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Banco de México

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Bank Credit and Productivity: Evidence from Mexican Firms*

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Abstract: Based on a survey of Mexican firms, this paper provides evidence of the positive effect of bank credit on firms' productivity. This effect is larger for those firms with access to bank credit and investment opportunities than for firms that only have either investment perspectives or bank credit. The potential problem of endogeneity in the empirical estimates is addressed by using instruments -collateral and expenses on energy and telecommunications- for the main explanatory variables. The relevant parameters indicating a positive effect of bank credit to productivity are consistent between estimation techniques.

Keywords: Bank credit; labor productivity.

JEL Classification: D220; D240.

Resumen: Con base en una encuesta de empresas mexicanas, en este artículo se proporciona evidencia del efecto positivo del crédito bancario sobre la productividad de las empresas. Este efecto es mayor para las empresas con acceso al crédito bancario y con oportunidades de inversión que para las empresas que sólo tienen oportunidades de inversión o sólo tienen crédito bancario. El problema potencial de endogeneidad en las estimaciones empíricas se resuelve utilizando instrumentos (garantías y gastos en energía y telecomunicaciones) para las principales variables explicativas. Los parámetros relevantes que indican el efecto positivo del crédito bancario en la productividad son consistentes entre técnicas de estimación.

Palabras Clave: Crédito bancario; productividad laboral.

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1. Introduction

The productivity of firms in Mexico and other developing countries is low compared to industrialized countries.¹ A main reason of low productivity is the abundance of small firms and Mexico has an overabundance of small firms (around 95 percent of all establishments have less than 11 employees)². At a Latin American level, Pages (2010) mentions that reducing the number of micro firms and increasing the participation of medium firms so as to replicate the structure in the U.S., would have the effect of doubling the level of productivity of the region.

Multiple studies have studied the factors that explain the level and growth of firms' productivity.³ Among those factors, however, the access of firms to finance and, in particular their access to bank credit, has been scarcely analyzed, especially among small-sized firms.⁴ Many productive firms cannot expand or make the technological improvements and investments needed to increase their productivity because they have no access to bank credit (Aghion 2007; Bloom, et. al. 2010; Lora y Pages 2011). At the aggregate level, some articles have found that financial development —measured by the level of credit and the size of the stock market— is a good predictor of growth over next 10 to 30 years (King and Levine 1993; Levine 2005). This observation, however, may be biased because financial development can be a leading indicator rather than a causal factor of growth (Rajan and Zingales 1998).

One way to make progress on causality is to focus on the theoretical mechanisms through which bank credit promotes productivity, which in turn provides a bridge between financial development and growth (Fazzari, et. al. 1988; King and Levine 1993; Butler and Cornaggia

¹ According to OECD statistics, productivity in Mexico and Chile, measured as GDP per hour worked, is 30 and 43 percent that of the United States, respectively. (<http://stats.oecd.org/Index.aspx?DatasetCode=LEVEL>).

² National Institute of Statistics and Geography (INEGI), *Economic Census*, 2009.

³ See Bartelsman and Doms (2000) and Syverson (2011) for a review of such studies.

⁴ Some papers addressing the effect of financial access on productivity are Butler and Corgaggia (2007) and Gatti and Love (2006).

2007). In this context, this paper contributes offering empirical evidence on the effect of bank credit on productivity.

As a matter of policy analysis, the potential impact of bank credit on firms' productivity is relevant in Mexico. Recent reforms to the financial regulatory framework have as a main objective to promote firms' access to bank credit at favorable terms, especially small-and-medium enterprises (SME).⁵ These reforms are based on the presumption that bank credit favors economic growth.

Figures from several sources provide evidence on the lack of bank credit among firms in Mexico, particularly small-ones. Only 36 percent of firms with up to 100 employees have any type of bank credit and just 50 percent of firms with more than 100 employees have this kind of financing.⁶ This scarcity of bank credit is more critical among micro firms. Only 9.3 percent of firms with 6 to 10 employees (CNBV-BID 2009) and just 4.2 percent of firms with less than 10 employees have bank credit (INEGI, *Economic Census* 2009).

There are compelling reasons to believe, however, that credit *per se* is not a sufficient ingredient to promote firms' productivity. Firms with credit access but without profitable opportunities will use borrowed funds for non-investment purposes, such as the financing of daily operations, or not to apply for investment loans (Ghani and Suri 1999; Butler and Cornaggia 2007). Thus, credit without investment opportunities may be inefficient in terms of productivity enhancement. The channel of transmission from credit to productivity is its efficiency rather than its volume (De Gregorio and Guidotti 1995). This observation is the basis of the empirical test implemented in this paper. Bank credit will have a greater favorable effect on productivity on firms with investment perspectives.

The outline of this paper is as follows. The next section provides some arguments that relate firms' bank credit access to their productivity levels. Section 3 describes the data and the

⁵ The mentioned Reforms were published January 10, 2014 in the Official Gazette.

⁶ Banco de Mexico, Survey on the Short-Term Situation of the Loan Market (*Encuesta de Evaluación Coyuntural del Mercado Crediticio*), January-March 2014.

determinants of productivity. This includes a description of the control variables. The fourth section describes the methodology including a discussion on the variables used to select the firms with investment opportunities. This section also contains the empirical results and explains how some methodological issues are addressed, such as the potential problem of endogeneity in the estimates. Section 5 includes the conclusions. Finally, the appendix describes the definitions and sources of the variables used in the study.

2. The Link between Bank Credit and Productivity

This section attempts to provide causal arguments that relate firms' bank credit access to their productivity levels. Different rates of return and productivity exist for different sources of finance.⁷ Firms have a preference ordering for the relevant finance where access to it is dictated by its costs. Initially, firms prefer to use internal finance for making investments to avoid paying a premium for external finance (Myers 1984).

