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Abstract

We study a model of the impact of climate risk on credit supply and test its predictions using data on all wildfires and corporate loans in Spain. Our findings reveal a significant decrease in credit following climate-driven events. This result is driven by outsider banks (large and diversified), which reduce lending significantly to firms in affected areas. By contrast, due to their access to soft information, local banks (geographically concentrated) reduce their loans to opaque affected firms to a lesser extent without increasing their risk. We also find that employment decreases in affected areas where local banks are not present.

Keywords: wildfire, asymmetric information, bank heterogeneity, firm lending.

JEL classification: Q54, G21, G32.

Resumen

En este trabajo se desarrolla un modelo del impacto del riesgo climático en la oferta crediticia y se evalúan sus predicciones según datos granulares sobre incendios forestales y préstamos corporativos en España. Los hallazgos revelan una disminución significativa del crédito de las empresas que se ven expuestas a un incendio. Este resultado se atribuye a los bancos de mayor tamaño y con mayor diversificación geográfica, que reducen de manera sustancial la concesión de crédito a las empresas en las zonas afectadas. En contraste, los bancos locales (más concentrados geográficamente), debido a su acceso a información blanda, reducen en menor medida sus préstamos a las empresas afectadas y más opacas en términos contables sin incurrir en mayores riesgos. También se muestra que el empleo disminuye en las áreas afectadas donde los bancos locales no están presentes.

Palabras clave: incendio, información asimétrica, heterogeneidad bancaria, crédito corporativo.

Códigos JEL: Q54, G21, G32.

1 Introduction

In recent years, climate-related disasters have increased in number and severity [1], escalating the challenges for the financial system. Beyond the transition risks stemming from shifts towards a lower-carbon economy, it is crucial to evaluate the financial sector's responses to the rising physical risks of climate change. Understanding these responses allows the assessment of the impact of physical risks on the economy.

The effects of physical climate risks on credit supply are unlike other credit or operational risks and, therefore, are not clear *a priori*. A decrease in bank lending after a climate-related disaster could be attributed to several factors, including, but not limited to, a decline of collateral value –due to the damage of corporate real estate assets– and the economic outlook of households and firms in the affected areas (see Garmaise and Moskowitz (2009); Hosono et al. (2016); and Gallagher and Hartley (2017)). Banks could also increase lending to secure additional recovery loans for firms within disaster-stricken zones (see Chavaz (2016); Cortés and Strahan (2017); and Koetter, Noth, and Rehbein (2020)). Overall, the determinants of banks' credit allocation strategies in response to climate physical risk when there is no perfect information need more study.

In this paper, we develop a bank lending model under climate shocks and with asymmetric access to information. There are two types of banks –local banks (geographically concentrated) and outsider banks (large and diversified)– and two types of firms –transparent and opaque–. Local banks can better monitor opaque firms because they have better access to soft information than outsider banks. The model includes shocks to the banks' deposits at the bank level and firms' productivity shocks at the firm level, as well as shocks at the economy level. It also incorporates firm-specific climate shocks, which have a different impact on the marginal returns of the loans depending on each bank's ability to monitor firms. Banks face the costs of raising external financing and choose loan amounts to maximize their expected profits subject to their balance sheet constraint. In equilibrium, local banks are more effective at absorbing the impact of climate shocks because they experience a smaller decrease in their marginal returns of lending after a climate shock compared to outsider banks.

Our findings uncover that the differential use of soft information by local and outside banks in their lending decisions may be a primary mechanism influencing bank credit allocation following a climate-related disaster. According to our model, after a climate event such as a wildfire, there is a decline in the credit amount extended to the affected firms. In addition, outsider banks cannot assess accurately the impact of physical climate risk on opaque firms and, therefore, they tend to respond by significantly reducing credit. Local

[1] See Smith and Katz (2013); Hulme (2014); Zscheischler et al. (2018); Zscheischler et al. (2020); and Tebaldi et al. (2021) for evidence on the increase in frequency and intensity of climate-driven disasters around the world. See Pechony and Shindell (2010); Moritz et al. (2012); Pausas and Keeley (2021) for studies that focus on wildfires.

banks have access to soft information, which allows them to restrict their lending less to those affected firms that are opaque, without taking on more risk.

We test the model's predictions using data on firms, banks, and wildfires in Spain. We do so for three main reasons. First, we focus on Spain because we can construct a unique dataset –with monthly detailed information on all companies, all banks, and all bank-firm credit relationships– that covers a long period (i.e., 2004-2017). Second, we focus on wildfires due to the level of accuracy in ascertaining whether a firm has been impacted by a fire and the growing number of such extreme events. Recent scientific studies have shown that high-intensity wildfires are increasing in frequency and severity fostered by climate change (see Organization for Economic Cooperation and Development (2023)). For example, between 1979 and 2019, the global wildfire season increased its duration by 27% (Jones et al. (2022)).[2] Third, we focus on wildfires in Spain because it is one of the countries most affected by wildfires in Europe (see Costa, De Rigo, Libertà, Houston Durrant, and San-Miguel-Ayanz (2020)).[3] The total area burned annually in Spain has been greater than 50,000 hectares in 13 of the last 18 years and at least 46.35% of Spanish municipalities are located in areas of high wildfire risk[4].

Our empirical design is based on a quasi-experimental design provided by wildfires. Specifically, in our empirical analyses, we use data on all wildfires in Spain from 2004 to 2017, detailed data on financial information for an average of 769,983 firms per year, and monthly data from the Banco de España on all bank-firm relationships over €6,000 which are reported by all credit institutions operating in Spain. The combination of geolocalized data on loan-firms-banks that are merged with the geolocalized wildfires enables us to implement a precise identification strategy. Then, we identify all firms that were located within a wildfire-affected area on the date. These wildfire-treated firms are assigned a dummy variable *Fire* that takes the value 1 if the firm is located within the affected area and 0 otherwise. This area is defined as the region that includes the burn-area plus a 10-kilometer peripheral ring around it. The control group consists of those firms located within a ring outside the treatment delimitation.

Our empirical analysis reveals that fires exert a negative effect on firms' access to financing. We estimate that the amount of outstanding credit of firms affected by fire drops by about 6% more than for firms with similar characteristics and located in the same municipality, but not affected by fire. These findings are unrelated to any previous information

[2]Notably, the Mediterranean region stood out, experiencing one of the most significant extensions with an additional 29 days added to its wildfire season (Jones et al. (2022)). As reported by the European Forest Fire Information System (EFFIS) (see `https://effis.jrc.ec.europa.eu/apps/effis.statistics/seasonaltrend`), the year 2022 marked the EU's second most severe wildfire season since 2006, with a staggering 785,605 hectares consumed by flames. This statistic only fell short of the devastating record set in 2017.

[3]Spain accounted for 40% of EU land lost to forest fires in 2022 and the number of days per year with high to extreme wildfire risk is increasing significantly due to higher temperatures and increasing drought (see Feyen, Ciscar, Gosling, Ibarreta, and Soria (2020))

[4]Vega (2021)

advantage banks might have concerning a firm's exposure to climate events. This is so as there is no significant difference in a firm's credit growth before a fire, whether or not the firm is affected by fire.[5]

For proper identification of the role of local banks extending more credit to firms affected by fire due to their better access to soft information, we implement an econometric specification that posits three drivers of credit changes: (i) an economy-wide shock, (ii) a firm's productivity shock, and (iii) a firm's climate shock. The approach builds on our model, which depends on whether the firm is affected by fire and the bank's ability to monitor the effect of such an event on the firm. We deal with the first driver (i.e., the economy-wide shock) through province-bank-time fixed effects. The second driver (i.e., the firm's productivity shock) is directly estimated through firm-time fixed effects, which also allow us to deal with the firm's demand for credit. The extent of the firm's climate shock –the third driver– hinges on the interaction of two factors: a binary indicator denoting the firm's exposure to the fire's impact and the proportion of bank credit within the province where the firm operates. This latter factor serves as a gauge of the bank's monitoring capabilities within that province. We posit that local banks heavily rely on qualitative insights and exhibit an enhanced aptitude for assessing firms' risk, in contrast to outsider banks.

Our econometric specification allows us to exploit the variation arising from the credit supply of banks with different exposures to the province where a specific firm affected by fire is located relative to firms with similar characteristics that are not affected by fire.[6] We show that firms affected by fire obtain more credit from local banks (i.e., banks with a higher proportion of their credit within a given province) than from outsider banks, which contract their credit supply to a greater extent. Our results are not influenced by the existence of potential public subsidies that the firms affected by fire might have received, by the collateralization of credit, or by the firms' availability of more collateralizable assets (i.e., more tangible assets). Moreover, we argue that our findings are not driven by the existence of property insurance.[7] Finally, we discard that the credit supply of local banks to firms affected by fire is driven by the lack of lending opportunities out of the area affected by fire.

We conduct additional robustness tests to elicit an identification strategy that isolates the effect of fires on the credit supply of local banks over and above any pattern of specialization

[5]Moreover, we perform several robustness analyses to check that our results are not driven by the definition of the area affected by fire, the time length of the analysis, and the fact that firms that belong to a business group could obtain financing from other firms within the group instead of relying on bank debt.

[6]Importantly, there are no significant differences between the affected and non-affected firms in terms of size, profitability, solvency, and their distribution across sectors, which means the effects associated with the climate event should be driven by fire itself and not by the fact that affected firms are different to non-affected firms.

[7]Firms with more tangible assets are more likely to purchase property insurance (see Zou and Adams (2008)). To remove the potential effects of property insurance, we use firm-time fixed effects in our empirical analyses. This allows us to compare the credit supply of two banks to the same firm depending on their specialization in the province where the firm is located, which enables us to abstract from the role of property insurance and the coverage of such insurance.

at the sector, province, or sector-province level and of market power.[8] We also confirm that the new credit to affected firms is not exclusively driven by relationship lending. In fact, consistently with their superior access to soft information, local banks are more likely to establish new credit relationships. We further support the role of soft information based on the distance between the borrower and the lender. More specifically, we observe that local banks extend more credit to firms affected by fire when they are closer to the lender but there are no significant differences in the credit supply of local and outsider banks when they are more distant from the borrower.

Consistently with our model, we also find that local banks extend more loans to opaque affected firms, where monitoring using soft information is more relevant. On the contrary, both local and outsider banks change their credit supply to less opaque firms that are affected by fire very similarly. Importantly, the credit supply of local banks flows to more opaque but non-distressed firms, therefore their lending practices do not induce credit misallocation.

We further confirm the information channel analyzing banks' ex-post risk-taking based on the performance of firm-bank relationships established after a fire. This approach guarantees that loan refinancing, or ever-greening, cannot impair the interpretation of our findings. We find that there are no significant differences in the performance of the new credit relationships depending on banks' exposures to each province. Therefore, although local banks extend more credit to more opaque firms affected by fire, their portfolios of credit perform similarly to those of outsider banks. Finally, we also find that employment decreases in affected areas, but this decrease is insignificant when local banks are present

Our work contributes to two strands of the literature. First, our work adds to the body of research in banking that examines the impact of asymmetric information on bank loan issuance. We build upon the classic idea that when a bank extends a loan to a company, it gains a competitive edge due to its superior knowledge about the borrower in comparison to other financial institutions (see Hodgman (1961); Kane and Malkiel (1965); Black (1975); Fama (1985); Sharpe (1990); and Holmstrom and Tirole (1997)). Other previous studies find that geographical distance affects the collection of firms' soft information by banks (Petersen and Rajan (2002); Degryse and Ongena (2005); Agarwal and Hauswal (2010); and Liberti and Petersen (2019)). We introduce heterogeneity in both banks (i.e., local *versus* outsider banks) and firms (i.e., transparent *versus* opaque firms), as well as incorporating climate-related shocks into the analysis. Overall, we contribute to this banking literature by incorporating acute physical climate risk into the lending framework of analysis in the presence of asymmetric information as well as heterogeneity in banks and firms.

Second, we add to the recently growing literature that studies the effects of climate-related shocks on bank lending (see Schüwer, Lambert, and Noth (2019); Brown, Gustafson, and Ivanov (2021); Kacperczyk and Peydró (2022); Nguyen, Ongena, Qi, and Sila (2022);

[8] Our results are also robust to alternative definitions of the areas that are affected by fire and to the use of alternative samples of firms to take into account the staggered nature of wildfires, which might occur in different locations during different periods.

