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Too Sunny to Borrow: Sunshine and Borrower Discouragement

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Abstract

We test the hypothesis that sunshine affects the discouragement of borrowing firms. Using a sample of about 45,000 firms from 124 countries, for the period 2010-2020, we find that higher sunshine is associated with a greater probability to be discouraged for the borrowing firm. We further establish that the discouraging impact of sunshine on the decision to apply for a loan is only observed in low latitude zones. We explain these findings by the fact that greater sunshine creates a negative mood in hot regions. Additional results suggest that managerial features affect the discouraging impact of sunshine.

JEL Codes: G21, G41.

Keywords: access to credit, borrower discouragement, sunshine, developing countries.

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1. Introduction

Access to credit for companies has been at the front of the agenda of international organizations for years. This policy choice has its roots in the body of evidence showing that greater access to credit facilitates economic growth. Reducing credit constraints fosters firm productivity (Butler and Cornaggia, 2011; Krishnan, Nandy and Puri, 2015) and enhances firm growth (Rahaman, 2011; Fafchamps and Schündeln, 2013).

Investigating the factors that influence access to credit is therefore an economic question of first-order importance. While a large body of literature investigates the supply-side determinants of access to credit,¹ much less is known about the demand-side determinants, meaning what shapes borrower discouragement. Borrower discouragement is a self-rationing mechanism through which borrowers decide not to apply for a loan. Discouraged borrowers self-impose credit constraints, because they consider that the benefits of asking for a loan are lower than the costs.

As explained by Han, Fraser and Storey (2009), borrower discouragement is not in itself a bad thing. If only bad borrowers, i.e. borrowers with poor chances of getting a loan and/or high default risk, are deterred from asking for a loan, the process is not detrimental for the economy. It then avoids the costs for the banks to manage loan applications with no chance of getting a loan and it avoids the costs for the economy of bad loans in terms of bank losses and waste of resources. In other words, it contributes to a better allocation of resources in terms of available funds and of bank inputs. However, borrower discouragement can be detrimental for the economy if it diminishes the willingness of borrowers on motives not related to the quality of the borrower.

The extant literature on the roots of discouragement has identified a large set of determinants. In particular, a handful of works has showed the influence of the personal characteristics of the firm manager like gender, experience, and education (Chakravarty and Xiang, 2009; Fraser, 2014; Gama, Duarte and Esperança, 2017). This finding raises questions about the efficiency of borrower discouragement since it suggests that psychological mechanisms affect the decision of a borrower to ask for a loan. Borrower discouragement can only be efficient if the self-rationing mechanism is based on the objective characteristics of the loan application such as the quality of the project and the financial situation of the borrowing

¹ See for instance Léon (2015) for bank competition and Mc Namara, Murro and O'Donohoe (2017) for regulatory environment.

company. If psychology of decision-maker matters, it can lead to inefficient borrower discouragement.

A natural question that emerges is therefore to know whether sunshine affects borrower discouragement. A body of literature on stock markets has shown that sunshine influences the behavior of individuals in financial decision-making (Hirshleifer and Shumway, 2003; Goetzmann and Zhu, 2005; Goetzmann et al., 2015) through psychological mechanisms. Sunshine exerts an impact on the mood, which affects judgment and decision-making processes of investors (Daniel, Hirshleifer and Teoh, 2002; Lucey and Dowling, 2005).

In this paper, we investigate whether sunshine affects borrower discouragement. We perform this analysis with firm-level data on access to credit from the World Bank Enterprise Survey. We are then able to analyze this question on a large sample of countries worldwide. We can thus provide information on the impact of sunshine on borrower discouragement for different types of countries, taking into account the climates of developing countries. We thus consider a large sample of about 45,000 firms from 124 countries, for the period 2010-2020. Our large cross-country sample provides a suitable setting for determining whether sunshine influences borrower discouragement in countries at different stages of economic development. Furthermore, the dataset contains mostly small firms, which are the ideal group to investigate the existence of the impact of sunshine. Their decisions are more affected by the mood and thus the behavior of the manager than those of large firms, for which the decision-making process is less concentrated and requires more interactions inside the firm. We adopt the approach from Chakravarty and Xiang (2013) to identify discouraged borrowers. We define discouraged firms as firms that did not apply for credit not because they had sufficient capital but because they consider that application procedures are complex, interest rates are unfavorable, collateral requirements are excessive, loan size and maturity are insufficient, or the application would be rejected.

Two views can be proposed on the impact of sunshine on borrower discouragement. They are both based on the premise that sunshine affects mood of borrowers, which in turn affects their decisions.

A first view considers that sunshine reduces borrower discouragement by improving the mood of firm managers. Greater sunlight would have a beneficial effect on the mood of firm managers, which makes them evaluate future prospects more positively. This conjecture is grounded in research in psychology supporting the view that good mood induces individuals to overestimate the likelihood of positive events and underestimate the likelihood of negative events (e.g. Wright and Bower, 1992). Consequently, borrowers would be more inclined to ask

for a loan when sunshine is greater because their better mood makes them overestimate their chances to have their loan application accepted. This view is empirically supported by the findings that sunny days are associated with a rise in stock prices (Hirshleifer and Shumway, 2003), more credit approval (Cortes, Duchin and Sosyura, 2016), higher credit card spending (Agarwal et al., 2020) and lead corporate executives to make upwardly biased earnings forecasts (Chen et al., 2021).

An alternative view can, however, be proposed according to which sunshine would increase borrower discouragement. The premise underlying the first view is that sunshine is beneficial to a good mood. However, this is not always true. Watson (2000) shows that if sunlight plays on the mood of individuals, it can go in both directions (more positive but also more negative). Moreover, this assumption does not necessarily make sense for all regions of the world. It can be relevant for regions with temperate climates but challenged in regions with hot climates. Empirical literature showing that sunshine fosters a good mood and that sunshine is associated with higher stock returns has been performed in developed countries, which have a temperate climate.² These countries are distinguished by the alternation of cold and hot seasons, with great variation in sunshine. In other words, high sunshine is not taken for granted every day in developed countries.

