

# FDI Spillovers and the Role of Local Financial Markets: Evidence from Mexico\*

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September 01, 2008

## Abstract

This paper presents new microeconomic evidence on the link between financial sector development, financial globalization and productivity. Using data of Mexican manufacturing firms operating in 1991, 1998 and 2000 it is found that in general, larger firms benefit from FDI in their same region of activity. However, domestic firms only enjoy productivity increases from FDI if they are relatively large *and* located in financially developed regions. All the findings are robust to instrumenting for financial development using historical conditions.

KEYWORDS: Productivity, FDI Spillovers, Financial Development.

JEL CLASSIFICATION: D24, F23, O16

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\*I would like to thank INEGI officials for granting on-site access to the firm level data used in this study under the commitment of complying with the confidentiality requirements set by the Mexican Laws and in particular, to Gerardo Leyva, Adriana Ramirez Nava and Gabriel Romero Velasco. I would also like to thank Aurora Ascione, Gustavo del Angel Mobarak, Mayssun El-Attar, Patrick Eozenou, Luigi Guiso, Stephen Haber, Leonardo Iacovone, Helmut Luetkepohl, Morten Ravn, Fabio Schiantarelli and Christophe Winter for valuable comments and suggestions. Many thanks also to seminar participants at the Macroeconomics Reading Group at the European University Institute, Institute for Advanced Studies in Vienna, Universidad de Navarra, University of Houston, Federal Reserve Bank of Atlanta, Trinity College in Dublin, CEPII and participants at the International Economic Association 15th World Congress in Istanbul.

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# 1 Introduction

In recent years a literature on the benefits and costs of financial globalization for developing countries has proliferated. In a recent review of the literature, Kose, Prasad, Rogoff and Wei (2006) suggest four sets of structural and policy-related country features that seem to determine whether countries will be able to benefit from financial globalization: financial sector development, overall institutional quality, macroeconomic policy framework and trade integration. In particular, the financial sector development is found not only to enhance the growth prospects but also reduce vulnerability to crises through direct and indirect channels. Based on country level studies there is a consensus on the relevance of domestic financial factors if countries are to benefit from financial globalization. However, there is limited microeconomic evidence that supports this hypothesis. This paper fills the gap between macroeconomic and microeconomic evidence. It studies the effects of foreign direct investment (FDI) on firm level productivity and shows that in general, larger firms benefit from foreign companies operating in their same region. In contrast, domestic firms only enjoy higher productivity if they are relatively large and located in well financially developed regions.

The theoretical benefits from FDI are based on the assumption that FDI not only brings in physical capital and employment opportunities but foreign affiliates possess a set of non-tangible assets, such as technological know-how, management skills and production techniques that confer them higher productivity than their domestic counterparts. Most of the relevance of FDI for the domestic economy relies on the possibility that domestic firms, by being exposed to the new products and production techniques brought in by the multinational company (MNC), manage to improve their own performance as well. However, despite the extensive empirical literature on FDI spillovers, studies focusing on developing and emerging countries fail to find any evidence of positive externalities derived from foreign presence in their *same* sector or region of activity<sup>1</sup>.

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<sup>1</sup>The following studies either fail to find an effect or hint to the existence of negative spillovers: Haddad and Harrison (1993) on Morocco, Aitken and Harrison (1999) on Venezuela, Djankov and Hoekman (2000) on Czech Republic and Konings (2001) on Bulgaria, Romania and Poland. More encouraging results have been found for firms operating in developed countries: Haskel, Pereira and Slaughter (2007) for the UK

Given the limited evidence on horizontal or regional FDI spillovers, I explore the role of local financial markets. In particular, this paper concentrates on the hypothesis that even if domestic firms would like to undertake investments to adopt new technologies brought in by foreign investors, they may lack access to the financial resources necessary to do so. Alfaro, Chanda, Kalemli-Ozcan and Sayek (2004) study this dimension of host country conditions at a macro level. Using cross-country data from 1975 to 1995 they show that the contribution of FDI to economic growth is ambiguous. However, countries with well-developed financial markets gain significantly from FDI. They suggest the following ways in which financial markets matter for FDI spillovers. First, in order to take advantage of new knowledge, domestic firms will need to undertake investments that allow them to reorganize their structure or upgrade their technology. Although some local firms will be able to finance these investments with internal funds, others will need external resources that in most cases are confined to domestic sources. Second, workers of foreign firms can learn the insights of the business from the MNC and if financial markets are well developed decide to set up their own business fostering the appearance of new entrepreneurs. Finally, well functioning financial markets can enhance the potential for FDI to create backward linkages. If foreign firms acquire most of their supplies in the domestic market, access to external finance can benefit those firms that were already producing inputs in the industry but also it can encourage the creation of new firms. More recently, Javorcik and Spatareanu (2008) find for a sample of 319 Czech firms supplying 88 MNCs operating in the Czech Republic that domestic firms supplying MNCs are less credit constrained than non-suppliers. Moreover, they argue that this results from less constrained firms self-selecting into becoming MNC suppliers rather than the benefits being derived from the supplying relationship.

I focus on the experience of Mexico during the 1990s. Although Mexico had started its liberalization process before the 1994 North American Free Trade Agreement (NAFTA), the agreement was particularly successful in stimulating large FDI inflows especially into the manufacturing sector. FDI inflows in Mexico increased from a yearly average of \$4.5

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or Keller and Yeaple (2003) for the US.

billion between 1988 and 1993 to a yearly average of \$13 billion between 1994 and 2002, and about half of the FDI flowed into manufacturing. At the same time, there were two simultaneous forces that made access to credit become more difficult especially for small and medium size companies. First, in order to attract FDI the government prioritized the control of inflation which translated into an overvalued exchange rate and high interest rates<sup>2</sup>. Second, the chronic inefficiency of the domestic banking system in allocating credit created shortages of credit for domestic firms (Gallagher and Zarsky (2004)). I will show that these difficulties in accessing credit vary widely across Mexican states due to legal and historical reasons.

I use firm level data from three cross-section surveys carried out by the Mexican national statistical office in 1992, 1999 and 2001. The fact that the surveys include micro and small establishments helps determining the role of size in FDI spillovers. Once, it has been established that it is larger firms that benefit from FDI, a small subsample of mainly medium and large firms that could be linked across surveys, is used to confirm that the main results are robust to controlling for firm specific effects. However, it is important to note that this subsample refers mainly to larger firms and therefore, the focus on the cross-section results is crucial in order to determine the importance of size. On the methodological side, to obtain firm level estimates of total factor productivity, the paper follows the literature on the structural identification of production functions, using a new approach that improves upon the Levinsohn and Petrin (2003) methodology. Finally, the endogeneity of financial development is addressed using historical instruments. I argue that there are differences in the legal framework and historical differences across the Mexican states that can explain current disparities in the regional banking sector development. In particular, Laeven and Woodruff (2008) show that the quality of legal institutions is lower in states where the indigenous population was more prevalent one hundred years ago. In addition, I argue that the Mexican government preferential credit program to small and medium firms from 1956 to 1989 shaped current regional differences in access to credit.

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<sup>2</sup>Interest rates averaged 22% between 1994 and 2002.

The paper is organized as follows. Section 2 describes the data and the estimation strategy. From the description of the estimation strategy it would be clear that in order to conduct the analysis firm level TFP estimates and an indicator of local financial development are required. Section 3 deals with the productivity estimation technique and results while Section 4 explains the construction of the financial development index and the effect of a well-developed financial system on productivity. Finally, Section 5 reports the results from the spillover effects and the role of local credit markets and Section 6 concludes.

## 2 Data and Estimation Strategy

### 2.1 Data

The data use in this study come from the Encuesta Nacional de Empleo, Salarios, Tecnología y Capacitación (ENESTyC) [National Survey of Employment, Wages, Technology and Training], which is a survey carried out by the Mexican National Statistical Office (INEGI). The analysis focuses on three waves of the survey, implemented in 1992, 1999 and 2001, which were designed as independent cross-sections.

The following characteristics make the ENESTyC survey ideal for the purposes of this study<sup>3</sup>. First, it is possible to identify the sector and region in which firms operate. There are 52 ramas (branches) of activity<sup>4</sup> and 32 regions corresponding to the different Mexican federal states. Second, the surveys do not only include medium and large firms but extend the analysis to micro and small establishments which are crucial to detect financial difficulties. According to the INEGI classification micro establishments are those with less than 16 employees; small establishments have between 16 and 100 employees; medium establishments are those that have between 100 and 250 employees and finally, large establishments report more than 250 employees<sup>5</sup>. Panel A of Table 1 presents data

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<sup>3</sup>See Appendix I for a detailed description of the data and cleaning procedure.

<sup>4</sup>The industrial classification is based on the Clasificación Mexicana de Actividades y Productos (CMAP) [Mexican Classification of Activities and Products]. Industries are grouped in 6-digit industries called clases (classes), 4-digit industries called ramas (branches), and 2-digit industries called divisiones (divisions).

<sup>5</sup>The survey is conducted at the establishment level. However, through out the analysis the words

on the final number of firms according to their size and year of survey. Third, maquiladora plants<sup>6</sup> are included in the surveys reflecting their rising importance in Mexico. According to aggregate INEGI data on employment in exporting maquiladora sectors, between 1991 and 2000 maquiladora employment grew 197 percent. Correspondingly, in the ENESTyC dataset the percentage of employment in maquila plants increased by 230 percent during the same period. Finally, and most importantly, firms provide detailed information about their ownership structure in each survey.

Panel B in Table 1 provides some basic information on foreign ownership. Foreign firms are defined as those whose capital share owned by foreign investors is at least 10 percent<sup>7</sup>. On average, the share of foreign investors in total manufacturing establishments remains almost unchanged over time however; the fraction of manufacturing output accounted for by foreign affiliates grew from 39% in 1991 to 52% in 2000.

Table 2A shows the industrial variation in foreign employment and output share. Similarly, Table 2B reports the regional variation. According to Table 2A, foreign investors account for most of the production and employment in sectors like Textiles, Chemicals and Machinery and Equipment. In addition, over time, Textiles and Non Metallic Minerals industries have experienced the greatest increase. With respect to the regional variation, Table 2B shows that the contribution of foreign investment to employment and output is greater in the border states, the Federal District and its adjacent states and in the north-center states.

The data have two important limitations. First, the share of micro establishments grew by more than 15 percentage points between the 1992 and 2001 surveys (Panel A in Table 1). This is the result of an increasing interest on the part of the Mexican authorities to study the behavior of micro establishments. However, this change in the sample composition could lead to erroneous conclusions and therefore, it seemed convenient to

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establishment, firm and plant will be used indistinctively.

<sup>6</sup>Maquiladora or maquila plants are assembly plants that participate in a Mexican government export promotion program.

<sup>7</sup>Results are robust to alternative percentage thresholds (i.e. 30 percent and 50 percent) which in turn suggests limited effects of the extent of foreign ownership. See section 5.4. for a complementary note to this comment.

exclude micro establishments from the general analysis<sup>8</sup>. Second, the sample was designed to be representative at the sectoral level. However, the wide coverage of the survey and the fact that large and medium firms were included with certainty make it possible to focus on regional aspects. A potential concern may arise if micro and small firms were drawn systematically from some particular regions. In order to rule out this possibility, I compared the contribution of sampled firms in each region to total value added with aggregate INEGI data on the share of regional GDP in total GDP and found no significant differences.

## 2.2 Estimation Strategy

To examine the relationship between the productivity of domestic firms and FDI in their same sector/region of activity the standard approach followed in other studies is to estimate an equation of the following form:

$$\ln TFP_{ijrt} = \alpha + \beta_1 Spillover_{\psi t} + \alpha_t + \alpha_r + \alpha_j + \varepsilon_{ijrt} \quad (1)$$

where  $TFP_{ijrt}$  stands for the total factor productivity of firm  $i$  operating in sector  $j$  and region  $r$  at time  $t$ ,  $Spillover$  is a variable that proxies the extent of foreign presence at time  $t$  in region  $r$  if  $\psi = r$  or in sector  $j$  if  $\psi = j$ .  $\alpha_t$ ,  $\alpha_r$  and  $\alpha_j$  are time, regional and sector-specific controls, respectively. The convention is to define the spillover variable as the ratio of foreign firms' sales over total sales in industry  $j$  or region  $r$ <sup>9</sup>. In addition, following Javorcik (2004) it is possible to take into account the share of foreign equity so that the final proxy for spillovers is:

$$Spillover_{\psi t} = \frac{\sum_{i \in \psi} ForeignShare_{it} * Y_{it}}{\sum_{i \in \psi} Y_{it}} \quad (2)$$

where  $ForeignShare$  represents the share of capital owned by foreign investors,  $\psi$  can represent either sector or region and  $Y_{it}$  is deflated output by firm  $i$  at time  $t$ . There

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<sup>8</sup>Micro establishments will only be considered in Section 4 when constructing the measure of regional financial development. In this case, only data from the 1999 and 2001 surveys is used and as shown in Panel A of Table 1, these are comparable in terms of sample composition.

<sup>9</sup>Similarly one can use employment as weights (see Aitken and Harrison (1999)).

is no theoretical consensus on how broadly regional and sectoral spillovers should be defined. I distinguish between 32 regions that correspond to the 31 Mexican federal states and the Federal District to compute regional spillovers. Regarding sectoral spillovers, I focus on the 4-digit CMAP industry classification and therefore, consider 52 branches of activity. Unfortunately, measures of vertical spillovers<sup>10</sup> could not be computed since the most recent Input-Output table is dated in 1980 while the period of analysis refers to the 90s. However, as we will see there is strong evidence suggesting the existence of regional FDI spillovers and considering that most of the supplier/distributor contacts are local in scope, it is most probable that these regional spillovers in fact take place through backward and forward linkages. Although, this is an open question given the impossibility of distinguishing between horizontal and vertical spillovers. Finally, in line with theories underlying the role of dynamics in technology diffusion (see Kugler (2006) for a particular application to FDI spillovers) it would have been more suitable to use lagged values of sectoral and regional spillovers rather than testing the contemporaneous effect. However, the cross-section nature of the ENESTyC survey made this exercise impossible. Nevertheless, the empirical literature does find a contemporaneous effect and if anything, using lagged values translates in larger estimates and higher statistical significance. Therefore, estimates from using current values of FDI spillovers are a lower bound to the greater positive effects that could take place over time.

