AGGLOMERATION AND THE LOCATION CHOICE OF FOREIGN DIRECT INVESTMENT: NEW EVIDENCE FROM MANUFACTURING FDI IN MEXICO*

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Resumen: Se estiman modelos de localización utilizando un modelo logit condicional para identificar las características regionales que influyeron en México para la elección del lugar hacia donde fluyó mayor IED en manufacturas en la segunda mitad de los 1990s, después de la creación del NAFTA. Los principales resultados son tres: 1) la demanda regional, los costos laborales, la calidad del trabajo, las economías de aglomeración y la distancia geográfica hasta la Ciudad de México y Estados Unidos son factores de localización importantes, 2) la decisión de localización de las empresas orientadas a la exportación no se ve afectada por la demanda regional y 3) se encontra evidencia de que las economías de aglomeración tienen una dimensión espacial.

Abstract: In this paper, I estimate conditional logit location models to identify the regional characteristics that influenced the location choice of the large influx of manufacturing FDI into Mexico that occurred in the second half of the 1990s following the creation of NAFTA. The main findings of the analysis are three-fold. First, regional demand, labor costs, labor quality, agglomeration economies and regional distance to Mexico City and the US are all important location factors. Second, findings indicate that the location decision of export-oriented firms is not affected by regional demand. Third, I find evidence that agglomeration economies have a spatial dimension.

Clasificación JEL/JEL Classification: F23, O18, O54, R12

Palabras clave/keywords: FDI*, location, agglomeration, conditional logit, nested Logit, Mexico, inversion extranjera, localización, aglomeración, logit condicional, logit jerárquico*

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1. Introduction

In the last two decades, there has been a markedly increased interest in the role of externalities in processes of economic growth. One research field that has experienced rapid growth consists of econometric studies on FDI spillovers that estimate the degree and nature of externality or productivity effects between foreign-owned and domestic firms in host economies (Venables and Barba-Navaretti, 2005; Jordaan, 2009; Jordaan, 2011a). Another field is concerned with the identification of growth effects that are linked to location patterns of economic activity within countries, whereby agglomerations of firms generate positive externality effects through the occurrence of knowledge spillovers, input-output linkages and thick labor markets (Rosenthal and Strange, 2004; Duranton and Puga, 2004).

In relation to these developments, several recent studies attempt to identify regional characteristics that influence location decisions of new FDI in host economies. In particular, these studies focus on whether regional agglomeration economies influence FDI location decisions. If agglomerations of activity generate knowledge spillovers and other externality-based productivity advantages, new FDI firms will prefer to locate in regions that contain such agglomerations. Examples of such FDI location studies include Coughlin, Terza and Arromdee (1991), Coughlin and Segev (2000) and Head, Ries and Swenson (1995, 1999) for the United States (US), Crozet, Mayer and Muchelli (2004) for France, Cheng and Kwan (2000) for China and Disdier and Mayer (2004) for the European Union.

Mexico constitutes a host economy for which there is only limited statistical evidence on location factors of FDI firms. Evidence on why FDI firms locate in Mexico points to the importance of relative low wages, proximity to the US, the size of the Mexican market for certain industries and of course the creation of the NAFTA agreement between the US, Mexico and Canada (Love and Lage-Hidalgo, 2000; Blomström and Kokko, 1997). However, there is much less statistical evidence on determinants of the regional distribution of FDI firms within Mexico. One recent paper on regional FDI flows during the period 1994-2001 provides evidence that the cross-regional variation of infrastructure has been an important element in the location process of FDI within Mexico (Mollick, Duran and Silva, 2006). Another more encompassing study on regional inward FDI flows for the period 1989-2006 finds evidence that factors such as regional demand, schooling and also infrastructure are important (Jordaan, 2008a).

