Laboratoire
de Recherche
en Gestion
& Economie

Working Paper

2020-05

Bank Efficiency and Access to Credit: International Evidence

Francis Osei-Tutu & Laurent Weill

December 2020

Université de Strasbourg
Pôle Européen de Gestion et d'Economie
61 avenue de la Forêt Noire
67085 Strasbourg Cedex
http://large.em-strasbourg.eu/

IFS
Institut de Finance de Strasbourg

Bank Efficiency and Access to Credit: International Evidence

Francis Osei-Tutu [+]
EM Strasbourg Business School, University of Strasbourg

Laurent Weill[*]
EM Strasbourg Business School, University of Strasbourg

Abstract

This paper examines the impact of bank efficiency on access to credit. We test the hypothesis that higher bank efficiency, meaning better ability of banks to operate at lower costs, favors access to credit for firms. To this end, we perform a cross-country analysis with firm-level data on access to credit and bank-level data to compute bank efficiency, using a sample of about 54,000 firms from 76 countries. We find that greater bank efficiency improves access to credit for firms. The beneficial impact of bank efficiency to alleviate credit constraints takes place through the demand channel by reducing borrower discouragement to apply for a loan. Whereas the positive impact of bank efficiency on credit access is observed for firms of all sizes, the effect tends to be more pronounced in countries with better economic and institutional framework. Our results therefore support policies favouring bank efficiency to enhance access to credit.

JEL Codes: G21, O16.

Keywords: bank efficiency, access to credit, borrower discouragement.

[+] EM Strasbourg Business School, Université de Strasbourg, 61 avenue de la Forêt Noire, 67000 Strasbourg, France. Email : oseitutu@unistra.fr

[*] Corresponding author. Sciences Po Strasbourg, Université de Strasbourg, 7 rue de l'Écarlate, 67082 Strasbourg, France. Email: laurent.weill@unistra.fr

1. Introduction

Access to credit is a key engine of economic growth. Credit constraints make firms unable to pursue attractive investment opportunities (Campello et al., 2010), limit their flexibility in resources allocation (Fafchamps, 1997), and hamper their productivity (Gatti and Love, 2008; Butler and Cornaggia, 2011). They consequently reduce firm growth, in particular for small and medium-sized firms (Beck and Demirgüc-Kunt, 2006: Nkurunziza, 2010).

A large strand of literature has therefore identified the determinants of financing constraints, including firm-level factors like size, and foreign ownership (Beck et al., 2006) and country-level factors such as the institutional framework (Qi and Ongena, 2019) and banking market characteristics. Among banking market characteristics, the influence of bank financial conditions (Popov and Udell, 2012) and bank competition (Léon, 2015) on access to credit has been put into evidence. The underlying hypothesis is that these banking market characteristics affect bank behavior in granting loans and through this mechanism exert an impact on access to credit.

It therefore appears surprising that the influence of bank efficiency on access to credit has never been investigated. Cost efficiency of banks measures the ability of a bank to operate at the minimal cost by comparing its cost structure to that of a best-practice bank. It therefore informs about the bank performance to produce with the lowest costs, and has been widely studied in banking literature over the last two decades (e.g., Bonin, Hasan and Wachtel, 2005; Berger, Hasan and Zhou, 2009). This omission from the literature is surprising since economic theory predicts that a greater ability of a bank to produce with the lowest costs should lead to lower banking prices, including lower loan rates. It should then reduce the financing obstacle generated by high loan rates and thus facilitates access to credit. Therefore, we can expect that higher bank efficiency should favor access to credit.

From a theoretical perspective, the rationale for our hypothesis is based on two mechanisms. First, bank efficiency should reduce cost of credit, which has been empirically confirmed by Shamshur and Weill (2019). Using a cross-country sample of firms from European countries, they provide evidence that greater bank efficiency diminishes cost of credit at the firm level. Second, firms should be constrained by high loan rates, which reduce their ability to access credit. This fact has been confirmed by a set of works supporting the

view that high interest rates are one of the major financing obstacles for firms (e.g., Beck et al., 2006; Coluzzi, Ferrando and Martinez-Carrascal, 2015).[1]

This paper aims to fill this loophole in the literature by examining how bank efficiency affects access to credit. To this end, we perform a cross-country analysis with firm-level data on access to credit and bank-level data to compute bank efficiency. We use firm-level data on access to credit from World Bank Enterprise Survey (WBES), which provides unique information at the firm level on access to credit for a large cross-country sample of countries and has been used similarly by Léon (2015). We utilize bank-level data from Bank Focus database to estimate bank efficiency with the stochastic frontier approach commonly adopted in the literature (Hasan, Koetter and Wedow, 2009; Shamshur and Weill, 2019). We thus consider a large sample of about 54,000 firms from 76 countries.

In our first estimations, we examine the impact of bank efficiency on access to credit. We are then able to answer the question to ascertain whether greater bank efficiency can contribute to facilitate access to credit. We further identify the channels through which bank efficiency affects access to credit. Higher bank efficiency can favor access to credit through two different mechanisms: the demand channel, and the supply channel. On the one hand, more efficient banks can charge lower loan rates because of their lowest costs. It would then lead to higher loan demand. This is the mechanism in line with economic theory according to which lower costs should favor lower prices and thus greater access to the products. On the other hand, more efficient banks can grant more loans for two reasons. First, their lower costs can reduce the cost of granting one loan and as such increase credit supply. Second, more efficient banks can be able to overcome the problems of moral hazard and adverse selection associated with the loan activity. As such, they would be able to have lower loan application denial rates resulting in higher loan supply.

We finally analyze whether the relationship between bank efficiency and access to credit is conditional to firm size and to the macroeconomic environment. Since access to credit is predominantly a concern for smaller firms, it is of importance to know whether smaller firms benefit the most of gains in bank efficiency. In addition, the macroeconomic environment can contribute to the magnitude of the impact of bank efficiency.

We face several challenges in our investigation. First, we must identify credit-constrained firms. This step is often challenging due to data limitations. Perception-based

[1] In the analysis of the determinants of financing obstacles based on a worldwide survey of firms proposed by Beck et al. (2006), "high interest rates" is the most often cited financing obstacle of all 12 proposed financing obstacles with more than half of the firms of the sample citing it as a major obstacle.

measures of credit access are problematic and may be subject to perception bias, whereas indirect indicators like the usage of credit do not take into account whether firms do not use credit because they actually do not need them. To address this issue, we follow Popov and Udell (2012) and Léon (2015) and measure credit-constrained firms as those firms that applied for credit and were denied or did not apply for credit because they were discouraged. In this way, we are able to account for firms that select themselves out of the loan application process.

Second, a credit-constrained firm can only be observed when the firm has a need for bank credit. This, however, raises potential sample selection issues which can affect the consistency of the estimates. To correct this potential bias, we employ a probit model with sample selection proposed by Van de Ven and Van Praag (1981) using two variables to control for the need of funds as selection variables. This approach aims to insulate our analysis from any potential bias and inconsistency.

Third, we must link measures on bank efficiency and on access to credit. Access to credit is computed at the firm level. Bank efficiency could be computed at the firm level if we were able to identify the name of the bank for each firm in the dataset. While such identification can be done with country datasets or for European countries thanks to Amadeus database (Shamshur and Weill, 2019), we cannot identify the partner bank for each firm in the WBES database which is a unique worldwide database to investigate financing constraints for a large sample of firms from developed and developing countries.

We thus choose to consider the mean bank efficiency score for each country as the indicator of bank efficiency for each firm. Léon (2015) adopts a similar choice in his analysis of the impact of bank competition on access to credit by utilizing the country-level degree of bank competition. We however make an improvement relative to Léon (2015) in the sense that we do not rely to a database on aggregate country measures but estimate bank efficiency scores for all banks from the countries of the study. Using these bank efficiency scores computed, we obtain the mean bank efficiency score and use it in our estimations to explain access to credit.

We find that bank efficiency exerts a beneficial impact on access to credit by alleviating firms' credit constraints. This effect takes place through the demand channel: when bank efficiency is higher, borrower discouragement is reduced with more firms applying for a loan. We do not observe any support for the supply channel according to which more efficient banks would increase their credit supply. We finally point out that the beneficial effect of bank efficiency on access to credit is observed for all firms whatever their

size and tends to be more pronounced in countries with better institutional and economic framework.

Our work contributes to three different streams of literature. First, we contribute to the substantial body of work on the finance-growth nexus. This strand of literature has examined how financial markets can affect economic development (Levine, 2005; Popov, 2018). Our study investigates a new channel through which banks can affect economic growth by alleviating credit constraints for firms. Second, we add to the literature on the determinants of access to credit. Our work emphasizes the role of bank efficiency in facilitating access to credit, which has been ignored in the literature. Third, we augment the literature on the consequences of bank efficiency. While the determinants of bank efficiency have been thoroughly investigated, the effects of bank efficiency have received much less attention. A handful of papers has examined the consequences of bank efficiency, notably on financial stability (Assaf et al., 2019), economic growth (Hasan, Koetter and Wedow, 2009), and cost of credit (Shamshur and Weill, 2019). We complement this literature by providing evidence on how bank efficiency affects access to credit.

The remainder of the paper proceeds as follows. Section 2 describes the data and methodology. Section 3 reports the main estimations, while additional estimations are displayed in Section 4. Section 5 presents the robustness checks. Section 6 concludes.

2. Data and Methodology

2.1 Data Sources

To investigate the effect of bank efficiency on firms' access to credit in a cross-country setting, we employ firm-level data on access to credit from the World Bank Enterprise Survey. We combine this data with bank-level information from Bank Focus database to compute bank efficiency scores. We consider only commercial banks to have a homogenous sample in terms of activities and only use unconsolidated statements for each bank. Data on macroeconomic variables are collected from World Development Indicators and data on institutional factors are from World Governance Indicators database.