As mentioned in the introduction, the traditional approach in search for horizontal or regional spillovers has not been very successful in finding positive effects from MNC presence. This paper concentrates on the role of financial markets as a channel for FDI spillovers. In particular, the following equation will be estimated:

$$\ln TFP_{ijrt} = \alpha + \beta_1 Spillover_{\psi t} + \beta_2 (Spillover_{\psi t} * FinDev_r) + \alpha_t + \alpha_r + \alpha_j + u_{ijrt} \quad (3)$$

where *FinDev* is a measure of financial development at the state level<sup>11</sup>. Since the specification controls for regional and industry specific effects the only effects that are

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<sup>10</sup>Vertical spillovers are inter-industry spillovers that usually take the form of backward linkages or contacts between clients and suppliers. Evidence of FDI spillovers through backward linkages has been found in Blalock (2001) for Indonesia, Javorcik (2004) for Lithuania and Kugler (2006) for Colombia.

<sup>11</sup>See Section 4 for a description of how this variable is constructed.

identified are those relative to variables that vary over time. Therefore, although the direct effect of financial development on productivity cannot be identified, following Rajan and Zingales (1998) estimation strategy, it is still possible to estimate the effect of FDI conditional on different regional levels of financial development. Regional dummies  $\alpha_r$  would capture overall region specific characteristics including differences in the financial system. In theory, we would expect  $\beta_2$  to be positive and significant so that controlling for sectoral/regional FDI, domestic firms located in states characterized by easier access to external funds will benefit more from MNC presence.

## 3 Productivity Estimation

### 3.1 Theoretical Background

Firm-level productivity estimates are obtained by estimating a Cobb-Douglas production function:

$$y_{it} = \beta_l l_{it} + \beta_m m_{it} + \beta_k k_{it} + \omega_{it} + u_{it} \quad (4)$$

where  $y_{it}$ ,  $l_{it}$ ,  $m_{it}$  and  $k_{it}$  denote the logarithm of deflated output, labor, deflated material inputs and deflated capital<sup>12</sup>, respectively. The firm specific error can be decomposed into a term capturing firm specific productivity  $\omega_{it}$  and an additional term that reflects measurement error or an unexpected productivity shock  $u_{it}$ . We are interested in estimating  $\omega_{it}$ . Given the characteristics of the ENESTyC survey the main concern related to the estimation of  $\omega_{it}$  is simultaneity bias<sup>13</sup>. Productivity is known by the firm but ignored by the econometrician, so if the firm knowing its own productivity chooses inputs accordingly, OLS will deliver a bias estimate. The direction of the bias will depend on the correlation between inputs and the correlation of inputs and productivity. In general,

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<sup>12</sup>See Appendix I for a description of the variables and price deflators used. Note that including separately skilled and unskilled labor was not possible due to lack of data referring to previous years.

<sup>13</sup>Sample selection due to exit should not be a problem given the cross-section and random selection nature of the survey. In addition, the “omitted price bias” derived from proxing physical output by deflated sales using an industry price deflator should be mitigated. The proxy for output used is not sales but the value of production priced at “factory” price. Moreover, Katayama, Lu and Tybout (2003) show that traditional TFP estimates are highly correlated with their proposed measure of TFP that accounts for imperfect competition. Finally, the ranking provided by the estimated measures of productivity would still be valid as long as more productive firms charge higher markups.

if more productive firms tend to hire more workers, buy more materials or invest more in capital, OLS may lead to an upward bias of the input coefficients. To control for the simultaneity bias I use a version of the Levinsohn and Petrin (2003) semiparametric estimator (LP hereafter) developed by Akerberg, Caves and Frazer (2006) (ACF hereafter) where I consider a gross output production function rather than a value added production function<sup>14</sup>.

ACF propose to “give up” the estimation of  $\beta_l$  in the first stage of the LP procedure and they formulate the following timing assumptions. First, as in the LP procedure,  $k_t$  is chosen at time  $t - 1$  however,  $l_{it}$  is assumed to be chosen at time  $t - b$  ( $0 < b < 1$ ) prior to the choice of  $m_{it}$  at time  $t$ . In other words, labor is considered a “less flexible” input than materials which they argue is consistent with firms needing time to train new workers or needing to give some period of notice before firing<sup>15</sup>. In addition, it is assumed that  $\omega_{it}$  evolves according to a first order Markov process between the subperiods  $t - 1$ ,  $t - b$  and  $t$  so that:

$$p(\omega_{it}|I_{it-b}) = p(\omega_{it}|\omega_{it-b}) \quad (5)$$

and

$$p(\omega_{it-b}|I_{it-1}) = p(\omega_{it-b}|\omega_{it-1}) \quad (6)$$

where  $I_{it-b}$  is the information set at time  $t - b$  and  $I_{t-1}$  is the information set at time  $t - 1$ . Given these timing assumptions, the firm’s material input demand function can be expressed as a function of  $l_{it}$ <sup>16</sup>:

$$m_{it} = f_t(\omega_{it}, k_{it}, l_{it}) \quad (7)$$

where  $f_t$  represents input prices and/or product market conditions that are allowed to vary over time but not across firms. Inverting this function it is possible to obtain an

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<sup>14</sup>See Akerberg et al (2006) for a discussion on the advantages and disadvantages of output versus value added production functions.

<sup>15</sup>Even in the context of high labor flexibility it is reasonable to assume that labor is less variable than material inputs.

<sup>16</sup>See Levinsohn and Petrin (2003) for a description of the conditions under which the material input demand function is a strictly increasing function of current productivity  $\omega_{it}$ .

expression for  $\omega_{it}$ , that substituted in the production function generates the following first stage equation:

$$y_{it} = \beta_k k_{it} + \beta_l l_{it} + \beta_m m_{it} + f_t^{-1}(m_{it}, k_{it}, l_{it}) + \epsilon_{it} \quad (8)$$

Although  $\beta_l$ ,  $\beta_k$  and  $\beta_m$  are not identified at this stage it is possible to recover an estimate of the composite term  $\hat{\Phi}_{it}$ ,

$$\hat{\Phi}_{it}(m_{it}, k_{it}, l_{it}) = \beta_k k_{it} + \beta_l l_{it} + \beta_m m_{it} + f_t^{-1}(m_{it}, k_{it}, l_{it})$$

Equation (9) is estimated as a partially linear model including a third order polynomial in capital, labor, materials and the corresponding cross products, to approximate the unknown functional form of  $f_t^{-1}$  and obtain as estimates of  $\hat{\Phi}_{it}$  the predicted residuals of this regression.

Given that no coefficient is identified in the first stage three independent moment conditions are required for identification in the second stage. From the first order Markov assumption on the evolution of productivity is it the case that

$$\omega_{it} = E[\omega_{it}|I_{it-1}] + \xi_{it} = E[\omega_{it}|\omega_{it-1}] + \xi_{it} \quad (9)$$

which simply decomposes  $\omega_{it}$  into its conditional expectation at time  $t - 1$ ,  $E[\omega_{it}|I_{it-1}]$  and a deviation from that expectation,  $\xi_{it}$ , which is often referred to as the “innovation” component of  $\omega_{it}$ . Since by assumption, capital was determined at time  $t - 1$  this implies that  $\xi_{it}$  is orthogonal to  $k_{it}$ , which is the same moment condition that LP uses to identify the capital coefficient. Regarding the identification of  $\beta_m$ , as  $m_{t-1}$  was decided at  $t - 1$  and hence part of  $I_{it-1}$ ,  $\xi_{it}$  should be uncorrelated with  $m_{t-1}$ . Finally, the identification of  $\beta_l$  is based on the observation that lagged labor  $l_{it-1}$ , was chosen at time  $t - b - 1$  and hence, it is in the information set  $I_{it-1}$  which is uncorrelated with  $\xi_{it}$ <sup>17</sup>. Therefore, the final moment conditions are:

$$E[\xi_{it} \cdot \begin{pmatrix} k_{it} \\ m_{it-1} \\ l_{it-1} \end{pmatrix}] = 0 \quad (10)$$

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<sup>17</sup>Akerberg et al (2006) propose to use wither contemporaneous labor or lagged labor as identifying conditions. In this case given the short time dimension of the data I opted for lagged labor values.

In practice, the implementation of these moment conditions is analogous to the second stage of the LP procedure. First, candidate values for  $(\beta_l, \beta_m, \beta_k)$  are to be chosen, say  $(\beta_l^*, \beta_m^*, \beta_k^*)$  which in this case correspond to the OLS estimates from a Coob-Douglas production function. I compute estimates of  $\omega_{it}$  as:

$$\hat{\omega}_{it} = \hat{\Phi}_{it} - (\beta_l^* l_{iy} + \beta_m^* m_{it} + \beta_k^* k_{it})$$

and regress non-parametrically  $\hat{\omega}_{it}(\beta_l, \beta_m, \beta_k)$  on  $\hat{\omega}_{it-1}(\beta_l, \beta_m, \beta_k)$  which implies regressing  $\hat{\omega}_{it}$  on a third order polynomial of  $\hat{\omega}_{it-1}$  and a constant term. Second, the predicted residuals from this regression,  $\hat{\xi}_{it}(\beta_l, \beta_m, \beta_k)$ , are used to form the sample analogue of the theoretical moment conditions:

$$\frac{1}{T} \frac{1}{N} \sum_t \sum_i \hat{\xi}_{it}(\beta_l, \beta_m, \beta_k) \cdot \begin{pmatrix} k_{it} \\ m_{it-1} \\ l_{it-1} \end{pmatrix} = 0 \quad (11)$$

and use non-linear least squares to estimate the  $(\hat{\beta}_l, \hat{\beta}_m, \hat{\beta}_k)$  that minimize this sample analogue.

## 3.2 Productivity Results

The production function is estimated separately for each industry <sup>18</sup>. Table 3 reports the estimated coefficients based on OLS, LP and ACF. In general, all estimation strategies provide estimates that are highly significant for all input variables and for all 9 different sectors. Although it is not possible to establish precisely the direction of the OLS bias in a setting with more than two inputs, comparing the OLS and the ACF results by sector reveals that OLS tends to overestimate the coefficient on the more flexible inputs. Regarding capital, there is only one sectors (36) where the ACF coefficients are higher than the corresponding OLS ones. As suggested in Akerberg et al (2006) this result corresponds to a case where labor is more “variable” than capital and as a result  $l_{it}$  is more correlated with  $\omega_{it}$  than  $k_{it}$ . Comparing the ACF results to the LP results, the most significant finding as in Akerberg et al (2006) is that the LP estimates of the labor coefficient are smaller than their ACF counterparts. This result hints the possibility that the LP labor coefficients from the first stage might be downward bias.

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<sup>18</sup>In order to have enough observations for the estimation I use the 2-digit sector classification.

Finally, to obtain a measure of total factor productivity as the difference between actual and predicted output<sup>19</sup>, I use the input coefficients from the ACF estimation:

$$tfp_{it} = y_{it} - \hat{\beta}_l l_{it} - \hat{\beta}_m m_{it} - \hat{\beta}_k k_{it} \quad (12)$$

Furthermore, following Pavnick (2002) I normalized the productivity estimate obtained from equation (12) so as to obtain a measure that describes firm productivity over time and firm's relative position compared to a reference plant. The normalization consists in subtracting to each plant's productivity, the productivity of a reference plant, which in this case is chosen to be a domestic plant with mean output and mean input level in 1989<sup>20</sup>:

$$tfp_r = \bar{y}_{89} - \hat{\beta}_l \bar{l}_{89} - \hat{\beta}_m \bar{m}_{89} - \hat{\beta}_k \bar{k}_{89} \quad (13)$$

where the bar denotes the mean in year 1989. Therefore, unless otherwise indicated, the measure of total factor productivity used from now onwards corresponds to:

$$IndTFP_{it} = tfp_{it} - tfp_r \quad (14)$$

## 4 Financial Development

The ENESTyC survey contains very limited information regarding the easiness with which firms access credit. Although, there is an extensive literature studying the interaction between financial markets and economic growth across countries<sup>21</sup> there are very few studies looking at within country differences in financial development<sup>22</sup>. One exception is Guiso, Sapienza and Zingales (2004) that develop a new indicator of the soundness of the local financial system across different Italian provinces. Better developed financial markets are defined as those that grant individuals and firms easier access to external

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<sup>19</sup>Rigorously, to obtain an accurate estimate of  $\omega_{it}$  one should subtract an estimate of error term  $u_{it}$ . However, given that  $E(u_{it}) = 0$  this is generally ignored. Van Biesebroeck (2007) proposes a way to purge the random noise from the productivity estimates obtained by the Olley and Pakes (1996) procedure.

<sup>20</sup>The 1992 survey includes questions on the production process from 1989 to 1991.

<sup>21</sup>See King and Levine (1993), Beck, Levine and Loayza (2000) and Levine, Loayza and Beck (2000).

<sup>22</sup>Jayaratne and Strahan (1996); Dehejia and Lleras-Muney (2003); Guiso, Sapienza and Zingales (2004); Bertrand, Schoar and Thesmar (2004); Cetorelli and Strahan (2006).

funds. Following their estimation strategy I obtain a similar indicator for the various Mexican states.