In contrast, a wide number of developing countries have hot climates with high sunshine all over the year. Thus, sunshine in these countries may not be positive for the mood since average daily sunshine is important. Going farther, sunshine can even be negative for the mood in countries with hot climates since greater sunshine is associated with hot weather affecting human physiology. High temperatures hamper health and reduce human performance. For example, Hewer, Daniel Scott and Fenech (2016) demonstrate that when the sunshine increases too much, the number of tourists in the parks decreases sharply. They attribute this to the fact that too much sunlight can be hard to bear and thus play negatively on people's mood. The climate of developing countries can then provide foundations for a detrimental impact of sunshine on the motivation of borrowers to ask for a loan. Sunshine affects this motivation by generating bad mood but also by reducing the willingness to exert the efforts associated with the loan request.

To sum it up, the sunshine-induced mood influencing borrower discouragement can be positive or negative, being conditional to the climate conditions of the country. Thus, since the

² Cortes, Duchin and Sosyura (2016), Agarwal et al. (2020), Chen et al. (2021) have all performed analyses on US data, while Hirshleifer and Shumway (2003) consider a cross-country dataset of 26 cities but 21 are located in temperate regions.

vast majority of countries in our dataset have hot climates, the negative mood impact of sunshine may dominate the positive one leading to more borrower discouragement associated to higher sunshine. In terms of economic development, such research question is of utmost interest given the importance of understanding what shapes access to credit in developing countries to boost their economic expansion. This potential determinant of the borrower behavior appears of particular importance to understand cross-country differences in access to credit and thus in economic development, since countries worldwide widely differ in terms of sunshine conditions through their different climates.

Our primary finding is that higher sunshine increases borrower discouragement. We provide clear support for the view that sunshine does not encourage the mood of firm managers to apply for a loan. We check the relevance of our interpretation about the negative perception of sunshine in hot countries by performing estimations comparing the impact of sunshine on borrower discouragement in low latitude regions and high latitude regions. We find evidence that sunshine has a discouraging impact on borrowers only in low latitude regions, corroborating our explanation. Further, we document that the sunshine effect varies with some manager and firm characteristics. Sunshine discourages less borrowing firms with experienced managers and with female managers. It has a stronger impact on firms facing obstacles to finance.

Our contribution to the literature is twofold. First, we provide an innovative contribution to the literature on access to credit. To our knowledge, no study has yet investigated the influence of any climate characteristic on access to credit. We identify a new determinant of borrower discouragement, sunshine, and show its importance in explaining borrower discouragement in hot countries. We thus link literature on the effects of geography to literature devoted to credit constraints. A large body of literature has examined the effects of geography on economic development (Henderson, Shalizi and Venables, 2001; Feldman and Storper, 2018). With our work, we suggest a new channel at the micro-level through which geography can affect economic growth.

Second, we contribute to the literature on the effects of sunshine on economic behavior. On the one hand, we provide the first work examining how sunshine affects borrower decisions. The impact of sunshine has been scrutinized on a set of financial decisions like stock investment, credit approval, and credit card spending, but never to the best of our knowledge on the borrowing decision. On the other hand, we provide the first investigation to the best of our knowledge analyzing the effects of sunshine on economic behavior on a sample including

mainly developing countries. In sharp contrast with the literature on developed countries, we do not find evidence corroborating the view that sunshine is associated with an upbeat mood.

The remainder of this paper is structured as follows. Section 2 presents the data and the methodology. Section 3 displays the results. Section 4 provides concluding remarks.

2. Data and methodology

To test the hypothesis that sunshine influences the probability to be discouraged, we employ the Enterprise Surveys (ES) conducted by the World Bank. The aim of this survey is to collect data about firms' experiences and perceptions of the operating environment. To collect the data, the World Bank hired private investigators to conduct face-to-face interviews with business owners and senior managers, to ensure the quality of the answers. At the end, the survey is composed of approximately 168,000 firms in 148 countries stratified through the company size, the industry, and the region within the country to ensure the representativeness of the final sample. The surveys cover a broad range of topics including access to finance, corruption, infrastructure, crime, competition, labor, obstacles to growth, and performance measures. Since 2006, the World Bank has standardized all data, to allow comparability between countries. To avoid any bias from the 2007-2008 financial crisis and to keep comparability we focus on data from the period 2009-2020. To build our database, we start with the initial sample from which we remove all the observations with missing information for our investigation. The final dataset is composed of 45,788 firms in 124 countries. The sample of countries and survey years is reported in the Appendix A.2.

Our goal is to investigate if the sunshine of the firm location affects the probability to be discouraged. Thus, we first need to measure the probability to be discouraged. To do so we rely on two questions in the survey. We first consider the question K16: *“In the last year, did this establishment apply for any loans or lines of credit?”*. Firms can answer ‘Yes’, ‘No’, or ‘Don’t know’ to this question. Firms which answered “No” to this question were asked the subsequent question K17: *“What was the main reason why this establishment did not apply for any line of credit or loan?”* Firms have nine possible answers: ‘No need for a loan - establishment had sufficient capital’, ‘Application procedures were complex’, ‘Interest rates were not favorable’, ‘Collateral requirements were too high’, ‘Size of loan and maturity were insufficient’, ‘Did not think it would be approved’, Other, ‘Don’t know’.

We classify a firm as discouraged if it did not apply for credit, not because they had sufficient capital but because they consider that application procedures were complex, interest rates were not favorable, collateral requirements were too high, the size of loan and maturity were insufficient, or because it did not think it would be approved. Hence, our variable is based on questions K16 answer 2 and K17 answers 2, 3, 4, 5 and 6. In other words, a firm is considered as discouraged only if the firm had a need for a loan but did not apply for it because it was discouraged to do so. This measure of discouragement has been applied in many studies (e.g. Chakravarty and Xiang, 2013; Gama, Duarte and Esperança, 2017). Our variable *Discouraged* is thus equal to one if the firm is discouraged following our definition, and zero if it decides to apply for a loan.