In constructing the dataset, we drop all bank-level observations with missing necessary accounting information and eliminate countries with only one bank. We winsorize all bank-level variables used to estimate bank efficiency scores at 5% (lowest and highest values) to eliminate the effect of outliers. Regarding the firm-level information collected from WBES, we drop responses that the interviewer does not believe to be reliable (question

a16) and firms with missing information on credit market experience. In addition, we exclude firms with more than 1,000 employees since they are not SMEs and may have access to multiple sources of financing.

The final sample covers 54,086 firms from 76 countries (89 surveys from 2012 to 2019). Table 1 presents the number of firms in our sample by country and the year of survey. For our sample period, most of the countries had only one survey. Variation exists in the coverage of firms by country. Russia, for example, has 4,693 firms covered in two surveys, whereas Moldova has 353 firms covered in two surveys. Definitions of variables and data sources are provided in the Appendix.

2.2 Measuring bank efficiency

Cost efficiency is commonly measured in works analyzing bank efficiency, and can be defined as the ability for a bank to produce at the minimal cost. It measures the difference between a bank's actual cost and its optimal cost for producing the same bundle of outputs.

To estimate cost efficiency, we must therefore have one approach to measure the optimal cost for each bank, given its bundle of outputs. Frontier efficiency techniques provide several approaches to reach this objective: they allow estimating the efficiency frontier on which the optimal cost is provided for each level of output. We adopt the stochastic frontier approach which is widely adopted in the literature (e.g., Hasan, Koetter and Wedow, 2009; Belke, Haskamp and Setzer, 2016; Shamshur and Weill, 2019). This approach decomposes the distance from the efficiency frontier into an inefficiency term and a random error, which represents random disturbances reflecting luck or measurement errors. We assume a normal distribution for the random error and a half-normal distribution for the inefficiency term.

To compute efficiency, we need to specify banking inputs and outputs. We adopt the intermediation approach, according to which the bank uses capital and labor to collect deposits and transform them into loans. Two outputs are then included in the cost frontier: loans, and investment assets. Three input prices are considered: the price of funds is the interest rate paid on borrowed funds, the price of labor is the ratio of personnel expenses to total assets, and the price of physical capital is defined as other operating expenses divided by fixed assets. Total cost is the sum of the costs incurred for borrowed funds, labor, and physical capital. The descriptive statistics for the inputs and outputs used in the stochastic frontier approach are presented in Table 2. We utilize the translog form to model the cost frontier, which is as follows:

$$\ln\left(\frac{TC}{w_3}\right) = \beta_0 + \sum_m \alpha_m \ln y_m + \sum_n \beta_n \ln\left(\frac{w_n}{w_3}\right) + \frac{1}{2}\sum_m\sum_j \alpha_{mj} \ln y_m \ln y_j$$
$$+ \frac{1}{2}\sum_n\sum_k \beta_{nk} \ln\left(\frac{w_n}{w_3}\right)\ln\left(\frac{w_k}{w_3}\right) + \sum_n\sum_m \gamma_{nm} \ln\left(\frac{w_n}{w_3}\right)\ln y_m \qquad (1)$$
$$+ \text{YEAR} + \text{COUNTRY} + u + v$$

where TC is total cost, y_m is the m^{th} bank's output (m = 1, 2), w_n is the n^{th} input price (n = 1, 2), w_3 is the price of borrowed funds, u the inefficiency term, and v the random error. For simplicity of presentation, the indices for each bank have been dropped. Homogeneity conditions are imposed by normalizing total costs, price of labor and price of physical capital, by the price of borrowed funds. We include year dummy variables in the cost frontier.

We add country dummy variables in the cost frontier since country differences can exert an influence on bank efficiency. As observed by Lozano-Vivas, Pastor and Pastor (2002), the omission of variables taking into account the country in the estimation of the frontier can lead to a misinterpretation of the cross-country differences in efficiency. Namely, the omission of country dummy variables would lead to the fact that each bank is compared to all other banks without taking into account the fact that they are located in different environments.

The objective of the paper is to investigate the impact of bank efficiency on access to credit. Since we cannot identify the lending bank for each firm, we consider the aggregate level of bank efficiency in each country in the estimations. This hypothesis accords with former papers considering the impact of bank competition on firm-level variables linked to financing constraints like Léon (2015) and Fungacova, Shamshur and Weill (2017) using the aggregate level of bank competition for a given country.

We therefore compute two measures of bank efficiency at the country level. The standard efficiency measure is the mean level of efficiency scores of all banks for each country. The hypothesis that bank efficiency for a given country is measured by the mean of efficiency scores of all banks is commonly adopted in former papers looking at the impact of country-level bank efficiency measures (Hasan, Koetter and Wedow, 2009; Belke, Haskamp and Setzer, 2016). However we can question whether the level of bank efficiency for a country would not be better measured with the asset-weighted mean of bank efficiency scores. Weighted efficiency scores have the key advantage of giving a higher weight to the largest banks, meaning those with greater market share and thus greater importance in the financing of firms, and can thus be a better indicator of the level of bank efficiency for each

country.

The descriptive statistics for the two types of efficiency measures are displayed in Table 3. We observe that standard efficiency and weighted efficiency measures are of the same order of magnitude for the whole sample, with respectively means of 72.8% and 72.7%. However they can differ substantially for several countries: for instance for Uruguay the standard efficiency measure is 67.4% while the weighted efficiency measure is 51.7%. The scores are displayed for each country in Table 4.

2.3 Measuring access to credit

We utilise data on access to credit from the World Bank Enterprise Surveys (WBES).[2] This is a cross-country survey of a large number of firms in several developed and developing economies around the world. The survey is based on a standard set of core questions and covers broad range of topics like access to finance, innovation, corruption, productivity, competition, and performance. In each country, the survey method guarantees that precise inferences can be made from the sample by employing stratified random sampling technique, using firm size, sector, and geographic region as strata. To ensure accurateness of the data, survey information is collected through face-to-face interviews with business owners and top managers of each of the enterprises as they have in-depth information about their firms.

Following Popov and Udell (2012) and Léon (2015), we use questions concerning the credit market experience of firms in the past year to measure access to credit. First, we distinguish between firms that have a need for credit and firms without a need for credit. Then among the firms that need credit, we identify the credit-constrained ones. Specifically, WBES asks firms the following question: "*Question K16: In the last year, did this establishment apply for loans or lines of credit?*" This question enables us to identify firms which expressed a formal demand for credit.

Firms which answered "No" to this question K16 were asked a subsequent question: "*Question K17: What was the main reason the establishment did not apply for any line of credit or loan in the past year?*" From this question, we are able to distinguish between firms which did not apply for credit because they did not need any loans from those firms who were discouraged from applying due to credit market imperfections such as high interest rates or high collateral requirements. For firms that answered "*No need for a loan - establishment*

[2] The database is available at the website: http://www.enterprisesurveys.org/data.

had sufficient capital" to this question, we classify them as non-borrowers whereas firms who give a different reason are classified as discouraged borrowers. Thus, a firm is classified as discouraged only when the firm needed bank loans but refused to apply because they are discouraged to do so, and not because the firm did not need a loan.

We group the firms that answered yes to question K16 and received at least one loan as credit unconstrained. Thus, a firm is classified as Approved if the firm responded "Yes" to Question K16 and at least one credit request was not rejected. Following Léon (2015), we define a firm as credit-constrained (*Constrained*) if they applied for credit and were denied or did not apply for credit because they were discouraged.

Table 3 presents the descriptive statistics for the main variables. We find that among the firms in our sample, more than half had a need for bank credit (52.3%). This emphasizes why it is important to identify and eliminate firms which select themselves out of the application process because they do not have a need for loan. We also observe that only 38.6% of the firms which needed credit actually expressed a formal demand for loans, even though a large percentage (91.5%) of those firms which applied received at least one loan. Among the firms with a need for external financing, 64.7% were credit-constrained because they were discouraged to apply for loans or were formally rejected.

Table 4 reports the means by country for all variables related to access to credit. We observe large cross-country differences. It is of particular interest to observe that the share of credit-constrained firms ranges from 19.9% in Peru to 91.2% in India. Also, the share of firms which need credit varies between 23% in Malta and 78% in Zimbabwe.

2.4 Methodology

To examine the impact of bank efficiency on access to credit, we estimate a probit regression with the following model specification:

$$\Pr(\text{Constrained}_{ik}=1) = \Phi(\alpha_0 + \alpha_1 \text{ Bank efficiency}_k + \alpha_2 X_{ik} + \alpha_3 Y_k + \varepsilon_{ik}) \quad (2)$$

where *Constrained* is a dummy variable which captures the credit access of firm *i* in country *k*; the variable *Bank efficiency* is the measure of bank efficiency; *X* is a set of firm-level control variables; *Y* is a set of country-level control variables; ε is the error term; and Φ is the cumulative density function of a normal distribution.

We incorporate several firm-level control variables that may influence firms' access to credit following previous studies (Popov and Udell, 2012; Asiedu et al., 2013; Léon,

2015). We control for *Firm size* measured as the natural logarithm of the number of permanent full-time employees. Firm ownership is taken into account by including dummy variables whether a firm is a *Sole Proprietorship*; a *Privately held* firm; a *Publicly listed* firm; and a *Foreign owned* firm if at least 50% of a firm's shares are held by foreigners. *Audited* captures whether a firm's financial statements were checked or certified by an external auditor. We also include *Exporter*, a dummy variable which equals one if at least 10 percent of a firm's annual sales is derived from direct exports. The dummy variable *Subsidiary* captures whether a firm is part of a larger group.

To control for country characteristics which can affect access to credit, we include four country-level control variables. We take into account the logarithm of GDP per capita to control for the level of economic development (*Log (GDP/capita)*). *Inflation* accounts for macroeconomic stability and *Rule of Law* captures the quality of institutions. We finally control for financial development measured by domestic credit to the private sector as a percentage of GDP (*Domestic Credit*). These variables come from World Development Indicators from the World Bank, with the exception of *Rule of law* extracted from World Governance Indicators. All country-level variables, including bank efficiency and country-level controls, are measured with a lag of one year to be consistent with the firm-level data from WBES.

