Controls	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	PDMax	PDMin	PDMax	PDMin	PDMax	PDMin	PDMax	PDMin	PDMax	PDMin
ROC area	0.8338	0.8247	0.8352	0.8261	0.8354	0.8208	0.8383	0.8315	0.7817	0.7730
S.e.	(0.0028)	(0.0029)	(0.0028)	(0.0029)	(0.0028)	(0.0029)	(0.0016)	(0.0016)	(0.0036)	(0.0036)
Observations	399,457	399,457	399,474	399,474	399,448	399,448	399,457	399,457	399,457	399,457
H0: area(PDMax)=area(PDMin)										
Chi2(1)	7.67***		7.77***		19.58***		10.90***		10.06***	
Prob>chi2	0.0056		0.0053		0.0000		0.0010		0.0015	

Notes. This table evaluates and compares the predictive accuracy of the PD assigned by banks with the highest and lowest degrees of local specialization within the same micro or small firm. The goodness of fit is assessed using the Area Under the Receiver Operating Curve by comparing the predicted PDs and the one-year ahead observed default (Default1y). Columns (1) and (2) present the baseline result using the PD for the bank with the highest degree of local specialization (PDMax) and the PD for the bank with the lowest degree of local specialization (PDMin), respectively. Columns (3) and (4) use provinces instead of municipalities. Columns (5) and (6) compute the specialization variable using lending for micro and small firms. Columns (7) and (8) include doubtful loans in the computation of one-year ahead observed default (Defaultdud1y). Columns (9) and (10) incorporate controls for bank-firm characteristics for both specialized and non-specialized banks. These controls include local market share, sector specialization, sector market share, percentage of collateralized lending, average loan rate, average maturity, natural logarithm of total lending amount, and the length of the relationship. A statistical test estimates if the difference between the AUCs is significant at conventional levels. The data are from the Spanish Credit Registry. The sample is from the fourth quarter of 2021 to the second quarter of 2024. *** indicates significance at the 0.01 level.

Table A9: Local Specialization, Loan Supply, and Micro-Small Firms: Robustness

	LoanGranted			
	Province&NACE2d	Spec MicroSmall	LoanGranted4m	LoanGranted5m
	(1)	(2)	(3)	(4)
Local Spec	0.0784***	0.133***	0.0990**	0.0952**
	(0.0198)	(0.0461)	(0.0425)	(0.0426)
Observations	209,416	196,137	198,810	198,810
R-squared	0.560	0.560	0.556	0.555
Bank-Month FE	Y	Y	Y	Y
Firm-Month FE	Y	Y	Y	Y
Controls	Y	Y	Y	Y
Control RelLength	Y	Y	Y	Y
Cluster s.e.	Firm-Month	Firm-Month	Firm-Month	Firm-Month
Sample of firms	MicroSmall	MicroSmall	MicroSmall	MicroSmall
Period	2018m9-2024m6	2018m9-2024m6	2018m9-2024m6	2018m9-2024m6

Notes. This table examines the relationship between local specialization and loan supply for micro and small firms with various specifications for robustness. The analysis is conducted at the application level. The data cover from September 2018 to June 2024. LoanGranted is an indicator that takes the value of 1 if the loan application is approved within three months of the application. Column (1) uses provinces and 2-digit NACE codes instead of municipalities and sectors. Column (2) computes the specialization variable using lending for micro and small firms. Columns (3) and (4) use as dependent variables an indicator that takes the value of 1 if the loan application is approved within four and five months, respectively. The variables are defined in Table 1. The data are sourced from the Spanish Credit Registry. Fixed effects are indicated at the bottom of the table. Standard errors are clustered by firm-month. **, *** denote significance at the 0.05, and 0.01 levels, respectively.

Table A10: Local Specialization, Loan Rate, and Micro-Small Firms

	Interest Rate	
	(1)	(2)
Local Spec	-0.0551	-0.0474
	(0.0791)	(0.0791)
Default		0.366***
		(0.0102)
Observations	5,717,604	5,717,604
R-squared	0.559	0.559
Bank-Quarter FE	Y	Y
MIST FE	Y	Y
Controls	Y	Y
Cluster s.e.	Firm-Quarter	Firm-Quarter
Sample of firms	MicroSmall	MicroSmall

Notes. This table estimates the relationship between banks' local specialization and loan rates for micro and small firms. The data are at the loan level, focusing on the first observation of a loan at the time it is granted, from the third quarter of 2018 to the second quarter of 2024. Interest Rate is the rate charged for the loan. The variables are defined in Tables 1 and 3. The data are from the Spanish Credit Registry. Fixed effects are denoted at the bottom of the table. Standard errors are clustered by firm-quarter. *** indicates significance at the 0.01 level.