## 4.1 Financial Development Indicator Methodology

The 1999 and 2001 surveys contain the following two questions:

1. “Mainly, which type of machinery and/or equipment did the establishment acquire in order to carry out the production process?”
2. “In case the establishment did not acquire any machinery or equipment, what was the main reason?”

Firms could choose among various options to answer question 2: (1) Because they did not need it; (2) Lack of financing; (3) Importing problems; (4) Trade union opposition; (5) Other; (6) Do not know. I am interested in option (2) where firms state that they did not invest in machinery and equipment because they lacked financial resources. Around seventy percent of the sampled firms did buy machinery and equipment, of the 30% remaining that did not buy machinery, 32% (1,311 firms) did not acquire it because of lack of external funds. In order to estimate the probability that a firm lacks access to external funds I consider a final sample of 11,574 firms that either acquired machinery or wanted to buy machinery but were prevented from doing so because of financial problems. Table 4 reports summary statistics of the distribution of firms across regions and the proportion of them that state difficulties in accessing credit. The Southern states of Chiapas, Guerrero and Oaxaca together with states from the Yucatan area like Tabasco and Campeche are the ones with the highest proportion of firms reporting difficulties in accessing credit. In addition, the availability of credit does not only vary across regions but also across sectors. Table 5 shows the sectoral distribution of firms and the percentage of them that report difficulties in financing their investment projects. Sectors 35 (Chemicals), 37 (Basic metals), 38 (Machinery and Equipment) and 32 (Textiles) are in this order the ones with the lowest percentage of firms reporting financial problems.

Following Guiso et al (2004), I estimate a linear probability model of the likelihood a firm cannot buy machinery and equipment because of lack of financial resources. Con-

trolling for firm characteristics and including regional dummies, it is possible to obtain an indicator of how much more likely a firm is to have difficulties in financing machinery investment in one state compared to another. The measure of financial development will be the ranking provided by the coefficients of the regional dummies included in the estimation<sup>23</sup>. Note that the choice of a regional financial development indicator rather than directly using the answers to the credit questions provided at the firm level is based on two issues. First, the credit questions were only included in the 1999 and 2001 surveys which would prevent the use of the 1992 survey<sup>24</sup>. Second, the subsample of credit constrained firms is as expected mainly composed of micro establishments. In fact, of the 1,311 firms that report some difficulty in financing machinery and equipment, 62% correspond to micro establishments and 19% to small establishments, while medium and large firms only represent a 13 and 6 percentage, respectively. Using a firm level measure of access to credit would mean restricting the analysis to mainly micro and small establishments which are later shown to be less likely to benefit from MNCs' activities. However, the information reported by these firms is still a valid indicator of the cross-regional variation in access to credit.

Table 6 reports the results from the linear probability model. As in Beck, Demirguc-Kunt, Laeven and Maksimovic (2006), older and bigger firms are less likely to have problems in accessing credit. Moreover, in the case of age there is an additional non-linear effect captured by the significance and positive sign of  $Age^2$ . This result indicates that there is a threshold age level above which the probability of having access to finance decreases. The difference with the Beck et al. (2006) study is that foreign ownership is not a significant determinant of access to external funds. The export status of the firm and whether the firm belongs to a group or not both decrease the probability of being credit constrained. In addition to these firm-specific characteristics, the estimation also controls for sector specific characteristics that might make firms in particular sectors

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<sup>23</sup>The choice of a linear probability model was done for ease of interpretation but since the object of interest is the ranking provided by the regional dummies, the same results were obtained from an exponential model.

<sup>24</sup>See the last paragraph of the section for a discussion on the validity of the financial development indicator over time.

more prone to financial constraints. First, the estimation includes the share of total credit in output by sector. This variable turns out to significantly decrease the probability of experiencing borrowing difficulties. Second, to further control for sectoral differences in the availability of credit, a dummy variable for sectors that benefited from the FOGAIN program is included<sup>25</sup>. If commercial banks specialized in lending to particular sectors, we would expect firms in those sectors to have easier access to credit. In fact, the estimated coefficient for the FOGAIN variable is statistically significant and signed in the expected direction. Finally, to control for the possibility that sectors with low financial constraints are also sectors with limited external dependence, the external dependence index developed by Rajan and Zingales (1998) is added to the estimation. Unexpectedly, according to the results in Table 6, sectors in higher need of external funds are less prone to financial constraints<sup>26</sup>.

The financial development indicator is based on the coefficient estimates of the regional dummies from the previous regression which are reported in Table 7. The reference region is Oaxaca that is situated in the South of Mexico and according to the results is the state where firms have more difficulties in accessing credit. In all other regions, the coefficient on the regional dummy is negative and significant at the 1 percent level, suggesting that compared to Oaxaca it is easier to access credit in any other state<sup>27</sup>. In order to have a measure of financial development that varies between 0 and 1, I normalize the regional coefficients according to:

$$FinDev = \frac{RegionalCoefficient}{min(RegionalCoefficient)} \quad (15)$$

Column (2) of Table 7 reports the final measure of financial development used in the rest

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<sup>25</sup>See section 5.2 for a description of the FOGAIN program. FOGAIN equals 1 in the food industry (31), textiles, leather and shoes (32), the basic metal industry (37), the chemical industry (35) and that of electric apparel (383) (Assidon and Estrada Calderon (2006)).

<sup>26</sup>An unsolved issue is that of overlending. If in certain states banks tend to lend more irrespective of the creditworthiness of the borrower, the financial development indicator would be higher but it would not reflect a better financial system. In order to avoid this potential bias, Guiso et al (2004) include in the estimation a measure of the percentage of non-performing loans on total loans by state. Unfortunately, this data in Mexico is not available and therefore, in some sense this measure reflects more credit availability than financial development.

<sup>27</sup>Only the regional dummy referring to the state of Colima is not significant, suggesting no differences between Oaxaca and Colima in access to credit.

of the analysis. The indicator of financial development displays great variation across different states, disregarding the extremes, it ranges from 0.449 in Tlaxcala to 0.991 in Nayarit. Although border states seem to be the ones with better credit markets the division is not clear cut. Figure 1 in Appendix III shows the regional distribution of the financial development indicator. Some Northern states like Coahuila, Chihuahua or BCS show a lower financial development indicator than we would expect while the opposite phenomenon occurs with southern states like Guerrero.

Finally, there are some issues associated with the financial development indicator. First, the measure might overstate the availability of credit. The reason is that it is not possible to know whether firms that financed the acquisition of machinery with external funds, obtained as much resources as they would have liked. However, the ranking provided by the indicator would be valid for our purposes if banking systems, in which firms cannot undertake investment projects because of lack of resources, are also systems that tend to pose greater difficulties in obtaining the full amount of credit. Second, the indicator is constructed using data only from the last two surveys (1999 and 2001) and does not vary over time. There are two main changes in the banking system during the 90s that could cast doubt on the validity of the ranking provided by the financial development indicator over time. First, in 1991 the banking system was privatized. Before, banks had channeled most lending to the federal government so private credit was very low. Once privatized, banks increased their lending to the private sector, especially to risky projects seeking high returns. However, soon after the privatization the country was shaken by the 1994 Tequila Crisis. The crisis mined the ability of borrowers to repay their debt which in turn made banks more vulnerable to the crisis and increased their reticence to lend. Consequently, from 1994 onwards, there has been a sharp decrease in private credit. These events show how, although for different reasons, the low lending rates in 1991 were also characteristic from the late 90s. The second major change in the banking system during the 90s was the entry of foreign banks in 1997. However, foreign banks contributed to the recapitalization of the banking sector after the crisis but, there is no evidence that they alleviated the credit crunch. Figure 2 shows the percentage of

banking credit to the industrial sector as a fraction of GDP and it can be observed that the low figures of 1991 (only 5% of GDP) were still characteristic of the late 90s. Finally, if firms could access credit in markets other than the local one, local market conditions would become irrelevant. Empirical evidence suggests that distance matters in the provision of credit and matters even more for small firms (Petersen and Rajan (2002), Guiso, Sapienza and Zingales (2004)). In the case of Mexico, high information costs make the local credit market even more pertinent. Moreover, results in Table 6 show statistical and highly significant coefficients of the regional dummies, suggesting regional differences on the probability of reporting financial problems.

## 5 Estimation Results

### 5.1 Baseline Specification

Table 8 and Table 9 report the results from estimating equation (3) when considering sectoral and regional spillovers, respectively. Here, sectoral spillovers refer to the 4-digit industry classification. The case for spillovers from foreign firms operating in the same sector and region turned out to be not significant and therefore is not reported<sup>28</sup>. In addition, all estimation equations include GDP per capita at the state level<sup>29</sup> to control for time varying regional characteristics and the Herfindahl index ( $HHN$ )<sup>30</sup> to control for industry concentration. It is argued that foreign entry can lead to more competition resulting in an improvement of domestic firms' productivity. This pro-competitive effect might be regarded as an spillover effect but since our primary concern is the existence of productivity spillovers due to knowledge transfer, the  $HHN$  index is supposed to help disentangling both effects. Finally, provided the main interest of this paper is the

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<sup>28</sup>However, when considering the case of spillovers from firms operating in the same 2-digit sector and region (i.e. a broader sector classification), results were this time significant. This in turn, would hint to the existence of vertical spillovers, since the broader sector definition comprises sectors that do not compete with each other. Nevertheless, these results were not robust to the instrumental variable approach and therefore were not carry on further.

<sup>29</sup>The first available year for state level GDP is 1993 therefore I use it as an approximation for the state level GDP in 1991.

<sup>30</sup>The index is defined as the sum of the squares of the market shares of each individual firm. To make the index vary between 0 and 1, it is normalized as  $HHN = \frac{H - (1/N)}{1 - (1/N)}$

productivity performance of domestic firms, results are reported separately for the whole sample of firms and for the sample of domestic firms only.

Regarding the estimation technique, results were obtained by weighted least squares (WLS). The weights used in estimation are firm's share of sectoral employment. The advantage of WLS is that it allows attaching greater importance to larger plants which might be crucial in the context of FDI spillovers if certain technology sophistication is necessary to benefit from MNCs activities<sup>31</sup>. In addition, all reported standard errors are clustered for all observations in the same 4-digit industry and year or region and year depending on the estimated regression. In the absence of clustering, Moulton (1990) showed that when an aggregated variable is used as a regressor in equations estimated at a micro level, OLS standard errors will be downward bias and will tend to find that the aggregate variable is statistically significant.

Table 8 shows the basic results when sectoral spillovers are considered. Columns (1) and (2) consider the total sample of firms while (3) and (4) look only at the sample of domestic firms. Moreover, in order to unmask any potential concern about the choice of productivity measure, columns (1) and (3) correspond to exploratory regressions where the dependent variable is  $\ln(output)$  and the explanatory variables include labor, materials, capital, whether the firms is foreign owned or not and proxies for spillovers, the interaction between spillovers and financial development, industry concentration and regional GDP. Similarly, columns (2) and (4) report results when the dependent variable is  $\ln TFP$  from the ACF estimation. It is reassuring that results across estimation strategies are highly consistent. In particular, it is shown that foreign owned firms are more productive than their domestic counterparts. However, as shown in column (2), there is only a marginal positive significant effect from foreign companies on firm productivity after conditioning on regional financial development. More importantly this marginal significant effect disappears once the sample of domestic firms is considered (see column (4)).

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<sup>31</sup>In addition to the economic reasoning behind the choice of WLS a Breusch-Pagan test for heteroskedasticity on size (firm number of workers) rejected the null hypothesis of homoskedasticity.

The lack of sectoral spillovers is consistent with results from previous studies using data from developing and emerging economies. However, there are reasons for productivity spillovers being geographically limited. Most of the channels for FDI spillovers are local in scope. Contacts between clients and suppliers are usually at the local level, labor mobility is rather limited across regions<sup>32</sup> and according to the economic geography literature tacit knowledge is transmitted more efficiently over small distances.

Consequently, Table 9 reports the basic results when considering regional spillovers. The structure of the table is similar to Table 8 and again, there is consistency between the results obtained with  $\ln(output)$  as dependent variable (columns (1) and (3)) and results where the dependent variable is  $\ln TFP$  (columns (2) and (4)). Table 9 highlights the importance of local financial markets conditions if firms are to benefit from FDI (i.e. the interaction term between the measure of spillovers and financial development is positive and significant both for the total sample of firms and the sample of domestic firms.).

The importance of local financial markets conditions if firms are to benefit from FDI is a key result given the little success of previous studies in finding significant effects of foreign presence in the same region on the TFP of domestic firms. However, at this point financial market development is not exogenous to firm level total factor productivity and before going into the interpretation of the results next section addresses endogeneity concerns.

## 5.2 Endogeneity Issues and Economic Relevance

One of the main concerns when studying the relationship between firm level TFP and indicators of financial development is that of reverse causality. In other words, it might not be that better financial systems contribute to higher firm level productivity but more productive firms might attract banking opportunities. In the case of Mexico, it is possible to find instruments that deal with the potential endogeneity of the financial development indicator, based on legal and historical factors shaping state differences in access to credit.

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<sup>32</sup>Esquivel (1999) shows that in Mexico the response of domestic labor migration flows to regional income differentials is small. Similarly, Chiquiar (2008) shows that NAFTA did not induce a significantly faster migration flow toward the border.

Regional differences in accessing credit are explained by two different sets of factors. First, differences in the legal framework across states can generate differences in the ease of accessing credit. The World Bank publication “Doing Business in Mexico 2007” reports significant differences in the time and costs involved in the signing and registering of the collateral required to obtain credit across Mexican states. Similarly, Laeven and Woodruff (2008) argue that state laws also vary on the ease with which collateral can be claimed by a victor in a court decision. Based on these legal factors shaping state differences in access to credit, I use a historical instrument that according to Laeven and Woodruff (2008) explain state-level variation in legal enforcement. They show that the quality of legal institutions is lower where the indigenous population was more prevalent at the beginning of the century<sup>33</sup>. In states where the share of indigenous population was higher, European settlers were more likely to develop institutions designed to exploit local labor and hence, establish a worse institutional environment. Therefore, I use their data from 1900<sup>34</sup> on the percentage of indigenous population at the state level.