The setting of the empirical investigation reduces endogeneity concerns since bank efficiency is computed at the bank level and then aggregated at the country level, while access to credit is firm-level information obtained from a different database. It is thus unlikely that access to credit can influence bank efficiency.[3]

Further, we include year dummies that control for any time-specific worldwide shocks that are common to all firms, and sector dummies accounting for sector-specific unobserved heterogeneity.

Finally, as previously discussed, we define credit-constrained firms as either firms that applied for credit and were rejected or did not apply for a loan because they were discouraged. Our estimation sample is therefore restricted to firms which have a need for bank credit. We can observe whether a firm is credit-constrained only if the firm has a need for external funds. This however raises a sample selection problem since we are not able to determine if firms which do not have a desire for a loan would have been credit-constrained or not should they have applied. The selection into the group of firms with a need for a loan

[3] We still address any potential endogeneity concerns in several ways in the robustness section.

might therefore not be random and may have some specific characteristics. Not taking into account the selection issue may represent a specification error which could bias our estimates.

To overcome the potential issue of selection bias, we apply a probit model with sample selection proposed by Van de Ven and Van Praag (1981). The probit model with sample selection, which assumes a bivariate normal and independent error distribution, takes into account two binary equations (selection and outcome equations), and thus estimates probit outcomes for both stages. For a robust identification, relevant exclusion variables should impact the selection equation (the need for credit) but do not directly influence the outcome equation (access to credit). Following Popov and Udell (2012) and Léon (2015), we use *Working Capital* and *Construction* as exclusion variables that are included in the selection equation but excluded from equation (2). *Working Capital* takes into account the proportion of the value of sales paid for after delivery by customers in the previous year. Intuitively, firms that have a greater need for working capital financing are more likely to desire external financing. *Construction* is a dummy variable equal to one if a firm submitted an application to obtain a construction permit in the previous two years, and zero otherwise.[4] These two variables are exogenous, and likely to signal the need for credit without directly influencing banks' decision to approve loan applications.

The first-stage (selection equation) of the probit model with sample selection is specified as follows:

$$\text{Need Credit}_{ik} = \alpha_0 + \beta_1 \text{ Working Capital}_{ik} + \beta_2 \text{ Construction}_{ik} + \tau X_{ik} + \lambda Y_k + \varepsilon_{ik} \qquad (3)$$

where *Need Credit* is a dummy variable which captures whether firm *i* in country *k* desires bank credit. *Working Capital* and *Construction* are the exclusion variables. We include the same set of firm-level (X_{ik}) and country-level (Y_k) control variables, and sector and year fixed effects.

[4] The variable *Construction* may, however, also reflect the recent investments of a firm. If banks had this information, the instrument could potentially be endogenous to the outcome equation. Whereas this variable appears to be statistically valid, we propose alternative instrumentation strategies in the Robustness Section since we cannot test the validity of the exclusion restriction.

3. Results

This section first describes the determinants of the need for credit. We then conduct our baseline estimations for the relation between bank efficiency and access to credit. Finally we explore the channels through which bank efficiency affects access to credit.

3.1 The determinants of need of credit

We begin with an investigation of the determinants of the need for credit before conducting our empirical models explaining access to credit. Table 5 reports the results of probit regressions.

We find that bank efficiency has a positive effect on the need for credit, which is only significant when we consider weighted efficiency. The need for credit decreases when firm size increases, which accords with the view that small firms have less internal financing for their financing needs. Ownership influences the need of credit: sole proprietorships have a lower need for loans whereas privately-held firms have more need of credit. Foreign-owned firms are less likely to need a loan, which can come from their access to alternative sources of funding. Subsidiaries have lower need for loan, in line with the view that they benefit from the internal capital markets of a group. Additionally, we find that exporters have a higher need for credit, which can result from the requirement to finance their expansion.

Regarding the country-level variables, we observe that firms located in countries with better quality of institutions and higher economic development have a lower desire for credit. Reversely the need for credit is higher for firms in countries with higher financial development and higher inflation.

Finally, we point out that both our exclusion variables, *Construction* and *Working Capital* have a significantly positive relation with the need for credit. This finding shows that firms that have to finance their working capital and those that have invested in construction have a higher probability to need credit.

3.2 Baseline Estimations

We proceed to the estimations for the relation between bank efficiency and access to credit. Tables 6 and 7 report the results respectively for standard efficiency and weighted efficiency. In all estimations, we report marginal effects. In each table, five different specifications are adopted to test the sensitivity of the results. We only include bank

efficiency with year fixed effects in column (1), while we add sector fixed effects in column (2). We continue by adding either firm-level controls in column (3) or country-level controls in column (4). Finally, the specification in column (5) includes all controls. We apply the probit model with sample selection to correct for the potential selection bias. The selection equation is estimated using equation (3).[5] We report the Wald test to compare the simple probit model with the probit with sample selection model. The Wald test in all estimations confirms the presence of a selection issue and shows that estimations obtained without the correction may be biased.

The key finding is the significantly negative coefficient for *Bank efficiency*. This result is observed for all specifications of the set of explaining variables and with both measures of bank efficiency. It therefore indicates that higher bank efficiency alleviates credit constraints for firms. The results are not only statistically significant, but also economically meaningful. We can illustrate the economic significance with the specification for standard efficiency measures with all controls from column (5): a one standard deviation increase in bank efficiency (0.038) is associated with a reduction in the probability of being credit-constrained by 1.84 percentage points (calculated as 0.038 × -0.484). Given that, on average, about 64% of firms which need loans are credit-constrained, the effect is moderate but economically significant. Therefore our results provide strong evidence that bank efficiency facilitates access to credit, in line with the hypothesis that more efficient banks can relax credit constraints for firms.

Regarding the control variables, we overall observe the expected results. In line with the findings from former literature on the determinants of access to credit, we find that larger, publicly listed, privately-held, and audited firms are less likely to be credit-constrained. We furthermore find that subsidiaries and exporting firms have higher access to credit. At the country level, better economic and institutional environment contribute to reduce financing constraints: access to credit is higher in presence of higher levels of quality of institutions, income per capita, and financial development. Reversely, higher inflation which proxies macroeconomic instability increases the probability to be credit-constrained.

[5] For brevity, we do not report the results of selection variables for estimations in columns (1)-(4). The results of selection variables for estimations in columns (5) are respectively presented in Table 5. We drop the selection variables "Construction" and "Working Capital" for identification purposes.

3.3 Exploring the channels

Our baseline estimations indicate that bank efficiency favors access to credit. We now explore the mechanisms that drive this result. Specifically, we examine whether greater bank efficiency fosters access to credit through credit demand by reducing the reluctance of firms to apply for credit and/or through credit supply by lowering loan application denial rates.

WBES database provides information which enables us to investigate each channel. It gives information to know whether a firm needing credit expressed a formal demand and provides information on the reasons why a firm did not ask for a loan. We can therefore examine how bank efficiency can influence the decision at the firm-level to apply for a loan (the demand channel), and the probability at the bank-level to accept loan applications (the supply channel).

3.3.1 Testing the demand channel

We first examine the impact of bank efficiency on a firm's decision to apply for credit. A strand of literature has examined the discouraged borrowers, defined as firms with a need for credit deciding not to apply for a loan. From a theoretical perspective, the existence of discouraged borrowers can be explained by credit market imperfections including imperfect screening by banks, and the scale of application costs (Kon and Storey, 2003). Empirically, Brown et al. (2011) document that high interest rates, collateral requirements, and complex application procedures contribute to discourage firms from applying for credit.

Higher bank efficiency can therefore influence the firm's decision to apply for a loan by reducing the interest rate charged for the loan thanks to lower bank costs. In addition to this straightforward mechanism, more efficient banks can also be perceived by firms as more likely to solve credit market imperfections thanks to their better managerial performance. We therefore expect that higher bank efficiency would reduce borrower discouragement.

To investigate the demand channel, we examine whether bank efficiency influences firm's decision to apply for a loan. We therefore perform estimations explaining *Apply*, a dummy variable which equals to one if a firm needed credit and applied for one, and zero otherwise. The risk of selection bias is controlled for using the probit with sample selection model.[6] We report the results in columns (1) and (2) of Table 8 respectively for standard efficiency and weighted efficiency measures.

[6] Table 5 presents results of the selection equation.

We observe that the coefficient of *Bank efficiency* is significantly positive in both estimations, indicating that greater bank efficiency increases the probability for a firm needing a loan to apply for one. Thus our finding supports the view that bank efficiency favors access to credit by reducing the discouragement of potential borrowers. The beneficial impact of bank efficiency on access to credit takes place through the demand channel.

This finding has important implications for the design of policies. Borrower discouragement has been identified as a key issue in SME financing. For instance, Brown et al. (2011) attribute the low usage of bank loans to borrower discouragement rather than bank loan application denial rates. Our data also reveals that over 60% of the firms with a need for bank credit refused to apply for loans because they were discouraged. Our results suggest that policy measures that foster bank efficiency would contribute to reduce borrower discouragement.

3.3.2 Testing the supply channel

As a further test of the channels through which bank efficiency can influence credit access, we investigate the effect of bank efficiency on bank's loan approval decisions.

Bank efficiency may affect decisions of banks to grant loans in two ways. First, a higher degree of bank efficiency is associated with a better control of costs which could facilitate loan approval decisions since loans would be cheaper for the banks. Lower costs can be transferred to borrowers through lower loan rates. They can also contribute to reduce the cost of producing a loan for the bank and as such can lead to an increase in credit supply.