Table A11: Sector Specialization, Loan Rate, and Medium-Large Firms

	Interest Rate	
	(1)	(2)
Sector Spec	-0.0505	-0.0444
	(0.105)	(0.105)
Default		0.416***
		(0.0361)
Observations	3,582,657	3,582,657
R-squared	0.849	0.849
Bank-Quarter FE	Y	Y
MIST FE	Y	Y
Controls	Y	Y
Cluster s.e.	Firm-Quarter	Firm-Quarter
Sample of firms	MedLarge	MedLarge

Notes. This table estimates the relationship between banks' sector specialization and loan rates for medium and large firms. The data are at the loan level, focusing on the first observation of a loan at the time it is granted, from the third quarter of 2018 to the second quarter of 2024. Interest Rate is the rate charged for the loan. The variables are defined in Tables 1 and 3. The data are from the Spanish Credit Registry. Fixed effects are denoted at the bottom of the table. Standard errors are clustered by firm-quarter. *** indicates significance at the 0.01 level.

Table A12: Relationship Lending, Loan Default, and Micro-Small Firms

	Default		
	(1)	(2)	(3)
RelLength	-0.000253***	-0.000256***	-0.000250***
	(4.00e-06)	(4.08e-06)	(4.12e-06)
Observations	5,921,551	5,783,376	5,717,604
R-squared	0.065	0.144	0.180
Bank-Quarter FE	Y	Y	Y
MT FE	Y	N	N
IT FE	Y	N	N
MIT FE	N	Y	N
MIST FE	N	N	Y
Controls	Y	Y	Y
Cluster s.e.	Firm-Quarter	Firm-Quarter	Firm-Quarter
Sample of firms	MicroSmall	MicroSmall	MicroSmall
Period	2018q3-2024q2	2018q3-2024q2	2018q3-2024q2

Notes. This table estimates the association between relationship lending and loan default for micro and small firms with different sets of fixed effects. The data are at the loan level, focusing on the first observation of a loan at the time it is granted, from the third quarter of 2018 to the second quarter of 2024. Default is an indicator that takes the value of 1 if the loan enters in default after its origination. Column (1) includes bank-quarter, municipality-quarter, and sector-quarter fixed effects. Column (2) includes bank-quarter and municipality-sector-quarter fixed effects. Column (3) includes bank-quarter and municipality-sector-size-quarter fixed effects. The variables are defined in Tables 1 and 3. The data are from the Spanish Credit Registry. Fixed effects are denoted at the bottom of the table. Standard errors are clustered by firm-quarter. *** indicates significance at the 0.01 level.

Table A13: Relationship Lending and Loan Rate

	Interest Rate			
	(1)	(2)	(3)	(4)
RelLength	-0.00266***	-0.00256***	-0.00183***	-0.00181***
	(0.000121)	(0.000122)	(0.000387)	(0.000387)
Default		0.366***		0.416***
		(0.0102)		(0.0361)
Observations	5,717,604	5,717,604	3,582,657	3,582,657
R-squared	0.559	0.559	0.849	0.849
Bank-Quarter FE	Y	Y	Y	Y
MIST FE	Y	Y	Y	Y
Controls	Y	Y	Y	Y
Cluster s.e.	Firm-Quarter	Firm-Quarter	Firm-Quarter	Firm-Quarter
Sample of firms	MicroSmall	MicroSmall	MedLarge	MedLarge
Period	2018q3-2024q2	2018q3-2024q2	2018q3-2024q2	2018q3-2024q2

Notes. This table estimates the association between relationship lending and loan rates for micro and small firms and for medium and large firms. The data are at the loan level, focusing on the first observation of a loan at the time it is granted, from the third quarter of 2018 to the second quarter of 2024. Interest Rate is the rate charged for the loan. The variables are defined in Tables 1 and 3. The data are from the Spanish Credit Registry. Fixed effects are denoted at the bottom of the table. Standard errors are clustered by firm-quarter. *** indicates significance at the 0.01 level.

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