Firms using only internal sources of finance, however, might be expected to earn lower rates of return on this source of finance compared to those using external sources. Credit allows firms to invest what their internal funds cannot support (Keasey and McGuinness 1990).

External finance is costly because there are fixed costs of external suppliers derived from informational asymmetries, which means that differences in borrower quality cannot be easily observed. One such information asymmetry relates to the problem of gauging firms' investment returns especially where there is no history of previous investments. This problem is more notorious for small- or new firms.

Another problem derived from informational asymmetries relates to the vigilance of external financiers. After granting a loan, the suppliers of credit will have enough incentives to monitor the borrower. This activity brings a positive effect on agency costs so funds are used

⁷ This statement is based on the view that internal and external capital are not perfect substitutes (see Fazzari, et. al. 1988), and that producer profits are a positive monotonic function of productivity, so selection on profits is equivalent to selection on productivity (Foster, et. al. 2008).

in a more efficient manner. For this reason, external finance will be closely related with the best projects.

The mentioned informational asymmetry problems mean that the returns to investment and productivity when financed by external rather than internal finance will need to be higher to compensate for such costs (Keasey and McGuinness 1990). For this reason, firms with investment perspectives with access to bank credit will be able to overcome financial restrictions and make technological improvements to increase their productivity (Schiantarelli and Jaramillo 1999; Gatti and Love 2006).

The aforementioned reasons of causality from bank credit to improvements in productivity and returns were proved empirically by Banerjee and Duflo (2004). They found that credit constrained firms that received bank lending increased their revenues after receiving subsidized credit.

Banks have advantages over alternative suppliers of credits. Banks have better information than other credit suppliers resulting from economies of scale and the comparative advantages of information gathering. Based on their cost and informational advantage, banks can offer better contract terms to firms than other available sources of financing (Berger and Udell 1995; Rajan and Zingales 2003; Pages 2010).⁸

In this regard, Keasey and McGuinness (1990) found that “small new firms are more efficient in their use of funds when they are answerable to, and are monitored by, private sector banks”. A more efficient use of bank credit leads to higher returns and productivity levels.

Projects financed with other sources of funds, such as government loans and trade credit, are expected to have lower returns than those financed with bank credit. Government loans are

⁸ Alternative suppliers of credit may not monitor efficiently the use of loans extended to them. For instance, trade credit is not usually granted to maximize a firms' return, but as a matter of exchange custom and to secure customer loyalty (Keasey and McGuinness 1990).

not necessarily granted to maximize firms' returns or enhance their productivity and trade credit is granted mainly to assure customer loyalty and its maturity is very short.

3. Data Description and Determinants of Productivity

The data used in this study come from the *Survey of Enterprises on Competitiveness, Financing and Use of Financial Services*⁹ (ENAFIN) conducted by the National Banking Commission and Inter-American Development Bank (2009). The survey collects information of sources and terms of financing and use of financial services, including data on firm profiles and characteristics of ownership, as well as measures of competitiveness.

The survey includes information of 986 non-financial firms with more than 5 employees in localities with at least 50 thousand inhabitants. Firms are grouped in four size categories (micro, small, medium and large) according to the number of employees (see Appendix for more information).

a. Labor productivity

The analysis is based on labor productivity (LP) measured as the output (y) to labor ratio (l):

$$LP = \frac{y}{l} \quad (1)$$

Labor is measured as the number of employees per firm. Output is computed as firm's total income weighted by an aggregate output price index at the sector level (industry, trade and services).¹⁰

LP is used for several reasons. LP is i) an informative measure of firms' unit labor cost, which is employed by entrepreneurs to make decisions on profitable opportunities, ii) a well-known

⁹ "Encuesta Nacional de Competitividad, Fuentes de Financiamiento y Uso de Servicios Financieros de las Empresas".

¹⁰ Theoretically the use of an aggregate price index may bias LP measures when there is not perfect competition. Deviations form a single price bias LP for firms with higher prices. On this respect, Bartelsman and Doms (2000) reviewed several studies and found that the use of an aggregate price index do not change the qualitative results. These authors also found that TFP measurements are also affected by the use of aggregate indexes when the input prices differ from their marginal products.

variable for evaluating firms' efficiency and c) highly correlated with total factor productivity measures (TFP). In a time series analysis, LP may be a misleading measure of productivity because LP growth may be derived from changes in the capital-labor ratio. In a *cross-section analysis*, however, this problem is absent because such capital-labor ratio is constant across firms.¹¹ Finally, both, LP and TFP, are the main productivity variables used for empirical research (Bartelsman and Doms 2000; Baily, et. al. 2001; Baily and Solow 2001; Easterly 2001).

Figure 1 shows the firm-level distribution of productivity.¹² LP dispersion is wide. This result is found in other countries (Bartelsman and Doms 2000). There is a positive relationship between firm size and productivity. As can be seen in Table 1, medium- and large-size enterprises have higher productivity levels than smaller ones (Leung, et. al. 2008). A small-sized firm is 52 percent less productive than a large-sized firm. The observed labor dispersion suggests resource allocation problems, so an efficient allocation would improve the aggregate productivity (Hsieh and Klenow 2009). The relationship between firm size and productivity also varies among economic sectors as seen in Figure 2 (Rajan and Zingales 1998).

b. Determinants of productivity

Besides that industries are collections of heterogeneous-productivity producers, businesses' measured productivity levels are persistent and vary significantly within industries, suggesting that productivity has an inherent idiosyncratic element (Alfaro, et. al. 2008). For this reason, the identification of the effect of bank credit on productivity requires to control for such factors. These selected factors constitute the main objects of study in the specialized literature (Bartelsman and Doms 2000 and Pages 2010).