Second, a higher degree of bank efficiency is the signal of a better bank management in line with the view that efficiency is an indicator of managerial performance. As such, more efficient banks may be able to overcome the problems of moral hazard and adverse selection associated with the loan activity. They could therefore grant more loans thanks to their better ability to screen and monitor borrowers. This argument is based on the fact that information asymmetries contribute to reduce access to credit (Stiglitz and Weiss, 1981). As a consequence, banks which can reduce information asymmetries can grant more loans. We thus test the hypothesis that bank efficiency increases the probability of being accepted for loan applicants.

To test the supply channel, we investigate whether bank efficiency influences bank's credit approval decisions. The dependent variable is *Approved*, a dummy variable that is coded as one if a firm applied for bank credit and received at least one line of credit, and zero

otherwise. Since loan approval/rejection is only observable for firms that express a formal demand for credit, we apply the probit model sample selection to control for the potential selection bias at the loan application stage.[7] We display the results in columns (3) and (4) of Table 8 respectively for standard efficiency and weighted efficiency measures.

We find that *Bank efficiency* is not significant in both estimations. In other words, bank efficiency does not exert an impact on the probability for a bank to accept a loan application. We therefore find no support for the supply channel in the sense that any change in bank efficiency does not affect credit supply.

3.3.3 Reasons for discouragement

We have shown above that higher bank efficiency reduces the discouragement of borrowers to apply for a loan. We can take one step further to analyze this demand channel by scrutinizing the reasons given by discouraged borrowers as to why they refused to apply for loans.

Since bank efficiency reduces borrower discouragement, this could possibly be motivated by different channels such as lower loan prices, lower collateral requirements and/or a high perception of being financed. Specifically, WBES asked firms *"what was the main reason the establishment did not apply for any line of credit or loan in the past year?"* The survey provides the following responses: credit conditions (unfavorable interest rates, too high collateral requirements, and insufficient loan size and maturity), complex application procedures, did not think it would be approved, and other reasons. We focus on the responses associated to credit conditions: "high interest rates", and "too high collateral requirements".

In fact, since efficient banks grant loans at cheaper costs (Shamshur and Weill, 2019), potential borrowers may be less reluctant to apply for credit. Bank efficiency could also reduce borrower discouragement through its impact on collateral requirements. Manove and Padilla (1999) and Manove, Padilla, and Pagano (2001) argue that more collateral requirements could decrease banks' efforts to thoroughly screen borrowers.[8] Since there is a possible trade-off between the use of collateral and screening efforts, banks operating at lower marginal costs could have more incentives to conduct adequate screening of their potential borrowers.

[7] To save space, we do not report results of the selection equation in this and subsequent sections.
[8] Jiménez and Saurina (2004) show that collateralised loans have a higher probably of default.

We therefore expect that bank efficiency lowers the likelihood of firms citing "unfavorable interest rate" and "high collateral requirements" as the reasons why they refused to formally apply for loans.

To investigate this question, we perform estimations by using *Interest rate* and *collateral requirements* as the dependent variables. *Interest rate* is a dummy variable equals to one if a firm mentions "Interest rates were not favorable" as the reason why they were discouraged, and zero otherwise; and *Collateral requirements* is a dummy variable that equal one if a firm cites "collateral requirements were too high" as the reason why they were discouraged, and zero otherwise. The results are reported in Table 9.

We observe that *Bank efficiency* is negative when explaining *Interest rate*, but the coefficient is only significant when using standard efficiency measures. Similarly, *Bank efficiency* is only significantly negative in one specification, this time with the weighted efficiency measures, when explaining *Collateral requirements*. These results therefore provide some evidence that bank efficiency contributes to reduce discouragement of borrowers through its impact on the interest rate and on collateral requirements.

4. Additional estimations

In this section, we delve deeper by examining the factors that may influence the relationship between bank efficiency and access to credit. We first assess the impact of firm size, and then examine the influence of macroeconomic factors.

4.1 The impact of firm size

We have shown that greater bank efficiency increases the ability for firms to access credit. We can question whether this impact varies with firm size. Extant literature documents that small firms particularly suffer from a lack of access to credit (e.g., Beck and Demirguc-Kunt, 2006). It is therefore of utmost interest to check whether small firms benefit of better access to credit when bank efficiency increases.

To explore the link between bank efficiency and access to credit across the different size group of firms, we define three groups of firms using the classification employed by WBES for firm size: small firms (between 5 and 19 employees), medium firms (between 20 and 99 employees), and large firms (100 employees or more). We perform separate regressions for each group of firms. The results are presented in Table 10.

We obtain two key findings. First, we find that the negative effect of bank efficiency on credit constraints is not size-specific. The coefficient of *Bank efficiency* is negative and significant in all estimations, with the exception of a non-significant coefficient in the specification with weighted efficiency for small firms. Second, the effect is stronger for large and medium firms than for small firms. When considering the standard efficiency indicators, we observe that the coefficient of *Bank efficiency* is respectively -0.213, -0.506, and -0.665 for small, medium, and large firms.

These findings have key implications. They suggest that greater bank efficiency has beneficial effects for firms of all sizes. The design of policies to improve bank efficiency would therefore enhance access to credit for all firms which are credit-constrained.

4.2 The impact of macroeconomic factors

Our finding that higher bank efficiency enhances access to credit can be influenced by the macroeconomic environment. Namely the mechanism through which greater bank efficiency alleviates financing constraints for firms can be affected by the environment since macroeconomic factors have been shown to exert a role on the bank behaviour in granting loans but also in the willingness of firms to apply for a loan (e.g., Qian and Strahan, 2007; Bae and Goyal, 2009).

It therefore appears of interest to check whether the macroeconomic environment affects the relation between bank efficiency and access to credit so that we have a better understanding of the beneficial effects of bank efficiency to reduce credit constraints.

We consider the four macroeconomic variables employed as control variables: *Log(GDP/capita)*, *Rule of law*, *Domestic credit*, and *Inflation*. As explained above, they assess the degree of economic development, of quality of institutions, of financial development, and of macroeconomic instability for a country. They consequently provide a comprehensive set of variables to consider the macroeconomic environment of one country. We redo the estimations by adding the interaction term between bank efficiency and each of these macroeconomic variables. We consider only the set of explaining variables with all controls. We can then assess whether the effect of bank efficiency on access to credit is influenced by macroeconomic factors. Table 11 displays the results of these estimations.

Our conclusion is that macroeconomic environment exerts an influence on the impact of bank efficiency on access to credit. We observe that the interaction term of *Bank efficiency* is significantly negative with *Log(GDP/capita)*, *Domestic Credit*, and *Rule of Law* (only

significant with weighted efficiency), while it is significantly positive with *Inflation*. In other words, the impact of bank efficiency to reduce credit constraints is stronger in countries more financially and economically developed, and with better quality of institutions. It is weaker in countries with higher inflation. In a nutshell, the beneficial effect of bank efficiency on access to credit is amplified when the country is more developed and more stable.

This finding emphasizes the fact that the role of bank efficiency to alleviate credit constraints is stronger in developed countries, benefiting from the more adequate macroeconomic environment to enjoy the benefits of bank efficiency for access to credit.

5. Robustness checks

To examine the robustness of our findings, we carry out a number of sensitivity tests. In all robustness checks, we perform regressions using the standard efficiency.

Alternative measures for credit constraints. We use two different proxies for financing constraints to check whether our results hold. First, following Asiedu et al. (2013) and Qi and Ongena (2019), we measure credit constraints based on responses to the WBES question "*To what degree is access to finance an obstacle to the current operations of this establishment?*" Five possible answers are provided: not an obstacle, minor obstacle, moderate obstacle, major obstacle, and very severe obstacle. We construct *Constrained (Perception)*, a dummy variable equals to one if a firm answered that access to credit was a moderate, major, or very severe obstacle, and zero otherwise.[9] Second, in line with Aterido, Beck and Iacovone (2013), we utilize firms' usage of credit as a proxy for financing constraints. *Constrained (Loan Use)* is a dummy variable coded as one if a firm does not have an overdraft facility, a credit line and/or a formal bank loan, and zero otherwise. Columns (1)-(2) of Table 12 present the simple probit estimation results.

In both estimations, we find negative and significant coefficients for *Bank efficiency*. This result confirms our main finding that bank efficiency is beneficial for access to credit.

Additional control variables. We include in our model a number of additional control variables to validate that our main findings are not biased due to the omission of some important variables. We first consider a set of three additional country-level control variables: depth of credit information with data from Doing Business (*Credit Info*), *Financial freedom*

[9] In unreported regressions, we assigned values of 0 (not an obstacle) to 4 (very severe obstacle) to the responses, where a high number shows that a firm is more financially constrained. We perform ordered probit regressions and obtain similar findings. Estimation results are available upon request.

with data from the Heritage Foundation, and *Institutional Development*, measured as the average of six governance indicators: voice and accountability, political stability, effectiveness of government, regulatory quality, rule of law, control of corruption, with data from the World Governance Indicators. We include the variables one by one and then simultaneously to check the stability of our results. The results are presented in columns (3)-(6) of Table 12. We still observe that the coefficient of *Bank efficiency* is negative and significant in all estimations.

Second, we take into account bank competition since it has been shown to influence access to credit (Beck, Demirguc-Kunt, and Maksimovic, 2004; Léon, 2015). We measure bank competition with three alternative indicators: the share of assets that are held by the three largest banks (*Concentration*), the Herfindahl-Hirschman index for assets (*Herfindahl*), and the Boone index (*Boone index*) which measures bank competition through the elasticity of profits to marginal costs. While we compute the *Herfindahl* index, the two other indicators are extracted from the Global Financial Development Database from the World Bank. Table 13 reports the estimations. In all estimations, we find negative and significant coefficients for *Bank efficiency*. We furthermore observe that lower bank competition and higher bank concentration are associated with lower access to credit in line with former works (e.g., Léon, 2015). All in all, our main findings are robust to the inclusion of additional controls.