Second, there are various historical reasons to think that the financial system varies across states. Although currently banks can branch freely across different states, from the end of the 19th century and during most of the 20th century the Mexican banking system was greatly segmented. At the beginning of the twentieth century, there were only two big banks, Banamex and Banco de Londres y Mexico, that were allowed to branch across state lines. As for the rest, each state had a bank that was given a local monopoly thanks to Federal Government restrictions to entry (Haber (2003)). In addition, the evolution of the regional banking system was affected by the development policies of the central government. From 1953 to 1989, the Mexican government channeled preferential credit (in the sense of availability at a lower interest rate) to targeted sectors and regions through com-

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<sup>33</sup>Laeven and Woodruff (2008) also find that lower quality levels in the legal framework are characteristic from states with higher production of agricultural crops with high economies of scale (i.e. sugar, coffee, rice and cotton.). Therefore, they suggest as a potential instrument the number of the aforementioned crops by state in 1939. However, first stage results showed that this variable is not significant and consequently I did not include it in the analysis.

<sup>34</sup>The states of Quintana Roo and Baja California were created after 1900. For these states data from the 1930 census, the first census after they became states, is used (Laeven and Woodruff (2008)).

mercial banks. Among different initiatives, the government set up a public fund named FOGAIN that granted preferential credit to small and medium firms<sup>35</sup>. In 1989, as part of a general attempt to reform the financial system the Mexican government eliminated this directed credit program<sup>36</sup>. However, given the high information costs characterizing the Mexican financial system, commercial banks previously doing the intermediary function may have continued lending from their own funds, to firms in earlier targeted sectors and regions. In fact, according to Galindo and Schiantarelli (2002), in Latin America access to credit does not only depend upon favorable balance sheet characteristics but also upon the closeness of the relationship between firms and banks. To the extent that credit allocation was driven by personal and political interests the effectiveness of the program in fostering widespread economic growth has been often questioned. However, the program strengthened the banking system by forcing contacts between private banks and credit seekers. By increasing the volume of operations in commercial banks of particular regions, the program generated an asymmetric evolution in the local banking system. Therefore, the second instrument only for the sample of domestic firms will be the average of the credit allocated under the FOGAIN program during 1960 to 1989 to the manufacturing sector by state and normalized by the state population in year 1980<sup>37</sup>.

Table 10 shows the results of estimating equation (3) instrumenting for the interaction term between regional spillovers and financial development. Standard errors are clustered at the region-time level<sup>38</sup>. The first stage regression is reported at the bottom of the table.

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<sup>35</sup>FOGAIN: Fondo de Garantía para la Industria Mediana y Pequeña (Small and Medium enterprise Fund). The criterion used to define small and medium firms was based on the social capital of the firm. During the first years of the program, the social capital required to benefit from the program was between 25,000 and 5 millions of pesos. The social capital requirement was modified thereafter, so that in 1979 it accounted to a figure between 50,000 and 40 millions of pesos and in 1980 a final upper limit of 60 million of pesos.

<sup>36</sup>Although the direct credit program was eliminated the development bank continued to offer rediscounting operations until 1994.

<sup>37</sup>The year 1980 is the earliest year for which population data is disaggregated by state. Normalizing by state level GDP would have been more relevant unfortunately, data was not available.

<sup>38</sup>The number of clusters (96 clusters=32regions\*3time periods) is smaller than the sum of exogenous regressors and excluded instruments and therefore, the covariance matrix of orthogonality conditions is not of full rank. To sidestep this problem, I follow Baum, Stillman and Schaffer (2003). They argue that by the Frisch-Waugh-Lovell theorem “partialling out” the exogenous regressors from all the other variables and constant, the two-step GMM estimation provides coefficients for the remaining regressors

Column (1) of Table 10 refers to the total sample of firms and instruments the interaction term with the interaction between spillovers and the share of indigenous population in 1900. The instrument is significant, with the expected sign and explains 24% of the variation in access to credit conditional on regional foreign presence. Compared with the WLS results in column (2) of Table 9, the interaction term remains positive and highly significant and the WLS-IV estimated coefficients are more than three times larger than the WLS counterparts in absolute terms<sup>39</sup>. Column (2) of Table 10 repeats the estimation for the sample of domestic firms using as instruments again the interaction between spillovers and the share of indigenous population in 1900 and adding the interaction between spillovers and the normalized FOGAIN data. The instruments are both significant, signed as expected and explain 46% of the variation in domestic firms' access to credit conditional of foreign presence in the region. The Hansen statistic confirms that the instruments pass the test of overidentification restrictions. The interaction term between spillovers and financial development remains significant and again comparing this WLS-IV results with the WLS results of column (4) in Table 9 shows that estimates almost tripled.

Although the overidentification test provides some confirmation of the validity of the instruments, there is some remaining concern with exclusion restrictions. In particular, the current share of indigenous population is highly correlated with the share in 1900. This will pose an identification problem if the current share of indigenous population is also correlated with firm level productivity. As suggested by Laeven and Woodruff (2008) I included the share of indigenous population in 2000 in the estimation and it turned out not to be statistically significant leaving the estimates and significance levels of the spillover and interaction variables unchanged.

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that are the same as if the variables would not have been partialled out. However, the IV identification tests are affected by the partialling out procedure since they depend on the number instruments and exogenous regressors used in the estimation. Hence, the F-test and Hansen test correspond to the equivalent regression without adjusting for clustering.

<sup>39</sup>As suggested by Tabellini (2005) the increase in the size coefficient after IV estimation, can be the result of measurement error in the financial development indicator or as indicated by Heckman (1997) the result of "heterogenous treatment effect". In the later case, if the instrument is correlated with the heterogeneity in the treatment, then IV estimates are inconsistent even with valid instruments.

As already mentioned, the lack of sectoral spillovers is consistent with previous studies using data from developing and emerging countries however, the existence of positive productivity spillovers at the regional level contrasts with the findings of Aitken and Harrison (1999) for Venezuela or recent evidence by Hale and Long (2007) using Chinese firm level data. The case of Mexico might in fact reflect positive agglomeration effects from FDI or be the result of a multicollinearity effect between the spillover variable and the measure of financial development. If foreign firms tend to locate in regions with better developed financial systems, the interaction term between the regional spillover variable and financial development will tend to overestimate the impact of MNC presence in that region. However, the correlation between these two variables is only 0.3418 and, as we will show later, foreign firms operating in Mexico do not seem to depend on the local banking system to finance their activities <sup>40</sup>.

Despite the positive and significant coefficient on the interaction term, the direct effect from FDI is negative and therefore, the total effect from FDI is not linear and depends on the level of financial development. According to the F-test reported in Table 10, the null hypothesis that the spillover variable and interaction term are jointly insignificant is rejected by the data. The total effect of the spillover variable on firm level TFP is derived from equation (3) and is given by<sup>41</sup>  $\beta_{total} = \beta_1 + \beta_2 * FinDev$ . Figures 3 and 4 show the total effect and confidence intervals for the total sample of firms and that of domestic firms, corresponding to the estimated coefficients in columns (1) and (2) of Table 10, respectively. Results from considering the total sample of firms, indicate that the total spillover effect is only positive and statistically significant for financial development values greater than 0.806. Regarding the sample of domestic firms, the WLS-IV results reveal a loss in significance of the total positive spillover effect. Why do results for the total sample of firms and that of domestic firms differ? There are two possible explanations. The first one asks whether foreign firms crowd out domestic firms from the credit market

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<sup>40</sup>The additional concern by which foreign firms might choose more developed regions to locate should be mitigated by the inclusion of regional fixed effects and GDP per capita.

<sup>41</sup>The corresponding standard errors are computed as  

$$sd(\beta_{total}) = \sqrt{Var(\beta_1) + FinDev^2 * Var(\beta_2) + 2FinDev * Cov(\beta_1, \beta_2)}$$

and whether it is foreign firms that are to benefit from being located in a region with a well developed financial system. In fact, re-estimating column (1) in Table 10 including interaction terms between *spillover*, *spillover \* FinDev* and whether the firm is foreign owned or not confirms that this does not seem to be the case. The insignificance of the triple interaction term between whether the firm is foreign owned or not, the regional measure of spillovers and the indicator of financial development shows that there is no significantly different effect for foreign firms. Foreign firms do not appear to crowd out domestic firms from local access to credit. This finding is in line with previous empirical evidence by Desai, Foley and Hines (2004) who showed for a sample of US foreign affiliates that affiliates were financed with less external debt in countries with underdeveloped capital markets or weaker creditor rights. The second interpretation is methodological, since results are obtained by WLS attaching greater importance to larger firms, once only the sample of domestic firms is considered we are left with a subsample of firms with lower average number of workers<sup>42</sup> and therefore, the scope for positive spillovers conditional on financial development is also lower. Section 5.3.2 pays particular attention to the role of size and column (2) in Table 12 shows results when only the sample of medium and large firms is considered. Figure 5 shows the corresponding total effect and significance levels derived from these estimates. The threshold level of financial development above which FDI spillovers are positive is very similar to the one when considering the total sample of firms (0.898). There are 6 regions in which financial development values are high enough to foster positive and significant productivity spillovers from FDI (Guanaajuato, Nayarit, Nuevo Leon, Sinaloa, Jalisco and Baja California Norte). In addition, the magnitude of the effect is economically meaningful, an exogenous 20 percent increase in the regional spillover variable (around one standard deviation of the regional spillover variable) would increase the productivity of medium and large domestic firms in a region with a well developed financial system like Durango (in the 75 percentile of the financial development distribution) by 17 percent compared to a region with low financial development levels

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<sup>42</sup>The average number of employees for the sample of foreign firms is 670 while the corresponding figure for the sample of domestic firms is 282.

like Michoacan (in the 25 percentile of the financial development distribution).<sup>43</sup>

### 5.3 Robustness Checks and Main Implications

So far I have shown evidence that larger firms located in financially developed regions manage to benefit from FDI in their same region. In what follows I will provide some robustness checks for the previous statement in particular for the sample of domestic firms. Table 11 shows the results from repeating the estimation in column (2) of Table 10 under different specifications that tackle potential estimation and interpretation concerns. All regressions are estimated by WLS-IV where instruments are the interaction between the spillover variable and the share of indigenous population and the FOGAIN data, respectively.

Column (1) in Table 11 repeats the estimation excluding both HHN and GDP per capita, since they are rarely significant across specifications. There is no apparent change in the results, if anything coefficients on the interaction term and the spillover variables become more significant and the total effect is positive and significant for lower values of financial development. Therefore, by including HHN and GDP per capita we are obtaining a conservative measure of the total effect of foreign presence in a region conditional on regional financial development. Similarly, column (2) considers the possibility that GDP per capita could in itself be endogenous to financial development and therefore, it is substituted by regional population with again no significant change in the main results. Finally, there are some remaining concerns regarding whether the measure of financial development does actually capture financial development or some other broader regional characteristic. Column (3) re-estimates the same specification inserting a dummy variable equal to one for regions located in the South of Mexico. As suggested by Guiso et al (2004) this procedure is important in order to ascertain that the estimated effect is not simply a North-South difference. The South dummy is negative but not statistically significant

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<sup>43</sup>This result is obtained from the coefficients from column (2) in Table 12 as:

$$Effect = (\beta_{Spillover*FinDev} * \Delta_{Spillover} * [FinDev_{High} - FinDev_{Low}]) * 100$$

and what is more important it does not impact the size of the coefficient of the interaction term. Nevertheless, columns (4) and (5) repeat the same regression using an alternative measure of financial development: the ratio of private credit to GDP in 2000 by state. A Spearman rank correlation test rejects the hypothesis that this measure and the one we obtained from the linear probability model are independent. The main drawback of the credit to GDP measure is that due to internal reporting procedures at Mexican banks, part of the bank lending taking place outside Mexico City is attributed to the Federal District (Laeven and Woodruff (2008)). Column (4) confirms the previous findings and shows that there is a positive and significant effect from the interaction between foreign presence and financial development and a negative and significant direct effect from foreign presence in the region. Given that the measure of private credit to GDP overstates the bank activity in the Federal District, column (5) confirms that results are robust to excluding the observations from the Federal District.

Once the robustness of the main results has been confirmed it is possible to turn to the main implications of these findings. First, it seems reasonable to ask about the importance of local financial markets. Second, I will analyze the importance of size.

### **5.3.1 The Role of Financial Development**

Would spillovers have taken place regardless of the local financial market conditions? To answer this question Table 12 shows the results from estimating equation (1) both by OLS and WLS (which attaches greater weight to larger firms). When the total sample of firms is considered (columns (1) and (2)) the positive spillover effect from MNCs gains significance in the WLS estimation, underlying the importance of size. These results indicate that in general larger firms would benefit from MNCs operating in their same region regardless of local banking conditions. However, domestic firms would have not benefit unconditionally from foreign companies, not even larger domestic firms (see columns (3) and (4)). It is only once we condition on financial development (see columns (5) to (7) in Table 12) that there are positive productivity spillovers for domestic firms located in regions where access to credit is relatively easier.