Reghezza, Altunbas, Marques-Ibanez, d'Acri, and Spaggiari (2022); and Correa, He, Herpfer, and Lel (2023)). Our paper is closely related to the work that analyzes the role of small or local banks in sustaining credit supply after natural disasters. Chavaz (2016) documents that local banks hit by the massive hurricanes in 2005 increased mortgage lending more than banks less concentrated in those areas. He shows that local banks use loan sales to finance the mortgages originated in affected areas. Similarly, Cortés and Strahan (2017) find that multi-market small banks respond by increasing mortgage lending in the areas affected by several types of natural disasters and taking credit away from other markets. Koetter, Noth, and Rehbein (2020) document that the access to large and geographically diversified intra-group markets is what determines the emergency lending by local banks, which in their paper are part of banking groups with parent banks intermediating intra-group liquidity. Our definition of local banks diverges from that examined in these papers. In our paper, local banks are defined as banks whose activities are concentrated in a specific region and, importantly, are not part of banking groups. Consequently, their activity cannot be explained by internal capital markets considerations, and we can isolate the soft information mechanism by which local banks maintain the provision of credit. Moreover, our findings cannot be driven by securitization given that only an average of 0.6% of the outstanding amount of corporate credit was securitized by Spanish banks over our sample period. As a result, we contribute to this literature by showing that local banks' better access to soft information enables them to restrict their lending less to those profitable firms that are affected by climate shocks and are opaque.[9]. Overall, local banks are better positioned than outsider banks to provide financial support to profitable companies in the aftermath of the physical climate shocks.

The remainder of the paper is organized as follows. Section 2 presents the model. Section 3 characterizes the equilibrium of the model and displays its predictions. Section 4 describes the data and the empirical strategy that we use to test these predictions. Section 5 displays the empirical results related to local banks and how they affect the relationship between climate-driven events (i.e., wildfires) and corporate credit. Section 6 provides evidence that soft information is the main channel that drives the relationship between climate risk and credit supply. Section 7 provides the quantification of the effects in the real economy focusing on employment in the affected area. Finally, section 8 concludes.

2 Model

Consider an infinite horizon model, where risk-neutral bank b provides financing to firm f. There are two types of banks: Local (l) and outsider (o) banks, $b = \{l, o\}$. For simplicity, we assume that a bank can only lend to one firm, but firms can borrow from multiple banks.

[9]Although they do not deal with climate-related shocks, Favara and Giannetti (2017), Giannetti and Saidi (2019), Dursun-de Neef (2023), and Izadi and Saadi (2023) also demonstrate that banking structure plays a key role in banks' lending strategies after economic shocks

Therefore, the budget constraint for each bank b in period t, must equal the total amount of the loan, L^t_{fb}, to the sum of its deposits, D^t_b, and external funding, B^t_b, such as equity or bonds:

$$D^t_b + B^t_b = L^t_{fb}. \tag{1}$$

Banks (credit supply). We assume that the marginal return on a loan L^t_{fb} decreases linearly in its size as $(\bar{r_f} - \alpha_L L^t_{fb})$, where $\bar{r_f}$ is a constant for each firm, α_L is a positive constant, and raising external financing is costly. We assume that banks can raise deposits to a certain limit $\bar{D}^t_b$ and the marginal cost of raising additional external financing is $\alpha_B B^t_b$, where α_B is a positive constant. At the end of period t, the economy receives a credit supply shock in the form of a shock to the deposits as follows:

$$D^{t+1}_b = D^t_b + \delta_E + \delta_b, \tag{2}$$

where δ_E and δ_b are shocks to the economy and to the specific bank b, respectively.

Firms (credit demand and climate shocks). The economy receives a credit demand shock at the end of period t in the form of a productivity shock to firm f and a climate shock, such that the marginal revenue of a loan L^{t+1}_{fb} is given by $\bar{r_f} - \alpha_L L^{t+1}_{fb} + \eta_E + \eta_f - (1 - \kappa_{fb})\nu_f$, where η_E and η_f are the productivity shocks to the economy and the firm f, respectively, and ν_f denotes a firm-specific climate shock. This shock has a lower impact on the marginal returns of the loan amount for banks that present a higher value of the scale factor κ_{fb}, which denotes the bank's ability to monitor opaque firms. We define κ_{fb} as a constant scale factor that is both firm (f) and bank (b) specific with $1 > \kappa_{fb} > 0$. Let κ_{fb} be the product of a firm-specific factor, κ^f, and a bank-specific factor, κ^b, that is, $\kappa_{fb} = \kappa^f \cdot \kappa^b$.

Local banks versus outsider banks (monitoring). We assume that local and outsider banks monitor opaque firms in different ways. Local banks present a higher value of κ^b than outsider banks, that is, $\kappa^l > \kappa^o$. The rationale behind this assumption is that the local bank has access to soft information about firms that the outsider bank does not have.

Opaque firms versus transparent firms. There are two types of firms f: transparent firms (tr) and opaque (op), with $f = \{tr, op\}$. Transparent firms are companies that operate with a high level of openness, disclosure, and accountability. These firms maintain clear and accessible communication channels with their stakeholders, including banks. Transparency allows banks to understand how the company operates and make informed decisions based on reliable information. On the other hand, opaque firms are companies that lack transparency and operate with limited disclosure of information. Opaque firms may have restricted communication channels, limited public reporting, and a lack of openness in their operations. This lack of transparency can make it challenging for banks to fully understand the company's operations, assess its performance, and make informed lending decisions. Therefore, we assume that $\kappa^{tr} > \kappa^{op}$. Overall, notice that the key mechanism is that $\kappa_{l,op} > \kappa_{o,op}$, that is, local banks can better monitor opaque firms.[10] Globally, climate shocks are better amortized by local banks, resulting in a lower impact on marginal returns. The following table summarizes the interactions between κ^f and κ^b for the different types of firms and banks in the model, as well as the parameter assumptions related to banks' monitoring of opaque firms, $\kappa^l > \kappa^o$ (i.e., high κ^l and low κ^o) and $\kappa^{tr} > \kappa^{op}$ (i.e., high κ^{tr} and low κ^{op}):

		Firms	
		Transparent	Opaque
Banks	Local	$\kappa_{tr,l} = \kappa^{tr}$ (high) $\times$ κ^l (high)	$\kappa_{op,l} = \kappa^{op}$ (low) $\times$ κ^l (high)
	Outsider	$\kappa_{tr,o} = \kappa^{tr}$ (high) $\times$ κ^o (low)	$\kappa_{op,o} = \kappa^{op}$ (low) $\times$ κ^o (low)

The bank's problem. Bank b chooses the loan amounts L^t_{fb} and L^{t+1}_{fb} that lends to firm f to maximize its expected profits subject to its balance sheet constraint (1) and the process for the bank's deposits (2). Therefore, bank b solves the following problem:

$$\max_{\{L^t_{fb}, L^{t+1}_{fb}\}} \{[\bar{r_f} - \alpha_L L^t_{fb}] \cdot L^t_{fb} - \alpha_B B^t_b + [\bar{r_f} + \eta_E + \eta_f - \alpha_L L^{t+1}_{fb} - (1 - \kappa_{fb})\nu_f] \cdot L^{t+1}_{fb} - \alpha_B B^{t+1}_b\} \quad (3)$$

such that

$$\begin{aligned} D^t_b + B^t_b &= L^t_{fb} \\ D^{t+1}_b + B^{t+1}_b &= L^{t+1}_{fb} \\ D^{t+1}_b &= D^t_b + \delta_E + \delta_b. \end{aligned}$$

Notice that we assume no discount for the profits at time $t+1$.

3 Equilibrium and Model Predictions

By plugging the constraints into the objective function above, we obtain the following optimization problem:

$$\max_{\{L^t_{fb}, L^{t+1}_{fb}\}} \{[\bar{r_f} - \alpha_L L^t_{fb} - \alpha_B] \cdot L^t_{fb} + \alpha_B D^t_b + [\bar{r_f} + \eta_E + \eta_f - \alpha_L L^{t+1}_{fb} - (1 - \kappa_{fb})\nu_f - \alpha_B] \cdot L^{t+1}_{fb} + \alpha_B D^{t+1}_b\}. \quad (4)$$

The first-order conditions (FOCs) of this problem can be expressed as:

$$\bar{r_f} - \alpha_B - 2\alpha_L L^t_{fb} = 0 \quad (5)$$

$$\bar{r_f} - \alpha_B - 2\alpha_L L^{t+1}_{fb} + \eta_E + \eta_f - (1 - \kappa_{fb})\nu_f = 0. \quad (6)$$

In equilibrium we can determine the amount of loans:

[10] We could even assume that $\kappa_{l,tr} = \kappa_{o,tr}$. In other words, transparent firms can be monitored equally by local and outsider banks.

$$L_{fb}^{*(t)} = (\bar{r_f} - \alpha_B)/2\alpha_L \quad (7)$$

$$L_{fb}^{*(t+1)} = (\bar{r_f} - \alpha_B + \eta_E + \eta_f - (1 - \kappa_{fb})\nu_f)/2\alpha_L. \quad (8)$$

Notice that any reduction in marginal revenue (i.e. raising the cost of external financing, negative economy-wide and firm-specific productivity, and climate shocks) has a negative effect on the loan amount in equilibrium. By combining (7) and (8) into a single difference equation, we obtain an expression for the change in the loan amount that firm f obtains from bank b:

$$\Delta L_{fb} = (\eta_E + \eta_f - (1 - \kappa_{fb})\nu_f)/2\alpha_L \quad (9)$$

Finally,

$$\Delta L_{fb} = \underbrace{-\frac{1 - \kappa_{fb}}{2\alpha_L}\nu_f}_{\text{Firm's climate shock}} + \underbrace{\frac{1}{2\alpha_L}\eta_E}_{\text{Economy-wide shocks}} + \underbrace{\frac{1}{2\alpha_L}\eta_f}_{\text{Firm's productivity shock}}, \quad (10)$$

where we obtain that ΔL_{fb} depends on the climate shock that affects the firm, as well as the economic-wide and firm's productivity shocks.

In the remainder of this section, we develop the main testable implications of the model, which we organize into two propositions that lead to 5 testable hypotheses. First, we focus on the study of the effects of climate shocks on changes in loan amounts in general. Proposition 1 formalizes this first model implication.

Proposition 1. *A climate shock reduces the amount of credit lent to a given firm.*

Proof. The derivative of (10) with respect to ν_f is given by the following expression, which is negative because $0 < \kappa_{fb} < 1$ and $\alpha_L > 0$.

$$\frac{\partial \Delta L_{fb}}{\partial \nu_f} = -\frac{1 - \kappa_{fb}}{2\alpha_L} < 0. \quad (11)$$

□

In summary, this proposition shows that climate-related events lead to a significant decline in corporate loans. Given that this derivative is negative for all banks, no matter their ability to monitor firms, this proposition shows that climate-related events lead to a decline in firms' credit. Following Proposition 1, we propose a hypothesis about the expected impact of climate shocks on loan amounts, as follows:

Hypothesis 1: *If a firm is affected by a climate event, then its amount of loan debt declines after the climate event.*

Second, we study whether banks' access to soft information affects the loan reduction driven by climate shocks. We specifically analyze the change in loan amounts lent by local banks (i.e., banks that perform good monitoring at the local level) when compared to the change in loan amounts lent by outsider banks (i.e., banks that perform bad monitoring at the local level) in the event of a climate shock, with direct implications of the firms' opaqueness on the loan reduction. The emphasis is placed on the change in loan amounts lent by local banks to more opaque firms when compared to the change in loan amounts lent by outsider banks. Proposition 2 formalizes this second equilibrium implication of the model.

Proposition 2. *The reduction of the loan amount lent from bank b to firm f decreases with κ_{fb}.*

Proof. Equation (11) (i.e., the derivative of (10) with respect to ν_f) becomes less negative as the value of κ_{fb} increases, where $0 < \kappa_{fb} < 1$. □

Under our assumptions, the reduction in loans for opaque firms is lower for local banks –when compared to outsider banks– because local banks show a greater value of $\bar{\kappa_b}$ than outsider banks, that is, $\bar{\kappa_l} > \bar{\kappa_o}$, which results in $\kappa_{l,op} > \kappa_{o,op}$. Overall, local banks reduce credit less than outsider banks.