To measure sunshine, we extract data from WorldData. This dataset provides information about the duration of sunshine in a given period for a given location. It informs about the city or at least the metropolitan area where the firm is located, which allows us to merge both datasets based on the firm location. *Sunshine* is thus the average length of sunshine in the year of the loan application at the city or the metropolitan area level.

We also control for several characteristics that can affect the probability to be discouraged. First, manager characteristics matter in discouragement, hence we control for experience and gender of the manager: *Managerial experience* measures the experience of the firm manager in years, while *CEO Female* is a dummy variable equal to one if the firm manager is a woman and zero otherwise. Second, several firm characteristics can also impact the discouragement and be correlated to sunshine or at least geographical location, hence we control for the firm size and age through the natural logarithm of these values ($\log(\text{Size})$, $\log(\text{Age})$), the ownership structure with a dummy variable for sole ownership (*Sole Ownership*), the presence of R&D activities with a dummy variable equal to one if the firm spent on formal R&D activities (*R&D*), and the legal status (with *Limited Corp.* being equal to one if the firm is a limited corporation). All these variables are determinants for opacity and risk, which are associated with discouragement (Stiglitz and Weiss, 1981; Kon and Storey, 2003) and have been formerly used as determinants of borrower discouragement (Chakravarty and Xiang, 2013). Moreover, we add some financial variables such as *Obstacle*, which is a dummy equal to one if the firm considers that the access to finance is at least a major obstacle for business growth, and *F.S. Certified*, which is a dummy equal to one if the firm has certified financial statements. Table 1 reports the descriptive statistics for all variables of the study, while Table 2 reports the correlation matrix.

To test our hypothesis that sunshine affects the probability to be discouraged, we estimate the following probit model:

$$Discouraged_{i,t} = \alpha + \beta_1 Sunshine_{j,t} + \beta_2 Firm\ Controls_{i,t} + \delta_k + \gamma_t + \varepsilon_{i,t} \quad (1)$$

The subscript i refers to firm, subscript j to the city or metropolitan area, subscript k to the region, and subscript t to year. Since the sunshine is at the level of the location of the firm, we include region dummies (for regions within the country) to control for the macroeconomic environment in which the firm evolves at a granular level, and since the survey goes from 2010 to 2020, we add year dummies.

Finally, no theoretical framework offers insights into how to use clustered standard errors by country. However, potential issues could arise if the variance differs by country, indeed, it seems easy to think that if the effect of the sun can be the same everywhere, its amplitude can differ according to the countries and their average temperature. Therefore, we test the sensitivity of our results by conducting the estimation with and without clustered standard errors by country.

3. Results

3.1 Main Estimations

Table 3 displays the results of the main estimations. The dependent variable is the dummy variable for discouragement. We consider five specifications according to the inclusion of dummy variables for region, year, and sector to test the sensitivity of the results. In column (1), we display our preferred specification, which includes dummies for region, year, and sector, we then test the sensitivity of our results clustering the standard errors by country in column (2) and considering different combinations of dummies in columns (3) to (6), specifically we only consider dummies for year and sector in column (3). In column (4), we include sector×year dummies and region dummies, while we consider region×year dummies and sector dummies in column (5). Finally, the specification in column (6) includes region×year×sector dummies.

The key finding is the positive and significant coefficient of *Sunshine* in all estimations. This result means that greater sunshine is associated with higher borrower discouragement. It supports the view that sunshine exerts a detrimental impact on the decision of the firm to ask for a loan. This finding is at odds with the studies concluding that sunshine creates a good mood for the decision-makers, resulting in positive decisions such as higher stock returns (Hirshleifer

and Shumway, 2003; Cortes, Duchin and Sosyura, 2016; Agarwal et al., 2020). However, these results have been documented in developed countries, mainly the US, with temperate climates. In countries with hot climates, sunshine can create a negative mood because, while sunny days are the norm and as such do not create a good mood as in temperate countries, greater sunshine is associated with high temperature, affecting the human body.

In terms of economic significance, the impact of sunshine on borrower discouragement is far from anecdotal. When considering the specification in column (1), we observe that a one standard deviation rise in sunshine is associated with a rise in borrower discouragement of 0.1394 percentage points. This result is economically sizeable, given that the average value for *Discouraged* is 0.458 for the sample.

We now turn to the analysis of control variables. Firms with larger size and higher manager experience are less likely to be discouraged in the line with the view that both these features are associated with higher expectations of obtaining a loan. Interestingly we do not find a significant result for age and CEO gender in most estimations, even if *CEO female* is significantly positive in our preferred specification suggesting that female entrepreneurs would be more discouraged than male entrepreneurs. Ownership affects borrower discouragement with more discouraged firms among those with sole entrepreneurship and limited corporation status. As expected, the fact the firm reports obstacles in access to finance is positively associated with greater borrower discouragement. Firms with certified financial statements and those with R&D activities are less discouraged.

3.2 Additional analyses

The above findings support that sunshine increases borrower discouragement. We explore this evidence in greater depth in two directions.

First, we examine the explanation of our key finding. Namely, we explain the discouraging effect of sunshine with the fact that sunshine exerts a negative impact on mood in hot regions. The reason is that people living under these latitudes associate greater sunshine with unpleasant experience. If this interpretation is accurate, the effect of sunshine should be more pronounced in low latitude regions.

We therefore test whether the effect of sunshine is greater in hot countries. We create the variable *Low Latitude*, equal to one if the region of the firm is located in the zone with a latitude lower than 40 degrees. The zone therefore includes all regions of the world with hot climates. For instance, Cairo has a latitude of 30.03 north and is not in the tropical zone. We then add

Low Latitude and the interaction term *Low Latitude*×*Sunshine* to the initial set of variables. The results are reported in column (1) of Table 4.