Competition is the main driver of productivity. In this paper, this element is measured by firms' foreign sales. A key prediction of some international trade models is that only the most

¹¹ For a cross-section analysis, the form of the production function is also not relevant because the technology is constant across firms.

¹² Data limitations allow the estimation of LP for a total of 369 firms.

productive firms succeed in exporting while the least productive firms survive entirely on their sales in the domestic market (Tybout and Roberts 1997; Melitz 2003 and Bernard, et. al. 2003). Table 2 shows evidence that export-oriented firms —defined as firms with export sales that exceed 50 percent of total revenue— have higher levels of productivity than other types of firms.

Human capital is regarded also as one of the main factors affecting productivity. Some studies based on firm-level data have found that the best human resources are concentrated in capital-intensive industries, which are usually large-sized firms, while low-skill workers are located in micro and small sized firms (Abowd, et. al. 2002). Table 3 shows similar patterns in Mexican firms. Workers with more years of education are concentrated in medium- and large-sized firms.

Decision-making in the firm also affects productivity. In developing countries, there is an abundance of family owned firms, where family members control the business and make the important decisions. In some family firms, owners are not entrepreneurs. Lack of entrepreneurship explains why some low-productivity firms remain in some "natural" small scale industries.¹³ Small business owners have "little desire to grow big or to innovate in any observable way" and may pursue non-pecuniary benefits (Hurst and Pugsley 2011).

In family firms, because entrepreneurial ability is not necessarily related to family ties, directors do not always make the best decisions, thus reducing the firm's efficiency (Bloom, et. al. 2010).

Also, badly managed firms and entrepreneurs pursuing non-pecuniary benefits combined with a "natural" small scale of some industries explain why some firms do not grow and maintain low levels of productivity.

¹³ Some examples of small-scale industries are plumbers, electricians, contractors, painters, skilled professionals, insurance and real estate agents and small shopkeepers.

At odds with small-sized firms, Maury (2006) found that in large firms active family control is associated with higher profitability compared to non-family firms because family control reduces the agency problem between owners and managers. For these reasons, the final verdict on the relation between family-owned firms and their productivity is an empirical matter.

Three variables are included in the empirical estimate for the factors associated with family enterprises. One variable indicates that if directors are relatives of owners, the second one indicates when the owner is the general manager and the third one is a measure of external control –where external shareholders own 50 per cent or more of the firm’s capital. Table 4 shows that a larger proportion of micro and small sized firms are family-owned with active family control and scarce external participation. More than half of large firms are family controlled. The bottom part of Table 4 shows firms’ LP and selected measures of internal decision making. The data show no significant differences in productivity among family-owned firms, firms where the owner is the general manager and firms with external control.

The prevalence of a large informal sector also helps to explain firms’ productivity. Pages (2010) showed that a complex taxation system negatively affects firms’ productivity. At the firm level, ill-designed taxes are an incentive for firms to dedicate time and money to avoid them, diverting resources from more productive uses. At the same time, some public policies to promote job creation favor small and medium enterprises (SME) whatever their productivity levels, shifting employment away from large firms in an inefficient manner.

There are also compelling reasons for the small entrepreneur to join the tax net. For SME, participation in the tax regime brings a firm into the formal sector, allowing it to access formal credit markets, government procurement, and access to markets including those for export.

Given the relevance of formality on productivity, the empirical estimate includes an index of formality¹⁴ based on the following variables:

1. Fiscal regime: a) sole proprietorship, b) limited liability partnerships or c) corporations.¹⁵
2. Registry of business operations: a) no bookkeeping, b) owner keeps transaction books, c) the firm has a certified accountant to keep the books or the firm has a certified cash register (SHCP).
3. Sales receipts: a) no receipts, b) only receipts, d) receipts and invoices.¹⁶
4. Business licensing. Firm is registered with the IRS, county, ministry of economy, secretary of health, etc.
5. Based on the above variables an index of formality is constructed. This index has a range of 0 to 8 with 8 being a firm inside the formal system (Table 5). Figure 3 suggest a positive relationship between the degree of formality and productivity. A plausible explanation of this finding is that the more productive firms have more incentives to be formal.

In the empirical estimate, the above-mentioned factors are included in an attempt to control their effect on productivity with the following expected results.

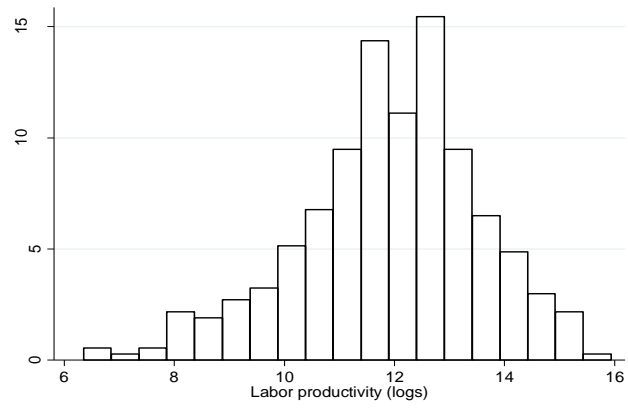
1. A positive relationship between firm size and productivity.
2. The existence of idiosyncratic differences among economic sectors.
3. Firms with a larger proportion of foreign sales are expected to have higher levels of productivity.
4. Concentration of skilled workers in large-sized firms with higher levels of productivity.
5. Formal firms are more productive than informal ones.

¹⁴ The meaning of this index of formality is independent of official definitions. For instance, INEGI considers informal those firms where the owner and firm's assets are not separated and their operations are outside of their legal framework.

¹⁵ These terms correspond roughly to the following Spanish terms: a) *persona física sin actividad empresarial*, b) *persona física con actividad empresarial* and c) *persona moral*.

¹⁶ These terms correspond roughly to the following Spanish terms: a) *no emite recibos ni facturas*, b) *sólo emite recibos* and c) *emite facturas y recibos o cuenta con caja registradora de SHCP*.