This lack of empirical evidence on what determines the regional distribution of FDI in Mexico is important for several reasons. First

and foremost, it is important to obtain a better understanding of the operations and effects of FDI firms, given the central role that foreign-owned firms play in the current and future processes of economic and technological development of the Mexican economy (see OECD, 2009a, 2009b). In this context, studies that present evidence that FDI generates positive externalities among Mexican firms underline the importance of FDI firms (Blomström and Persson, 1983; Kokko, 1994; Jordaan, 2005; Jordaan, 2010). Second, the Mexican manufacturing sector has undergone important structural and spatial changes following the introduction of trade liberalization in the mid 1980s (Hanson, 1996, 1997, 1998; Chiquiar, 2008). As a result of these changes, Mexico City has experienced a marked decrease in its level of participation in overall manufacturing activity. In contrast, states that share a border with the US have seen their share in manufacturing activity increase substantially. During the same time period, Mexico experienced a dramatic increase in its level of inward FDI. New empirical evidence on what factors affected the location choice of this large inflow of new FDI will help in understanding whether and how foreign-owned firms have played a role in the strong spatial changes of the Mexican economy. Third, regional governments see the attraction of new FDI as an important tool to stimulate industrialization, generate employment, promote exporting activities and obtain new technologies through technological spillovers. In this context, recent findings for Mexico that indicate that FDI spillovers are particularly pronounced at the regional level (Jordaan, 2008b; 2011b) and that agglomeration may in fact enhance these spillovers (Jordaan, 2005; 2008c) are particularly relevant. A better knowledge of what determines the location choice of new FDI and whether FDI firms are attracted to agglomerations of economic activity within Mexico will facilitate the creation and implementation of better-informed and more effective regional development policies.

The purpose of this paper is to address the described gap in the literature and conduct an empirical analysis of location factors of inward FDI into Mexico. Using a dataset containing the location decisions of almost 3 500 new foreign-owned manufacturing firms during the period 1994-1999, I estimate conditional logit models based on McFadden (1974) to statistically identify regional characteristics that have influenced the regional distribution of this set of FDI firms. The contribution of the analysis is three-fold. First, I provide new quantitative evidence on the importance of a variety of regional characteristics that have influenced FDI location decisions. In particular, extending from the work by *e.g.* Crozet, Mayer and Muchielli (2004),

Head, Ries and Swenson (1995, 1999), and Hilber and Voicu (2010), the analysis takes great care in identifying the effects of agglomeration economies on FDI location. Compared to these studies, I deploy a more diverse distinction between agglomeration economies from different sources. In particular, I distinguish between agglomeration economies from manufacturing activity, commercial services (distributors) and financial services, separate for Mexican and foreign-owned firms. Second, the analysis assesses whether the effects of regional demand and agglomeration economies are confined within regions or are also transmitted across geographical space. If so, evidence of such spatial effects carries important policy implications, suggesting the need for multi-regional or federal coordination of regional policies that aim to attract new FDI. Third, the analysis addresses potential heterogeneity among FDI firms concerning their location decisions. By comparing empirical estimates obtained from the full sample and from restricted samples and by estimating nested logit location models, I evaluate whether the location process differs between FDI firms that are more likely to produce for the Mexican market and FDI firms that produce for the international (US) market.

The article is constructed as follows. Section two discusses briefly the importance of FDI in the Mexican economy and describes the main spatial changes of the Mexican economy and inward FDI in the last two decades. The main finding of this section is that new FDI firms have concentrated in a select group of states within Mexico, states that also incorporate agglomerations of economic activity. This suggests that foreign-owned firms are influenced in their location behavior by the regional presence of agglomeration economies.

Section three discusses the methodology, the dataset and defines the explanatory variables. The data consists of a large number of new FDI firms that located in Mexico during the period 1994-1999. I analyze the regional distribution of this large set of firms using the conditional logit model as introduced by McFadden (1974), see also Bartik (1985), Carlton (1983). In the empirical analysis, I focus on identifying the effects of four main types of regional characteristics: regional demand, labor costs and labor quality, a variety of regional agglomeration economies and regional distance to the main markets: Mexico City and the US.