We first show that *Sunshine* is significantly negative. Since we include now the interaction term *Low Latitude*×*Sunshine* measuring the specific effect of sunshine in low latitude zones in the estimation, this finding means that greater sunshine is associated with lower borrower discouragement in high latitude zones.

We also find that *Low Latitude*×*Sunshine* is significantly positive. The total effect of sunshine on borrower discouragement in low latitude zones is then the sum of the coefficient for *Sunshine* (-0.196) and the coefficient for *Low Latitude*×*Sunshine* (0.445). Therefore, the total effect of sunshine on borrower discouragement in low latitude zones is positive.

Thus, these results mean that while greater sunshine is associated with lower borrower discouragement in high latitude zones, it is associated with higher borrower discouragement in low latitude zones. They support our interpretation of this discouraging impact that sunshine creates a negative mood in regions with hot climates.

Interestingly, *Low Latitude* is significantly negative suggesting that, all other things equal and controlling for sunshine, borrower discouragement would be lower in hot regions relative to other regions.

Second, we explore the impact of sunshine on the components of borrower discouragement. We can disentangle borrower discouragement in emotional discouragement, and rational discouragement. Rational discouragement is motivated by rational reasons such as high interest rates or complex loan applications. These reasons may be erroneously motivated but they are based on the perception of objective features. Emotional discouragement is associated with the fear of not obtaining a loan. Discouragement is only motivated by the expectation that application would be rejected without any other reason. An alternative way to define both forms of discouragement is to consider that emotional discouragement is the fear of not getting the loan while rational discouragement is any other discouragement.

In line with the view that sunshine affects the mood of borrowers, one might consider that the discouraging effect of sunshine should be particularly pronounced on emotional discouragement since the mood is emotion-driven. However, sunshine might also affect rational discouragement since the perception of objective features like the level of interest rates can also be influenced by the mood of borrowers.

To investigate the effect of sunshine on rational and emotional discouragement, we redo our estimations with two new explaining variables. *Discouraged (Emotional)* is a dummy variable equal to one if the firm decided not to apply because application would be rejected,

and to zero otherwise. *Discouraged (Rational)* is a dummy variable equal to one if the firm decided not to apply because of other reasons (application procedures are complex, interest rates are unfavorable, collateral requirements are excessive, loan size and maturity are insufficient), and to zero otherwise.

The estimations are reported in columns (2) and (3) in Table 4. We find that *Sunshine* is significantly positive in both estimations. In other words, higher sunshine contributes to increasing emotional and rational discouragement. We do not observe that sunshine would only affect emotional discouragement. As explained above, greater sunshine can also exert an impact on rational discouragement by increasing the perception of difficulties associated with objective features. Interestingly, we even observe that the coefficient of *Sunshine* is greater when explaining *Discouraged (Rational)* than when explaining *Discouraged (Emotional)*, adding one more piece of evidence that sunshine does not only affect borrower discouragement through emotional discouragement.

3.3 Splitting analysis

Our key finding is the discouraging impact of sunshine on borrower discouragement. A natural question that emerges deals with the effect of firm characteristics on this relation. We can indeed question whether the features of the firm manager and of the firm influence the effect of sunshine.

To investigate this question, we redo the estimations by adding one by one the interaction term between *Sunshine* and each of the six following firm-level variables: *Manager Experience*, *CEO Female*, *Obstacle*, *F.S. Certified*, *Size*, and *Age*. To allow an easier interpretation and comparison of the results, we use dummy variables for all these characteristics. Hence, we create *Manager Experience (0/1)* which is equal to one if the manager experience is higher than the average experience in the sample and follow the same approach for *Size(0/1)* and *Age(0/1)*. Table 5 reports the results. Several conclusions emerge.

First, we observe that managerial characteristics exert an influence on the relation between sunshine and borrower discouragement. This finding accords with our interpretation since the effect of sunshine takes place through the decision-making of firm managers. We find that firms with more experienced managers and female managers have a lower discouraging impact of sunshine. We can interpret the finding on experienced managers with the fact that greater experience reduces the influence of mood on decisions. The result for female managers can be explained with the fact that the impact of mood on decision-making has been shown to be moderated by gender (Gault and Sabini, 2000).

Second, we find that firms considering access to finance as an obstacle are associated with a more discouraging impact of sunshine. It makes sense that greater sunshine by increasing the rational reasons for discouragement like high interest rates or collateral requirements also contributes to affecting more firms characterized by difficulties in access to finance. Indeed these difficulties are often related to these rational reasons since high interest rates and collateral requirements are two of the major obstacles to get a loan (Beck et al., 2006).

Third, we point out that firm size and firm age do not affect the relation between sunshine and borrower discouragement, while firms with certified financial statements are associated with a more discouraging impact of sunshine.

To sum it up, these estimations let us conclude that the effect of sunshine on borrower discouragement is affected by manager characteristics but also by some firm characteristics. These results have policy implications. We have shown above that the discouraging impact of sunshine on borrowing decision is economically significant. Given the key issue of access to credit in developing countries, we can therefore question which levers can be activated to reduce this detrimental consequence of the climate. The finding that firms with more experienced managers and female managers have a lower discouraging impact of sunshine therefore provides two public policy lessons. On the one hand, managerial experience should be particularly promoted to diminish borrower discouragement in countries with high sunshine. On the other hand, a more gendered-equal presence of women at the management of firms can reduce borrower discouragement in developing countries.

3.4 Robustness tests

We check the robustness of our results in three ways.

First, we mitigate the omitted variables bias. The probability to be discouraged and the sunshine can be correlated with some omitted firm-level variables (e.g., industry clusters or constraints in certain geographic areas) or local-level attributes (e.g., specific financial or legal constraints in some regions). Hence, our results can be biased by these omitted variables. To solve this bias, we rely on the literature on unexpected sky coverage (e.g., Bushee and Friedman 2016; Chhaochharia et al. 2017) and calculate unexpected sunshine. *Unexpected Sunshine* is measured by the difference between annual sunshine in the region and the average length of sunshine in the 5 years prior to the loan. With this variable, in addition to firm's geographic location fixed effects, we try to mitigate the potential bias. The results are reported in column

(1) in Table 6. We find that *Unexpected Sunshine* is significantly positive. Therefore, this estimation confirms our key finding that greater sunshine discourages borrowers.