Figure 1 Distribution of firm-level labor productivity (logs)



Note: Labor productivity measured in logs. Source: Author’s calculations based on ENAFIN.

Table 1 Descriptive statistics of LP and LP relative index by firm size

Firm size	Average	Standard Deviation	Number of observations	Relative Index
Micro	11.47	1.62	138	62.6
Small	11.83	1.62	111	52.1
Medium	12.68	1.57	52	122.5
Large	12.48	1.43	68	100.0
All firms	11.93	1.64	369	n.a.

Notes: LP measured in logs; the relative index is constructed as the LP for each firm size with respect to large firms, in other words, this index measures firms’ LP with respect to large firms. Source: Author’s calculations based on ENAFIN.

Table 2 LP of export and non-export oriented firms^{1/}

Firm size	Export-oriented firms^{2/}	Non export-oriented firms
Micro	12.4	11.4
Small	12.7	11.8
Medium	14.0	12.5
Large	12.6	12.5
All firms	12.1	11.7

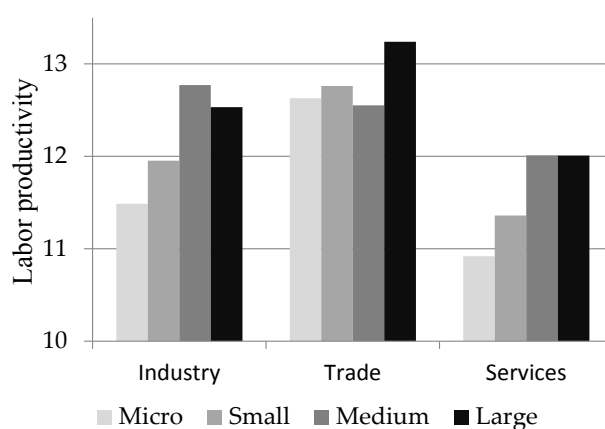
1/ LP in logs. The difference between export-oriented and non-export-oriented firms is statistically significant at 5 percent level. 2/ Firms with export sales that exceed 50 percent of total revenue. Source: Author’s calculations based on ENAFIN.

Table 3 **Workers by level of education** (percentage of firms)^{1/}

Firm size	Workers with basic education	Workers with secondary education	Workers with college education
Micro	51.1	31.5	17.4
Small	46.8	28.6	24.6
Medium	47.8	31.3	20.9
Large	46.2	30.3	23.5
All firms	48.5	30.5	21.2

1/ Total number of permanent and temporary workers. Source: Author's calculations based on ENAFIN.

Figure 2 **LP by firm size and economic sector**^{1/}



1/ LP measured in logs. Source: Author's calculations based on ENAFIN.

Table 4 **Decision-makers in the firm and productivity by firm size**

<i>Number of firms (%)</i>			
Micro	66.5	89.3	13.1
Small	52.6	82.8	9.7
Medium	50.0	81.0	10.3
Large	36.6	54.3	30.3
<i>Labor Productivity (logs)</i>			
Micro	12.2	12.3	11.5
Small	12.9	12.9	12.9
Medium	15.1	15.1	15.8
Large	15.6	15.9	15.0

Source: Author's calculations based on ENAFIN.

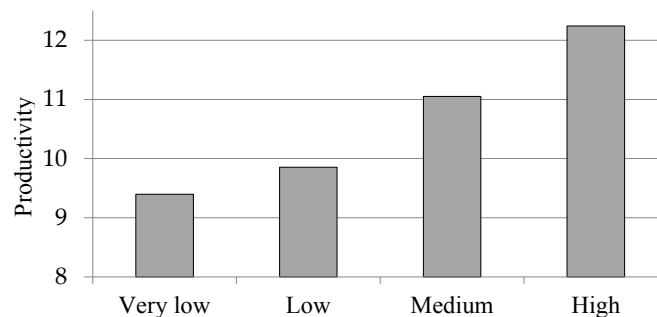
Table 5 **Index of Formality**^{1/}

Informality \longleftrightarrow **Formality**

(1)	(2)	(3)	(4)
<i>Fiscal regime</i>	Sole proprietorship	Limited liability partnerships	Corporation
<i>Registry of business operations</i>	No bookkeeping	Owner keeps transaction books	Firm has a certified accountant
<i>Sales receipts</i>	No receipts	Receipts	Receipts and invoices
<i>Business licensing</i>	With one authority	With two authorities	With more than two authorities

1/ The index of formality is constructed as follows. A firm gets 0, 1 or 2 points if it is located in column (2), (3) or (4) of each row, respectively. The index is the sum of the previous points across rows. This index ranges from 0 through 8. Source: Author's calculations based on ENAFIN.