In addition, despite the statistically insignificant results from OLS and WLS in columns (3) and (4), it is worth noting the sign discrepancy. Traditionally, the negative sign from OLS estimation was associated with the way the spillover measure is constructed. If domestic productivity is procyclical, a negative shock that translates in lower production of domestic firms but has no effect or takes time to affect the production of foreign firms could mistakenly be interpreted as a negative spillover effect from MNC presence (Aitken and Harrison (1999)). WLS and OLS estimations were repeated including the numerator and denominator of the spillover variable separately in the regression and similar results to the ones reported in Table 12 were obtained. Moreover, this explanation would have only accounted for the negative sign of the OLS results but would have not explained the positive spillover effects from WLS. The sign discrepancy between WLS and OLS estimation strategies might reflect the role of size or point to the possibility that WLS, by giving more weight to larger firms, hides two types of sample composition bias. First, if regions with low inflows of FDI are also characterized by a high proportion of small firms, which are usually endowed with lower productivity levels than larger firms, OLS will tend to find a negative effect of FDI on productivity that will not be present in the WLS estimation. Figure 6 plots the percentage of small firms by region against the extent of foreign presence in that region. It is clear that overall the relationship is flat, except in the case of five regions: Baja California Sur (3), Campeche (4), Quintana Roo (23), Chiapas (7) and Colima (6). Excluding these regions from the estimation still reveals an insignificant but negative spillover effect for the sample of domestic firms and WLS estimation results remain unchanged. Second, the negative coefficient from OLS estimation might reflect sample selection. Cross-section studies focusing in the sample of domestic firms tend to find downward bias estimates of FDI spillovers. If foreign firms do not invest at random and choose the most productive domestic firms (“cherry picking” phenomenon), *expost* the TFP distribution of domestic firms is upper truncated. The higher the share of foreign firms in the sector or region, the lower the truncation point and hence, the more likely to find a negative effect from foreign presence. Given the difficulties in finding valid instruments, panel estimation studies have opted for fixed effect estimation hoping

that unobserved firm level characteristics correlated with the presence of foreign firms are relatively fixed over time. The cross-section nature of the ENESTyC dataset makes it impossible to control for this dimension at this point however, section 5.4. presents panel fixed effects results for a subsample of firms that confirm the sample selection hypothesis (i.e. once individual fixed effects are controlled for the estimated coefficient on the spillover variable for the sample of domestic firms although not significant is positively signed (see columns (1) and (4) in Table 14).

Most importantly, results in Table 12 highlight the importance of local credit markets for domestic firms. In the absence of a good financial system we would have found no significant effect of foreign companies on domestic firm level productivity. Moreover, results repeating the estimation in column (2) but adding an interaction term between whether the firm is foreign owned or not and the spillover variable turned out to be positive and highly significant, showing that foreign firms tend to benefit more from the presence of other foreign firms than domestic firms, irrespective of local credit conditions. This in turn favors the hypothesis outlined in the previous section by which foreign firms do not depend as much on local financial market conditions in order to finance their investment projects.

### 5.3.2 The Role of Size

The previous results suggest the existence of regional FDI spillovers given relatively good state level access to credit and firm size. Table 13 shows how relevant firm size is in the previous findings. Considering the sample of domestic firms only, columns (1) and (2) repeat the estimation for the sample of small (between 16 and 100 employees) and medium and large firms (more than 100 employees), respectively<sup>44</sup>. It is clear that the positive regional spillover effect conditioned on financial development is due to medium and large firms. These results reinforce the hypothesis that positive spillovers are concentrated in larger firms, which is consistent with theories in which larger firms are able to

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<sup>44</sup>Size categories are the official ones provided by INEGI however, although not the scope of this paper a more thorough analysis of the cutoff points could follow a threshold regression analysis approach.

compete more efficiently with foreign entrants or where the technology gap between large domestic firms and foreign entrants is relatively smaller. In fact, following Girma (2005) I define the absorptive capacity of a firm as the ratio between its own productivity and the productivity of a firm in the 99 percentile of the productivity distribution within an industry<sup>45</sup>. In theory, we would expect firms with higher absorptive capacity to benefit more from the presence of foreign companies and this is actually, what it is shown in column (4) of Table 13. According to these results, FDI will have a higher positive impact on the productivity levels of those firms with higher absorptive capacities. Contrary to the findings of Aghion, Blundell, Griffith, Howitt and Prantl (2006) including a sectoral measure of the technology gap between domestic and foreign firms did not turn out to be significant, meaning that in the case of Mexico irrespective of the technology endowment of the sector is the firm specific technology gap that matters for FDI spillovers. Moreover, we would expect the effect of FDI to be even greater for firms with higher absorptive capacities that have relative good access to credit. Hence, column (5) in Table 13 shows the effect of FDI on firm level productivity conditioned on firm's absorptive capacity and regional financial development. A test for the joint significance of the terms involving the spillover variable cannot be rejected which in turn confirms the hypothesis that FDI is more relevant for firms operating close to the sector technology frontier and with better prospect of accessing credit.

However, there are some caveats associated to these results. First, it is somewhat counterintuitive to think that larger firms are the ones benefiting from better access to credit provided that usually these firms are less financially constrained. It is reasonable to think that larger firms can finance their investment projects internally or can more easily tap the local banking system. In fact, column (3) in Table 13 shows that the result does not hold for the sample of very large firms<sup>46</sup>

Second, one could be concerned that this evidence corresponds to a situation in which

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<sup>45</sup>Girma (2005) uses the maximum productivity level and corrects for outliers ex-post. By taking the 99 percentile I expect to avoid the problem of outliers.

<sup>46</sup>The threshold level of 500 employees was chosen based on the facts that the average size within the sample of large firms (those with more than 250 employees) is 620 employees and the median is 450 employees.

smaller firms tend to locate in or are the result of less financially developed regions. If this was the case, the lack of positive spillovers in less financially developed regions does not arise from worse conditions in accessing credit but from the abundance of small firms that will not in any case benefit from the MNC presence. Figure 7 shows the correlation between the percentage of small firms by region and the financial development indicator and it rules out this possibility. The percentage of small firms is roughly the same regardless of the financial development indicator values and, it is only particularly high in some regions characterized by medium financial development indicator values<sup>47</sup>. The only problematic region a priori would be Colima (6) that is characterized by low levels of financial development and a high proportion of small firms. I repeated the estimation excluding the observations from Colima with no apparent statistical different results.

Finally, as already mentioned, there are some issues related to the use of cross-section data. In particular, the potential bias associated to unobserved firm specific characteristics, especially when considering the sample of domestic firms. However, once the importance of size has been highlighted and in particular once it has been confirmed that it is medium and large firms that are to benefit from regional FDI and financial development, it is possible to consider a subsample of mainly large and medium firms in a panel context.

## 5.4 Panel Fixed Effect Results

The advantage of focusing on large and medium firms is that it is possible to link firms across the three different surveys, 1991, 1999 and 2001 and have a balanced panel of firms with data for 1991, 1997, 1998, 1999 and 2000<sup>48</sup>. Having a panel of firms allows to control

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<sup>47</sup>This evidence seems to contradict a priori the Laeven and Woodruff (2008) results. They find that lower quality institutions limit the size of an entrepreneur's firm. However, the difference might be the result of the different samples used. While here the paper focus on manufacturing firms, Laeven and Woodruff (2008) use census data including manufacturing, commerce, services and construction sectors. In fact, they show that changes in the quality of the legal system impact sectors where proprietorships predominate (such as services) more than sectors where corporations predominate (such as manufacturing of basic metals).

<sup>48</sup>The sample design of the ENESTyC surveys guarantees that medium and large firms are included with certainty.

for firm-specific unobservable characteristics that do not vary over time and therefore, partially tackles the potential endogeneity of foreign acquisitions (cherry picking).

The total number of firms that could be linked across surveys is 945. Table 14 reports the results from panel fixed effect estimation. It turned out that being foreign owned or not was not a significant determinant of firm level productivity however, the percentage of foreign capital owned by a foreign investor had a positive and significant effect and was therefore, the variable included in the estimation. This result confirms previous empirical findings in which the extent of foreign ownership mattered for FDI spillovers (see Javorcik (2004)). Results corroborate the findings of the cross-section estimation even after instrumenting for financial development. Figure 8 reports the total effect when all sampled firms are considered corresponding to the FE-IV estimation in column (3). Similarly, Figure 9 shows the total effect associated with coefficients in column (6) of Table 14 for the sample of domestic firms. Comparing Figure 3 (WLS-IV estimation for the subsample of medium and large domestic firms) and Figure 9 (FE-IV estimation for the subsample of domestic firms) shows the same threshold level of financial development above which domestic firms benefit from FDI. Moreover, the overall economic impact is also highly similar. Repeating the same exercise as in section 5.2., an exogenous increase in the regional spillover variable of 20 percent would increase the productivity of domestic firms in a region with relative good access to credit by 14 percent compared to domestic firms in regions with low financial development values.

## 6 Conclusion

During the last two decades developing and emerging countries have implemented policies to attract FDI flows as a means of development and growth. This competition for FDI flows is based on the believe that the growth-enhancing effects of FDI go beyond the natural increase in the capital stock of the host country and involve spillovers stemming from the introduction of new processes and technologies by foreign affiliates. Despite theoretical predictions regarding the positive externalities of FDI, in general, in the case

of emerging and developing countries empirical studies find no evidence of horizontal or regional FDI spillovers taking place. This is the case of Mexico, which despite large flows of FDI and the consolidation of the openness process during the 90s through the NAFTA agreement, has not been able to reap off the benefits of globalization.

Results in this study confirm that in contrast to previous empirical findings, in Mexico, there is a positive spillover effect from MNCs operating in the same region, conditioned on firm size. In the case of domestic firms they do not only need to be large but also operate in a region with a well functioning financial system. A 20 percent increase in the FDI spillover variable would increase the productivity of domestic firms in financially advanced regions by 17 percent compared to domestic firms located in less financially developed regions.

The results of this paper suggest that countries involved in the process of attracting FDI should not disregard policies aimed at improving local financial market conditions. Maximum benefits could be attained through the right combination of policies fostering the attraction of foreign capital flows and reasonable access to credit by domestic firms.

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# A APPENDIX I: Data and Cleaning Procedure

## A.1 Variable Description

-**Output**: Manufacturing plants: Value of production priced at "factory price" (ENESTyC). Maquila plants (99/01): Value of production in pesos according to the exch. Rate in place at the moment of the transaction (ENESTyC). - **Labor**: Average number of workers (ENESTyC). - **Materials**: Expenditure in materials (ENESTyC) - **Capital**: Value of Total Assets (ENESTyC). - **Age**: Number of years since the beginning of operation (ENESTyC). **Foreign**: Dummy equal 1 if the capital owned by foreign investors is more than 10% (ENESTyC). - **Exporter**: Dummy equal 1 if firm sells to non domestic markets (ENESTyC). - **Group**: Dummy equal 1 if the firm belongs to a group (ENESTyC). - **SectCred**: Share of commercial credit on value of production by sector of activity (Central Bank of Mexico and INEGI). - **ExtDepen**: External Dependence Index (Rajan and Zingales (1998)). - **FOGAIN**: Variable that equals one in sectors 31, 32, 35, 37 and 383 (Electrical Apparel) (Own Construction). - **Fogainpop**: Credit allocated by NAFINSA from 1960 to 1989 by state and normalized by population (Juan Estrada Calderon from NAFINSA reports) - **Indigenous1900**: Share of indigenous population in total population in 1900 (Laeven and Woodruff (2007)) - **lGDPpc**: Logarithm of GDP per capita by state level expressed in constant pesos of 1993 (INEGI).

## A.2 Cleaning Procedure

The following establishments were removed: 1. Establishments that report zero or missing values for Output, Materials, Average employment and/or Total Assets. This means removing a total of 216 firms in 1992, 822 in 1999 and 640 in 2001. 2. Establishments fully or partially owned by the government. 3. In order to make more comparable the surveyed samples in 1992, 1999 and 2001, I remove establishments in sector 3511 "Basic Petrochemicals" and sector 3530 "Oil refinery" because these sectors were only included in the 2001 survey.

In addition, following Angrist and Krueger (1999) I winsorize the main variables at the tails. The key variables are the real value of output, the real value of materials expenditure, the real value of total assets and the average number of workers. I replace values in the lower and upper 1% tails with values at the 1st and 99th percentiles, respectively. However, I use different samples to determine the critical values. In the case of real assets and average number of employees I consider the distribution of all firms included in the sample. Since maquila establishments use mainly imported materials in their production process and I have use different price deflators for domestic and imported materials, I winsorize differently the variable real materials for the sample of maquila plants and the sample of nonmaquila plants. Finally, regarding the process of winsorizing real output first, I winsorize the real output corresponding to the sample of all firms included in the 1992 survey and only those included in the manufacturing surveys of 1999 and 2001. Second, I winsorize real output for the sample of maquila plants identified in 1999 and 2001.

## A.3 Price Index

Ideally, for output, materials and capital we would need data on physical quantities rather than values. Unfortunately this data is not available in the ENESTyC survey hence, in order to

approximate quantities and express all monetary variables in real terms I use industry wide price index deflators.