Measurement of bank efficiency. The bank efficiency variable employed in this study is estimated at the bank level and aggregated at the country level. We therefore utilize the mean bank efficiency for each country. It is consequently possible that depending on the variation of efficiency, the estimated mean bank efficiency could have different impact on access to financing. As a robustness check, we perform estimations in which we weight mean bank efficiency by the inverse of the standard deviation of bank efficiency. Love and Martinez-Peria (2015) adopt a similar approach in their investigation of the impact of bank competition on access to credit, by weighting the estimated measures of competition by the inverse of their standard deviation. The results are reported in column (4) of Table 13. In line with our main finding, we still observe that bank efficiency reduces firms' credit constraints.

Alternative exclusion variables. The potential selection issue is addressed using a probit model with sample selection. Relevant exclusion variables, which are uncorrelated with the outcome equation (credit access), are included in the selection equation for a robust identification. We therefore employed *Working Capital* and *Construction* as exclusion variables in our regressions. As noted earlier, *Construction* could potentially be correlated to the outcome equation (credit access) since it could capture a firm's recent investments. Since

we are unable to test for the validity of the exclusion restrictions, we follow two alternative strategies to examine the sensitivity of our results.

First, we re-estimate our model using *Working Capital* as the only exclusion variable. We do not include the variable *Construction* since it could potentially be endogenous to the outcome equation. Second, we include a firm's perceived degree of competition from the informal sector (*Perceived competition)* in addition to *Working Capital* as exclusion variables in line with previous studies (Léon and Weill, 2018; Popov and Udell, 2012). Firms operating in competitive environments may have a higher desire for bank credit since they may want to invest more in order to match their competitors, and should therefore serve as a good demand shifter without affecting credit access. We display the results in columns (1) and (2) of Table 14.

Notwithstanding this change in instrumentation strategy, we still note that the estimated coefficient of bank efficiency is negative and significant. From the marginal effects, we observe that *Bank efficiency* has coefficients of -0.476 and -0.482 in columns (1) and (2) respectively, which is similar in magnitude to our main finding of -0.484 (column (5) of Table 6). The Wald test statistic is also highly significant in both models. Overall, the consistent results confirm our earlier findings and show that our results are robust to the alternative instrumentation approach.

Sample Construction. We assess the sensitivity of our results to the construction of the sample. First, we perform regressions by excluding countries that have less than 100 firms in a survey. Due to the small number of observations of firms in such countries, they may suffer from a lack of representativeness. Column (3) of Table 14 displays the estimations. We still observe that the estimated coefficient of *Bank efficiency* is negative and significant.

Second, we include firms which reported not having a need for credit. Until now, our estimation sample is only restricted to firms which have a desire for bank credit. We therefore excluded firms without a need for bank loans. It is consequently possible that we may not capture some important information since we do not utilize all firms in our sample. To test the stability of our results, we include these firms by examining the credit market experience of firms which do not have a desire for bank credit. We define a firm that has no need for bank credit as credit unconstrained if the firm has an overdraft facility, a credit line and/or a formal bank loan, or finances part of its working capital/fixed asset investment with bank loans. Due to the fact that these firms already use bank credit, it suggests that they may have the ability to access bank financing. We also classify a firm that has no need for external financing as credit-constrained if the firm finances all of its working capital and/or fixed

assets with funds from moneylenders/friends/relatives. We present the results of simple probit regressions in Column (4) of Table 14. Despite the extension of the sample size, we still observe that the coefficient on bank efficiency is negative and significant, supporting the robustness of our finding.

6. Conclusion

In this paper we investigate the impact of bank efficiency on access to credit. To this end we combine firm-level data on access to credit with bank-level data to estimate bank efficiency using the stochastic frontier approach. We then perform estimations on a large sample of about 54,000 firms from 76 countries.

Our main finding is that bank efficiency exerts a positive impact on access to credit. We consequently support the view that gains in bank efficiency result in alleviating credit constraints. We find that higher bank efficiency favors access to credit through the demand channel: a higher degree of bank efficiency increases the likelihood that firms with a need for credit apply for a loan. The beneficial impact of bank efficiency on access to credit is observed for all firms, irrespective of their size. Finally, we find that greater bank efficiency alleviates more credit constraints when the macroeconomic environment is more developed and stable.

This study has major implications. From a positive perspective, our results can contribute to explain why access to credit is lower in developing countries than in developed countries. Lower degree of bank efficiency in developing countries exerts a detrimental impact on access to credit for firms. From a normative perspective, the result that higher bank efficiency alleviates financing constraints provides additional support for policies aimed at improving bank efficiency. Given the importance of access to credit for economic development, policies favoring bank efficiency should be implemented to favor economic development. To design such policies, lessons can be taken from the wide literature identifying the determinants of bank efficiency including bank ownership.

References

Asiedu, E., Kalonda-Kanyama, I., Ndikumana, L., Nti-Addae, A., 2013. Access to Credit by Firms in Sub-Saharan Africa: How Relevant is Gender? American Economic Review 103, 293–97.

Assaf, A.G., Berger, A.N., Roman, R.A., Tsionas, M.G., 2019. Does Efficiency Help Banks Survive and Thrive During Financial Crises? Journal of Banking & Finance 106, 445–470.

Aterido, R., Beck, T., Iacovone, L., 2013. Access to Finance in Sub-Saharan Africa: Is There a Gender Gap? World Development 47, 102–120.

Bae K.H. and V.K. Goyal, 2009. Creditor Rights, Enforcement, and Bank Loans, Journal of Finance 64, 2, 823-860.

Beck, T., Demirgüc-Kunt, A., 2006. Small and Medium-Size Enterprises: Access to Finance as a Growth Constraint. Journal of Banking & Finance 30, 2931–2943.

Beck, T., Demirgüc-Kunt, A., Laeven, L., Maksimovic, V., 2006. The Determinants of Financing Obstacles. Journal of International Money and Finance 25, 932-952.

Beck, T., Demirgüc-Kunt, A., Maksimovic, V., 2004. Bank Competition and Access to Finance: International Evidence. Journal of Money, Credit, and Banking 36: 627-648.

Belke, A., Haskamp, U., Setzer, R., 2016. Regional Bank Efficiency and its Effect on Regional Growth in "Normal" and "Bad" Times. Economic Modelling 58, 413–426.

Berger, A., Hasan, I., Zhou, M., 2009. Bank Ownership and Efficiency in China: What Will Happen in the World's Largest Nation? Journal of Banking & Finance 33, 113–130.

Bonin, J., Hasan, I., Wachtel, P., 2005. Bank Performance, Efficiency and Ownership in Transition Countries. Journal of Banking & Finance 29, 31-53.

Brown, M., Ongena, S., Popov, A., Yeşin, P., 2011. Who Needs Credit and Who Gets Credit in Eastern Europe? Economic Policy 26, 93–130.

Butler, A., Cornaggia, J., 2011. Does Access to External Finance Improve Productivity? Evidence from a Natural Experiment. Journal of Financial Economics 99, 1, 184-203.

Campello, M., Graham, J.R., Harvey, C.R., 2010. The Real Effects of Financial Constraints: Evidence from a Financial Crisis. Journal of Financial Economics 97, 470–487.

Coluzzi, C., Ferrando, A., Martinez-Carrascal, C., 2015. Financing Obstacles and Growth: An Analysis for Euro Area Non-Financial Firms. European Journal of Finance, 21, 10-11, 773-790.

Fafchamps, M., 1997. Trade Credit in Zimbabwean Manufacturing. World Development 25, 795–815.

Fungacova, Z., Shamshur, A., Weill, L., 2017. Does Bank Competition Reduce Cost of Credit? Cross-Country Evidence from Europe. Journal of Banking & Finance 83, 104-120.

Gatti, R., Love, I., 2008. Does Access to Credit Improve Productivity? Evidence from Bulgaria. Economics of Transition 16, 3, 445-465.

Hasan, I., Koetter, M., Wedow, M., 2009. Regional Growth and Finance in Europe: Is There a Quality Effect of Bank Efficiency? Journal of Banking & Finance 33, 1446–1453.

Jiménez, G., Saurina, J., 2004. Collateral, Type of Lender and Relationship Banking as Determinants of Credit Risk. Journal of Banking & Finance 28, 2191–2212.

Kon, Y., Storey, D.J., 2003. A Theory of Discouraged Borrowers. Small Business Economics 21, 37–49.

Léon, F., 2015. Does Bank Competition Alleviate Credit Constraints in Developing Countries? Journal of Banking & Finance 57, 130–142.

Léon, F., Weill, L., 2018. Islamic Banking Development and Access to Credit. Pacific-Basin Finance Journal 52, 54–69.

Levine, R., 2005. Finance and Growth: Theory and Evidence. Handbook of Economic Growth 1, 865–934.
Love, I., Martinez-Peria, M.S., 2015. How Bank Competition Affects Firms' Access to Finance. World Bank Economic Review 29, 3, 413-448.
Lozano-Vivas, A., Pastor, J.T., Pastor, J.M., 2002. An Efficiency Comparison of European Banking Systems Operating under Different Environmental Conditions. Journal of Productivity Analysis 18, 59-77.
Manove, M., Padilla, A.J., 1999. Banking (conservatively) With Optimists. The RAND Journal of Economics 324–350.
Manove, M., Padilla, A.J., Pagano, M., 2001. Collateral Versus Project Screening: A Model of Lazy Banks. The RAND Journal of Economics 726–744.
Musso, P., Schiavo, S., 2008. The Impact of Financial Constraints on Firm Survival and Growth. Journal of Evolutionary Economics 18, 135–149.
Nkurunziza, J.D., 2010. The Effect of Credit on Growth and Convergence of Firm Size in Kenyan Manufacturing. The Journal of International Trade & Economic Development 19, 465–494.
Popov, A., 2018. Evidence on Finance and Economic Growth. In Handbook of Finance and Development (editors: T. Beck and R. Levine), Edward Elgar, 63-104.
Popov, A., Udell, G.F., 2012. Cross-Border Banking, Credit Access, and the Financial Crisis. Journal of International Economics 87, 147–161.
Qi, S., Ongena, S., 2019. Will Money Talk? Firm Bribery and Credit Access. Financial Management 48, 117–157.
Qian, J., Strahan, P., 2007. How Laws and Institutions Shape Financial Contracts: The Case of Bank Loans. Journal of Finance LXII, 6, 2803-2834.
Shamshur, A., Weill, L., 2019. Does Bank Efficiency Influence the Cost of Credit? Journal of Banking & Finance 105, 62–73.
Stiglitz, J.E., Weiss, A., 1981. Credit Rationing in Markets With Imperfect Information. American Economic Review 71, 393–410.
Van de Ven, W.P., Van Praag, B.M., 1981. The Demand for Deductibles in Private Health Insurance: A Probit Model with Sample Selection. Journal of Econometrics. 17, 229–252.