Figure 3 **Index of Formality and Firms' LP**^{1/}

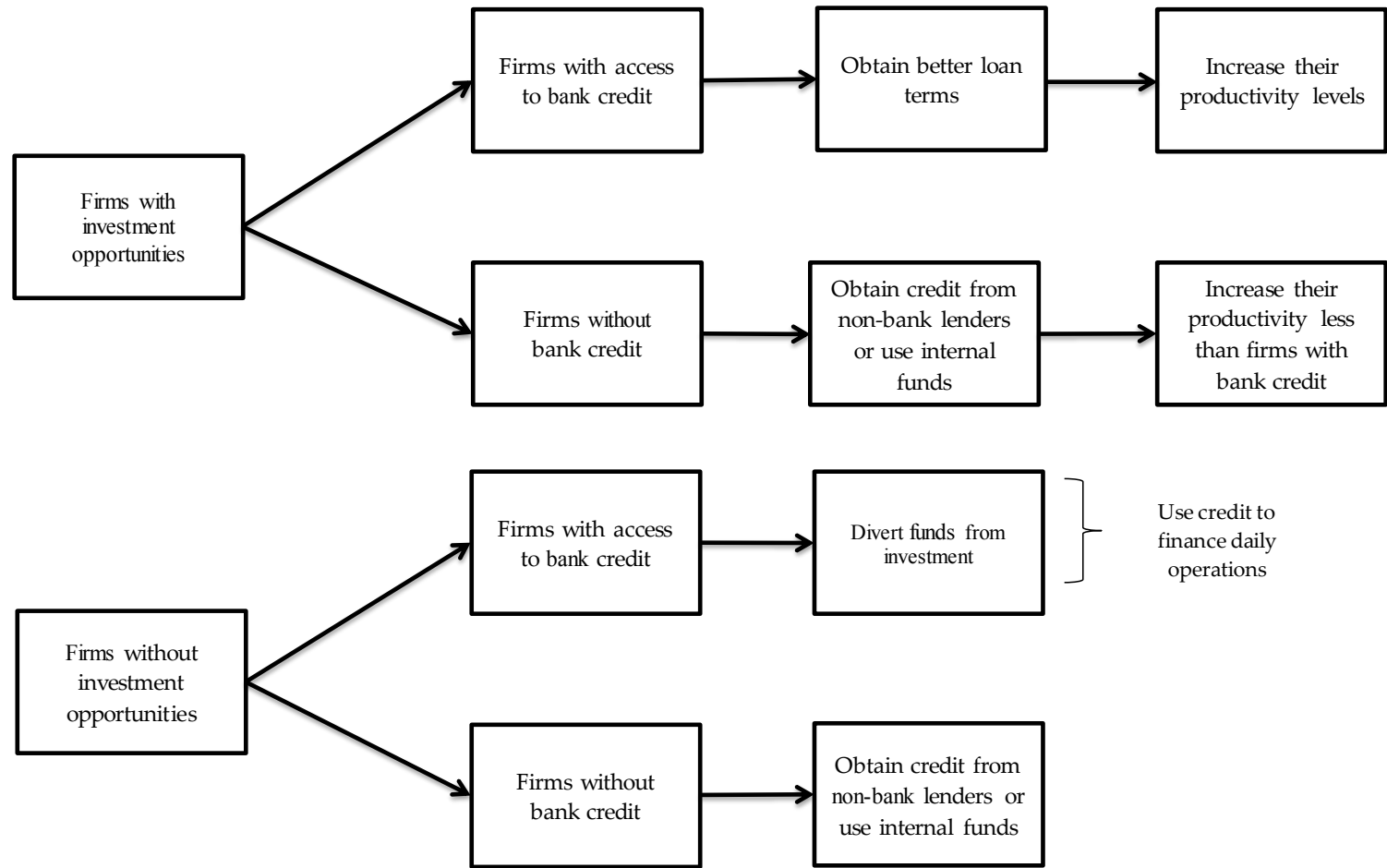


1/ Index of formality: Very low (0 – 4); Low (5); Medium (6 – 7) and High (8). LP is in logs. Source: Author's calculations based on ENAFIN.

4. Methodology

This section tests empirically the hypothesis that bank credit enhances firms' productivity. Figure 4 illustrates the strategy used to test this hypothesis. Initially, firms with investment opportunities are identified. With these firms, two groups of enterprises are formed. One group includes only firms with access to bank credit and the other group includes firms with alternative sources of finance. Under the assumption that banks can offer better credit terms, we examine whether firms with access to bank credit have relatively higher levels of productivity than the other group of firms (Berger and Udell 1995; Rajan and Zingales 2003; Pages 2010).

Figure 4 The Relationship between Bank Credit and Productivity



a. The Basic Test

Econometrically, the hypothesis is tested using the following model¹⁷:

$$\begin{aligned} \text{Labor productivity } i = & \quad \text{Constant} + \sum (\gamma_s \text{ Control variables } i) & (2) \\ & + \beta (\text{Investment opportunities } i \cdot \text{Bank credit } i) + \varepsilon_i \end{aligned}$$

Productivity is measured in logs for each firm indexed by i . The Greek letters β and γ represent parameters and ε is an error term with the usual properties. The control variables (indexed by s) are the following.

1. Firm size and firm age attempt to control for productivity dispersion and heterogeneity. Size and age are positively related to productivity levels, so positive coefficients on these variables are expected.
2. Economic sector. Data show that capital intensive firms have higher productivity levels. There could be a technological reason why some firms are more capital-intensive than others. The initial project scale, the gestation period and the cash harvest period are different among sectors.
3. Workers' years of education, as a *proxy* of human capital.
4. Export-oriented firms. Firms with larger foreign sales also have higher levels of productivity.
5. Decision-maker. As discussed in the previous section, whether the owner or some other person is the key decision-maker for investment choices affects productivity. In this

¹⁷ This model is used for several reasons. First, it is simple and based on the interaction of two dummy variables. "By looking at interaction effects ... rather than direct effects, we reduce the number of variables that we rely on..." (Rajan and Zingales 1998, p. 584). As stated in the hypothesis, a positive and significant parameter of the interaction term will indicate that firms with both investment opportunities and bank credit have larger productivity levels than other type of firms. Second, this specification is based on the assumption that firms with bank credit can reach higher levels of productivity given a set of control variables. This means that bank credit access allows firms to be more productive independent of their size, age, economic sector, and other factors.

regard, three variables are considered. In a family-owned firm, the owner is the general manager of the firm.

6. The firm's degree of formality. Firms operating in the informal sector have limited capital, low technology and less-skilled workers, so their productivity level is below the industry average.