Output: I express the value of production priced at the "factory" price (venta de fabrica) in pesos of 2003 using producer price index (PPI) data breakdown by industry, facilitated by the Central Bank of Mexico. The Central Bank of Mexico uses a different industry classification (CMAE, Clasificacion Mexicana de Actividades Mexicanas) than the one used in the ENESTyC (CMAP). I use a table of correspondence between CMAE and CMAP provided by INEGI and a PPI deflator at the branch level. In order to obtain the PPI at the branch level, for each branch I take the average over the corresponding classes belonging to that branch. In addition, I deflate differently output from maquila plants included in the surveys of 1999 and 2001. In these two years, the survey was conducted separately for manufacturing and exporting maquila plants. The questionnaire was the same for both types of plants and therefore all variables of interest are equivalent except for the value of production. In fact, rather than providing the value of production priced at the factory price, maquila plants were required to provide the value of production in pesos according to the exchange rate in place at the moment of the commercial transaction. There is no export price deflator breakdown by industry readily available so I follow Lach, Roberts and Tybout (1998) and Fernandes and Isgut (2005) in the construction of export price indexes. As in Lach et al (1998) I use data from the United Nations COMTRADE database on the values and quantities of manufactured exports from Mexico to the rest of the world by product category, and I conduct the following exercise. First, I develop a correspondence between the UN ISIC Rev3 classification and the Mexican CMAP branch classification by careful examination of the product descriptions in each system. Second, I compute unit export values for each ISIC category by dividing the trade value figures by the trade quantity figures. These unit export values are expressed in current US dollars so I convert them into unit values in pesos using the average nominal ER between peso and dollar. Third, following Fernandes and Isgut (2005) I regress the log of the unit export price on 2-digit sector dummies, year dummies and year-sector fixed effects. The estimation is done by weighted least squares, with weights corresponding to the square root of the share of each product category trade value in the total 2-digit sector trade value. From this regression I obtain predicted log unit export prices for each UN ISIC Rev3 category. Finally, using the previous weights and the correspondence between the ISIC classification and the CMAP classification I compute a weighted average of the predicted unit values belonging to the same 2-digit sector CMAP classification. I normalize the export price series for each industry to the same base year as the domestic producer price index.

Materials: I express the expenditure in materials in pesos of 2003 using a materials price index (MPI) provided by the Central Bank of Mexico. In particular, I use the MPI according to which sector consumes those materials. Again, the industry classification of the Central Bank of Mexico is the CMAE and I use the same previous table of correspondence between CMAE and CMAP to obtain the CMAP figures at the branch level. Although this price index might be relevant for plants that buy their materials domestically it might as well be misleading in the case of plants that import most of their raw materials. To avoid such a bias, I use different price indexes for the expenditure in materials paid at home and the expenditure in imported materials. To obtain a price index for imports at the CMAP branch level I follow the same procedure as for the export price index, this time using Mexican imports from the rest of the world by product category.

Capital: The ENESTyC survey does not differentiate among different types of capital stock and therefore I use the PPI to deflate the value of total assets.

## B APPENDIX II: Tables

TABLE 1 — BASIC CHARACTERISTICS OF THE SAMPLE

Panel A: Number of firms by size and year			
	1991	1998	2000
Large	1,701	2,177	2,195
Medium	1,548	1,814	1,942
Small	942	1,098	1,648
Micro	528	1,434	2,243
Total	4,719	6,523	8,028
Panel B: Foreign Ownership Statistics			
	1991	1998	2000
Domestic	3,223	3,916	4,547
Foreign	968	1,173	1,238
Total	4,191	5,089	5,785
% Employment(a)	36	41	42
% Output(b)	39	42	52
Maquila (Total)	383	572	588
Maquila (Foreign)	306	467	453

(a) Percentage of Employment in Foreign Plants

(b) Percentage of Output produced by Foreign Plants

TABLE 2A — SHARE OF FOREIGN OUTPUT BY INDUSTRY

code	Sector	1991	1998	2000
31	Food, Beverages and Tobacco	0.19	0.17	0.19
32	Textiles	0.18	0.34	0.35
33	Wood products	0.15	0.27	0.27
34	Paper and Printing products	0.35	0.20	0.26
35	Chemicals	0.58	0.52	0.57
36	Non Metallic Mineral Products	0.10	0.18	0.26
37	Basic Metals	0.10	0.08	0.07
38	Machinery and Equipment	0.56	0.68	0.74
39	Other Manufacturing	0.25	0.35	0.46

TABLE 2B — SHARE OF FOREIGN OUTPUT BY REGION

code	State	1991	1998	2000
1	Aguascalientes	0.19	0.41	0.44
2	BCN	0.73	0.75	0.80
3	BCS	0.05	0.29	0.19
4	Campeche	0.00	0.13	0.02
5	Coahuila	0.23	0.50	0.50
6	Colima	0.00	0.00	0.41
7	Chiapas	0.00	0.19	0.23
8	Chihuahua	0.70	0.79	0.77
9	DF	0.47	0.46	0.42
10	Durango	0.10	0.32	0.22
11	Guanajuato	0.15	0.21	0.28
12	Guerrero	0.01	0.01	0.03
13	Hidalgo	0.10	0.23	0.21
14	Jalisco	0.34	0.26	0.38
15	Edo	0.37	0.34	0.39
16	Michoacan	0.08	0.06	0.12
17	Morelos	0.68	0.71	0.74
18	Nayarit	0.00	0.09	0.27
19	Nuevo	0.22	0.33	0.45
20	Oaxaca	0.01	0.00	0.00
21	Puebla	0.13	0.29	0.35
22	Queretaro	0.49	0.46	0.57
23	Quintana	0.00	0.20	0.00
24	San	0.19	0.24	0.34
25	Sinaloa	0.02	0.00	0.03
26	Sonora	0.33	0.66	0.68
27	Tabasco	0.33	0.04	0.00
28	Tamaulipas	0.73	0.78	0.87
29	Tlaxcala	0.27	0.27	0.34
30	Veracruz	0.17	0.26	0.30
31	Yucatan	0.06	0.03	0.19
32	Zacatecas	0.04	0.03	0.25

TABLE 3 — PRODUCTION FUNCTION ESTIMATES

	Sector 31			Sector 32			Sector 33			Sector 34			Sector 35		
	OLS	LP	ACF	OLS	LP	ACF	OLS	LP	ACF	OLS	LP	ACF	OLS	LP	ACF
bL	0.405*** (0.022)	0.312*** (0.018)	0.364*** (0.022)	0.712*** (0.024)	0.449*** (0.018)	0.674*** (0.024)	0.645*** (0.071)	0.417*** (0.045)	0.632*** (0.067)	0.716*** (0.055)	0.430*** (0.042)	0.478*** (0.044)	0.543*** (0.028)	0.414*** (0.022)	0.676*** (0.028)
bM	0.645*** (0.017)	0.773*** (0.127)	0.502*** (0.016)	0.541*** (0.014)	0.393*** (0.151)	0.495*** (0.013)	0.590*** (0.032)	0.715*** (0.238)	0.543*** (0.022)	0.609*** (0.030)	0.034 (0.180)	0.550*** (0.023)	0.586*** (0.019)	0.000 (0.279)	0.545*** (0.020)
bK	0.237*** (0.014)	0.240*** (0.055)	0.176*** (0.016)	0.169*** (0.011)	0.172*** (0.038)	0.024** (0.012)	0.147*** (0.029)	0.259** (0.114)	0.005 (0.033)	0.123*** (0.018)	0.148** (0.053)	0.083*** (0.017)	0.235*** (0.015)	0.098** (0.044)	0.076*** (0.019)
obs	2885	5770	5770	2617	5234	5234	597	1194	1194	1064	2128	2128	2344	4688	4688

	Sector 36			Sector 37			Sector 38			Sector 39		
	OLS	LP	ACF	OLS	LP	ACF	OLS	LP	ACF	OLS	LP	ACF
bL	0.372*** (0.047)	0.346*** (0.042)	0.336*** (0.034)	0.543*** (0.070)	0.379*** (0.059)	0.640*** (0.224)	0.768*** (0.019)	0.590*** (0.017)	0.704*** (0.018)	0.697*** (0.094)	0.520*** (0.061)	0.599*** (0.091)
bM	0.801*** (0.027)	0.651*** (0.131)	0.679*** (0.050)	0.652*** (0.032)	0.305** (0.212)	0.616*** (0.096)	0.516*** (0.012)	0.000 (0.059)	0.368*** (0.016)	0.468*** (0.051)	0.332 (0.269)	0.353*** (0.033)
bK	0.091*** (0.019)	0.071 (0.092)	0.104*** (0.038)	0.161*** (0.028)	0.067 (0.091)	0.039 (0.145)	0.183*** (0.010)	0.153*** (0.045)	0.124*** (0.015)	0.271*** (0.031)	0.218 (0.131)	0.143*** (0.037)
obs	694	1388	1388	387	774	774	4233	8466	8466	244	488	488

Notes: OLS: Ordinary Least Squares; LP: Levinhson and Petrin; ACF: Ackerberg, Caves and Frazer. Standard errors in parenthesis. ACF bootstrapped using 1000 replications. \* Significant at the 10-percent level; \*\* Significant at the 5-percent level; \*\*\* Significant at the 1-percent level.

TABLE 4 — REGIONAL DISTRIBUTION OF FIRMS WITH FINANCING PROBLEMS

code	State	Total	NLF	LF	%LF
1	Aguascalientes	317	265	52	16.4
2	BCN	389	376	13	3.3
3	BCS	33	28	5	15.2
4	Campeche	35	27	8	22.9
5	Cohauila	380	346	34	8.9
6	Colima	27	17	10	37.0
7	Chiapas	85	65	20	23.5
8	Chihuahua	452	427	25	5.5
9	DF	1,886	1,669	217	11.5
10	Durango	230	200	30	13.0
11	Guanajuato	607	559	48	7.9
12	Guerrero	111	84	27	24.3
13	Hidalgo	177	153	24	13.6
14	Jalisco	1007	910	97	9.6
15	Edo Mexico	1781	1590	191	10.7
16	Michoacan	247	195	52	21.1
17	Morelos	138	118	20	14.5
18	Nayarit	27	24	3	11.1
19	Nuevo Leon	1,030	978	52	5.0
20	Oaxaca	78	48	30	38.5
21	Puebla	568	452	116	20.4
22	Queretaro	275	248	27	9.8
23	Quintana Roo	26	21	5	19.2
24	San Luis Potosi	249	226	23	9.2
25	Sinaloa	140	125	15	10.7
26	Sonora	225	210	15	6.7
27	Tabasco	38	30	8	21.1
28	Tamaulipas	300	287	13	4.3
29	Tlaxcala	156	124	32	20.5
30	Veracruz	281	230	51	18.1
31	Yucatan	204	170	34	16.7
32	Zacatecas	75	61	14	18.7
	Total	11,574	10,263	1,311	11.3

Notes: NLF: Firms that did not lacked financial resources. LF: Firms that lacked financial resources. %LF: Percentage of firms that lacked financial resources.

TABLE 5 — SECTORAL DISTRIBUTION OF FIRMS WITH FINANCING PROBLEMS

	Sector	Total	NLF	LF	%LF
31	Food, Beverages and Tobacco	2,358	2,053	305	12.9
32	Textiles	1,830	1,639	191	10.4
33	Wood Products	643	511	132	20.5
34	Paper and Printing Products	760	668	92	12.1
35	Chemicals	1,600	1,507	93	5.8
36	Non Metallic Mineral Products	683	517	166	24.3
37	Basic Metals	233	215	18	7.7
38	Machinery and Equipment	3,252	2,977	275	8.5
39	Other Manufacturing	215	176	39	18.1
	Total	11,574	10,263	1,311	11.3

Notes: NLF: Firms that did not lacked financial resources. LF: Firms that lacked financial resources. %LF: Percentage of firms that lacked financial resources.

TABLE 6 — THE DETERMINANTS OF LIMITED ACCESS TO CREDIT  
(Dependent Variable: "LackFin")

	LackFin
Age	-0.0022*** (0.0005)
Age2	0.00002*** (0.0000)
Labor	-0.00004*** (0.0000)
Foreign	-0.0101 (0.0072)
Group	-0.0519*** (0.0057)
Exporter	-0.0936*** (0.0093)
SectCred	-2.9504** (1.0816)
ExtDepen	-0.4736** (0.2286)
FOGAIN	-0.5110** (0.2118)
Obs	11,565

Notes: Robust standard errors clustered for each region are presented in parenthesis. Regression includes industry, year and region fixed effects. \*Significant at the 10-percent level; \*\* Significant at the 5-percent level;\*\*\* Significant at the 1-percent level.

TABLE 7 — THE FINANCIAL DEVELOPMENT INDICATOR

code	State	Coeff. Regional Dummy	Financial Development Indicator
11	Guanajuato	-0.253	1
18	Nayarit	-0.251	0.991
19	Nuevo Leon	-0.238	0.941
25	Sinaloa	-0.236	0.934
14	Jalisco	-0.230	0.909
2	BCN	-0.227	0.898
26	Sonora	-0.217	0.856
10	Durango	-0.208	0.821
28	Tamaulipas	-0.205	0.810
24	San Luis Potosi	-0.205	0.809
8	Chihuahua	-0.204	0.806
22	Queretaro	-0.199	0.784
9	DF	-0.192	0.760
15	Edo Mexico	-0.192	0.759
13	Hidalgo	-0.191	0.756
5	Cohauila	-0.191	0.756
12	Guerrero	-0.189	0.748
17	Morelos	-0.184	0.729
32	Zacatecas	-0.178	0.705
3	BCS	-0.170	0.672
23	Quintana Roo	-0.169	0.666
1	Aguascalientes	-0.167	0.658
31	Yucatan	-0.163	0.642
16	Michoacan	-0.156	0.615
30	Veracruz	-0.153	0.605
27	Tabasco	-0.151	0.598
21	Puebla	-0.150	0.593
4	Campeche	-0.122	0.481
7	Chiapas	-0.121	0.479
29	Tlaxcala	-0.114	0.449
6	Colima	-0.013	0.052
20	Oaxaca	0.000	0

TABLE 8 — FDI SECTORAL PRODUCTIVITY SPILLOVERS AND FINANCIAL DEVELOPMENT

	All		Domestic	
	(1) Output	(2) Productivity	(3) Output	(4) Productivity
Foreign	0.225*** (0.033)	0.129*** (0.035)		
Spillover	-0.004 (0.004)	-0.004 (0.004)	-0.005 (0.003)	-0.004 (0.003)
Spillover*FinDev	0.010** (0.005)	0.009* (0.005)	0.007* (0.004)	0.006 (0.004)
HHN	-0.144 (0.192)	-0.320 (0.208)	0.043 (0.134)	-0.073 (0.139)
lGDPpc	1.703*** (0.528)	1.902*** (0.552)	0.426 (0.451)	0.505 (0.482)
cons	-15.050*** (5.082)	-18.171*** (5.328)	-2.875 (4.352)	-4.765 (4.675)
Obs	15,043	15,043	11,673	11,673
R2	0.859	0.2025	0.8876	0.2214

Notes: Standard errors in parenthesis have been corrected for clustering at the 4 digit sector level. In columns (1) and (3) the dependent variable is ln firm output and the right hand side includes ln labor, ln materials and ln capital. In columns (2) and (4) the dependent variable is normalized TFP from the ACF estimation. All regressions include 4 digit sector, region and time fixed effects. Weights in the WLS estimation are firm share of employment in total 4-digit sectoral employment.