Section four presents the main empirical findings from the analysis, which can be summarized as follows. For the full sample of firms, I find evidence that all regional characteristics are important. The level of regional demand and labor quality enhance the probability that a region is selected, whereas labor costs lower this probability.

As for the effects of agglomeration economies, the regional presence of agglomerations of manufacturing firms and distributors both have a positive effect. In contrast, the regional presence of an agglomeration of financial services deters new FDI. Regional distance to the main markets Mexico City and the US also has a negative effect. Regarding agglomeration economies that attract new FDI, agglomerations of Mexican manufacturing firms and foreign-owned distributors are most important. Estimations on a restricted sample show that regional demand is not a significant location factor for those FDI firms that are most likely to be producing for international markets. This is confirmed by the findings from estimating a nested logit location specification. The non-importance of regional demand is also indicated by findings from estimating regression models that incorporate spatial effects from demand and agglomeration economies. In contrast, I find that agglomeration economies do have an inter-regional reach; again, agglomerations of Mexican manufacturing firms and foreign-owned distributors have the largest positive effect on the probability that a region is selected by new FDI firms, whereas financial services lower this probability.

Finally, section five summarizes and discusses policy implications.

2. Trade liberalization and the location of FDI

2.1. *Locational changes in the Mexican economy*

Prior to the introduction of policies of economic liberalization and trade promotion in the mid 1980s, the distribution of economic activity in Mexico was characterized by a large geographical concentration of economic activity in and around Mexico City (Krugman and Elizondo, 1996). The rationale behind the existence of this agglomeration was that Mexico City constituted the main domestic market. By concentrating in Mexico City, firms could generate economies of scale and benefit from being located in proximity to other manufacturing firms. This led to a process of cumulative causation, creating a situation where almost 50% of Mexico's total manufacturing activity was agglomerated in and around Mexico City in the late 1960s (Hanson, 1997). Following the introduction of policies of economic liberalization and trade promotion in the 1980s, the regional distribution of economic activity changed dramatically. Although all regions were

of course affected, Mexico City and the border states experienced changes that have been most marked. Table 1 shows the development of employment shares of Mexico City, the border states and the group of other states for the period 1980-2003. Mexico City saw its share in total manufacturing activity decrease markedly. To indicate the magnitude of this decrease, Mexico City's share more than halved from 44% in 1980 to about 20% in 2003 (see also Hanson, 1997; Jordaan, 2009). In contrast to this development, the border states experienced a strong increase in manufacturing employment, from 21% in 1980 to 36% in 2003. The strength of these spatial changes is most marked for sector 38, containing modern industries including the car, computer and electronics industries. Mexico City's share in total employment of this sector decreased dramatically from 52% to 15% in 2003, whereas the share of the border states more than doubled from 27% to 60 percent.

Table 1
Regional employment shares 1980-2003

Regions	*Share in manufacturing employment (%)*				
	1980	*1985*	*1993*	*1998*	*2003*
Mexico City	44.4	36.8	29	23	21
Border States	21	23	30	35	36
Other states	34.6	40	31	42	43
	Share in employment sector 38 (%)				
	1980	*1985*	*1993*	*1998*	*2003*
Mexico City	51	40	26	18	15
Border States	27	34	50	58	60
Other states	22	26	24	24	25

Sources: Regional employment shares taken from Hanson (1997) and Jordaan and Sanchez-Reaza (2006). Mexico City = Federal District and *Estado de México*; Border States = *Baja California, Coahuila, Chihuahua, Nuevo León, Sonora, Tamaulipas*

The main explanation for this marked shift in the distribution of manufacturing industries is that the opening up of the Mexican economy made the US the main destination market for many firms, and in fact entire industries (Krugman and Elizondo, 1996; Hanson, 1996,