Second, we consider the problem of sample selection. Our sample only includes firms with a need for credit. Our results might then be subject to a sample selection bias, since the sub-sample of firms with a need for credit can differ from the sub-sample of firms without a need for credit. To overcome this potential criticism, we run a probit model with sample selection, which is the equivalent of Heckman's selection model with the exception that the outcome equation is a probit equation instead of a linear equation. As in the Heckman's procedure, exclusion variables are included in the selection equation. Relevant exclusion variables have to influence the need for loans but not directly impact borrower discouragement to finance. The exclusion variables are (i) the perceived constraints due to inadequately educated workforce, (ii) the natural logarithm of firm sales; (iii) a dummy variable equal to one if the firm submitted an application to obtain a construction-related permit and zero otherwise. The selection equation (need for credit) is fully observed while the outcome equation (credit discouragement) is only observed for firms with a need for credit. The results are reported in columns (2) and (3) of Table 6. We still find that *Sunshine* is significantly positive. In other words, this estimation corroborates our findings.

Third, we consider possible nonlinearity in the relation between sunshine and borrower discouragement. To this end, we add the squared term for the sunshine variable in the estimations. The results are reported in column (4) in Table 6. We find that *Sunshine* is significantly negative and *Sunshine*² is significantly positive. In other words, we observe a nonlinear relation between sunshine and borrower discouragement with greater sunshine reducing borrower discouragement up to a certain value, above which greater sunshine increases borrower discouragement. We can compute this threshold. It is equal to 9.1875. This value for sunshine measure is in the range of the values of the sample and below the mean. Thus, the analysis of the nonlinear relation suggests that the result that sunshine fosters borrower discouragement should only be observed after sunshine attains a certain level. This finding is fully in line with our interpretation. Sunshine exerts a negative influence on borrower discouragement by stimulating good mood as long as it does not exceed a certain level. Once it reaches a certain value, the positive effect on borrower discouragement overrules the negative one and thus sunshine discourages borrowers in regions with high sunshine.

4. Conclusion

In this paper, we analyzed the impact of sunshine on borrower discouragement using a cross-country sample of about 45,000 firms from 124 countries for the period 2011-2020. Borrower discouragement is a major obstacle to access to credit, which hampers firm growth and thus impedes economic development.

Our main finding is that higher sunshine increases borrower discouragement. Our baseline estimations show a positive relation between sunshine and the probability to be discouraged. We further find that the positive relation is only observed in low latitude zones. We explain these findings by the fact that greater sunshine creates a negative mood in hot regions, where sunny days are common and where it is associated with high and unpleasant temperature. Additionally, we document that the effect of sunshine is influenced by manager characteristics, discouraging less firms with experienced and female managers.

Our conclusions are of major interest in two aspects. First, they complement the literature devoted to the effects of geographic on economic development. Our results provide micro-level foundations to the influence of latitude on economic growth through the effect of sunshine on borrower discouragement, thereby affecting access to credit and thus firm growth. They do not however bring a pessimistic view about findings ways to improve access to credit, since policymakers can influence managerial features like female CEO. Second, they suggest that future explorations of the role of sunshine on corporate decisions in developing countries may find it fruitful to pay attention. The findings of the beneficial effect of sunshine on the mood of decision-makers observed in former works might be conditional to the climate of the region. This conclusion opens avenues for further research.

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Table 1
Descriptive Statistics

This table provides descriptive statistics for the variables used in the analysis.

	Mean	Std. Dev.	Applicants	Discouraged borrowers	Mean Diff. Test
<i>Dependent variables</i>					
Discouraged	0.458	0.498			
Discouraged (Emotional)	0.038	0.191			
Discouraged (Rational)	0.420	0.494			
<i>Independent variables</i>					
<i>Sunshine variables</i>					
Sunshine	11.561	0.708	11.560	11.612	-0.052***
Unexpected Sunshine	0.001	0.197	-0.000	0.002	-0.002**
<i>Control variables</i>					
Manager Experience	18.627	14.672	20.087	16.899	3.188***
CEO Female	0.148	0.356	0.142	0.156	-0.014***
Log(Size)	3.367	1.384	3.656	3.025	0.631***
Log(Age)	2.844	0.982	2.923	2.750	0.173***
Sole Ownership	0.486	0.500	0.411	0.575	-0.163***
Limited Corp.	0.114	0.317	0.114	0.113	0.000
Obstacle	0.308	0.462	0.267	0.356	-0.088***
F.S. Certified	0.516	0.500	0.585	0.434	0.151***
R&D	0.208	0.406	0.261	0.147	0.114***
Observations	45,788		20,968	24,820	