TABLE 9 — FDI REGIONAL PRODUCTIVITY SPILLOVERS AND FINANCIAL DEVELOPMENT

	All		Domestic	
	(1) Output	(2) Productivity	(3) Output	(4) Productivity
Foreign	0.238*** (0.033)	0.141*** (0.033)		
Spillover	-0.016* (0.009)	-0.016 (0.010)	-0.015** (0.006)	-0.017** (0.007)
Spillover*FinDev	0.028** (0.012)	0.027** (0.013)	0.020** (0.009)	0.022** (0.010)
HHN	0.053 (0.203)	-0.134 (0.223)	0.051 (0.161)	-0.035 (0.175)
lGDPpc	1.460* (0.738)	1.676** (0.765)	0.349 (0.274)	0.440 (0.268)
cons	-12.826* (7.119)	-16.109** (7.380)	-2.085 (2.640)	-4.066 (2.600)
Obs	15,043	15,043	11,673	11,673
R2	0.8586	0.2008	0.8876	0.2213

Notes: Standard errors in parenthesis have been corrected for clustering at the region time level. In columns (1) and (3) the dependent variable is ln firm output and the right hand side includes ln labor, ln materials and ln capital. In columns (2) and (4) the dependent variable is normalized TFP from the ACF estimation. All regressions include 4 digit sector, region and time fixed effects. Weights in the WLS estimation are firm share of employment in total 4-digit sectoral employment.

TABLE 10 — FDI REGIONAL PRODUCTIVITY SPILLOVERS AND FINANCIAL DEVELOPMENT:  
INSTRUMENTAL VARIABLE APPROACH  
(Dependent variable: Normalized firm total factor productivity from ACF estimation)

	(1) All	(2) Domestic
Foreign	0.141*** (0.032)	
Spillover	-0.047** (0.019)	-0.031** (0.012)
Spillover*FinDev	0.066*** (0.025)	0.039** (0.016)
HHN	-0.132 (0.222)	-0.052 (0.172)
lGDPpc	1.608** (0.774)	0.402 (0.276)
<u>First Stage: Spillover*FinDev</u>		
Indigenous1900*spillover	-0.452*** (0.106)	-0.309*** (0.049)
Fogainpop*spillover		0.108*** (0.016)
Spillover	0.829*** (0.020)	0.694*** (0.023)
HHN	-0.021 (0.156)	0.144 (0.138)
lGDPpc	0.724 (2.015)	-0.375 (1.393)
Foreign	0.009 (0.013)	
Hansen (p-value)		0.540
F-test	396.710	509.040
Joint Significance (p-value)	0.009	0.040
Partial R2	0.243	0.461
R2	0.199	0.221
Obs	15,043	11,673

Notes: Standard errors in parenthesis have been corrected for clustering at the region-time level. All regressions include 4 digit sector, region and time fixed effects. Weights in the WLS estimation are firm share of employment in total 4-digit sectoral employment. \* Significant at the 10-percent level; \*\* Significant at the 5-percent level; \*\*\* Significant at the 1-percent level

TABLE 11 — ROBUSTNESS CHECKS: SAMPLE OF DOMESTIC FIRMS  
(Dependent variable: Normalized firm total factor productivity from ACF estimation)

	(1)	(2)	(3)	(4)	(5)
Spillover	-0.033*** (0.012)	-0.032*** (0.012)	-0.031** (0.012)	-0.009*** (0.003)	-0.008*** (0.003)
Spillover*FinDev	0.043*** (0.016)	0.043*** (0.016)	0.039** (0.016)	0.061** (0.024)	0.063*** (0.024)
HHN		-0.053 (0.170)	-0.052 (0.172)	-0.054 (0.170)	0.068 (0.210)
lGDPpc			0.402 (0.276)	0.543 (0.264)	0.438 (0.292)
lpop		0.029 (0.276)			
South			-0.060 (0.148)		
Hansen (p-value)	0.522	0.519	0.540	0.518	0.525
F-test	539.04	492.29	509.04	3251.45	3052.37
Joint Significance (p-value)	0.024	0.031	0.040	0.030	0.013
R2	0.220	0.220	0.221	0.222	0.219
Obs	11,673	11,673	11,673	11,673	9,273

Notes: Standard errors in parenthesis have been corrected for clustering at the region time level. All regressions include 4 digit sector, region and time fixed effects. Weights in the WLS estimation are firm share of employment in total 4-digit sectoral employment. WLS-IV: Weighted least squares- instrumental variable approach. Instruments are *spillover \* indigenous1900* and *spillover \* fogainpop*. Columns (4) and (5) use as measure of financial development, commercial credit by region as a percentage of regional GDP.

TABLE 12 — REGIONAL FDI SPILLOVERS: THE ROLE OF FINANCIAL DEVELOPMENT  
(Dependent variable: Normalized firm total factor productivity from ACF estimation)

	All		Domestic				
	(1) OLS	(2) WLS	(3) OLS	(4) WLS	(5) OLS	(6) WLS	(7) WLS-IV
Foreign	0.115*** (0.020)	0.141*** (0.032)					
Spillover	0.003* (0.002)	0.005** (0.003)	-0.001 (0.002)	0.0002 (0.002)	-0.012** (0.006)	-0.017** (0.007)	-0.031** (0.012)
Spillover*FinDev					0.014* (0.008)	0.022** (0.010)	0.039** (0.016)
HHN	0.058 (0.104)	-0.136 (0.223)	0.133 (0.095)	-0.029 (0.177)	0.134 (0.095)	-0.035 (0.175)	-0.052 (0.172)
lGDPpc	0.788 (0.524)	1.724** (0.753)	0.088 (0.200)	0.492* (0.266)	0.053 (0.202)	0.440 (0.268)	0.402 (0.276)
Hansen (p-value)							0.540
F-test							509.040
Joint Significance (p-value)						0.0624	0.040
R2	0.165	0.2001	0.169	0.2208	0.1694	0.2213	0.221
Obs	15,043	15,043	11,673	11,673	11,673	11,673	11,673

Notes: Standard errors in parenthesis have been corrected for clustering at the region time level. All regressions include 4 digit sector, region and time fixed effects. Weights in the WLS estimation are firm share of employment in total 4-digit sectoral employment. Column (4) corresponds to column (5) in Table 9 and Column (5) corresponds to column (2) in Table 10.

TABLE 13 — THE ROLE OF SIZE AND ABSORPTIVE CAPACITY: SAMPLE OF DOMESTIC FIRMS  
(Dependent variable: Normalized firm total factor productivity from ACF estimation)

	Size			Absorptive Capacity	
	(1) Small	(2) Medium /Large	(3) +500	(4) Total Domestic	(5) Total Domestic
Spillover	-0.001 (0.012)	-0.030** (0.012)	-0.030 (0.019)	-0.001 (0.001)	-0.044*** (0.016)
Spillover*FinDev	0.002 (0.015)	0.040** (0.016)	0.041 (0.026)		0.055*** (0.021)
AbsCap				0.130* (0.073)	0.139 (0.322)
AbsCap*Spillover				0.003** (0.002)	0.0002 (0.020)
AbsCap*FinDev					0.024 (0.397)
AbsCap*Spillover*FinDev					0.003 (0.025)
HHN	0.299** (0.130)	-0.139 (0.197)	-0.316 (0.283)	0.250 (0.162)	0.275* (0.155)
lGDPpc	0.534 (0.326)	0.344 (0.299)	0.531 (0.794)	0.185 (0.240)	0.003 (0.249)
Hansen (p-value)	0.233	0.734	0.361		0.145
F-test	147.014	491.469	84.911		15.255
<i>JointSignificance</i> <sup>1</sup>	0.984	0.039	0.285		0.019
<i>JointSignificance</i> <sup>2</sup>				0.000	0.000
<i>JointSignificance</i> <sup>3</sup>				0.031	0.022
R2	0.263	0.232	0.245	0.324	0.326
Obs	3,406	8,292	1,637	11,673	11,673

Notes: Standard errors in parenthesis have been corrected for clustering at the region time level. The dependent variable is normalized TFP from the ACF estimation. All regressions include 4 digit sector, region and time fixed effects. Columns (1) and (2) have estimated by weighted least squares where weights are firm share of employment in total 4-digit sectoral employment. *AbsCap* refers to the variable *AbsorptiveCapacity*. *JointSignificance*<sup>1</sup> refers to a test for the joint significance of spillover and spillover\*FinDev. *JointSignificance*<sup>2</sup> refers to a test for the joint significance of AbsCap, AbsCap\*Spillover, AbsCap\*FinDev and AbsCap\*Spillover\*FinDev. *JointSignificance*<sup>3</sup> refers to a test for the joint significance of spillover, spillover\*FinDev, AbsCap\*Spillover and AbsCap\*Spillover\*FinDev. \* Significant at the 10-percent level; \*\* Significant at the 5-percent level; \*\*\* Significant at the 1-percent level

TABLE 14 — PANEL FIXED EFFECT ESTIMATION  
(Dependent variable: Normalized firm total factor productivity from ACF estimation)

	All			Domestic		
	(1) FE	(2) FE	(3) FE-IV	(4) FE	(5) FE	(6) FE-IV
Foreign	0.001*	0.001*	0.001*			
	(0.001)	(0.001)	(0.001)			
Spillover	0.002	-0.014**	-0.016***	0.001	-0.021***	-0.027***
	(0.001)	(0.005)	(0.006)	(0.001)	(0.007)	(0.010)
Spillover*FinDev		0.019***	0.022***		0.027***	0.034***
		(0.006)	(0.008)		(0.008)	(0.012)
HHN	0.328	0.308	0.305	0.170	0.171	0.165
	(0.219)	(0.216)	(0.211)	(0.159)	(0.153)	(0.150)
lGDPpc	-0.298	-0.394	-0.410	-0.029	-0.170	-0.186
	(0.396)	(0.348)	(0.346)	(0.397)	(0.330)	(0.333)
Hansen (p-value)			0.000			0.165
F-test			209.64			182.48
Joint Significance (p-value)		0.0009	0.0089		0.0004	0.0135
R2-within	0.1014	0.104	0.104	0.107	0.113	0.112
Groups	945	945	945	834	834	834
Obs	4,725	4,725	4,725	3,877	3,877	3,877

Notes: Standard errors in parenthesis have been corrected for clustering at the region time level. The dependent variable is normalized TFP from the ACF estimation. All regressions include time fixed effects.\* Significant at the 10-percent level;\*\* Significant at the 5-percent level;\*\*\* Significant at the 1-percent level.