From the second proposition, we derive the following two testable hypotheses related to the role of information on the causal relationship between climate risk and firms' credit:

Hypothesis 2: *Local banks reduce lending to firms to a significantly lesser extent than outsider banks.*

The main implication of this hypothesis is that in areas where local banks are not present and firms get loans only from outsider banks, the impact of a climate shock is larger. In other words, the decline in business loans after a climate event is driven by outsider banks. In addition, if our results are due to better soft information, local banks should extend more credit to opaque firms.

Hypothesis 3: *Local banks lend significantly more to opaque firms than outsider banks.*

Next, we check that the mechanism that drives these results is access to soft information and not risk-taking. Particularly, we want to confirm that local banks do not increase their risk by lending significantly more or lending more to opaque firms than outsider banks. Hypothesis 4 summarizes this prediction, which has important implications for banking stability (see Blickle, Hamerling, and Morgan (2021); Noth and Schüwer (2023); and Klomp (2014) for studies on the effect of natural disasters on financial stability).

Hypothesis 4: *Local banks do not take more risk after a climate shock.*

Finally, we study the impact of local banks in the local economy in the presence of climate shocks.[11] Building upon the fact that there is a lower contraction of credit associated with local banks after a climate event, we expect that employment in areas where local banks are present does not decrease after a climate shock as it does in areas with no presence of local banks. Hypothesis 5 predicts that local banks play a critical role in mitigating the effects of climate shocks in the real economy.

[11] Previous research has examined the impact of bank lending frictions on employment using firm-level data from the 2008 Financial Crisis (see Chodorow-Reich (2014)).

Hypothesis 5: *Employment in fire-affected areas served by local banks does not decrease significantly after fire.*

4 Data and Empirical Strategy

In this section, we explain the data that we use in our empirical analysis and define the empirical strategy that we implement to test the main theoretical predictions from the model in section 3.

4.1 Data

We assemble data from multiple sources to create a dataset that contains information on all firms' characteristics, corporate loans, and attributes of all lender banks, as well as all wildfires in Spain for the period 2004-2017. Our complete micro approach provides an effective way to test the effects of physical climate risk on credit supply based on geolocalized matches at the loan- firm-, and bank- levels.

Firms' characteristics. We use the Banco de España's Central Balance Sheet Data Office (CBSDO). It contains the balance sheets and profit and loss accounts, as well as other non-financial characteristics such as industry, year of incorporation, and demographic status, among others, for an average of 769,983 non-financial corporations per year with adequate accounting quality (based on the Banco de España's internal classification criteria).[12] We merge CBSDO with the Iberian Balance Sheet Analysis System (SABI) from which we obtain the geographical coordinates where each firm is located. We exclude from our sample firms that belong to the agriculture, livestock, forestry, and fishing sectors as the location of their economic activity in many cases differs from where the firms are domiciled.[13]

Corporate loan data. We use the Banco de España's Central Credit Register (CCR) data. It contains monthly information on all bank-firm relationships over a reporting threshold of €6,000 for credit institutions operating in Spain.[14] As loans to companies are normally larger than the reporting threshold, we can claim that we have the whole population of loans to those firms. We match firm information in CBSDO to all their entities' relationships by using the firm fiscal identifier, which uniquely identifies firms in all datasets.

Firms affected by wildfires. We use detailed Civio data on all fires in Spain with a burned area of at least 1 hectare from 2001 to 2017. This data contains data attributes such

[12] We provide the details about the filters that we apply to the data in the Appendix.

[13] For example, some companies in our sample that are involved in agriculture have their crops located far away from where the company is registered.

[14] We note that most of the external financing obtained by the firms in our sample is in the form of standard loans. Arce, Mayordomo, and Gimeno (2021) document that only 94 Spanish non-financial companies issued a bond at any time between 2006 and 2015. Moreover, the securitization of corporate loans is very low (on a monthly average basis, around 0.6% of the amount outstanding of corporate credit was securitized by Spanish banks over our sample period).

as coordinates, burned area, and time to fire extinction.[15] We use the fire data from 2004 since from this year most fires are geolocated with exact precision.[16] We drop fires with a lack of precise geolocation. Moreover, we restrict the sample to those fires equal to or larger than 500 hectares, which corresponds to the threshold that determines whether a fire can be considered a large fire with a sizeable economic impact.[17] Panel A of Table 1 shows the descriptive statistics of fires in our sample. The initial sample consists of 54,032 fires equal to or greater than 1 hectare with a mean size of 24.6 hectares burned. There are 337 fires larger or equal to 500 hectares,[18] which represents 48.7% of the total burned area between 2004 and 2017.

[INSERT TABLE 1 AROUND HERE]

4.2 Empirical Strategy

Our empirical analysis is based on a quasi-experimental design provided by wildfires. We combine the panel of geolocalized database on loans-firms-banks with the database on wildfires such that we achieve a very precise identification strategy. Recent literature has quantified the effects of climate-driven events by using approaches that employ less granular information such as ZIP codes, counties, or municipalities as an identification method (see Ramos and Sanz (2020); Rehbein and Ongena (2022) and Ouazad and Kahn (2022)).[19]

We estimate the effects of climate-driven events (i.e., wildfires) on firms' loans using an OLS regression which is defined based on the model predictions. More specifically, equation (10) consists of three drivers of credit growth: (i) firm's climate shock, (ii) economy-wide shock, and (iii) firm's productivity shock. First, the firm's climate shock depends on whether the firm is affected by the wildfire event and the bank's ability to monitor the effect of such an event on the firm. The bank's monitoring ability is defined based on the credit granted in the province where the firm is located over the total amount of credit granted by that bank in Spain. We assume that local banks (i.e., those with a high proportion of their credit in one province) rely on soft information to a higher extent and exhibit a greater ability to monitor firms' risk. As a consequence, the credit contraction for a firm affected by the wildfire event

[15] Civio extracts data from the General Forest Fire Statistics (Estadística General de Incendios Forestales, EGIF) published by the Spanish Ministry for the Ecological Transition and the Demographic Challenge. See `https://datos.civio.es/dataset/todos-los-incendios-forestales/` for more details. EGIF merges the data of all the wildfire reports from all the Spanish regions. These reports contain 150 variables. They are prepared *in situ* by fire engineers.

[16] Data available in EGIF covers the period 1983-2015. Wildfire data for 2016 and 2017 are incomplete.

[17] For more details on big fires see section 4 in López-Santalla and López-Garcia (2019).

[18] The biggest fire in our sample, which took place in Cortes de Pallás in 2012, has a total burnt area of 28,879 hectares.

[19] Issler, Stanton, Vergara-Alert, and Wallace (2023) also uses granular data but their analysis focuses on the effects of wildfires on housing and mortgage characteristics rather than firms' lending from banks.

that operates in provinces with local banks is expected to be lower than that in provinces without local banks. Second, each bank transmits differently the economy-wide shock to the firms in a given province. Therefore, the intensity of the productivity shock to the economy depends on the existence of banks specialized in lending to firms in that province (Giannetti and Saidi (2019)). Finally, the firm's productivity shock can be directly estimated through firm fixed effects.

Henceforth, we propose the following empirical specification to estimate equation (10) and disentangle the credit supply provided by local banks from the one provided by outsider banks:

$$\Delta L_{f,b,t+1} = \beta LocalBank_{b,p,t-1} \times Fire_{f,t} + \gamma_{b,p,t} + \gamma_{f,t} + \epsilon_{f,b,t+1}, \tag{12}$$

where the dependent variable, $\Delta L_{f,b,t+1}$, is the logarithm change in the amount of firm f's outstanding loans with bank b between December of year $t-1$ and December of year $t+1$.[20]

The explanatory variable of interest is the interaction between the fraction of bank b's credit balance in province p where firm f is located, as of December of year $t-1$, $LocalBank_{b,p,t-1}$, and the dummy variable $Fire_{f,t}$, which takes the value of 1 if the firm is located within the *affected* area and 0 otherwise. The coefficient β of this interaction term captures the supply of credit to firms affected by fire depending on the presence of local banks (i.e., depending on the concentration of credit of the bank in the province where the firm is located).

We consider that a firm is affected by fire if it is located within a circle defined by the *affected* or treatment area. We define this area as the region that includes the burn-area (i.e., circle with radius r) plus a 10-kilometer ($10km$) peripheral ring around it (see Figure 1).[21] This ring enables us to account for the fact that some firms are not physically located in the burn-area, but are largely suffering the consequences of wildfire, for example, because of supply-chain disruption, damaged infrastructure, and utility service disruption.[22] The *non-affected* or control area is defined as the peripheral ring (i.e., the grey ring with inner radius $r + 20km$ and outer radius $r + 40km$. We exclude the firms located in the peripheral ring with inner radius $r + 10km$ and outer radius $r + 20km$. This is to guarantee that the group of non-affected firms is not contaminated by firms surrounding the affected area whose businesses could be ultimately damaged because of the fire. Panel B of Table 1 shows the

[20]We adjust credit balances to deal with bank mergers so that we capture the true variation of the credit of a firm with each specific bank. In particular, before calculating the credit variation between a year $t-1$ and a year $t+1$, we aggregate the credit balances of a firm by the entities that will operate —due to bank mergers-– as a single entity by the end of year $t+1$. Therefore, the change at the entity level is clean of the effects due to mergers of banks and reflects the real change of credit of a firm with a particular bank.

[21]We use the coordinates of the origin of the wildfire as the center of the circle and its radius, r, is such that the total area of the circle is equal to the number of hectares burned by fire. We assume a circular shape for the area burnt by each fire.

[22]Appendix A2 provides a further discussion about the choice of 10 kilometers as a distance of large economic influence of a wildfire.

number of firms affected and non-affected by fires between 2004 and 2017. Importantly, there are no significant differences between the affected and non-affected firms in terms of size –measured as total assets–, returns –ROA–, solvency –capital over total assets–, and their distribution across sectors. Thus, the effects associated with the climate event should be driven by the fire itself and not by the fact that affected firms are different from non-affected firms.

[INSERT FIGURE 1 AROUND HERE]

Additionally, we use bank-province-time fixed-effects, $\gamma_{b,p,t}$, to account for concurrent bank-specific time-varying factors that affect banks' credit supply around the occurrence of the fire in a specific province p. The specification also includes firm-time fixed effects, $\gamma_{f,t}$, to proxy the firm's productivity shock. They also allow us to deal with the firm's demand for credit. As a result, we can exploit the variation arising from the credit supply of banks with different exposures to the province where a specific firm affected by fire is located relative to firms that are not affected by fire. Finally, $\epsilon_{f,b,t+1}$ in equation (12) denotes the error term.

5 Local Banks and Change in Credit After a Climate-Driven Event

In this section, we test the first two main theoretical predictions from the model. In Section 5.1, we provide the test of Hypothesis 1 and study whether the credit of firms affected by a climate event declines. In Section 5.2, we empirically test Hypothesis 2 and analyze the change in loan amounts lent by local banks when compared to the change in credit supplied by outsider banks in the event of a fire.

5.1 Change in Credit After a Climate-Driven Event

We first study whether the occurrence of a wildfire in year t is associated with a significant decrease in firms' credit (Hypothesis 1). To this aim, we estimate a variation of equation (12) in which the credit growth is defined at the firm level instead of at the bank-firm level. More specifically, we exploit the exogenous variation of firms' exposure to economic damage due to wildfires each year and run an OLS regression in which the dependent variable is the logarithm change in the amount of credit of firm f drawn between December of year $t-1$ and December of year $t+1$, $\Delta L_{f,t+1}$. The credit growth at the firm level is regressed on the dummy variable denoting if the firm f is affected by fire at time t and a set of additional explanatory variables that include firm characteristics as of December of year $t-1$ to control for its size (logarithm of total assets), profitability (return on assets), and solvency (equity over total assets). In addition, we use industry-municipality-size-time fixed effects.[23]

The results of this analysis are reported in Table 2. We find that the amount of outstanding credit of firms affected by fire drops by about 6% more than for firms with similar characteristics and located in the same municipality, but not affected by fire (column 1). This result confirms that fires exert a negative effect on firms' access to financing. To check whether this effect is exclusively driven by firms that are closer to the burn area, we split the dummy variable denoting firms affected by fire, $Fire$ $(10km)$, into two groups depending on their proximity to the burn-area: $Fire$ $(5km)$ includes firms located inside the area defined by the burn-area plus a peripheral ring of 5 km outside the burn-area, and $Fire$ $(5km - 10km)$ incorporates the peripheral ring with inner radius $r + 5km$ and outer radius $r + 10km$. Column (2) of Table 2 shows that firms located in both areas suffer a larger drop in their credit growth when compared to the control group.