The hypothesis that bank credit enhances the productivity of firms with investment opportunities is tested through the interaction of two dichotomous variables (0,1): i) investment opportunities and ii) bank credit. The significance of parameter β will indicate that bank credit promotes productivity.

b. The Proxy for Firms with Investment Opportunities

Firms with investment opportunities are selected by means of a question on managers' expectations for investment plans in the next two years.¹⁸ Here, it is assumed that there is a relationship between investment opportunities and the need to buy capital. The relevance of this question and its relationship with bank credit is analyzed in the upper half of Table 6.

As can be seen, more than 60 percent of total firms answered planning to invest in machinery/equipment over the next two years. With respect to credit availability, of all firms only one fifth has a bank loan. Access to bank credit increases with firm size.

The bottom part of Table 6 provides evidence on a positive relationship between productivity and access to bank credit. Firms with *both* investment opportunities and bank credit are more productive than firms with investment opportunities and *without* bank credit.¹⁹ Those productivity differences are larger and significant for small and micro firms. This finding suggests that bank credit has a larger impact on the productivity of firms with fewer credit alternatives.

¹⁸ Question number 9.24 on the *ENAFIN* questionnaire asks the following: "Is the firm planning to buy machinery/equipment in the next two years?" A caveat regarding this question is that entrepreneurs are expressing their expectations, so labor productivity is measured before any investment takes place.

¹⁹ Statistically significant at 1-percent level.

Table 6 Productivity of firms with plans to buy machinery/equipment in the next 2 years with and without bank credit^{1/}

Variable	Micro	Small	Medium	Large	All
<i>Percentage of Firms</i>					
Firms with plans to buy machinery /equipment in the next 2 years	59.2	62.2	57.8	66.2	61.0
Firms with bank credit	9.3	23.5	30.4	32.2	20.5
Firms with bank credit <i>and</i> plans to buy machinery/equipment in the next 2 years	6.1	16.4	17.0	23.9	13.7
<i>Productivity (logs)</i>					
Firms <i>with</i> bank credit <i>and</i> plans to buy machinery/equipment in the next 2 years	13.3	12.4	13.0	12.6	12.7
Firms <i>without</i> bank credit <i>and</i> plans to buy machinery/equipment in the next 2 years	11.4	11.6	12.6	12.4	11.8

1/ See Appendix for definitions and source of variables. Source: Author's calculations based on ENAFIN.

c. Results of the Basic Test

Table 7 reports the final estimates of specification (2). The specification controls for firm characteristics and factors that affect productivity as described in the previous section. In all estimates, labor productivity is the dependent variable. There are 369 available observations for which there are non-missing data. Details of the econometric estimate are described at the bottom of Table 7.

Equations (1) to (3) were estimated by OLS, identifying firms with investment opportunities as those firms with plans to buy machinery/equipment in the next two years. Firms with bank credit have loans, revolving facilities, or both. As can be seen in Table 7, the coefficient estimate for the interaction term is positive and statistically significant at the 1-percent level (in all estimates, the reported standard errors are robust to heteroscedasticity). This result supports the hypothesis that bank credit enhances the productivity of firms with investment opportunities.

The relevance of this result may be questioned, because the parameter may be biased due to an endogeneity problem. Banks may grant loans to the more productive firms, so bank credit flows to more productive firms not enhancing productivity. To address this issue, a variable indicating firms that pledge collateral is used as an instrument for firms with bank credit. The correlation between firms with collateral and bank credit is high (85 percent), but the correlation between firms with collateral and their productivity level is not statistically significant. This is particularly true for small-sized and new firms, where their productivity has no relation with their lack of available properties or assets to pledge against loans. Furthermore, lack of collateral is as a well-known small businesses owners' reason to explain their lack of interest in applying for bank loans (Kon and Storey 2003; Chakravarty and Xiang 2009). Collateral is correlated with bank credit, but not otherwise correlated with productivity; this variable seems to be an adequate instrument for firms with bank credit.

The result that bank credit enhances productivity may also be questioned because firms with investment opportunities are not being correctly identified. An alternative way to identify firms with investment opportunities is through their consumption of energy and use of communication services. Firms with *prospects* of an increase in demand are likely to increase their consumption of electricity and make more phone calls. On the contrary, a firm with a lack of investment opportunities would save on utility costs. Firm spending on utilities is used as an instrument for investment opportunities.²⁰ The correlation between utility costs and investment opportunities is 82 percent and with productivity 23 percent.

Table 7 shows the estimated parameters of specification (2) using firms with collateral and firms' utility costs as instruments for bank credit and investment opportunities, respectively.²¹ As can be seen, the results coincide with OLS estimates. The coefficient estimate for the interaction term is positive and statistically significant at the 1-percent level. These results

²⁰ Utilities include consumption of electricity, telephone and internet service and rent of business space.

²¹ The applied methodology utilized in this paper follows Rajan and Zingales (1998). These authors mentioned that "our methodology may have wider applications, such as testing the existing of channels through which human capital can affect growth." (p. 584). This paper follows their advice.

confirm that firms with access to bank credit and investment opportunities are more productive than other firms.

d. Decomposition of the Effect of Bank Credit on Productivity

A second specification is used as an alternative test of the effect of bank credit on productivity.²² The alternative specification is the following:

$$\begin{aligned} \text{Labor productivity } i = & \quad \text{Constant} + \sum (\gamma_s \text{ Control variables } i) & (3) \\ & + \beta_1 (\text{Investment opportunities } i) + \\ & + \beta_2 (\text{Bank credit } i) \\ & + \beta_3 (\text{Investment opportunities } i \cdot \text{Bank credit } i) + \varepsilon_i \end{aligned}$$

Equation (3) is estimated by OLS in four steps. In all steps, the control variables are included and the dependent variable is the log of labor productivity. In the first step corresponding to column (1), only the dummy variable that indicates firms with investment opportunities is introduced. As can be seen in Table 8, the coefficient estimate of the dummy variable is positive and statistically significant at the 1-percent level. As in the previous table, all standard errors are robust to heteroscedasticity and are reported in parenthesis. Column (2) reports the estimated coefficient of bank credit measured as a dummy variable. Its sign is positive and statistically significant at the 10-percent level. In column (3), both variables, the one indicating investment opportunities and the other indicating bank credit, are included at the same time.