1998). Instead of producing for Mexico City, many manufacturing firms started to produce for the US market. As a result, proximity of the border states to the US became a prime location factor for many firms, fostering the rapid build up of manufacturing activity in these states. Having said this, the actual locational changes have been more nuanced than suggested by these broad trends. In particular, whereas the border states gained markedly in their share in export-oriented manufacturing activities, Mexico City has continued to incorporate substantial shares of import-competing industries, industries that produce mainly for the domestic market (Faber, 2007; Jordaan and Sanchez-Reaza, 2006). As a result of these changes, the distribution of economic activity has changed from containing one main agglomeration of economic activity in Mexico City to a situation where there is a limited number of agglomerations in the border states and Mexico City.

In line with these spatial changes, studies on regional convergence and divergence have identified a structural change in the spatiality of regional growth in the Mexican economy. For the period of import substitution, regional growth is characterized by a process of absolute convergence (Juan-Ramon and Rivera-Batiz, 1996; Chiquiar, 2005; Rodriguez-Oreggia, 2005; Rodriguez-Pose and Sanchez-Reaza, 2002). In strong contrast to this, the period following the introduction of trade liberalization is characterized by regional divergence (Rodriguez-Oreggia, 2005). In particular, a growing level of divergence is identifiable between the border states and also Mexico City on the one hand and the southern states on the other hand (Aroca, Bosch and Maloney, 2005; Chiquiar, 2005).

2.2. *FDI location*

Mexico has benefited from substantial levels of inward FDI for several decades(UNCTAD, 2005). Furthermore, following the introduction of trade liberalization and the creation of the NAFTA agreement in the mid 1990s, the level of inward FDI has increased markedly (Pacheco-Lopez, 2005; Jordaan, 2009; Blomström and Kokko, 1997). As a result, the level of foreign participation in the Mexican economy has increased substantially. To indicate the magnitude of the increase in the level of foreign participation, the share of the stock of inward FDI in Mexico's total GDP has risen from a little over 8% in 1990 to more than 27% in 2006 (Jordaan, 2008a).

Where did the large influx of new FDI firms locate? Table 2 presents the regional distribution of inward FDI flows and the re-

gional distribution of Maquiladora activity for the period 1989-2004. The first characteristic of the distribution of inward FDI flows is that Mexico City is clearly the favored region for new FDI. For instance, between the years 2001-2005 the average share of Mexico City averaged well over 60% of total inward FDI. One reason for the dominance of this region is that it contains the main financial centre of the country, attracting the vast majority of FDI in financial services and related activities. Also, Mexico City attracts FDI as it continues to represent one of the major agglomerations of economic activity in the country. Having said this, it is important to consider that the share of Mexico City in inward FDI flows is inflated. Many foreign-owned firms have their head quarters in Mexico City to which they assign inward FDI flows, whilst actual new production sites and back offices may be located elsewhere in the country.

Table 2
Regional distribution inward FDI and Maquiladora activity 1989-2004

Regions	*Total inward FDI flows (%)*			*Maquiladora employment (%)*		
	1989-1993	*1994-1999*	*2000-2004*	*1992*	*1996*	*2004*
Mexico City	67.3	58.5	65.5	0.6	0.9	0.5
Border States	12.2	30.6	24.2	91.7	87	83.1
Other states	20.5	10.9	10.3	7.7	12.1	16.4

Sources: Regional inward FDI based on data provided by Secretaria de Economía and Jordaan (2008a); regional employment shares in maquiladora industries based on data in INEGI (various years) and Jordaan (2009). Mexico City = Federal District and *Estado de México*; border states = *Baja California, Coahuila, Chihuahua, Nuevo León, Sonora, Tamaulipas.*

The second feature of the regional distribution of FDI flows is that the border states have clearly become a more important region for new FDI. During the period of trade liberalization, the share of the border regions in inward FDI flows increased from 12% to more than 30% in the 1990s and then decreased to about 25% in the first half of the 2000s. Importantly, it is very likely that the growing importance of the border regions is not fully captured in table 2. The reason for this is that the border states incorporate many FDI firms with

low capital-labor ratios, given the preponderance of labor-intensive production technologies. As a result, the share of the border states in total FDI flows is likely to be deflated.[1] Also, as mentioned above, the border states are likely to incorporate foreign-owned activities that are assigned to headquarters located in Mexico City.