[INSERT TABLE 2 AROUND HERE]

One potential concern with these results is that banks might have prior information regarding firm exposure to climate events. If this is the case, banks could have incorporated their prior information advantage into their ex-ante screening process and adjusted the credit supply to such firms before the fire occurred at time t. To address this concern, we perform a robustness test in which we re-estimate the specification in (1) of Table 2 but using the change in the logarithm of credit between December of year $t-3$ and December of year $t-1$ as the dependent variable. Column (3) shows that there is no significant difference in the credit growth of a firm before the fire regardless of whether the firm is affected by the fire at time t.[24]

A second concern regarding this test is that our sample contains firms that belong to a business group. Firms within a group could be located in a different municipality or province than their headquarters. Therefore, a fire could affect a given subsidiary but not its headquarters. These firms could obtain financing from the group instead of relying on debt at the subsidiary's level. To tackle this issue, we remove firms that are part of a group and re-estimate the specification in column (1). We report the outcome of this robustness test

[23]Specifically, we consider the interaction of a set of fixed effects that deal with the industry in which the firm operates (1-digit NACE), the municipality where the firm is located, several dummy variables dealing with the firm-size (micro, small, medium-sized, and large corporations) and year dummy variables. This set of fixed effects enables us to estimate whether the credit growth of two firms with similar characteristics within a given municipality differs between them when one of these firms is affected by fire and the other one is not. Comparing firms within a given municipality is important to deal with political connections at the municipality level or the effectiveness of forestry brigades, among other factors.

[24]We conduct this analysis using data for the period 2006–2017. We replicate the estimation from column (1) using this shorter period and find a similar effect in sign and magnitude.

in column (4) and find that the overall results presented in column (1) remain unaffected by this concern.

Moreover, we run a robustness check on the period of the dependent variable, $\Delta L_{f,t+1}$, which considers the variation of credit between December of $t-1$ and December of $t+1$ to evaluate the effects of a fire at time t. To further confirm the validity of our results, we re-estimate our main specification when the dependent variable is obtained using the variation of credit between December of year $t-1$ and December of year t. Column (5) displays the result of this analysis, which presents a larger magnitude than our baseline outcome in column (1).

Finally, we check whether the drop in the amount of credit obtained by firms affected by fire is because some of these firms became inactive. To do so, we exclude from our sample the firms that became inactive the year in which the fire occurred or the year after.[25] Results of this robustness test are reported in column (6) and present the same sign and magnitude as those in column (1).

Overall, this first empirical result shows that there is a significant drop in the credit balance of firms affected by fire. In the following section, we explore whether this drop in credit balance arises from supply or demand factors and to what extent local banks play a role in extending credit to firms affected by fires.

5.2 Local Banks and Credit Supply with Climate Risk

In this subsection, we test whether local banks reduce lending to firms to a significantly lesser extent than outsider banks (Hypothesis 2). This hypothesis postulates that the decline in business loans after a climate event is driven by outsider banks. First, we present the baseline results and analysis of this test (subsection 5.2.1). Second, we conduct robustness tests on this hypothesis using different sample sets (subsection 5.2.2). Third, we examine whether the lending activity of local banks is indeed influenced by the limited lending opportunities outside the fire-affected area (subsection 5.2.3). Fourth, we account for bank specialization– across industries and industries and provinces–, bank market power, and relationship lending (subsection 5.2.4).

5.2.1 Baseline analysis

First, we provide the baseline analysis of the test of Hypothesis 2. Table 3 exhibits the results of this test. Column (1) presents the estimated coefficients from equation (12). The positive and significant sign of the interaction term $LocalBank_{b,p,t-1} \times Fire_{f,t}$ shows that a firm affected by fire obtains more credit from local banks (i.e., banks with a larger proportion of its credit outstanding in the province where the firm is located).

[25] We define inactive firms as firms that went out of business based on their status in CBSDO the year in which the fire occurred or the year after. We consider a firm as active if it was inactive at time t but became active at time $t+1$.

[INSERT TABLE 3 AROUND HERE]

The firm-time fixed effects employed in equation (12) prevent us from estimating the coefficient for the variable $Fire_{f,t}$. Thus, in column (2) we propose a more flexible specification, which is saturated with industry-municipality-size-time fixed effects instead of firm-time fixed effects. This specification allows us to control for firm-specific shocks under the assumption that firms in a given industry (1-digit NACE industry), municipality, and size in year t are affected similarly by shocks. This means that we exploit the variation arising from the credit supply of banks with different credit concentrations in a given province to firms affected by fire in a given year that have a similar size, are located in the same municipality, and operate in the same industry. The coefficient associated with the dummy $Fire_{f,t}$ measures the credit supply to firms affected by fire by banks with zero exposure to a given province. This coefficient is negative and significant, which confirms the negative effect of the fires on the credit supply of banks that are not active in the province where the firm is located. However, the higher the fraction of credit in a given province, the lower the cut in credit supply to firms affected by fire in that province. In fact, local banks with a relatively high concentration of credit in a given province could even increase the credit balance of fire-affected firms.

Furthermore, we investigate whether additional attributes of banks, aside from the proportion of credit allocated within a specific province, lead to a significant effect on credit supply to firms affected by fire. To do so, we include different interaction terms in our baseline specification. Columns (3)–(5) in Table 3 report the results of this analysis. In column (3) we include the interaction of the logarithm of total assets, TA with the dummy $Fire_{f,t}$. The interaction term is not significant and, therefore, we reject the hypothesis that the results in columns (1) and (2) are driven by the fact that the bank's exposure to a given province reflects just the size of the bank. In column (4), we show that our results are not driven by the banks' reporting standards because the interaction between the dummy IRB, which is equal to one if the bank uses internal rating-based models and zero otherwise, and the dummy $Fire_{f,t}$ is not statistically significant. The dummy IRB deals with the reporting standards and it can be understood as a variable that measures the quality of risk management in a bank.[26] In column (5), we include all the previous interaction terms as well as the interaction of the bank's capital, Cap, and ROA. These results confirm that the bank characteristic that leads to a statistically significant differential effect is the fraction of credit that the bank has in a specific province.

5.2.2 Alternative samples

In this subsection, we provide robustness tests based on alternative samples. Firstly, we address the concern that wildfires might happen in a staggered way, that is, fires might

[26] Banco de España approved the IRB models for the first time in 2008. We assume that the IRB dummy is always equal to one for the observations linked to those banks that had adopted the IRB model as of the end of our sample period.

occur in different locations during different periods. If locations were close enough, firms subject to wildfires early in our data could appear later as controls. However, we assess the robustness of our findings by conducting an analysis that excludes from the sample firms once they are affected by fire (column 2 in Table 4) and that considers only firms the first year that they appear in the sample (column 3). They show that our results are robust to the concerns regarding the potential staggered nature of wildfires.

Secondly, one could question the exclusion of firms geographically located in a ring between the treatment and control groups from the sample (see Figure 1). To address this issue, we restrict our sample to firms located within the ring of $r + 20km$ (i.e., radius of the fire area plus 20km) surrounding the edge of the burn-area, such that the *non-affected* or control area of this alternative sample is defined as the peripheral ring with inner radius $r + 10km$ and outer radius $r + 20km$.[27] Results are reported in column (4). We confirm that there are significant differences between the treatment and this alternative control group but consistently with the idea that the activity of firms in this new non-affected area might be contaminated, we observe that the estimated coefficient is lower than in column (1).

[INSERT TABLE 4 AROUND HERE]

Thirdly, we respond to the concern that local banks could be aware of the firms' abilities to receive subsidies. To abstract from the effect of public subsidies or aids on credit supply, we remove from our sample those firms that have received any aid or subsidy according to the information available in the CBSDO. Results are reported in column (5) of Table 4 and confirm that subsidies do not drive local banks' credit supply.

Another factor that might contribute to explaining credit supply by local banks to firms affected by a fire is the requirement of guarantees. Collateral contributes to mitigating not only asymmetric information but also the potential losses faced by the bank in case of a firm default. Therefore, we re-estimate equation (12) using only the evolution of credit without guarantees. If the activity of a local bank is driven by a more extensive use of guarantees, then we should expect no differences between the credit supply of local and outsider banks to firms affected by fire. However, the results in column (6) fully support those obtained in the baseline analysis (column 1).

Finally, although we find that the credit supply of local banks is also channeled through loans without guarantees, banks may extend more credit to firms with more tangible assets just because in case of liquidation, the recovery rate would be higher (see Davydenko and Franks (2008)). Alternatively, firms with more tangible assets could suffer more losses in case they are affected by fire. To understand, which of the two effects dominates, we split the sample into two parts depending on whether their ratio of tangible assets over total assets is below or above the median of the distribution in each year. We find that local banks extend

[27]Note that these firms were not considered in previous analyses to avoid including areas that are not directly affected by fire but their activity might suffer from externalities of the fire.

new credit similarly to firms no matter their ratio of tangible assets (see columns (7) and (8) in Table 4).

5.2.3 Banks' lending opportunities

Local banks' credit supply to firms affected by fire could be driven by the local banks' lack of lending opportunities out of the area affected by fire, which forces them to lend to affected firms. To check this possibility we compute the lending opportunities (LO) that banks have in a given province p in a given year t as the ratio of the sales of the firms non-affected by fire in that province over the total amount of sales of the firms in the province as in Mayordomo and Rachedi (2022):

$$LO_{p,t} = \frac{\Sigma_{f \epsilon PROV_p}^{\textit{Non-affected}} Sales_{f,p,t}}{\Sigma_{f \epsilon PROV_p}^{All} Sales_{f,p,t}} \tag{13}$$

A high value of the variable $LO_{p,t}$ implies that, in a given province, there are relatively more lending opportunities outside the set of firms affected by fire. Therefore, if a bank operates in areas with fewer lending opportunities, then it might be forced to continue lending to affected firms.[28]

To test whether the role of local banks is exclusively explained by the lack of lending opportunities –instead of the advantages of soft information–, we split the sample of firms into two groups depending on whether the province offers low or high lending opportunities to banks. We assume that a given province offers low opportunities in a given year t when the measure $LO_{p,t}$ is in the bottom quintile of the distribution across provinces and it is not the case when it is above the 20th percentile. The results for the two subsamples of firms are reported in columns (1) and (2) of Table 5. We observe that banks with a higher share in a given province lend significantly more to firms that are affected by fire for the two subsamples. However, the credit supply of local banks to affected firms is higher in provinces with lower lending opportunities. Moreover, we obtain similar results when we use alternative definitions of lending opportunities based on the gross value added (columns 3 and 4), the total assets (columns 5 and 6), and the employment (columns 7 and 8) instead of sales.

[INSERT TABLE 5 AROUND HERE]

[28] Alternatively, they can reshuffle their loan portfolio away from these provinces. For instance, local banks could be forced to lend outside their local areas and make distant loans when they face fierce competition in their local branch markets (see Granja, Leuz, and Rajan (2022)). The latter possibility is beyond the scope of our paper and we exclusively focus on the lending practices within the affected province.