Table 2
Correlation Matrix

	Discouraged	Discouraged (Emotional)	Discouraged (Rational)	Sunshine	Unexpected Sunshine	Manager Experience	CEO Female	Log(Size)	Log(Age)	Sole Ownership	Limited Corp.	Obstacle	F.S. Certified
Discouraged	1.000												
Discouraged (Emotional)	0.216***	1.000											
Discouraged (Rational)	0.926***	-0.169***	1.000										
Sunshine	0.042**	0.044***	-0.015***	1.000									
Unexpected Sunshine	0.005*	0.003	0.004	0.288***	1.000								
Manager Experience	-0.108***	-0.030***	-0.098***	0.013***	0.007	1.000							
CEO Female	0.019***	0.003	0.018***	-0.046***	-0.012**	-0.048***	1.000						
Log(Size)	-0.227***	-0.064***	-0.205***	0.012***	0.015***	0.107***	-0.067***	1.000					
Log(Age)	-0.088***	-0.013***	-0.084***	0.060***	0.001	0.226***	-0.018***	0.219***	1.000				
Sole Ownership	0.163***	0.036***	0.151***	-0.103***	-0.027***	-0.118***	0.023***	-0.305***	-0.126***	1.000			
Limited Corp.	-0.001	-0.002	0.000	0.142***	-0.012***	0.011**	-0.000	0.061***	0.010**	-0.227***	1.000		
Obstacle	0.095***	0.047***	0.078***	0.068***	0.010**	-0.009*	-0.007	-0.129***	-0.046***	0.031***	0.009**	1.000	
F.S. Certified	-0.150***	-0.031***	-0.140***	0.132***	-0.002	0.051***	-0.070***	0.312***	0.108***	-0.172***	0.099***	-0.042***	1.000
R&D	-0.140***	-0.034***	-0.128***	0.139***	-0.015***	0.031***	-0.026***	0.247***	0.074***	-0.149***	0.075***	-0.025***	0.190***

Table 3
Estimations

Probit estimations are performed. The dependent variable is *Discouraged*. Definitions of all variables are reported in the Appendix A.1. Table reports marginal effects and associated standard errors in parentheses. *, **, *** denote an estimate significantly different from 0 at the 10%, 5% or 1% level.

	Main estimation	Sensitivity analysis				
	Discouraged	Discouraged	Discouraged	Discouraged	Discouraged	Discouraged
	(1)	(2)	(3)	(4)	(5)	(6)
Sunshine	0.197*** (0.000)	0.197*** (0.004)	0.043* (0.082)	0.046*** (0.000)	0.095*** (0.000)	0.047*** (0.000)
Manager Experience	-0.007*** (0.000)	-0.007*** (0.000)	-0.004*** (0.000)	-0.012*** (0.000)	-0.010*** (0.000)	-0.012*** (0.000)
CEO Female	0.040** (0.022)	0.040 (0.273)	0.024 (0.205)	-0.013 (0.434)	0.013 (0.461)	-0.011 (0.505)
Log(Size)	-0.155*** (0.000)	-0.155*** (0.000)	-0.160*** (0.000)	-0.142*** (0.000)	-0.159*** (0.000)	-0.143*** (0.000)
Log(Age)	-0.007 (0.311)	-0.007 (0.591)	-0.024*** (0.001)	-0.006 (0.326)	-0.008 (0.224)	-0.007 (0.294)
Sole Ownership	0.143*** (0.000)	0.143*** (0.000)	0.099*** (0.000)	0.243*** (0.000)	0.234*** (0.000)	0.242*** (0.000)
Limited Corp.	0.099*** (0.000)	0.099* (0.064)	0.072*** (0.001)	0.182*** (0.000)	0.150*** (0.000)	0.182*** (0.000)
Obstacle	0.194*** (0.000)	0.194*** (0.000)	0.146*** (0.000)	0.195*** (0.000)	0.221*** (0.000)	0.194*** (0.000)
F.S. Certified	-0.299*** (0.000)	-0.299*** (0.000)	-0.321*** (0.000)	-0.200*** (0.000)	-0.225*** (0.000)	-0.199*** (0.000)
R&D	-0.245*** (0.000)	-0.245*** (0.000)	-0.211*** (0.000)	-0.284*** (0.000)	-0.273*** (0.000)	-0.285*** (0.000)
Region dummies	Yes	Yes		Yes		
Year dummies	Yes	Yes	Yes			
Sector dummies	Yes	Yes	Yes		Yes	
Sector × Year dummies				Yes		
Region × Year dummies					Yes	
Region × Sector × Year dummies						Yes
Country cluster		Yes				
Constant	-2.108*** (0.000)	-2.108** (0.012)	0.935** (0.047)	0.145 (0.168)	-0.056 (0.665)	0.105 (0.313)
Observations	45,788	45,788	45,788	45,788	45,788	45,788
Pseudo R ²	0.119	0.119	0.177	0.068	0.092	0.069

Table 4
Additional analysis

Probit estimations are performed. The dependent variable is *Discouraged*. Definitions of all variables are reported in the Appendix A.1. Table reports marginal effects and associated standard errors in parentheses. *, **, *** denote an estimate significantly different from 0 at the 10%, 5% or 1% level.

	Discouraged	Discouraged (Emotional)	Discouraged (Rational)
Sunshine	-0.196*** (0.000)	0.103*** (0.000)	0.171*** (0.000)
Low Latitude	-4.842*** (0.000)		
Low Latitude × Sunshine	0.445*** (0.000)		
Manager Experience	-0.007*** (0.000)	-0.005*** (0.000)	-0.006*** (0.000)
CEO Female	0.039** (0.030)	0.005 (0.871)	0.040** (0.022)
Log(Size)	-0.156*** (0.000)	-0.094*** (0.000)	-0.138*** (0.000)
Log(Age)	-0.006 (0.358)	0.007 (0.558)	-0.010 (0.126)
Sole Ownership	0.149*** (0.000)	0.038 (0.141)	0.134*** (0.000)
Limited Corp.	0.098*** (0.000)	-0.012 (0.747)	0.107*** (0.000)
Obstacle	0.193*** (0.000)	0.183*** (0.000)	0.151*** (0.000)
F.S. Certified	-0.293*** (0.000)	-0.101*** (0.000)	-0.271*** (0.000)
R&D	-0.246*** (0.000)	-0.157*** (0.000)	-0.214*** (0.000)
Region dummies	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes
Sector dummies	Yes	Yes	Yes
Constant	2.108*** (0.000)	-2.428*** (0.000)	-2.021*** (0.000)
Observations	45,788	45,554	45,788
Pseudo R ²	0.120	0.059	0.101

Table 5
Splitting analysis

Probit estimations are performed. The dependent variable is *Discouraged*. Definitions of all variables are reported in the Appendix A.1. Table reports marginal effects and associated standard errors in parentheses. *, **, *** denote an estimate significantly different from 0 at the 10%, 5% or 1% level.