Finally, table 2 shows that the group of remaining states has seen its share in inward FDI flows deteriorate. In the early years of trade liberalization, these states received over 20% of total inward FDI flows. In more recent years, this share has halved to about 10%. Also, the number of states with little or negligible shares in inward FDI has increased, further indicating the growing concentration of inward FDI into Mexico City and the border states (see Jordaan, 2009).

The second part of table 2 presents the regional distribution of Maquiladora activity. Started in the mid-1960s to promote industrial development in Mexicos northern states, the relative importance of Maquiladora activity remained modest until the mid-1980s. With the introduction of trade liberalization, the Maquiladora program received an important stimulus, leading to a rapid growth of activity. To indicate the growing importance of this program, the share of Maquiladora firms in total manufacturing employment has increased from a modest 6% in 1980 to 25% in 2006 (Jordaan, 2009).

Looking at the employment shares of the different groups of regions, it is clear that the border states represent the main location for this type of FDI. Importantly, starting with the government of de la Madrid in the mid-1980s, locational restrictions on Maquiladora firms were loosened on several occasions (CEPAL, 1996), making it possible for these firms to locate outside the border states (Weiler and Zerlentes, 2003). Also, it has become easier for Maquiladora firms to sell part of their production on the Mexican market. However, the loosening of these restrictions has not affected the position of the border states as prime location for Maquiladora activity. Of course, proximity to the US, representing the main source of inputs and machinery and main destination market, is the continuing motivating factor for Maquiladora firms to locate in these states.[2]

[1] For instance, in the second half of the 1990s the share of inward FDI in the industry of clothing and leather represented less than 8% of total FDI inflows. In terms of number of firms, this industry incorporated over 15% of the total number of new FDI firms (Pacheco-Lopez, 2005).

[2] The group of other states has also seen its share in Maquiladora activity increase. This development particularly concerns firms operating in sector 32 (textiles and leather) and to a lesser degree sector 38 (metal products). States that have benefited from this trend include *Yucatán, Durango* and *Puebla*.

Summing up, the introduction of trade liberalization in the Mexican economy has generated important structural and spatial changes. One main trend is that the regional distribution of economic activity has changed from containing one main agglomeration in and around Mexico City to a situation where agglomerations of activity are located in the border states and Mexico City. Second, the large influx of inward FDI flows that followed the introduction of trade liberalization and the creation of the NAFTA agreement, and the large growth of Maquiladora activity are concentrated in a limited number of regional economies within Mexico. In particular, foreign-owned firms show a tendency to locate in those states that contain agglomerations of economic activity. This suggests that agglomeration economies constitute an important location factor for FDI.

This is especially important given related evidence that FDI spillovers in Mexico are most pronounced at the regional level and that agglomeration enhances FDI externalities. For instance, Jordaan (2011b, 2011c) finds robust evidence that FDI firms in Nuevo Leon, representing the second most important agglomeration of manufacturing industries, generate substantial positive spillover effects among their local suppliers. Aitken, Hanson and Harrison (1997) present findings that market access spillovers from FDI do not materialize at the national level, but are instead confined within states. Jordaan (2009) estimates conditional convergence growth models for the period from the late 1980s to the mid-2000s and finds that regional FDI has been an important driver of regional growth (see also Jordaan and Rodriguez-Oreggia, 2010). As for direct effects of agglomeration, Jordaan (2005) finds that manufacturing industries that have a high degree of agglomeration within Mexico benefit from larger positive FDI spillovers. Similar evidence of this positive effect of agglomeration for Mexico City and the border states is presented by Jordaan (2008c). In order to assess whether FDI firms are indeed attracted to agglomerations and what the relative importance of this factor of agglomeration is with respect to other location factors, a more formal and encompassing empirical analysis is required, which I introduce and conduct in the next sections.