5.2.4 The Role of Bank Specialization and Relationship Lending

Our identification of the credit supply channel hinges on two key assumptions. First, firms' credit demand is held constant across banks within a given province. Second, changes in credit supply do not vary systematically across firms. This second assumption is challenged by the presence of firm- and sector-specific patterns in credit supply due to bank specialization (see De Jonghe, Dewachter, Mulier, Ongena, and Schepens (2020) and Paravisini, Rappoport, and Schnabl (2023)). However, the use of bank-province-time fixed-effects enables us to identify the credit supply of local banks to firms affected by fire over and above any pattern of bank specialization at the province level. We take a further step and expand our analysis in equation (12) with bank-industry-time and bank-industry-province-time fixed effects to account for bank specialization across industries and industries and provinces, respectively. This approach allows us to obtain an identification strategy that isolates the effect of fires on the credit supply of local banks over and above any pattern of specialization at the sector level and province level or the sector-province level. The results are reported in columns (2) and (3) of Table 6 and confirm that our results are not affected by any type of specialization at the levels considered in our analyses. Column (1) is identical to column (1) of Table 3 and is included to ensure comparability.

[INSERT TABLE 6 AROUND HERE]

The set of fixed effects in column (1) enables us to account for any effect that occurs at the bank-province-time level, including the consequences of market power. Nevertheless, in column (4) we advance one step and show that the information advantage is not driven by the market share but by the bank's credit concentration in a given location. To do so, we interact the market share of each bank in each province in a given year, $BankMarketShare$, with the dummy variable $Fire$. We obtain results of the same sign and magnitude as the baseline ones in column (1). Importantly, this new interaction term is not statistically significant and as a consequence, we discard that our results are driven by banks' market power.

Berg and Schrader (2012) illustrate that bank relationships improve credit access following a volcanic eruption in Ecuador. We next consider whether our results are affected by bank-firm relationships. One might argue that the credit supply of local banks in the affected areas could be driven not only by their better ability to monitor local firms but also by the fact that they are relationship lenders. Therefore, local banks might aim to continue the relationship with the existing clients that are affected by fire because they might be able to extract future rents from this relationship. To address this concern, we run two additional robustness tests.

First, we add the share of total credit (drawn and undrawn) that a bank bears for each firm the year before the fire event, $Share\ Bank\text{-}Firm$, as well as its interaction with the dummy variable $Fire$ to our baseline specification in equation (12). We restrict this analysis to firm-bank pairs with an existing relationship before the fire, so that we can compute the growth of credit.[29] Results are reported in column (5) of Table 6. We observe that the coefficient *Share Bank-Firm* is positive and significant, which indicates that banks with higher exposure to a particular company tend to provide that company with a greater amount of credit. This outcome is consistent with the empirical literature on relationship lending.[30] However, the interaction between *Share Bank-Firm* and *Fire* is not significant, which shows that the increase of credit to affected firms is not exclusively driven by relationship lending.

Second, we study whether banks are more likely to extend credit to their existing clients when they are affected by fire because they might have incentives to engage in loan evergreening to avoid an increase in their non-performing loans (NPLs) and loan loss provisions. These incentives exclusively impact loans already in place and do not apply to new credit arrangements. Therefore, to support our soft information channel, we should observe that local banks are also lending to firms without previous relationships. To confirm if this is indeed true, we conduct a robustness analysis in which the dependent variable is a dummy that takes the value 1 if the firm had a positive balance of credit (draw and undrawn) with the bank before the fire. We restrict the sample to firms with a positive variation of credit to understand whether it is more likely that local banks establish new relationships when they are affected by fire. Results are reported in column (6) of Table 6 and show that local banks are more likely to establish new credit relationships which might be consistent with their superior use of soft information.

6 Soft Information and the Relationship Between Climate Risk and Credit Supply

In this section, we provide evidence that soft information is the main channel that drives the relationship between climate risk and credit supply. First, subsection 6.1 documents that local banks extend more credit to firms affected by a fire when they are closer to the lender. In subsection 6.2, we formally test the third main theoretical prediction from the model, that is, we test whether local banks lend more to opaque firms than outsider banks (Hypothesis 3). This result indicates that soft information plays a major role as a driver of the relationship between climate-driven events and credit supply. Finally, subsection 6.3

[29] Our restriction to firms with bank relationships before the fire closely follows the paper by Sette and Gobbi (2015), which studies the contribution of relationship lending to credit supply during a financial crisis. This approach eliminates the bias that would result from defining the growth of credit for firms with zero initial outstanding credit. If we include such firms, then a mechanical positive association would arise between firms with zero initial outstanding credit (and, thus, a very low relationship strength with the considered bank) and the growth of credit.

[30] For further empirical evidence on the connection between relationship lending and bank credit see Petersen and Rajan (1994), Boot (2000), Elsas (2005), Bolton, Freixas, Gambacorta, and Mistrulli (2016), Sette and Gobbi (2015), Kysucky and Norden (2016), López-Espinosa, Mayordomo, and Moreno (2017), and Banerjee, Gambacorta, and Sette (2021).

confirms the soft information channel further by testing that local banks do not take more risk after a climate-driven event, which corresponds to Hypothesis 4.

6.1 The Role of Soft Information: Distance Borrower-Lender

To further illustrate that our results are not driven by relationship lending and that local banks have better access to soft information, we follow Agarwal and Hauswal (2010) and assume that greater soft information is achieved when there is a shorter distance between the borrower and the lender. Moreover, Berger, Miller, Petersen, Rajan, and Stein (2005) provide evidence consistent with small banks being better able to collect and act on soft information than large banks.[31] In fact, outsider banks rely on hard information to a higher extent given their more advanced technology (Liberti and Petersen (2019)).

To study the role of soft information based on the distance between the borrower and the lender, we estimate equation (12) for two subsamples of bank-firm relationships. We split the sample of firms depending on whether the distance between the lender and the borrower is in the bottom or the top quintile of the distribution of the distance of all credit relationships in our sample.[32] Results are reported in columns (1) and (2) of Table 7, for the bottom and top quintiles of the distance borrower-lender distribution, respectively. We observe that local banks extend more credit to firms affected by fire when they are closer to the lender (bottom quintile, column 1). Conversely, there are no significant differences in the credit supply of local and outsider banks when they are more distant from the borrower (top quintile, column 2). That is, local banks rely to a higher extent on soft information and the proximity to the borrower enables them to collect this type of information more efficiently. Interestingly, we find that the average distance between local banks, those with more than 90% of their credit balance in the province where the firm is located, and their borrowers is significantly lower (2.5 km) than the one between outsider banks and their borrowers (6.5 km).

[INSERT TABLE 7 AROUND HERE]

6.2 The Role of Soft Information: Local Banks and Credit to Opaque Firms

If the supply of business loans by local banks is driven by their superior ability to extract and use soft information, then local banks should extend more credit to those affected firms

[31]These authors state that large banks are less willing to lend "informationally difficult" credits, such as it could be the case of firms affected by fire. Other papers documenting the local nature of the soft information in credit decisions include Petersen and Rajan (2002) and Degryse and Ongena (2005).

[32]We calculate the distance between each firm in our sample and the credit institutions with which it has credit relationships after geolocating all branches using their addresses. We do not have information on the branch that granted the credit to each firm but we assume that the credit is extended by its nearest branch in the same province where the firm is located.

that are more opaque. In this subsection, we test whether local banks lend significantly more to opaque firms than outsider banks (Hypothesis 3). To test this hypothesis, we employ the same specification that we use in column (1) of Table 3 and split the sample according to the level of firm's opacity, which is measured based on accruals.[33] Columns (3)-(8) of table 7 shows the results of this test.

The specification in column (3) of Table 7 is equivalent to the one in column (1) of Table 3, but includes only firms with information on their accruals. Columns (4) and (5) report the results for the samples of the most opaque and the least opaque firms, respectively. The most and the least opaque firms are those whose levels of accruals are in the top and bottom quintiles of the distribution of accruals of the firms in our sample, respectively.

Consistently with our model, we find that both local and outsider banks change their credit supply to transparent firms that are affected by a fire in a similar manner. However, local banks provide more loans to opaque and fire-affected firms because these banks have superior access to soft information, enabling more accurate credit risk assessment.[34] On the contrary, banks that rely on hard information might consider it suboptimal to conduct thorough credit risk assessments for the pool of borrowers affected by fire.[35]

In columns (7) and (8) of Table 7 we consider an alternative measure of firms' opaqueness which is defined depending on the type of questionnaire that firms report to the Banco de España. More opaque firms are those that sent the reduced questionnaire whereas less opaque (i.e., more transparent) firms are those that sent the normal questionnaire.[36] Consistent with the outcomes in columns (2) and (3), we observe a significant increase in the supply of credit from local banks to more opaque firms but we do not observe significant differences for more transparent firms. Column (4) is equivalent to column (1) and it is included for comparability purposes.

[33]We measure a firm's opacity as the proportion of a firm's inflows and outflows of cash that cannot be predicted accurately. Earnings can be split into cash flows and accruals. Earnings quality is a concept related to earnings persistence (the ability to predict future earnings based on the information of current earnings). Sloan (1996) shows that the persistence of accruals is much lower than that of cash flows. So, firms with extremely positive and negative accruals are considered to have poor earnings quality (Bhattacharya, Desai, and Venkataraman (2013)) that, as a consequence, damage the information that lenders can infer from the earnings. Following Leuz, Nanda, and Wysocki (2003), we measure opacity as the ratio of the accruals over the net cash flows from operating activities. The accruals are measured as the absolute value of the difference between the change of non-cash current assets and non-cash current liabilities minus depreciation and amortization. The net cash flows from operating activities are defined as the absolute value of the difference between the net operating income and our proxy for accruals. Thus, the higher the ratio, the higher a firm's opacity is.

[34]Our paper does not consider differences in the organizational structures of local and outsider banks which might affect information production and the allocation of credit. Skrastins and Vig (2019) find that increased hierarchization in a bank induces credit rationing, reduces loan performance, and generates standardization in loan contracts. The authors relate hierarchization (typical of large diversified banks) to the loss of soft information.

[35]For a better comparison of the estimated effects, we report in the last row of Table 7 the relative economic impact which is obtained as the product of the coefficient times the average concentration of credit at the province level across provinces relative to the standard deviation of the dependent variable. We observe that the effect of the concentration of credit of a given bank in a given province on credit supply to affected firms that are opaque (2.4%) is much higher than that associated with affected but transparent firms (1.5%).

Nevertheless, if local banks extend more credit to opaque and distressed firms, these outcomes may result in the misallocation of credit. To understand whether this is the case, we estimate equation (12) for two subsamples of firms: (i) opaque firms with negative equity (i.e., distressed firms); and (ii) opaque firms with positive equity (i.e., non-distressed firms).[37] Results are reported in columns (2) and (3) of Table 8, respectively. Column (1) contains the results for the whole sample of opaque firms for comparability. The classification of firms depending on their level of opacity is based on accruals, as in columns (2) and (3) of Table 7.

[INSERT TABLE 8 AROUND HERE]

We find that the additional credit that local banks supply to the most opaque firms is concentrated in non-distressed firms. We obtain similar results when we define opaque firms as those that send the reduced questionnaire to the CBSDO (see columns 4–6). Overall, the fact that the credit supply of local banks flows to more opaque but non-distressed firms suggests that their lending practices do not lead to credit misallocation. This finding supports that of Bolton, Freixas, Gambacorta, and Mistrulli (2016) who show that banks that acquire soft information about firms provide loans to profitable firms in crisis times.

6.3 The Role of Soft Information: Lenders' Risk-Taking with Climate Risk

In this subsection, we explore the information channel further. We have already shown that local banks extend more credit to firms affected by a wildfire –especially if they are more opaque– given that they rely on their superior ability to incorporate soft information into their lending decisions. However, although local banks' lending practices do not point to credit misallocation *ex-ante*, the quality of local banks' loan portfolios could deteriorate after lending to firms affected by fire. In other words, local banks could be increasing *ex-post* risk-taking when increasing their exposure to affected firms. Our empirical analysis shows that this is not the case. We formally test that local banks do not take more risk after a climate shock (Hypothesis 4). To test this hypothesis, we compare the *ex-post* fraction of non-performing loans (NPL) held by locals and outsiders in areas affected by fire.

First, we consider only the firm-bank pairs featuring no credit relationship before the fire.[38] The main advantage of this approach is that loan refinancing or evergreening cannot impair the interpretation of our findings. We first calculate the euro amount of NPLs (i.e., doubtful, non-performing, and default loans) for all new firm-bank relationships as of December of year $t+2$, that is, in December of year 2 after the event. Then, we define $NPL_{b,m,i,t+2}$

[37] Bonfim, Cerqueiro, Degryse, and Ongena (2022) define zombie firms as those with negative equity.