Table 1. Number of firms by country and year of survey

This table presents the coverage of firms by country and the year of survey.

Country	Survey year									Number of surveys
	2012	2013	2014	2015	2016	2017	2018	2019	Total	
Afghanistan			256						256	1
Albania								335	335	1
Armenia		332							332	1
Belarus							521		521	1
Benin					127				127	1
Bolivia						301			301	1
Bosnia-Herzegovina		315						274	589	2
Bulgaria		256							256	1
Burundi			146						146	1
Cambodia		375			270				645	2
Cameroon					263				263	1
China	2,377								2,377	1
Colombia						912			912	1
Cote d'Ivoire					290				290	1
Croatia		317						395	712	2
Cyprus								218	218	1
Czech Republic		216							216	1
DRC		400							400	1
Dominican Republic					282				282	1
Ecuador						335			335	1
Egypt		1,523			1,543				3,066	2
El Salvador					657				657	1
Eswatini					104				104	1
Georgia								512	512	1
Ghana		645							645	1
Guatemala						314			314	1
Guinea					97				97	1
India			7,980						7,980	1
Indonesia				1165					1,165	1
Italy								682	682	1
Kenya		645							645	1
Kosovo		174							174	1
Kyrgyz Republic								328	328	1
Latvia								314	314	1
Lebanon		444							444	1
Lesotho					120				120	1
Liberia						135			135	1
Malaysia				728					728	1
Mali					119				119	1
Malta								227	227	1
Mauritania			127						127	1
Moldova		279						74	353	2
Mongolia								351	351	1
Montenegro		106						134	240	2
Morocco		312						507	819	2
Myanmar			484		543				1,027	2
Namibia			342						342	1
Nepal		447							447	1

Niger						111			111	1
Nigeria			1,823						1,823	1
Macedonia		334						327	661	2
Pakistan		786							786	1
Papua New Guinea				63					63	1
Paraguay						311			311	1
Peru						903			903	1
Philippines				841					841	1
Poland		416						905	1,321	2
Portugal								1,005	1,005	1
Russia	3,571							1,122	4,693	2
Senegal			450						450	1
Serbia		340						319	659	2
Sierra Leone						145			145	1
Slovakia		210							210	1
Slovenia								383	383	1
Tanzania		400							400	1
Thailand					670				670	1
Togo					138				138	1
Tunisia		557							557	1
Turkey		940						1,042	1,982	2
Uganda		502							502	1
Ukraine								1,156	1,156	1
Uruguay						296			296	1
Vietnam				896					896	1
Yemen		311							311	1
Zambia		608							608	1
Zimbabwe					530				530	1
Total	5,948	12,190	11,608	3,693	5,753	3,763	521	10,610	54,086	89

Table 2. Bank inputs and outputs

This table presents the descriptive statistics for the inputs and outputs.

Variable	Obs.	Mean	Std. Dev.
Inputs:			
Price of labor	1,312	0.024	0.019
Price of physical capital	1,312	3.56	5.683
Price of borrowed funds	1,312	0.042	0.03
Outputs:			
Loans	1,312	1,054,177	4,287,410
Investment assets	1,312	578,383.2	2,437,082

Table 3. Descriptive statistics

This table presents the descriptive statistics for the main variables used in the study.

Variable	Obs.	Mean	Std. Dev.
Need Credit	54,086	0.523	0.499
Constrained	28,309	0.647	0.478
Apply	28,309	0.386	0.487
Approved	10,915	0.915	0.278
Firm size	54,086	3.245	1.294
Sole proprietorship	54,086	0.354	0.478
Publicly listed	54,086	0.048	0.214
Privately held	54,086	0.353	0.478
Subsidiary	54,086	0.171	0.376
Audited	54,086	0.509	0.5
Exporter	54,086	0.15	0.357
Construction	54,086	0.107	0.309
Working Capital	54,086	40.29	36.341
Rule of law	54,086	-0.351	0.536
Domestic credit	54,086	50.346	30.511
Log(GDP/capita)	54,086	8.24	1.01
Inflation	54,086	6.454	3.992
Bank efficiency:			
Standard efficiency	54,086	0.728	0.038
Weighted efficiency	54,086	0.727	0.056

Table 4. Means by country: Access to credit and bank efficiency

This table presents the means by country for access to credit and bank efficiency.

Country	Percentage of firms				Bank efficiency	
	Need Credit	Constrained	Apply	Approved	Standard efficiency	Weighted efficiency
Afghanistan	0.621	0.975	0.044	0.571	0.701	0.707
Albania	0.272	0.33	0.67	1.00	0.750	0.73
Armenia	0.551	0.372	0.65	0.966	0.771	0.774
Belarus	0.553	0.458	0.576	0.94	0.728	0.74
Benin	0.638	0.58	0.444	0.944	0.74	0.707
Bolivia	0.598	0.422	0.6	0.963	0.743	0.719
Bosnia-Herzegovina	0.45	0.381	0.664	0.932	0.735	0.755
Bulgaria	0.469	0.592	0.425	0.961	0.771	0.764
Burundi	0.733	0.477	0.561	0.933	0.767	0.76
Cambodia	0.349	0.578	0.44	0.96	0.68	0.69
Cameroon	0.608	0.763	0.275	0.864	0.72	0.681
China	0.566	0.602	0.422	0.942	0.737	0.764
Colombia	0.751	0.282	0.743	0.967	0.756	0.749
Cote d'Ivoire	0.659	0.754	0.309	0.797	0.752	0.762
Croatia	0.434	0.382	0.706	0.876	0.752	0.771
Cyprus	0.362	0.582	0.456	0.917	0.66	0.804
Czech Republic	0.315	0.176	0.882	0.933	0.694	0.758
DRC	0.62	0.798	0.234	0.862	0.723	0.67
Dominican Republic	0.376	0.179	0.83	0.989	0.704	0.662
Ecuador	0.651	0.33	0.692	0.967	0.698	0.632
Egypt	0.29	0.804	0.245	0.798	0.75	0.717
El Salvador	0.549	0.476	0.548	0.955	0.744	0.752
Eswatini	0.644	0.716	0.284	1.00	0.764	0.76
Georgia	0.404	0.29	0.783	0.907	0.751	0.768
Ghana	0.78	0.738	0.300	0.874	0.737	0.806
Guatemala	0.465	0.384	0.637	0.968	0.725	0.732
Guinea	0.515	0.92	0.08	1.00	0.739	0.712
India	0.57	0.912	0.104	0.844	0.742	0.737
Indonesia	0.641	0.819	0.185	0.978	0.74	0.744
Italy	0.425	0.817	0.193	0.946	0.7	0.752
Kenya	0.516	0.465	0.562	0.952	0.652	0.695
Kosovo	0.489	0.494	0.518	0.977	0.746	0.77
Kyrgyz Republic	0.387	0.543	0.504	0.906	0.726	0.756
Latvia	0.373	0.402	0.658	0.909	0.743	0.709
Lebanon	0.489	0.442	0.613	0.91	0.748	0.74
Lesotho	0.533	0.438	0.578	0.973	0.749	0.788
Liberia	0.659	0.753	0.27	0.917	0.763	0.752
Malaysia	0.622	0.587	0.417	0.989	0.657	0.656
Mali	0.723	0.593	0.465	0.875	0.752	0.738
Malta	0.233	0.189	0.868	0.935	0.708	0.736
Mauritania	0.661	0.607	0.429	0.917	0.718	0.722
Moldova	0.459	0.568	0.512	0.843	0.771	0.776
Mongolia	0.829	0.574	0.481	0.886	0.75	0.716
Montenegro	0.588	0.496	0.532	0.947	0.751	0.745
Morocco	0.482	0.744	0.296	0.863	0.756	0.75
Myanmar	0.389	0.783	0.233	0.935	0.726	0.647
Namibia	0.485	0.608	0.446	0.878	0.714	0.635
Nepal	0.609	0.684	0.338	0.935	0.671	0.559

Niger	0.595	0.667	0.348	0.957	0.754	0.772
Nigeria	0.577	0.971	0.05	0.566	0.768	0.778
Macedonia	0.43	0.479	0.546	0.955	0.745	0.76
Pakistan	0.452	0.837	0.203	0.806	0.726	0.676
Papua New Guinea	0.492	0.484	0.516	1.00	0.772	0.771
Paraguay	0.418	0.215	0.785	1.00	0.714	0.783
Peru	0.764	0.199	0.823	0.974	0.726	0.744
Philippines	0.276	0.384	0.634	0.973	0.723	0.701
Poland	0.283	0.449	0.583	0.945	0.758	0.62
Portugal	0.349	0.305	0.718	0.968	0.593	0.678
Russia	0.56	0.666	0.426	0.784	0.72	0.767
Senegal	0.651	0.788	0.218	0.969	0.739	0.728
Serbia	0.563	0.299	0.712	0.985	0.71	0.751
Sierra Leone	0.724	0.819	0.248	0.731	0.721	0.725
Slovakia	0.381	0.363	0.675	0.944	0.737	0.701
Slovenia	0.439	0.137	0.881	0.98	0.771	0.77
Tanzania	0.753	0.784	0.233	0.929	0.766	0.746
Thailand	0.54	0.887	0.119	0.953	0.579	0.546
Togo	0.688	0.495	0.547	0.923	0.749	0.742
Tunisia	0.618	0.366	0.674	0.94	0.689	0.738
Turkey	0.511	0.393	0.621	0.978	0.745	0.773
Uganda	0.572	0.875	0.132	0.947	0.737	0.718
Ukraine	0.633	0.81	0.223	0.853	0.706	0.695
Uruguay	0.53	0.299	0.732	0.957	0.674	0.517
Vietnam	0.552	0.244	0.788	0.959	0.728	0.668
Yemen	0.383	0.773	0.235	0.964	0.757	0.738
Zambia	0.546	0.84	0.199	0.803	0.719	0.615
Zimbabwe	0.783	0.892	0.173	0.625	0.721	0.733

Table 5. Determinants of firms' need of credit

This table presents results of probit estimations examining the relation between bank efficiency and firms' credit access. The dependent variable is "Need Credit". Definitions of variables are provided in the Appendix. Estimated marginal effects are reported and standard errors are in parentheses. *, **, and *** indicate statistical significance at the 10%, 5% and 1% level, respectively.