	Discouraged (1)	Discouraged (2)	Discouraged (3)	Discouraged (4)	Discouraged (5)	Discouraged (6)
Sunshine	0.248*** (0.000)	0.218*** (0.000)	0.160*** (0.000)	0.172*** (0.000)	0.212*** (0.000)	0.210*** (0.000)
Manager Experience (0/1)	1.137*** (0.000)					
Sunshine × Manager Experience (0/1)	-0.086*** (0.000)					
CEO Female	0.044** (0.014)	1.369*** (0.000)	0.039** (0.026)	0.041** (0.022)	0.044** (0.012)	0.041** (0.021)
CEO Female × Sunshine		-0.116*** (0.000)				
Obstacle	0.196*** (0.000)	0.194*** (0.000)	-1.061*** (0.000)	0.195*** (0.000)	0.205*** (0.000)	0.195*** (0.000)
Obstacle × Sunshine			0.109*** (0.000)			
F.S. Certified	-0.301*** (0.000)	-0.300*** (0.000)	-0.298*** (0.000)	-0.973*** (0.000)	-0.332*** (0.000)	-0.299*** (0.000)
F.S. Certified × Sunshine				0.058*** (0.002)		
Size (0/1)					0.468** (0.023)	
Size (0/1) × Sunshine					-0.013 (0.450)	
Age (0/1)						0.312 (0.142)
Age (0/1) × Sunshine						-0.025 (0.172)
Manager Experience		-0.007*** (0.000)	-0.007*** (0.000)	-0.007*** (0.000)	-0.007*** (0.000)	-0.007*** (0.000)
Log(Size)	-0.154*** (0.000)	-0.155*** (0.000)	-0.154*** (0.000)	-0.155*** (0.000)		-0.154*** (0.000)
Log(Age)	-0.011 (0.102)	-0.007 (0.325)	-0.006 (0.352)	-0.007 (0.307)	-0.018*** (0.006)	
Sole Ownership	0.143*** (0.000)	0.143*** (0.000)	0.144*** (0.000)	0.144*** (0.000)	0.168*** (0.000)	0.142*** (0.000)
Limited Corp.	0.096*** (0.000)	0.100*** (0.000)	0.096*** (0.000)	0.097*** (0.000)	0.103*** (0.000)	0.098*** (0.000)
R&D	-0.246*** (0.000)	-0.244*** (0.000)	-0.245*** (0.000)	-0.247*** (0.000)	-0.271*** (0.000)	-0.245*** (0.000)
Region dummies	Yes	Yes	Yes	Yes	Yes	Yes

Year dummies	Yes	Yes	Yes	Yes	Yes	Yes
Sector dummies	Yes	Yes	Yes	Yes	Yes	Yes
Constant	-2.911*** (0.000)	-2.354*** (0.000)	-1.672*** (0.000)	-1.821*** (0.000)	-2.908*** (0.000)	-2.295*** (0.000)
Observations	45,788	45,788	45,788	45,788	45,788	45,788
Pseudo R ²	0.119	0.119	0.119	0.119	0.114	0.119

Table 6
Robustness tests

Probit estimations are performed. The dependent variable is *Discouraged*. Definitions of all variables are reported in the Appendix A.1. The robustness check in column (1) replaces *Sunshine* by *Unexpected Sunshine* in the set of explained variables. The robustness check in columns (2) and (3) analyzes the sample selection bias. The robustness check in column (4) adds *Sunshine*² in the set of explained variables. Table reports marginal effects and associated standard errors in parentheses. *, **, *** denote an estimate significantly different from 0 at the 10%, 5% or 1% level.

	Unexpected Sunshine	Sample selection bias		Nonlinear analysis
Explained variable	Discouraged	Need	Discouraged	Discouraged
	(1)	(2)	(3)	(4)
Sunshine			0.199*** (0.000)	-0.735** (0.018)
Sunshine ²				0.040*** (0.003)
Unexpected Sunshine	0.069** (0.038)			
λ			0.050 (0.199)	
Manager Experience	-0.004*** (0.000)	0.001** (0.021)	-0.007*** (0.000)	-0.007*** (0.000)
CEO Female	0.024 (0.203)	-0.008 (0.517)	0.041** (0.020)	0.039** (0.028)
Log(Size)	-0.160*** (0.000)	0.011** (0.028)	-0.154*** (0.000)	-0.155*** (0.000)
Log(Age)	-0.024*** (0.001)	0.003 (0.536)	-0.007 (0.321)	-0.006 (0.347)
Sole Ownership	0.100*** (0.000)	-0.006** (0.042)	0.143*** (0.000)	0.145*** (0.000)
Limited Corp.	0.073*** (0.001)	-0.028*** (0.006)	0.097*** (0.000)	0.100*** (0.000)
Obstacle	0.146*** (0.000)	-0.034** (0.035)	0.214*** (0.000)	0.194*** (0.000)
F.S. Certified	-0.321*** (0.000)	0.718*** (0.000)	-0.299*** (0.000)	-0.295*** (0.000)
R&D	-0.210*** (0.000)	0.026** (0.014)	-0.241*** (0.000)	-0.247*** (0.000)
Log(Sales)		-0.006** (0.042)		
Construction		0.090*** (0.000)		
WK		0.208*** (0.000)		
Region dummies	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes

Sector dummies	Yes	Yes	Yes	Yes
Constant	1.422*** (0.000)	0.154 (0.381)	-2.168*** (0.000)	3.297* (0.067)
Observations	45,788	87,225	45,788	45,788
Pseudo R ²	0.177	0.100	0.119	0.119