[38] We do this because we cannot identify the specific loan facility that turns out to be non-performing in the post-fire period. If we were to consider the firms with a relationship with a bank before the fire, some NPLs reported afterward might be associated with lending that originated before the climate event.

as the ratio of the total amount of NPLs of each bank b associated to firms affected by fire that are domiciled in a given municipality m and operate in industry i in December of year $t+2$ relative to the total outstanding credit that comes from new bank-firm relationships involving firms affected by fire in that municipality and industry.[39] We use $NPL_{b,m,i,t+2}$ as the dependent variable in the following specification:

$$NPL_{b,m,i,t+2} = \beta LocalBank_{b,p,t-1} + \delta X_{b,m,i,t-1} + \gamma_{i,m,t} + \gamma_{b,t} + \epsilon_{b,m,i,t+2}, \tag{14}$$

where the variable of interest is the fraction of bank b's credit balance in province p, which encompass the municipality m where its borrowers are located, as of December of year $t-1$, $LocalBank_{b,p,t-1}$. The vector $X_{b,m,i,t-1}$ contains the average characteristics (i.e., size, profitability, and solvency) of firms that had a positive credit exposure to bank b as of December of year $t-1$ in municipality m and industry i. We aim to control for the characteristics of bank b portfolio of existing borrowers that could affect bank future lending policies. $\gamma_{i,m,t}$ and $\gamma_{b,t}$ denote the use of fixed effects at the industry-municipality-time and bank-time levels.[40]

Column (1) of Table 9 shows the results obtained from equation (14). We show that there is no significantly different performance of the new credits granted after fire between local and outsider banks. In other words, although local banks extend more credit to firms affected by fire, their portfolios of credit perform similarly to outsider banks' portfolios. Similar results are obtained when we estimate the most saturated specification in equation (14) as shown in column (2). Furthermore, we broadened our analysis to encompass all bank-firm pairs in areas affected by fire, irrespective of their credit relationship before the climate event. The outcomes of this analysis can be found in columns (3)-(4), which show analogous results to the ones presented in columns (1)-(2). We also find that the profitability and solvency of local banks are not damaged as compared to those of outsider banks as a consequence of these lending practices (untabulated). Overall, these results confirm that local banks manage to provide more credit without increasing their risk.

[INSERT TABLE 9 AROUND HERE]

7 Effects in the Real Economy

We have documented that there is a significant decrease in firms' credit after fire. We have also shown that local banks reduce lending to a lesser extent than outsider banks. In this subsection, we study the effect of these results on the real economy. Specifically, we test whether employment in fire-affected areas served by local banks does not decrease significantly (Hypothesis 5).

[39] The maturity of more than 90% of the new credit granted during our sample period is lower than one year. Therefore, a 2-year time window enables us to deal with the performance of the credit granted after fire until their maturity.

[40] Note that we cannot use bank-province-time fixed effects as in previous specifications because it would prevent us from estimating the coefficient associated to the variable of interest.

To estimate how local banks contribute to mitigating the negative consequences on firm real outcomes, we propose the following specification:

$$\Delta Employm_{f,t+2} = \beta Fire_{f,t} + \delta X_{f,t-1} + \gamma_{i,m,s,t} + \epsilon_{f,t+2}, \tag{15}$$

where $\Delta Employm_{f,t+2}$ denotes the growth of the average number of employees at the firm level between $t-1$ and year $t+2$ and $Fire_{f,t}$ is a dummy variable that indicates whether the firm is affected by fire at time t. Let $X_{f,t-1}$ and $\gamma_{i,m,s,t}$ denote control for firm characteristics (solvency, size, and profitability) and fixed effects at the industry-municipality-size-time level, respectively. $\epsilon_{f,t+2}$ represents the error term.

Next, we divide the sample into two groups based on whether local banks operate in the municipality where the company is situated.[41] Results are reported in Table 10. Column (1) reports the results obtained for the whole sample of firms and shows that the occurrence of a fire in year t is associated with a drop in the employment of the firms in areas affected by fire two years later. Columns (2) and (3) show the results obtained for the subsample of firms in municipalities with and without local banks, respectively. Importantly, the drop in employment after fire is specific to municipalities where local banks are not active lenders. On the contrary, the employment of firms affected by fire in municipalities with local banks does not decrease as compared to the employment of non-affected firms. Columns (4) and (5) show similar results when we use a stricter definition of local banks.

[INSERT TABLE 10 AROUND HERE]

8 Conclusions

This paper shows that local banks are better positioned than outsider banks to support borrowers affected by physical climate risks. We use a simple model of bank lending under climate shocks with asymmetric access to information and test its main predictions using data on all wildfires and bank-firm credit relationships in Spain from 2004 to 2017. We find that climate-related events lead to a significant decline in corporate loans in the affected areas. This reduction is driven by outsider banks, which drastically contract lending in the affected areas. In contrast, access to and superior use of soft information enable local banks to be more accurate in their lending practices. Interestingly, local banks lend more to opaque firms than outsider banks without incurring a greater risk exposure. Finally, the paper documents that the ability of local banks to extend credit after climate-related disasters benefits the economy. Specifically, employment in fire-affected areas served by local

[41] We consider that a municipality has active local banks if any firm in the municipality has a positive credit exposure to a bank with more than 90% of its credit balance in the province where the firm is located. This split enables us to exploit the exogenous variation in the existence (or not) of local banks operating in a specific municipality.

banks does not decrease significantly after fire, while employment decreases in fire-affected areas without local banks.

The findings of this paper provide relevant policy implications. Our results suggest that local banks play a critical role in mitigating the effects of climate shocks in the real economy, mainly because they can use soft information to provide recovery lending to the opaque firms that have been impacted by climate disasters. Overall, networks of local banks have more access to the necessary soft information to buffer local climate shocks, when compared to relatively large and diversified outsider banking systems.

Figures and Tables

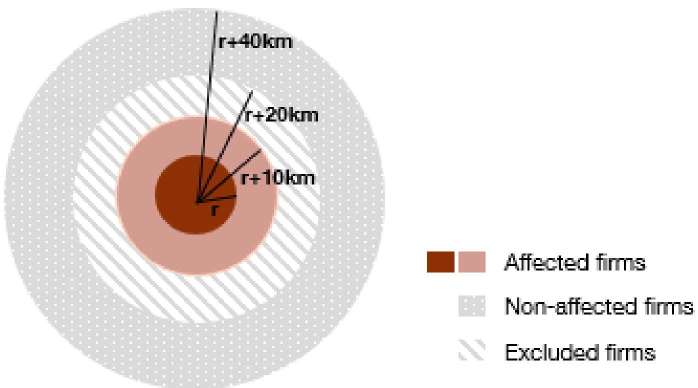

Figure 1: **Definition of affected and non-affected firms by wildfires.** This figure shows a sketch of the areas where firms have been affected and those that remain unaffected by wildfires. We consider the *affected* or treatment area as the region that includes the burn area (i.e., a circle with radius r) plus a 10-kilometer ($10km$) peripheral ring around it. The *non-affected* or control area is defined as the peripheral ring with inner radius $r + 20km$ and outer radius $r + 40km$. We exclude the firms located in the peripheral ring with inner radius $r + 10km$ and outer radius $r + 20km$.

Size (hectares)	Number of fires	Mean	Median	Std. Dev.	p5	p95	Mean time to extinguish (hours)
>= 1	54,032	24.6	3	276	1	59.8	12.3
>= 500	337	1,923.7	1,009.0	2,896.5	533.6	7,161.0	165.8

Panel A: Descriptive statistics of fires (2004-2017)

	Affected firms		Non affected firms	
	Obs.	Mean	Obs.	Mean
Log (total assets)	54,317	5.8	423,342	5.9
ROA (%)	54,317	-1.4	423,342	-1.5
Capital over total assets (%)	54,317	14.7	423,342	14.4

Panel B: Descriptive statistics of firms affected and non-affected by fires (2004-2017)

	Affected firms		Non affected firms	
	Obs.	Percentage	Obs.	Percentage
Industrial	8,627	15.9	72,934	17.2
Retail	15,726	29.0	115,722	27.3
Services	18,469	34.0	153,191	36.2
Construction	11,495	21.2	81,495	19.3

Panel C: Sector distribution of firms affected and non-affected by fires (2004-2017)

Table 1: **Descriptive statistics.** Panel A of this table reports the number of fires in each group according to their size and their summary statistics. The last column shows the mean of the number of hours employed to extinguish fires. Panel B shows the number of observations and the mean of several firm characteristics: size as Log(total assets), profitability as ROA, and solvency as capital over total assets depending on whether they are affected by fire or not. Panel C displays the distribution of firms across sectors depending on whether they are affected by fire or not. We only consider fires greater or equal to 500ha. We consider the *affected* or treatment area as the region that includes the burn area (i.e., a circle with radius r) plus a 10-kilometer ($10km$) peripheral ring around it. The *non-affected* or control area is defined as the peripheral ring with inner radius $r + 20km$ and outer radius $r + 40km$. We exclude the firms located in the peripheral ring with inner radius $r + 10km$ and outer radius $r + 20km$.

Dep. Var.: $\Delta L_{f,t+1}$	(1)	(2)	(3)	(4)	(5)	(6)
	All firms	All firms	All firms	No groups	All firms	Active firms
	[t-1, t+1]	[t-1, t+1]	[t-3, t-1]	[t-1, t+1]	[t-1, t]	[t-1, t+1]
Fire (10km)	-0.059*		-0.005	-0.054*	-0.079***	-0.057*
	(0.032)		(0.035)	(0.032)	(0.025)	(0.032)
Fire (5km)		-0.065*				
		(0.038)				
Fire (5km-10km)		-0.057*				
		(0.033)				
Observations	444,772	444,772	356,621	437,454	428,961	440,743
R-squared	0.126	0.126	0.126	0.124	0.111	0.127
Firm controls	YES	YES	YES	YES	YES	YES
Ind.-Municipality-Size-Time FE	YES	YES	YES	YES	YES	YES

Table 2: **Corporate credit growth after fire.** Column (1) of this table reports the effect of a firm being affected by fire in year t on the change in the logarithm of credit (plus one to deal with zeros) between December of year $t-1$ and December of year $t+1$. We consider the *affected* or treatment area as the region that includes the burn area (i.e., a circle with radius r) plus a 10-kilometer ($10km$) peripheral ring around it. The *non-affected* or control area is defined as the peripheral ring with inner radius $r+20km$ and outer radius $r+40km$. We exclude the firms located in the peripheral ring with inner radius $r+10km$ and outer radius $r+20km$. We consider fires with an area burned equal to or larger than 500 ha. The estimation period in all columns is 2004-2017, unless otherwise specified. In column (2) we split the dummy variable denoting firms affected by fire into two groups depending on whether the firm is located within the circle comprising the radius plus 5 km or between the border of this circle and the radius plus 10 km. In column (3) the dependent variable is the change in the logarithm of credit (plus one to deal with zeros) between December of year t-3 and December of year $t-1$ (i.e., before the fire) over the period 2006-2017. In column (4) we remove firms that are part of a business group (e.g., subsidiaries). Column (5) is analogous to column (1) but the dependent variable is the change in the logarithm corporate credit between December of year t-1 and December of year t. Column (6) is analogous to column (1) but we exclude from the sample firms that were inactive and had gone out of business based on their status in CBSDO at time t or t+1. We consider a firm as active if it was inactive at time t but became active at time t+1. All specifications include firm controls and industry-municipality-size-time fixed effects, where the industry is measured at a 1-digit level and size refers to the four categories considered by the EC: micro, small, medium-sized, and large corporations. Standard errors in parenthesis are clustered at the firm level. ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Dep. Var.: $\Delta L_{f,b,t+1}$	(1)	(2)	(3)	(4)	(5)
LocalBank × Fire	0.324***	0.219***	0.290**	0.328***	0.306**
	(0.069)	(0.081)	(0.110)	(0.091)	(0.118)
Fire		-0.082**			
		(0.031)			
TA × Fire			-0.007		-0.006
			(0.013)		(0.023)
IRB × Fire				0.003	0.015
				(0.052)	(0.072)
Cap × Fire					0.437
					(0.621)
ROA × Fire					-3.578
					(8.245)
Observations	664,960	892,942	664,960	664,960	664,960
R-squared	0.441	0.146	0.441	0.441	0.441
Firm-Time FE	YES	NO	YES	YES	YES
Ind.-Municipality-Size-Time FE	NO	YES	NO	NO	NO
Bank-Province-Time FE	YES	YES	YES	YES	YES