	Standard efficiency	Weighted efficiency
	(1)	(2)
Bank efficiency	0.002	0.432***
	(0.066)	(0.044)
Firm size	-0.005**	-0.005**
	(0.002)	(0.002)
Sole proprietorship	-0.017***	-0.020***
	(0.006)	(0.006)
Publicly listed	0.004	0.001
	(0.011)	(0.011)
Privately held	0.013**	0.010*
	(0.006)	(0.006)
Audited	-0.006	-0.010**
	(0.005)	(0.005)
Foreign owned	-0.117***	-0.115***
	(0.010)	(0.010)
Subsidiary	-0.018***	-0.021***
	(0.006)	(0.006)
Exporter	0.018***	0.015**
	(0.006)	(0.006)
Construction	0.085***	0.084***
	(0.007)	(0.007)
Working Capital	0.001***	0.001***
	(0.000)	(0.000)
Rule of law	-0.028***	-0.028***
	(0.006)	(0.006)
Domestic credit	0.000***	0.001***
	(0.000)	(0.000)
Log (GDP/capita)	-0.053***	-0.055***
	(0.004)	(0.004)
Inflation	0.003***	0.004***
	(0.001)	(0.001)
Year FE	Yes	Yes
Sector FE	Yes	Yes
Observations	54,086	54,086
Log Likelihood	-36277.82	-36230.56
Pseudo R^2	0.031	0.032

Table 6. Main estimations: Standard efficiency

This table presents estimation results examining the relation between bank efficiency and firms' credit access. The dependent variable is "Constrained". Definitions of variables are provided in the Appendix. We apply the probit model with sample selection to control for the potential selection issue. The Wald test compares the simple probit model with the probit with sample selection model. Under the null hypothesis, the probit model with sample selection is not different from the simple probit model. Estimated marginal effects are reported and standard errors are in parentheses. *, **, and *** indicate statistical significance at the 10%, 5% and 1% level, respectively.

	(1)	(2)	(3)	(4)	(5)
Bank efficiency	-0.261***	-0.232***	-0.333***	-0.538***	-0.484***
	(0.065)	(0.066)	(0.068)	(0.076)	(0.075)
Firm size			-0.051***		-0.051***
			(0.002)		(0.002)
Sole proprietorship			0.024***		0.006
			(0.007)		(0.007)
Publicly listed			-0.037***		-0.035***
			(0.012)		(0.012)
Privately held			-0.070***		-0.055***
			(0.007)		(0.007)
Audited			-0.081***		-0.082***
			(0.005)		(0.005)
Foreign owned			-0.001		-0.009
			(0.011)		(0.012)
Subsidiary			-0.014**		-0.013*
			(0.007)		(0.007)
Exporter			-0.075***		-0.058***
			(0.007)		(0.007)
Rule of law				-0.064***	-0.056***
				(0.007)	(0.007)
Domestic credit				-0.000**	0.000
				(0.000)	(0.000)
Log(GDP/capita)				-0.058***	-0.050***
				(0.005)	(0.004)
Inflation				0.006***	0.007***
				(0.001)	(0.001)
Year FE	Yes	Yes	Yes	Yes	Yes
Sector FE	No	Yes	Yes	Yes	Yes
Observations	28,309	28,309	28,309	28,309	28,309
Log Likelihood	-35876.56	-35549.12	-34307.47	-34987.5	-33931.84
Wald Test	708.80 ***	682.56***	349.45***	602.50***	302.33***

Table 7. Main estimations: weighted efficiency

This table presents estimation results examining the relation between bank efficiency and firms' credit access. The dependent variable is "Constrained". Definitions of variables are provided in the Appendix. We apply the probit model with sample selection to control for the potential selection issue. The Wald test compares the simple probit model with the probit with sample selection model. Under the null hypothesis, the probit model with sample selection is not different from the simple probit model. Estimated marginal effects are reported and standard errors are in parentheses. *, **, and *** indicate statistical significance at the 10%, 5% and 1% level, respectively.

	(1)	(2)	(3)	(4)	(5)
Bank efficiency	-0.239***	-0.277***	-0.212***	-0.256***	-0.151***
	(0.048)	(0.049)	(0.049)	(0.060)	(0.051)
Firm size			-0.052***		-0.052***
			(0.002)		(0.002)
Sole proprietorship			0.025***		0.006
			(0.007)		(0.007)
Publicly listed			-0.033***		-0.030**
			(0.012)		(0.012)
Privately held			-0.067***		-0.052***
			(0.007)		(0.007)
Audited			-0.081***		-0.084***
			(0.005)		(0.005)
Foreign owned			-0.000		-0.008
			(0.012)		(0.012)
Subsidiary			-0.012*		-0.012*
			(0.007)		(0.007)
Exporter			-0.074***		-0.058***
			(0.007)		(0.007)
Rule of law				-0.065***	-0.057***
				(0.011)	(0.007)
Domestic credit				-0.000	0.000***
				(0.000)	(0.000)
Log(GDP/capita)				-0.055***	-0.049***
				(0.008)	(0.004)
Inflation				0.006***	0.007***
				(0.001)	(0.001)
Year FE	Yes	Yes	Yes	Yes	Yes
Sector FE	No	Yes	Yes	Yes	Yes
Observations	28,309	28,309	28,309	28,309	28,309
Log likelihood	-35834.91	-35477.33	-34280.66	-34958.3	-33916.61
Wald test	683.25***	707.28***	335.01***	588.64***	291.26***

Table 8. Firms' decision to apply for loans and Banks' credit approval/rejection decisions

This table presents estimation results examining the relation between bank efficiency and firms' credit access. The dependent variable in columns (1)-(2) is "Apply" and columns (3)-(4) is "Approved". All controls represent the full set of firm-level and country-level control variables used in Table 6. Definitions of variables are provided in the Appendix. We apply the probit model with sample selection to control for the potential selection issue. The Wald test compares the simple probit model with the probit with sample selection model. Under the null hypothesis, the probit model with sample selection is not different from the simple probit model. Estimated marginal effects are reported and standard errors are in parentheses. *, **, and *** indicate statistical significance at the 10%, 5% and 1% level, respectively.

	Apply		Approved	
	Standard efficiency	Weighted efficiency	Standard efficiency	Weighted efficiency
	(1)	(2)	(3)	(4)
Bank efficiency	0.493***	0.155***	-0.016	0.053
	(0.075)	(0.052)	(0.146)	(0.228)
All controls	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes
Observations	28,309	28,309	10,914	10,914
Log likelihood	-34531.72	-34517.07	-10853.06	-10853.87
Wald test	289.66***	279.84***	13.74***	13.13***

Table 9. Reasons for discouragement

This table presents results of probit estimations examining the relation between bank efficiency and firms' credit access. The dependent variable in columns (1)-(2) is "Interest rate" and columns (3)-(4) is "Collateral requirements". All controls represent the full set of firm-level and country-level control variables used in Table 6. Definitions of variables are provided in the Appendix. Estimated marginal effects are reported and standard errors are in parentheses. *, **, and *** indicate statistical significance at the 10%, 5% and 1% level, respectively.

	Interest Rate		Collateral Requirements	
	Standard efficiency	Weighted efficiency	Standard efficiency	Weighted efficiency
	(1)	(2)	(3)	(4)
Bank efficiency	-0.653***	-0.035	0.072	-0.135***
	(0.13)	(0.083)	(0.11)	(0.067)
All controls	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes
Observations	17,395	17,395	17,335	17,335
Log likelihood	-10471.76	-10484.2	-7465.23	-7463.43
Pseudo R^2	0.068	0.067	0.031	0.031

Table 10. Estimations by firm size

This table presents estimation results examining the relation between bank efficiency and firms' credit access. The dependent variable is "Constrained". All controls represent the full set of firm-level and country-level control variables used in Table 6. Definitions of variables are provided in the Appendix. We apply the probit model with sample selection to control for the potential selection issue. The Wald test compares the simple probit model with the probit with sample selection model. Under the null hypothesis, the probit model with sample selection is not different from the simple probit model. Estimated marginal effects are reported and standard errors are in parentheses. *, **, and *** indicate statistical significance at the 10%, 5% and 1% level, respectively.

	Small firms		Medium firms		Large firms	
	Standard efficiency	Weighted efficiency	Standard efficiency	Weighted efficiency	Standard efficiency	Weighted efficiency
	(1)	(2)	(3)	(4)	(5)	(6)
Bank efficiency	-0.213*	0.042	-0.506***	-0.213**	-0.665***	-0.362***
	(0.111)	(0.071)	(0.143)	(0.092)	(0.162)	(0.121)
All controls	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	12,598	12,598	10,251	10,251	5,460	5,460
Log likelihood	-14717.44	-14709.31	-12375.91	-12366.82	-6545.45	-6542.54
Wald test	156.91***	149.63***	141.84***	137.64***	75.78***	71.43***

Table 11. Impact of macroeconomic factors

This table presents estimation results examining the relation between bank efficiency and firms' credit access. The dependent variable is "Constrained". All controls represent the full set of firm-level and country-level control variables used in Table 6. Definitions of variables are provided in the Appendix. We apply the probit model with sample selection to control for the potential selection issue. The Wald test compares the simple probit model with the probit with sample selection model. Under the null hypothesis, the probit model with sample selection is not different from the simple probit model. Estimated marginal effects are reported and standard errors are in parentheses. *, **, and *** indicate statistical significance at the 10%, 5% and 1% level, respectively.