Appendix A.1: Definitions of Variables

Variables	Definition
<i>Dependent variables</i>	
Discouraged	Dummy variable equals to one if the firm is discouraged (i.e., decides not to apply), zero if it applied for a credit.
Discouraged (Emotional)	Dummy variable equals to one if the firm decided not to apply because of emotional reasons (application would be rejected), zero otherwise.
Discouraged (Rational)	Dummy variable equals to one if the firm decided not to apply because of rational reasons (application procedures are complex, interest rates are unfavorable, collateral requirements are excessive, loan size and maturity are insufficient), zero otherwise.
<i>Independent variables</i>	
<i>Sunshine variables</i>	
Sunshine	Average length of sunshine in the year of the loan application.
Unexpected Sunshine	Difference between Sunshine and the average length of sunshine in the 5 years prior to the loan.
<i>Control variables</i>	
Manager Experience	Manager experience.
CEO Female	Dummy variable equals to one if the manager of the firm is a woman, zero otherwise.
Log(Size)	Natural logarithm of the firm total assets.
Log(Age)	Natural logarithm of the firm age.
Sole Ownership	Dummy variable equals to one if the firm has only one owner, zero if it has more.
Limited Corp.	Dummy variable equals to one if the firm is limited corporation, zero otherwise.
Obstacle	Dummy variable equals to one if the firm considers that the access to finance is a "Major Obstacle" or a "Very Severe Obstacle", zero otherwise.
F.S. Certified	Dummy variable equals to one if the firm annual financial statements are checked or certified by an external auditor, zero otherwise.
R&D	Dummy variable equals to one if the firm spent on formal R&D activities, zero otherwise.
<i>Other variables</i>	
Low Latitude	Dummy variable equals to one if the firm region is located in a zone with a latitude lower than 40 degrees, zero otherwise.

Appendix A.2: Sample of countries

Countries in our sample include (year of the survey):

Afghanistan (2013, 2014), Albania (2013, 2018, 2019), Antigua (2011), Argentina (2010, 2011, 2017, 2018), Armenia (2012, 2013, 2020), Azerbaijan (2013, 2019, 2020), Bahamas (2011), Bangladesh (2013), Barbados (2011), Belarus (2012, 2013, 2018, 2019), Belize (2011), Benin (2011, 2016), Bhutan (2015), Bolivia (2010, 2017), Bosnia and Herzegovina (2012, 2013, 2019), Bulgaria (2012, 2013, 2019, 2020), Burundi (2014, 2015), Cambodia (2016), Cameroon (2016), Central African Republic (2011), Chad (2018), Chile (2010, 2011), Colombia (2010, 2011, 2017, 2018), Cote D'Ivoire (2016, 2017), Croatia (2013, 2018, 2019), Cyprus (2018, 2019), Czech Republic (2013, 2014, 2019, 2020), Democratic Republic of Congo (2013, 2014), Djibouti (2013), Dominica (2011), Dominican Republic (2011, 2016, 2017), Ecuador (2010, 2017), Egypt (2013, 2014, 2016, 2017, 2019, 2020), El Salvador (2010, 2011, 2016), Estonia (2013, 2019), Eswatini (2016), Ethiopia (2011, 2012, 2015, 2016), Gambia (2018), Georgia (2012, 2013, 2019, 2020), Ghana (2012, 2013, 2014), Greece (2018, 2019), Grenada (2011), Guatemala (2010, 2011, 2017, 2018), Guinea (2016), Guyana (2011), Honduras (2010, 2011, 2016, 2017), Hungary (2013, 2018, 2019, 2020), India (2013, 2014), Indonesia (2015), Israel (2013, 2014), Italy (2018, 2019), Jamaica (2011), Jordan (2013, 2014, 2019), Kazakhstan (2012, 2013, 2019), Kenya (2013, 2014, 2018, 2019), Kosovo (2013, 2018, 2019), Kyrgyz Republic (2013, 2018, 2019), Laos (2016, 2018), Latvia (2013, 2018, 2019), Lebanon (2013, 2014, 2019, 2020), Lesotho (2016), Liberia (2017), Lithuania (2013, 2018, 2019), Malawi (2014, 2015), Malaysia (2015, 2016), Mali (2016), Malta (2019), Mauritania (2014, 2015), Mexico (2010, 2011), Moldova (2012, 2013, 2019), Mongolia (2012, 2013, 2018, 2019), Montenegro (2013, 2019), Morocco (2013, 2014, 2018, 2019), Mozambique (2018, 2019), Myanmar (2014, 2016, 2017), Namibia (2014, 2015), Nepal (2013), Nicaragua (2010, 2011, 2016, 2017), Niger (2017), Nigeria (2014, 2015), North Macedonia (2012, 2013, 2018, 2019), Pakistan (2013, 2014, 2015), Panama (2010, 2011), Papua New Guinea (2015, 2016), Paraguay (2010, 2011, 2017), Peru (2010, 2017, 2018), Philippines (2014, 2015, 2016), Poland (2013, 2019), Portugal (2018, 2019, 2020), Romania (2012, 2013, 2018, 2019, 2020), Russia (2011, 2012, 2019), Rwanda (2011, 2012, 2019), Senegal (2014, 2015), Serbia (2013, 2018, 2019), Sierra Leone (2017), Slovakia (2013, 2014, 2019, 2020), Slovenia (2013, 2018, 2019), Solomon Islands (2015, 2016), South Sudan (2014), Sri Lanka (2011), St Kitts and Nevis (2011), St Lucia (2011), St Vincent and Grenadines (2011), Sudan (2014), Suriname (2011, 2018), Tajikistan (2013, 2014, 2019), Tanzania (2013, 2014), Thailand (2015, 2016), Timor-Leste (2015, 2016), Togo (2016), Trinidad and Tobago (2011), Tunisia (2013, 2014, 2019, 2020), Turkey (2013, 2014, 2018, 2019), Uganda (2013, 2014), Ukraine (2013, 2019), Uruguay (2010, 2011, 2017), Uzbekistan (2013, 2019), Venezuela (2010, 2011), Vietnam (2014, 2015, 2016), West Bank and Gaza (2013, 2019), Yemen (2013, 2014), Zambia (2012, 2013, 2014, 2019, 2020), Zimbabwe (2011, 2016, 2017).