Table 3: **Credit supply by local banks after fire.** Column (1) of this table reports the results obtained from the estimation of equation (12) in which the dependent variable is the log-change in credit (plus one to deal with zeros) extended by bank b to firm f between December of year $t-1$ and December of year $t+1$. The explanatory variable of interest is the interaction of a dummy variable that is equal to one if the firm was affected by fire in year t and the fraction of credit of bank b in December of year $t-1$ in the province where the firm is located (*LocalBank*). We consider the *affected* or treatment area as the region that includes the burn area (i.e., a circle with radius r) plus a 10-kilometer ($10km$) peripheral ring around it. The *non-affected* or control area is defined as the peripheral ring with inner radius $r+20km$ and outer radius $r+40km$. We exclude the firms located in the peripheral ring with inner radius $r+10km$ and outer radius $r+20km$. We consider fires with an area burned equal to or larger than 500 ha. The regression analysis includes firm-time and bank-province-time fixed effects. In column (2) we propose a less demanding specification of equation (12) which is saturated with industry-municipality-size-time fixed effects, instead of firm-time fixed effects. Industry is measured at a 1-digit level and size refers to the four categories considered by the European Commission: micro, small, medium-sized, and large corporations. These sets of fixed effects allow for the use of the dummy variable that denotes if the firm has been affected by fire as an additional variable of interest. Columns (3) – (5) are similar to column (1) but we included additional interaction terms where the dummy $Fire$ is interacted with the logarithm of total assets –column (3)–, a dummy that denotes if the bank uses IRB models –column (4)–, and the two previous variables plus the interactions with banks' capital and ROA –column (5). The estimation period is 2004-2017. Standard errors in parenthesis are clustered at the province and bank level. ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Dep. Var.: $\Delta L_{f,b,t+1}$	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
LocalBank × Fire	0.324***	0.333***	0.368***	0.204**	0.357***	0.320***	0.351***	0.280**
	(0.069)	(0.079)	(0.085)	(0.093)	(0.077)	(0.113)	(0.100)	(0.133)
Observations	664,960	602,081	386,420	249,815	584,866	472,517	447,554	215,373
R-squared	0.441	0.437	0.452	0.449	0.450	0.465	0.428	0.494
Firm-Time FE	YES	YES	YES	YES	YES	YES	YES	YES
Bank-Province-Time FE	YES	YES	YES	YES	YES	YES	YES	YES

Table 4: **Credit supply by local banks after fire. Alternative samples.** This table reports the results obtained for alternative samples in equation (12). Column (1) is identical to column (1) of Table 3 and is included for comparability reasons. The dependent variable is the log change in credit (plus one to deal with zeros) extended by bank b to firm f between December of year $t-1$ and December of year $t+1$. The explanatory variable of interest is the interaction of a dummy variable that is equal to one if the firm was affected by fire in year t and the fraction of credit of bank b in December of year $t-1$ in the province where the firm is located ($LocalBank$). We consider fires with an area burned equal to or larger than 500 ha. Columns (1) - (5) are analogous to column (1) of Table 3 but with different samples of firms. In column (2) we restrict the group of *affected* firms to first-time fire-damaged firms. Similarly, in column (3) we only consider firms the first year that they appear in the sample (independently of whether they were affected by fire or not). In columns (1) - (3) and (5) – (8) we consider the *affected* or treatment area as the region that includes the burn area (i.e., a circle with radius r) plus a 10-kilometer ($10km$) peripheral ring around it. The *non-affected* or control area is defined as the peripheral ring with inner radius $r+20km$ and outer radius $r+40km$. We exclude the firms located in the peripheral ring with inner radius $r+10km$ and outer radius $r+20km$. However, in column (4) we restrict our sample to those firms located less than $r+20km$ from the centroid of the fire, such that *non-affected* firms are those beyond the threshold of $r+10km$ and they are not considered in columns (1) - (3). In column (5) we restrict our sample to firms that have not received subsidies in years t and $t+1$. In column (6) we remove firms that had credit with any type of guarantee either the year before or after fire. Column (7) only considers firms with a ratio of tangible assets over total assets equal to or below the median ratio each year. In column (8) only those firms with a ratio of tangible assets over total assets greater than the median in each year are included in the sample. The estimation period is 2004-2017. Standard errors in parenthesis are clustered at the province and bank levels. ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Dep. Var.: $\Delta L_{f,b,t+1}$	(1) Sales Low LO	(2) Sales High LO	(3) GVA Low LO	(4) GVA High LO	(5) Assets Low LO	(6) Assets High Low	(7) Employment Low LO	(8) Employment High LO
LocalBank × Fire	0.468***	0.226**	0.467***	0.227**	0.359***	0.304***	0.421***	0.246**
	(0.084)	(0.087)	(0.084)	(0.087)	(0.072)	(0.100)	(0.078)	(0.099)
Observations	119,854	545,092	116,442	548,506	122,723	542,225	130,525	534,423
R-squared	0.429	0.443	0.429	0.443	0.428	0.443	0.427	0.444
Firm-Time FE	YES	YES	YES	YES	YES	YES	YES	YES
Bank-Prov-Time FE	YES	YES	YES	YES	YES	YES	YES	YES

Table 5: **Credit supply by local banks after fire depending on their lending opportunities.** This table reports the results obtained from the estimation of equation (12) for alternative samples of firms depending on the lending opportunities (LO) that exist in the province where they are located. The dependent variable is the log change in credit (plus one to deal with zeros) extended by bank b to firm f between December of year $t-1$ and December of year $t+1$. The explanatory variable of interest is the interaction of a dummy variable that is equal to one if the firm was affected by fire in year t and the fraction of credit of bank b in December of year $t-1$ in the province where the firm is located ($LocalBank$). We consider the *affected* or treatment area as the region that includes the burn area (i.e., a circle with radius r) plus a 10-kilometer ($10km$) peripheral ring around it. The *non-affected* or control area is defined as the peripheral ring with inner radius $r+20km$ and outer radius $r+40km$. We exclude the firms located in the peripheral ring with inner radius $r+10km$ and outer radius $r+20km$. We consider fires with an area burned equal to or larger than 500 ha. We consider that lending opportunities in a specific province in a given year are low when the ratio of the total sales of the firms non-affected by fire relative to the total amount of sales of firms within a given province (see equation 13) is in the bottom quintile of the distribution across provinces (Low LO) and it is not the case when it is above the 20th percentile (High LO). Column (1) reports the results for this subsample of firms in low lending opportunities provinces whereas column (2) contains the results for the subsample of firms located in provinces where the lack of lending opportunities is not an issue according to the total amount of sales of non-affected firms. We use alternative definitions of lending opportunities based on the gross value added –columns (3) and (4)–, total assets –columns (5) and (6)–, and employment –columns (7) and (8)– instead of sales. The regression analysis includes firm-time and bank-province-time fixed effects. The estimation period is 2004-2017. Standard errors in parenthesis are clustered at the province and bank levels. ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
LocalBank × Fire	0.324***	0.358***	0.349***	0.308***	0.216***	-0.033**
	(0.069)	(0.071)	(0.073)	(0.066)	(0.056)	(0.016)
Bank Market Share × Fire				0.210		
				(0.188)		
Share Bank-Firm × Fire					0.002	
					(0.075)	
Share Bank-Firm					0.398***	
					(0.055)	
Observations	664,960	663,481	653,201	664,960	495,832	208,577
R-squared	0.441	0.449	0.465	0.441	0.456	0.502
Firm-Time FE	YES	YES	YES	YES	YES	YES
Bank-Province-Time FE	YES	YES	NO	YES	YES	YES
Bank-Industry-Time FE	NO	YES	NO	NO	NO	NO
Bank-Industry-Province-Time FE	NO	NO	YES	NO	NO	NO

Table 6: **The role of bank specialization and relationship lending.** This table reports the results obtained for alternative specifications of equation (12). Column (1) is identical to column (1) of Table 3 and is included for comparability reasons. The dependent variable is the log change in credit (plus one to deal with zeros) extended by bank b to firm f between December of year $t-1$ and December of year $t+1$. The explanatory variable of interest is the interaction of a dummy variable that is equal to one if the firm was affected by fire in year t and the fraction of credit of bank b in December of year $t-1$ in the province where the firm is located ($LocalBank$). We consider the *affected* or treatment area as the region that includes the burn area (i.e., a circle with radius r) plus a 10-kilometer ($10km$) peripheral ring around it. The *non-affected* or control area is defined as the peripheral ring with inner radius $r+20km$ and outer radius $r+40km$. We exclude the firms located in the peripheral ring with inner radius $r+10km$ and outer radius $r+20km$. We consider fires with an area burned equal to or larger than 500 ha. Columns (2)-(3) include bank-industry-time and bank-industry-province-time fixed effects, respectively. Column (4) includes the interaction of the market share of bank b in December of year $t-1$ in the province where the firm is located with a dummy variable that is equal to one if the firm was affected by fire in year t. The market share of bank b is calculated as the total credit (drawn and undrawn) of the bank in a province over the total credit in the province. Column (5) includes the share of total credit (drawn and undrawn) that a bank has of each firm at $t-1$, Share Bank-Firm, and its interaction with $Fire$. In this case, the sample is restricted to the firm-bank relationships with positive credit at $t-1$. In column (6) the dependent variable is a dummy that takes the value 1 if the firm had a positive balance of credit (drawn and undrawn credit) with the bank at $t-1$ and the sample is restricted to the firms with positive variation of credit between $t-1$ and $t+1$. The estimation period is 2004-2017. Standard errors in parenthesis are clustered at the province and bank level. ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Dep. Var.: $\Delta L_{f,b,t+1}$	(1) Distance bottom quintile	(2) Distance top quintile	(3) All	(4) More opaque	(5) Less opaque	(6) All	(7) Reduced questionaire	(8) Normal questionaire
LocalBank × Fire	0.500**	0.277	0.301***	0.382**	0.247	0.324***	0.332***	0.371
	(0.191)	(0.285)	(0.077)	(0.163)	(0.196)	(0.069)	(0.064)	(0.284)
Observations	80,663	84,649	590,683	114,001	117,853	664,960	608,003	55,445
R-squared	0.529	0.512	0.427	0.453	0.470	0.441	0.451	0.412
Firm-Time FE	YES	YES	YES	YES	YES	YES	YES	YES
Bank-Province-Time FE	YES	YES	YES	YES	YES	YES	YES	YES
Relative Economic Effect	0.038	0.010	0.019	0.024	0.015	0.020	0.021	0.015