3. Econometric model and data

3.1. *Econometric model*

The process of FDI location in a host economy can be understood as the outcome of a profit maximization strategy, where a new foreign

firm chooses the region with the highest expected profit (Bartik, 1985; Carlton, 1983). Therefore, the regional distribution of a set of new firms can be seen as a set of discrete choices between regions in a host economy. The real profit of locating in a region is unknown, only the choices and the regional characteristics can be observed. In other words, the observed regional distribution can be interpreted as the revealed preference for locational attributes by FDI firms. In this setting, the conditional logit model, as originally introduced by McFadden (1974), can be used to obtain statistical evidence on which regional characteristics affect the location choice of new FDI firms. A new FDI firm can choose between n regions, $J = (1, 2, 3, ...n)$. Each region j offers an expected profit as follows:

$$\pi j = Dj + \varepsilon j \tag{1}$$

This equation indicates that the expected profit of region j is a function of a regional observable part D and an unobservable part ε. The observable part D contains a vector of regional characteristics Xj and a vector bj, representing the coefficients to be estimated. A FDI firm chooses location j if expected profits of this region are higher than in the other regions:

$$Pj \equiv \Pr ob(\pi j > \pi k) = (\varepsilon k < \varepsilon j + b(Xj - Xk)) \quad \forall \neq j \tag{2}$$

As McFadden (1974) (see also, *e.g.*, Head, Ries and Swenson, 1995) explains, if the errors are distributed as a Type I Extreme Value independent random variable, equation (2), the probability of a firm choosing region j becomes:

$$Pj = e^{bXj} / \sum_{i=1}^{n} e^{bXi} \tag{3}$$

This equation can be estimated with maximum likelihood techniques to obtain the b's.

Previous research on FDI location behavior shows that four main types of regional characteristics are included in vector X: regional demand, regional cost factors, agglomeration economies and public policies to attract foreign investment (see, *e.g.*, Crozet, Mayer and Muchielli, 2004; Hilber and Voicu, 2010; Coughlin and Segev, 2000). Of these variables, regional public policies are the most difficult to include, as information on this type of regional characteristic is often

not available. In the empirical analysis, I focus on the first three types of regional characteristics, as data constraints prevent the use of a variable on regional policies that were in operation in the 1990s to attract inward FDI.

3.2. *Data*

To estimate the regression model, I use a dataset provided by the *Secretaría de Economía* containing the location decisions of new FDI manufacturing firms during the period 1994-1999. The motivation for choosing this time period is that Mexico experienced a marked increase in inward FDI following the creation of NAFTA in 1994 and that the majority of new FDI firms consisted of greenfield investments into the manufacturing sector. Table 3 presents the location decisions of the set of manufacturing firms. Similar to the distribution of inward FDI flows shown in table 2, the geographical distribution of the large set of new manufacturing firms is characterized by a concentration in Mexico City and the border states. Whereas Mexico City received over 54% of the total number of new manufacturing firms, the share of the border states amounted to almost 27%. Of the remaining states, *Jalisco*, *Puebla* and *Guanajuato* are also listed among the top ten receiving states.[3]

The set of regional characteristics that I use in the empirical analysis is presented in table 4. All control variables are calculated with 1993 data. The first variable that I include is the level of regional demand (Coughlin, Terza and Arromdee, 1991; Coughlin and Segev, 2000). All else equal, a region is more likely to be selected by a new FDI firm when the firm expects the region to have a relative high demand for its products. I measure regional demand as the value of state level GDP.