## C APPENDIX III: Figures

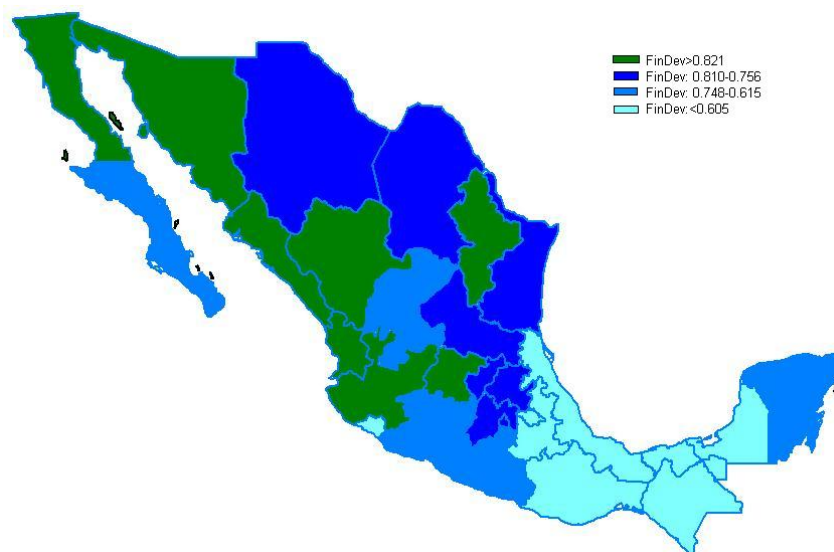


Figure 1: Financial Development by Region

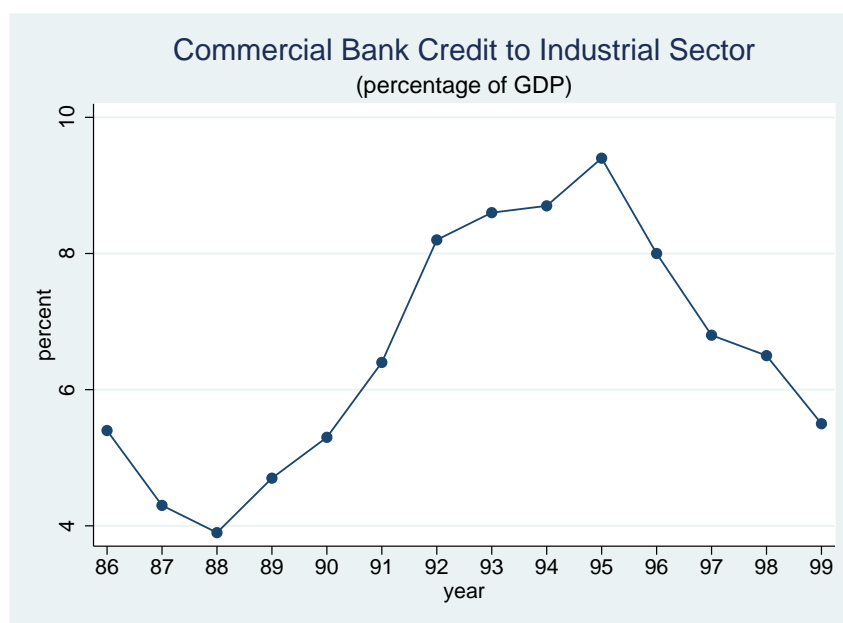


Figure 2: Commercial Bank Credit to the Industrial Sector as a percentage of GDP

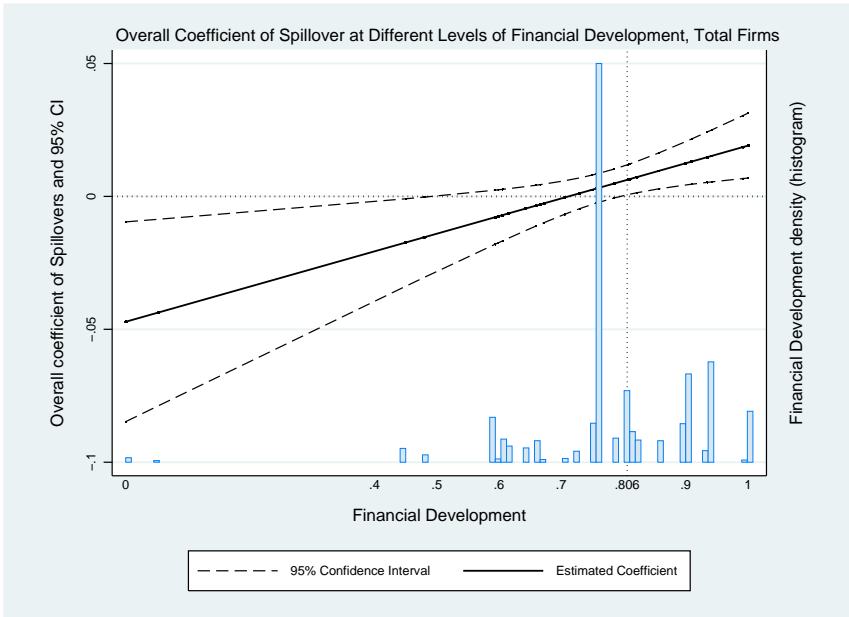


Figure 3: WLS-IV Estimation, Total Sample of Firms

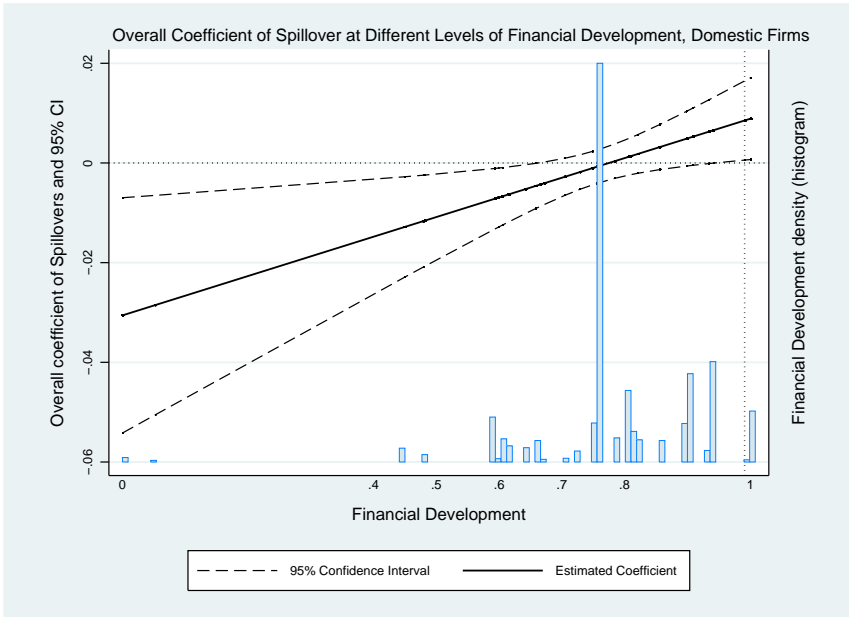


Figure 4: WLS-IV Estimation, Domestic Sample of Firms

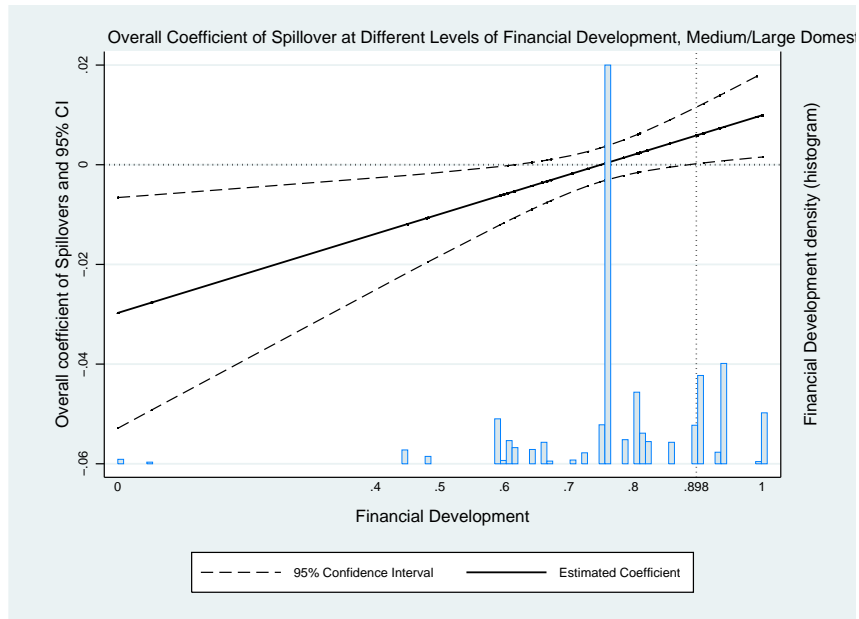


Figure 5: WLS-IV Estimation, Medium/Large Domestic Sample of Firms

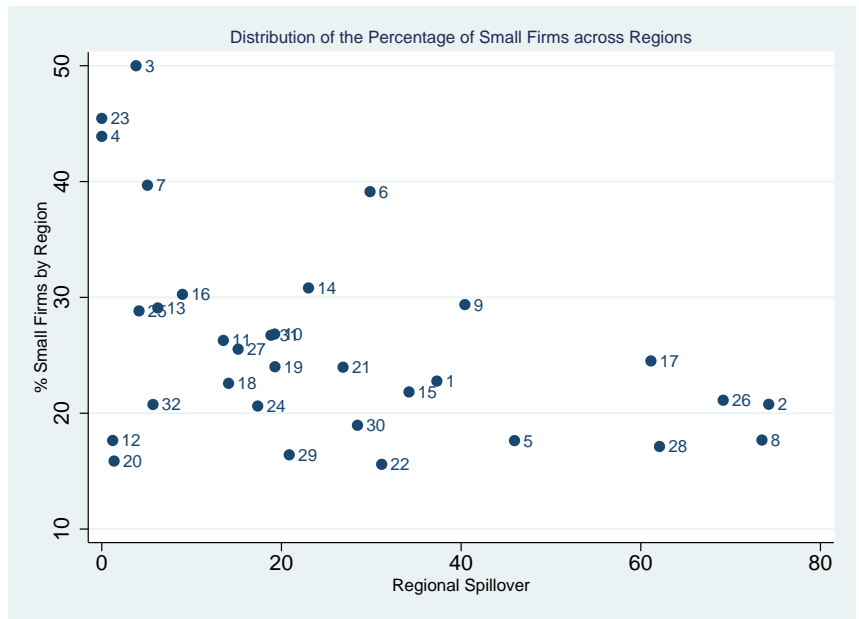


Figure 6: Percentage of Small Firms and Regional Spillovers by Region

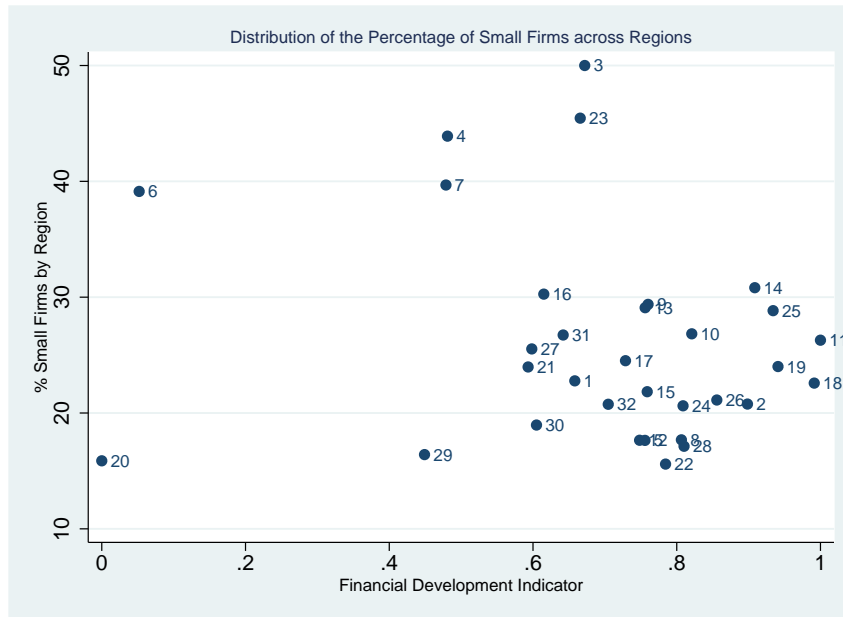


Figure 7: Percentage of Small Firms and Financial Development Indicator by Region

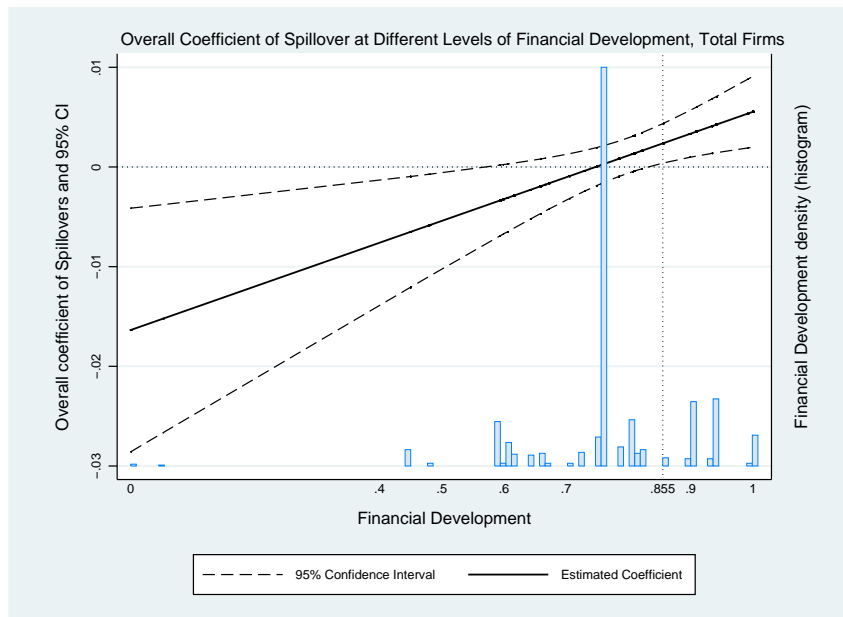


Figure 8: Panel FE-IV Estimation, Total Sample of Firms

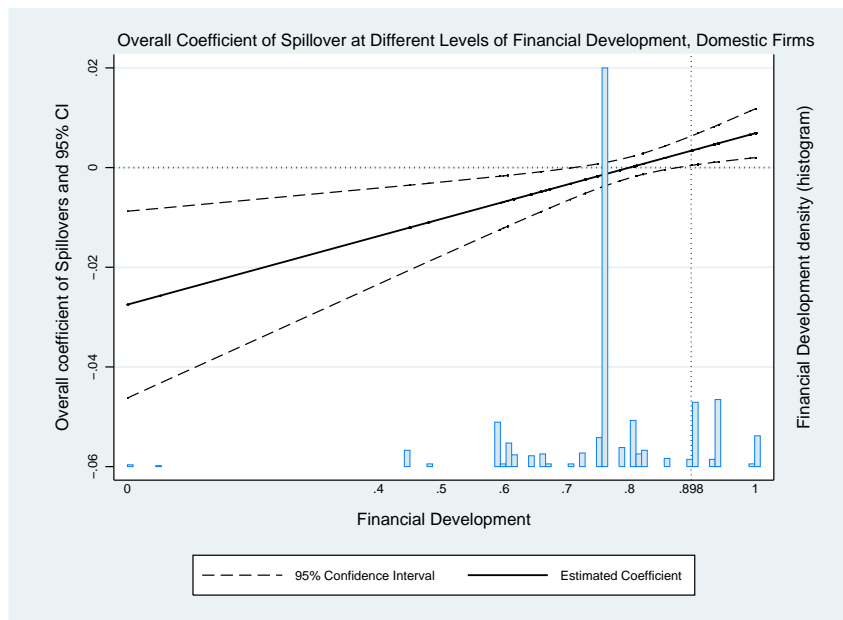


Figure 9: Panel FE-IV Estimation, Domestic Sample of Firms