Table 7: **Soft information and credit supply by local banks after fire.** The results in this table are analogous to those in column (1) of Table 3 but the firms are split in columns (1) - (2) depending on the distance in km between each borrower and the nearest branch of each lender with which it has a credit relationship and in columns (3) - (8) depending on the firm opacity. The dependent variable is the log change in credit (plus one to deal with zeros) extended by bank b to firm f between December of year $t-1$ and December of year $t+1$. The explanatory variable of interest is the interaction of a dummy variable that is equal to one if the firm was affected by fire in year t and the fraction of credit of bank b in December of year $t-1$ in the province where the firm is located ($LocalBank$). We consider the *affected* or treatment area as the region that includes the burn area (i.e., a circle with radius r) plus a 10-kilometer ($10km$) peripheral ring around it. The *non-affected* or control area is defined as the peripheral ring with inner radius $r+20km$ and outer radius $r+40km$. We exclude the firms located in the peripheral ring with inner radius $r+10km$ and outer radius $r+20km$. We consider fires with an area burned equal to or larger than 500 ha. In column (1) we consider the firm-bank pairs in which this distance is the bottom quintile of the distribution whereas in column (2) we consider the pairs in which this distance is in the top quintile. Column (3) is the same as in Table 3 but it is estimated just for firms with information on their accruals and is included for comparability reasons. Column (4) reports the results for the sample of more opaque firms whereas column (5) includes the results for the least opaque corporations. Firms used in the estimation of column (4) are those whose levels of accruals are in the top quintile of the distribution of accruals of the firms in our sample whereas those in column (5) correspond to the sample of the least opaque firms whose levels of accruals are in the first quintile of the distribution of accruals. Columns (6) – (8) are analogous to columns (3) – (5) but opaque firms are those that send the reduced questionnaire to the CBSDO. The estimation period is 2004-2017. The last row reports the relative economic impact of each variable that is obtained as the product of the coefficient times the average of the share of credit of banks across provinces relative to the standard deviation of the dependent variable. Standard errors in parenthesis are clustered at the province and bank levels. ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Dep. Var.: $\Delta L_{f,b,t+1}$	(1) Bottom quint. Distressed	(2) Bottom quint. Non-distr.	(3) Opaque All	(4) Opaque Distressed	(5) Opaque Non-distr.	(6) Red. quest. All	(7) Red. quest. Distressed	(8) Red. quest. Non-distr.
LocalBank × Fire	-0.025	0.568***	0.382**	0.152	0.424***	0.332***	0.317	0.334***
	(0.954)	(0.204)	(0.163)	(0.313)	(0.157)	(0.064)	(0.243)	(0.081)
Observations	8,659	71,105	114,001	12,351	100,316	608,003	62,856	543,307
R-squared	0.629	0.526	0.453	0.584	0.447	0.451	0.561	0.442
Firm-Time FE	YES	YES	YES	YES	YES	YES	YES	YES
Bank-Prov.-Time FE	YES	YES	YES	YES	YES	YES	YES	YES

Table 8: **Soft information and credit supply by local banks to distressed firms after fire.** Columns (1) and (2) in this table are analogous to column (1) of Table 7 but firms are further split into two groups depending on whether they can be classified as distressed firms or not. Columns (3) - (8) are analogous to those in columns (4) and (7) of Table 7 but opaque firms are divided into two groups based on their classification as distressed firms or not. We consider that a firm is in financial distress if it has negative equity. The dependent variable is the log change in credit (plus one to deal with zeros) extended by bank b to firm f between December of year $t-1$ and December of year $t+1$. The explanatory variable of interest is the interaction of a dummy variable that is equal to one if the firm was affected by fire in year t and the fraction of credit of bank b in December of year $t-1$ in the province where the firm is located ($LocalBank$). We consider the *affected* or treatment area as the region that includes the burn area (i.e., a circle with radius r) plus a 10-kilometer ($10km$) peripheral ring around it. The *non-affected* or control area is defined as the peripheral ring with inner radius $r+20km$ and outer radius $r+40km$. We exclude the firms located in the peripheral ring with inner radius $r+10km$ and outer radius $r+20km$. We consider fires with an area burned equal to or larger than 500 ha. Columns (1) - (2) consider the firm-bank pairs in which this distance in km between each borrower and the nearest branch of each lender with which it has a credit relationship is in the bottom quintile of the distribution. In this sample, column (1) reports the results only for the distressed firms and column (2) reports the results only for the non-distressed. In columns (3) - (5) we report the results obtained for the sample of firms that are classified as opaque because their levels of accruals are in the top quintile of the distribution of accruals of the firms in our sample. Column (3) reports the results for the whole sample of opaque firms and it is equivalent to column (4) in Table 7 whereas columns (4) and (5) report the results for the sample of opaque firms that are distressed and non-distressed, respectively. Columns (6) - (8) report the results obtained for those firms that are classified as opaque because they sent the reduced questionnaire to the CBSDO. Column (6) reports the results for the whole sample of opaque firms based on this criteria and it is equivalent to column (7) in Table 7 whereas columns (7) and (8) report the results for the sample of opaque firms that are distressed and non-distressed, respectively. The estimation period is 2004-2017. Standard errors in parenthesis are clustered at the province and bank levels. ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Dep. Var.: $NPL_{b,m,i,t+2}$	New credit relationships		All credit relationships	
	(1)	(2)	(3)	(4)
LocalBank	-0.022	-0.049	-0.033	-0.158
	(0.052)	(0.515)	(0.027)	(0.123)
Observations	5,459	5,304	20,523	20,261
R-squared	0.397	0.449	0.529	0.553
Avg Firm controls	YES	YES	YES	YES
Ind-Municipality-Time FE	YES	YES	YES	YES
Bank-Time FE	YES	YES	YES	YES
Bank-Province FE	NO	YES	NO	YES

Table 9: **The quality deterioration of loans granted after fire by local banks.** This table reports the results obtained from the estimation on equation (14) in which the dependent variable is the ratio of the total amount of NPLs of each bank b associated to firms affected by fire that are domiciled in a given municipality m and operate in industry i in December of year $t+2$ relative to the total outstanding credit involving firms affected by fire in that municipality and industry. In columns (1) and (2) we define this ratio using only the firm-bank pairs featuring no credit relationship before the fire. The variable of interest is the fraction of bank b's credit balance in province p, which encompass the municipality m where its borrowers are located, as of December of year $t-1$ ($LocalBank$). Column (2) also includes bank-province fixed effects. Columns (3) - (4) are analogous to columns (1) - (2) but the dependent variable considers all firm-bank pairs and not only those featuring no credit relationship before the fire. All specifications include the average characteristics (size, profitability, and solvency) of the firms to which each bank had a positive credit exposure as of December of year $t-1$ in municipality m and industry i to control for the characteristics of the bank's portfolio of existing borrowers and industry-municipality-time and bank-time fixed-effects. The estimation period is 2004-2017. Standard errors in parenthesis are clustered at the bank level. ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Dep. Var.: $\Delta Employm_{f,t+2}$	(1) All	(2) Local banks $> 90\%$	(3) Outsider banks $> 90\%$	(4) Local banks $> 95\%$	(5) Outsider banks $> 95\%$
Fire	-0.013*	-0.006	-0.018*	-0.003	-0.019**
	(0.007)	(0.012)	(0.010)	(0.012)	(0.009)
Observations	466,455	206,297	260,158	176,260	290,195
R-squared	0.136	0.119	0.150	0.110	0.152
Firm controls	YES	YES	YES	YES	YES
Ind.-Municipality-Size-Time FE	YES	YES	YES	YES	YES

Table 10: **The contribution of local banks to mitigate the negative consequences of fires on firms' employment.** This table reports the effect of a firm being *affected* by fire in year t on the growth of the average number of employees between December of year $t-1$ and December of year $t+2$. We consider the *affected* or treatment area as the region that includes the burn area (i.e., a circle with radius r) plus a 10-kilometer ($10km$) peripheral ring around it. The *non-affected* or control area is defined as the peripheral ring with inner radius $r+20km$ and outer radius $r+40km$. We exclude the firms located in the peripheral ring with inner radius $r+10km$ and outer radius $r+20km$. We consider fires with an area burned equal to or larger than 500 ha. Column (1) reports the results for the whole sample whereas columns (2) and (4) report the results for those municipalities with active local banks whereas columns (3) and (5) contain the results obtained from municipalities without active local banks. In columns (2) and (3) we consider that a municipality has active local banks if any firm in the municipality has a positive credit exposure to a bank with more than 90% of its credit balance in the province where the firm is located whereas this threshold is set at 95% in columns (4) and (5). All specifications include firm controls and industry–municipality–size-time fixed effects, where the industry is measured at a 1-digit level and size refers to four categories: micro, small, medium-sized, and large corporations. The estimation period is 2004-2017. Standard errors in parenthesis are clustered at the firm level. ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

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Appendix

A1. Data Filters

This Appendix describes extra details related to the construction of our database and, specifically, the filters that we apply. We apply several filters to the CBSDO data to define our final sample. First, we exclude firms with financial ratios that may not be comparable with those of the rest of the firms, as their goal is not profit maximization such as state-owned companies, local corporations, non-profit organizations, membership organizations, associations, foundations, and religious congregations.

Second, we also remove holding companies because their financial results may not be comparable with those of the rest of the firms. Our sample does not include foreign companies and permanent establishments of entities that do not reside in the country.

Third, financial firms and companies that do not belong to the market economy are also excluded according to the NACE industry classification. This set of firms includes financial service activities, except insurance and pension funding (64); insurance, reinsurance, and pension funding, except compulsory social security (65); activities auxiliary to financial services and insurance activities (66); public administration and defense, as well as compulsory social security (84); activities of membership organizations (94); activities of households as employers of domestic personnel (97); undifferentiated goods- and services-producing activities of private households for own use (98); and activities of extraterritorial organizations and bodies (99).

Fourth, we also remove firms that according to the CBSDO have balance sheets with (i) non-reliable monetary units or (ii) errors regarding positive/negative values. We replace the employment with missings when it is classified as non-consistent in the CBSDO.

Fifth, we remove observations that violate basic accounting rules or have impossible values (e.g. negative age).

A2. Distance of Large Economic Impact Outside the Wildfire

In this Appendix, we present a comprehensive collection of academic papers that validate the statement that businesses located within a 10-kilometer radius from the periphery of a wildfire experience adverse consequences attributable to the fire. In general, it is important to define firms' losses to understand which firms can be considered affected by a natural disaster event and what impact that event had on their businesses. The literature has extensively discussed how to account for the losses caused by natural disasters and the effect that they have on business performance (see Lindell and Prater (2003); Cochrane (2004) and Rose (2004)). As a broad explanation, losses can be distinguished between direct losses and indirect losses. Direct losses are the immediate consequences of the disaster's physical phenomenon and are suffered by businesses directly affected by the event. Destruction of a warehouse by fire or damage in a retail store by a water inundation are examples of direct losses.

Otherwise, indirect losses include all losses not caused by the natural disaster, but by its consequences and affect not only the business in the extension of the event but also business in a larger spatial scale. As defined by Okuyama and Chang (2004) indirect effects or high-order losses are “all flow losses beyond those associated with the curtailment of output as a result of hazard-induced property damage in the producing facility itself”. In other words, businesses not affected but near the event might be unable to produce at pre-event levels.

Some of the causes could be explained by supply-chain disruption, damaged transportation infrastructure, utility service disruption, or damaged infrastructure (see Gordon, Richardson, and Davis (1998); Hallegatte (2015) and Carvalho, Nirei, Saito, and Tahbaz-Salehi (2021)). The main origin of underperformance is caused through the collateral constraint channel as loss of asset value by the depreciation of prices in the closest reduces the company debt and investment capacity (see Chaney, Sraer, and Thesmar (2012); Kiel and Matheson (2018) and Wang (2023)).

The literature supports the idea that a first ring embodying all firms in a 10 km radius from the edge of the wildfire is a good approximation for those companies only suffering indirect effects, especially for a devaluation on collateral assets such as properties. Stetler, Venn, and Calkin (2010) studies how prices of non-burned houses change when a big wildfire occurs near them. They show that house prices drop by -13.7% and -7.6% if they were within 5 km of the fire or between 5 km and 10km, respectively. However, they do not find significant effects beyond a 10 km distance. Other papers found similar results on prices of properties nearby (see Loomis (2004);Henriet, Hallegatte, and Tabourier (2012)).

To determine whether a firm has been affected by fire we calculate the distance in kilometers from the location of the firm to the coordinates of the fire. For this purpose, we use the Stata module geodist, which calculates geographical distances by measuring the length of the shortest path between two points along the surface of a mathematical model of the Earth. We drop fires with impossible coordinates or coordinates outside the geographical limits of Spain. Also, we drop the fire-firm observations where the fire took place previous to the existence of the firm.

Firms not affected by fire are those located in the peripheral ring with inner radius $r + 20km$ and outer radius $r + 40km$. Note that we exclude from our sample those firms situated in the peripheral ring with inner radius $r + 10km$ and outer radius $r + 20km$. This is to guarantee that the unaffected group of firms remains untainted by businesses in the vicinity of the affected area, which might potentially suffer damage due to the wildfire. We subject this assumption to a series of robustness tests and find that our results remain resilient in the face of the definition of the control area.

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