²² The author thanks an anonymous referee for the suggestion to include this alternative test.

Table 7 Estimate Results of Specification (2)

Variable	Dependent variable: labor productivity				
	OLS			IV	
	(1)	(2)	(3)	(4)	(5)
Interaction term (investment opportunities x bank credit)	0.444*** (0.178)	0.465*** (0.182)	0.400** (0.165)	0.804*** (0.233)	0.618*** (0.216)
Formality	0.896*** (0.077)	0.830*** (0.088)	0.781*** (0.091)	0.797*** (0.088)	0.761*** (0.090)
Age		0.010* (0.006)	0.008 (0.006)	0.010* (0.006)	0.008 (0.006)
Micro or small firm		-0.117 (0.185)	-0.047 (0.178)	-0.106 (0.185)	-0.040 (0.177)
Family-owned firm		-0.204 (0.160)	-0.273* (0.148)	-0.260 (0.161)	-0.308** (0.149)
Export-oriented firm		0.525** (0.250)	0.357* (0.227)	0.529** (0.252)	0.365* (0.223)
Industry			0.325** (0.154)		0.307* (0.153)
Trade			1.095*** (0.209)		1.080*** (0.209)
Constant	0.444*** (0.178)	0.525*** (0.250)	9.112*** (0.374)	9.332*** (0.371)	9.165*** (0.372)
R ²	0.314	0.349	0.408	0.340	0.340
Number of observations	359	344	344	343	343

*** Significant at the 1 percent level; ** at the 5 percent level; * at the 10 percent level. Standard errors are in parentheses. *Notes:* labor productivity is measured as the log of output per employee; output is equal to sales income deflated by its respective sector producer price index; the formality index has a range of 0 to 8, where 8 is totally formal; investment opportunities refers to question number 9.24 on the ENAFIN questionnaire that asks the following: “Is the firm planning to buy machinery/equipment in the next two years?”; bank credit is a dichotomous (0,1) variable where 1 indicates the firm has a loan or a revolving credit facility from a commercial bank; firm age is measured as the log of years of the firm in the market; firm size is defined by the number of employees; family-owned businesses are firms where owners or their relatives are general managers; export-oriented firms are those with 50 percent or more of their sales abroad; industry and trade sectors are dichotomous variables (1,0); regressions (1) to (3) are estimated with OLS; regressions (4) and (5) are estimated with instrumental variables; workers’ years of educations were highly correlated with firm size, so this was omitted from the final estimates; instrumental variables are bank credit and firms that have investment opportunities with firms with guarantees and utility expenses, respectively; the validity of these instruments is corroborated by implementing the Hausman test; in all estimates the errors are heteroscedasticity-robust standard errors; there are 343—359 available observations for which data are not missing. Regressions are estimated with unweighted sample observations because the interest lay in the relationship between the independent and dependent variables (Cameron and Trivedi 2005; Aronow and Samii 2014). Source: Author’s calculations based on ENAFIN.

Table 8 Estimate Results of Specification (3)

Variable	Dependent variable: labor productivity			
	OLS			
	(1)	(2)	(3)	(4)
Investment opportunities	0.339** (0.149)		0.320** (0.148)	0.382** (0.177)
Bank credit		0.436*** (0.088)	0.390*** (0.155)	0.596** (0.280)
Interaction term (investment opportunities x bank credit)				-0.295 (0.322)
Formality	0.799*** (0.091)	0.783*** (0.088)	0.770*** (0.090)	0.773*** (0.090)
Age	0.007 (0.006)	0.009 (0.006)	0.008 (0.006)	0.008 (0.006)
Micro or small firm	-0.072 (0.178)	-0.018 (0.180)	-0.026 (0.181)	-0.013 (0.183)
Family-owned firm	-0.227** (0.144)	-0.288** (0.148)	-0.276** (0.146)	-0.263* (0.147)
Export-oriented firm	0.381* (0.223)	0.377* (0.219)	0.419** (0.218)	0.437** (0.219)
Industry	0.344** (0.153)	0.295* (0.153)	0.304** (0.154)	0.302** (0.154)
Trade	1.130*** (0.206)	1.000*** (0.217)	1.067*** (0.210)	1.055*** (0.213)
Constant	8.887*** (0.388)	9.059*** (0.366)	8.917*** (0.383)	8.851*** (0.400)
R²	0.410	0.409	0.419	0.420
Number of observations	344	347	344	344

Note: See notes to Table 7.

The estimated parameters of specification (3) do not contradict the results of specification (2). Firms with plans to buy machinery/equipment in the next two years and have bank credit are more productive than firms that have either bank credit or investment opportunities. In addition to this conclusion, specification (3) provides evidence on the impact of bank credit on the level of productivity of firms. Bank credit, in general, enhances productivity independently if the firm has investment opportunities. This result agrees with the general perception among entrepreneurs and policy-makers that credit is good for enterprises.

5. Conclusions

The idea that credit promotes productivity is common sense among entrepreneurs and policy-makers. Credit allows many productive firms to expand or make technological improvements and investments needed to increase their productivity beyond what their internal funds can support. Under these conditions, credit is efficiently assigned. However, the absence of investment opportunities may lead firms to divert credit to non-investment uses or not to apply for investment loans. Thus, the channel of transmission from credit to productivity is efficiency rather than its volume.