	Standard efficiency	Weighted efficiency	Standard efficiency	Weighted efficiency	Standard efficiency	Weighted efficiency	Standard efficiency	Weighted efficiency
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Bank efficiency	5.036***	3.635***	-0.479***	-0.222***	1.132***	0.521***	-1.194***	-0.524***
	(0.614)	(0.394)	(0.075)	(0.053)	(0.153)	(0.082)	(0.105)	(0.087)
Bank efficiency x log(GDP/capita)	-0.631***	-0.451***						
	(0.07)	(0.047)						
Bank efficiency x Rule of law			-0.115	-0.504***				
			(0.101)	(0.097)				
Bank efficiency x Domestic credit					-0.021***	-0.012***		
					(0.002)	(0.001)		
Bank efficiency x Inflation							0.172***	0.071***
							(0.018)	(0.013)
All controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	28,309	28,309	28,309	28,309	28,309	28,309	28,309	28,309
Log likelihood	-33889.77	-33868.81	-33931.19	-33901.75	-33855.07	-33855.07	-33868.82	-33901.12
Wald test	282.60***	278.88***	298.45***	292.49***	277.35***	288.29***	286.82***	289.21***

Table 12. Robustness checks -1

This table presents estimation results examining the relation between bank efficiency and firms' credit access. The dependent variable is presented at the top of each column. Columns (1) and (2) are estimated using a simple probit model. All controls represent the full set of firm-level and country-level control variables used in Table 6. Definitions of variables are provided in the Appendix. We apply the probit model with sample selection to control for the potential selection issue in columns (3)-(6). The Wald test compares the simple probit model with the probit with sample selection model. Under the null hypothesis, the probit model with sample selection is not different from the simple probit model. Estimated marginal effects are reported and standard errors are in parentheses. *, **, and *** indicate statistical significance at the 10%, 5% and 1% level, respectively.

	Constrained (Perception)	Constrained (Loan Use)	Constrained			
	(1)	(2)	(3)	(4)	(5)	(6)
Bank efficiency	-0.566***	-0.368***	-0.468***	-0.529***	-0.494***	-0.518***
	(0.065)	(0.061)	(0.077)	(0.076)	(0.075)	(0.079)
Financial freedom			-0.001***			-0.001***
			(0.000)			(0.000)
Credit Info				0.005***		0.002
				(0.001)		(0.001)
Institutional development					-0.014***	-0.012***
					(0.003)	(0.004)
All controls	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	54,086	53,998	27,133	28,309	27,976	27,133
Log likelihood	-35541.18	-32248.14	-32379.86	-33903.53	-33473.54	-32288.11
Pseudo R^2	0.034	0.131	-	-	-	-
Wald test	-	-	325.18***	317.63***	306.82***	337.56***

Table 13. Robustness checks - 2

This table presents estimation results examining the relation between bank efficiency and firms' credit access. The dependent variable is "Constrained". All controls represent the full set of firm-level and country-level control variables used in Table 6. Definitions of variables are provided in the Appendix. Estimation in column (4) is weighted by the inverse of standard deviation of bank efficiency. We apply the probit model with sample selection to control for the potential selection issue. The Wald test compares the simple probit model with the probit with sample selection model. Under the null hypothesis, the probit model with sample selection is not different from the simple probit model. Estimated marginal effects are reported and standard errors are in parentheses. *, **, and *** indicate statistical significance at the 10%, 5% and 1% level, respectively.

	(1)	(2)	(3)	(4)
Bank efficiency	-0.491***	-0.517***	-0.272**	-0.019***
	(0.091)	(0.075)	(0.129)	(0.003)
Concentration	-0.002***			
	(0.000)			
Herfindahl Index		-0.064***		
		(0.016)		
Boone Index			-0.152**	
			(0.078)	
All controls	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes
Observations	23,136	28,309	17,522	28,309
Log likelihood	-26792.57	-33924.07	-20135.34	-33931.84
Wald test	213.43***	303.53***	142.59***	302.33***

Table 14. Robustness checks - 3

This table presents estimation results examining the relation between bank efficiency and firms' credit access. The dependent variable is "Constrained". All controls represent the full set of firm-level and country-level control variables used in Table 6. Definitions of variables are provided in the Appendix. We apply the probit model with sample selection to control for the potential selection issue in columns (1)-(3). The Wald test compares the simple probit model with the probit with sample selection model. Under the null hypothesis, the probit model with sample selection model is not different from the simple probit model. We perform simple probit regression in column (4). Estimated marginal effects are reported and standard errors are in parentheses. *, **, and *** indicate statistical significance at the 10%, 5% and 1% level, respectively.

	Alternative exclusion variables		Sample construction	
	Using only "Working Capital"	Using "Working Capital" & "Perceived competition"	Excluding countries with <100 obs.	Alternative definition of "Constrained"
	(1)	(2)	(3)	(4)
Bank efficiency	-0.476***	-0.482***	-0.48***	-0.454***
	(0.075)	(0.113)	(0.075)	0.066
All controls	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes
Observations	28,309	27,041	8,187	49,964
Log likelihood	-34112.97	-32313.32	-33785.72	-30346.375
Wald test	186.80***	101.09***	304.79***	-
Pseudo R^2	-	-	-	0.079

Appendix

This table presents the definition and sources of the variables employed in the study.

Variable	Definition and source
Constrained	Dummy =1 if a firm that needed external funds applied for credit and was rejected or refused to apply because the firm was discouraged; 0 otherwise. Source: WBES.
Need credit	Dummy =1 if a firm desires bank credit; 0 otherwise. Source: WBES.
Apply	Dummy =1 if a firm needed external funds and applied for credit; 0 otherwise. Source: WBES
Approved	Dummy =1 if a firm applied for loans and received at least one line of credit; 0 otherwise. Source: WBES.
Constrained (perception)	Dummy =1 if a firm reported that access to credit was a moderate, major, or very severe obstacle; 0 otherwise. Source: WBES.
Constrained (loan use)	Dummy =1 if a firm does not have an overdraft facility, a credit line and/or a formal bank loan; 0 otherwise. Source: WBES.
Bank efficiency	Mean of bank cost efficiency scores by country (standard efficiency) or mean of asset-weighted bank cost efficiency scores by country (weighted efficiency). Source: own computation.
Firm size	Logarithm of the number of permanent full-time employees. Source: own computation.
Sole proprietorship	Dummy =1 if a firm is a sole proprietorship; 0 otherwise. Source: WBES
Privately held	Dummy =1 if shares of a firm are privately traded; 0 otherwise. Source: WBES.
Publicly traded	Dummy =1 if a firm is a publicly traded company, 0 otherwise. Source: WBES.
Audited	Dummy =1 if a firm's financial statements were checked or certified by an external auditor; 0 otherwise. Source: WBES.
Foreign owned	Dummy =1 if at least 50 percent of a firm's ownership is held by foreigners; 0 otherwise. Source: WBES.
Exporter	Dummy =1 if at least 10 percent of a firm's annual sales is derived from direct exports and zero otherwise. Source: WBES.
Subsidiary	Dummy =1 if a firm is part of a larger group; 0 otherwise. Source: WBES.
Construction	Dummy =1 if a firm submitted an application to obtain a construction-related permit over the last two years; 0 otherwise. Source: WBES.
Working capital	Captures the proportion of goods or services paid for after the delivery by customers. Source: WBES.
Perceived competition	A firm's perceived degree of competition from the informal sector. Source: WBES.
Log(GDP/capita)	Logarithm of Gross Domestic Product (GDP) per capita. Source: World Development Indicators.
Domestic credit	Domestic credit to the private sector as a percentage of GDP. World Development Indicators.
Rule of law	Measures the perceptions of the extent to which people have confidence in and abide by the rules of society. Source: World Governance Indicators.

Inflation	Rate of inflation. Source: World Development Indicators.
Credit info	Depth of credit information index measures the coverage, scope and accessibility of credit information available through either a public credit registry or a private credit bureau. Source: Doing Business.
Herfindahl Index	Sum of the squares of market shares of each bank. Source: own computation.
Concentration	Share of assets that are held by the three largest banks in each country. Source: Global Financial Development Database.
Boone Index	Measure of bank competition calculated at the elasticity of profit to marginal cost. Source: Global Financial Development Database.
Financial freedom	The Index scores an economy's financial freedom by looking into the following five broad areas: (i) the extent of government regulation of financial services; (ii) the degree of state intervention in banks and other financial firms through direct and indirect ownership; (iii) the extent of financial and capital market development; (iv) government influence on the allocation of credit, and (v) openness to foreign competition. These five areas are considered to assess an economy's overall level of financial freedom that ensures easy and effective access to financing opportunities for people and businesses in the economy. An overall score on a scale of 0 to 100 is given to an economy's financial freedom through deductions from the ideal score of 100. Source: Heritage Foundation.
Institutional development	Average value of six governance indicators: voice and accountability, political stability, effectiveness of government, regulatory quality, rule of law, control of corruption. Source: World Governance Indicators.

Working Papers

Laboratoire de Recherche en Gestion & Economie

http://ideas.repec.org/s/lar/wpaper.html

Université de Strasbourg
Pôle Européen de Gestion et d'Economie
61 avenue de la Forêt Noire
67085 Strasbourg Cedex

http://large.em-strasbourg.eu/