Based on a survey of Mexican firms, this paper provides evidence of the positive effect of bank credit on firms' productivity. This effect is larger for those firms with access to bank credit and investment opportunities than other firms included those that only have either investment perspectives or bank credit. The potential problem of endogeneity in the empirical estimates is addressed by using instrument –collateral and expenses on energy and telecommunications- for the main explanatory variables. The relevant parameter indicating a positive effect of bank credit to productivity is consistent among estimates and estimation techniques.

6. References

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7. Appendix

The data used in the current study comes from the Survey of Enterprises on Competitiveness, Financing and Use of Financial Services²³ (ENAFIN) (*Encuesta Nacional de Competitividad*,

²³ “Encuesta Nacional de Competitividad, Fuentes de Financiamiento y Uso de Servicios Financieros de las Empresas”.

Fuentes de Financiamiento y Uso de Servicios Financieros de las Empresas)²⁴ conducted by the Banking and Securities Supervisory Agency (*Comisión Nacional Bancaria y de Valores*) and the International Development Bank (IDB) with respect to information on firms' financing sources. The survey collected information for 2009 on 986 non-financial firms with more than 5 employees in localities with at least 50 thousand inhabitants. The ENAFIN collected information on firms' characteristics on age, formality compliance, decision-makers in the firm, business income and expenses; financing sources and terms, and access and use of financial services. Firms are grouped in four size-categories (micro, small, medium and large) according to the number of employees (Table 7).

Table 9 Firm Size Categories by Number of Employees and Number of Firms included in the ENAFIN

Firm size	Number of employees			Total number of firms
	Trade	Services	Industry	
Micro	6 to 10	6 to 10	6 to 10	367
Small	11 to 30	11 to 50	11 to 50	328
Medium	31 to 100	51 to 100	51 to 250	148
Large	101 or more	101 or more	251 or more	143
Total number of firms				986

Table 10 Dummy variables utilized in the empirical specifications

Dummy variables utilized in the empirical specifications	No. of non-missing observations	Observations with value = 0	Observations with value = 1	% of observations with value = 1
Firm with bank loans	986	784	202	20.5
Firms with investment opportunities	975	380	595	61.0
Family-owned firm	984	442	542	55.1
Export-oriented firm	965	916	49	5.1
Firms in the industry sector	986	631	355	36.0
Firms in the trade sector	986	766	220	22.3
Firms with investment opportunities and bank loans	975	841	134	13.7
Firms with collateral	986	739	247	25.1

Source: ENAFIN.

²⁴ Data is available at the following internet address:
http://www.cnbv.gob.mx/Prensa/Estudios/Base%20ENAFIN_website_.dta

Table 11 **Definitions and Source of Variables from ENAFIN**

Firm Variables	Question number
Number of employees	Q. 1.01. “En 2009 ¿cuántos empleados tuvo la empresa o negocio (incluyendo personal administrativo)? Por favor indique cuántos empleados son permanentes y cuántos temporales en este establecimiento”.
Sales income	Q. 9.02 En 2009, aproximadamente ¿cuál fue el monto de sus ingresos anuales por ventas?
Output	Sales income deflated by producer price indices
Investment opportunities	Q. 9.24 ¿Planea comprar maquinaria y/o equipo en los próximos 2 años?
Collateral	Q. 15.12 ¿Aportó alguna garantía por esta línea de crédito? Q. 16.13 ¿Aportó alguna garantía por este crédito de largo plazo además del bien que adquirió?
Utilities expense	Q. 9.11 En 2009, ¿aproximadamente, cuánto pagó la empresa en un mes promedio por...? 3. Pagos recurrentes como luz, renta, teléfono, internet, televisión de paga, etc.
Age	Q. 2.07. ¿Cuántos años tiene esta empresa (negocio) operando en su actividad principal?
Family-owned	Q. 2.02 ¿Es esta una empresa (negocio) familiar?
Owner is general manager	Q. 2.03 ¿El director de esta empresa (negocio) es también el dueño principal o socio de la misma?
External participation	Q. 2.05 ¿Otra compañía o grupo económico es dueña de más del 50% de esta empresa (negocio)?
Fiscal regime	Q. 2.01 ¿Esta empresa (negocio) está registrada como una...? 1. Persona física sin actividad empresarial, 2. Persona física con actividad empresarial, 3. Persona moral.
Registry of business Operations	Q. 2.08 2.08 ¿Esta empresa (negocio)...? 1. No lleva ningún registro contable 2. El dueño lleva sus cuentas personalmente 3. Acude o cuenta con los servicios de un contador o profesional para llevar las cuentas 4. Utiliza la caja registradora de la Secretaría de Hacienda.
Sales receipts	Q. 2.09 ¿Qué tipo de comprobantes expide esta empresa (negocio) a sus clientes? 1. Facturas, 2. Recibos 3. Facturas y recibos, 4. Ninguno de los anteriores.

Firm Variables	Question number
Business licensing	Q. 2.10 ¿Esta empresa está registrada en...? 1. Servicio de Administración Tributaria, 2. Municipio o delegación, 3. Secretaría de Economía, 4. Secretaría de Salud5. IMSS, 6. Ninguna de las anteriores.
Foreign sales	Q. 9.03 En 2009, ¿qué porcentaje de sus ingresos por venta de productos o servicios se destinó a mercados en el extranjero?
Bank credit	Questions 15.01, 15.02, 16.01 and 16.02.
	15.01 Al cierre de 2009, ¿cuál fue el saldo total de deuda de la empresa en todas las líneas de crédito vigentes?
	15.02 Durante el período 2005-2009, ¿cuántas líneas de crédito revolvente obtuvo la empresa?
	16.01 Al cierre de 2009, ¿cuál el saldo total de deuda de la empresa en todos sus créditos simples de corto plazo?
	16.02 Al cierre de 2009, ¿cuál el saldo total de deuda de la empresa en todos sus créditos simples de largo plazo?