The second factor that I expect to influence the location choice of new FDI is the level of production costs. I include an indicator of the regional wage level, measured as the total wage bill of the manufacturing sector divided by the total number of manufacturing

[3] Unfortunately, the dataset does not contain information on the size, industry or nationality of the firms, characteristics that would have been very interesting to include in the analysis. These shortcomings of the dataset do not appear to be too problematic, as the main interest in this article lies in identifying the determinants of the main location trends among new manufacturing firms following the creation of NAFTA.

employees. Importantly, when using wages as an explanatory variable, I need to correct for the fact that the wage level reflects both labor costs and productivity. I include two variables to do this. One variable captures the cross- regional variation of the level of schooling, indicating the general education level of the regional labor force. The second variable captures regional labor quality, measured as the ratio of the total number of white collar employees over blue collar employees in the regional manufacturing sector (see Jordaan, 2005, 2008c). The third type of regional characteristic is the presence of agglomerations of manufacturing and services. The regional presence of an agglomeration can deter or attract inward FDI. The deterring effect is caused by the fact that an agglomeration is an expensive place to operate in. Prices for regional inputs such as land and labor are higher and agglomerations are characterized by congestion costs. The attractive influence of an agglomeration originates from the fact that a geographical concentration of firms may generate positive agglomeration economies, offering productivity advantages to firms in the agglomeration over firms located elsewhere (Rosenthal and Strange, 2004). In particular, agglomeration economies may be created via input-output linkages, search and match externalities on labor markets and knowledge spillovers (Duranton and Puga, 2004). If large enough, these positive agglomeration economies outweigh the higher costs of operating in the agglomeration, resulting in positive productivity effects.

Table 3
Regional distribution new FDI manufacturing firms, 1994-1999

Regions	*Nr of new plants*	*(%)*	*Rank*
Mexico City	**1 895**	**54.3**	1
Baja California	440	12.6	2
Coahuila	73	2.1	9
Chihuahua	100	2.9	6
Nuevo León	212	6.1	4
Sonora	19	0.50	17
Tamaulipas	82	2.4	7
Total Border States	**926**	**26.5**	
Aguascalientes	36	1.05	13
Baja California Sur	35	1	14
Campeche	4	0.11	23

Table 3
(*continued*)

Regions	*Nr of new plants*	*(%)*	*Rank*
Colima	4	0.11	23
Chiapas	1	0.03	24
Durango	12	0.34	20
Guanajuato	61	1.75	10
Guerrero	7	0.20	21
Hidalgo	14	0.40	19
Jalisco	174	5.00	5
Michoacán	1	0.03	24
Morelos	14	0.40	19
Nayarit	12	0.34	20
Oaxaca	1	0.03	24
Puebla	78	2.23	8
Queretaro	61	1.75	11
Quintana Roo	30	0.86	15
San Luis Potosí	25	0.72	16
Sinaloa	7	0.20	21
Tabasco	1	0.03	24
Tlaxcala	19	0.54	18
Veracruz	19	0.54	18
Yucatán	50	1.43	12
Zacatecas	5	0.14	22
Total other states	**671**	**19.2**	

Note: Mexico City = Federal District and *Estado de México*.

Table 4
Description of regional characteristics

Description	*Definition*
Market demand	State level GDP (1)
Wages	Total wage costs manufacturing sector/number of manufacturing employees (2)

Table 4
(*continued*)

Description	*Definition*
Schooling	Schooling attainment of regional labor force (1)
Labor quality	Number of white collar employees/number of blue collar employees (2)
Agglomeration of Mexican-owned manufacturing	Number of Mexican-owned manufacturing firms (3)
Agglomeration of Mexican-owned financial services	Number of Mexican-owned financial services firms (3)
Agglomeration of Mexican-owned commercial services	Number of Mexican-owned commercial services firms (3)
Agglomeration of foreign-owned manufacturing	Number of foreign-owned manufacturing firms (3)
Agglomeration of foreign-owned financial services	Number of foreign-owned financial services firms (3)
Agglomeration of foreign-owned commercial services	Number of foreign-owned commercial services firms (3)
Distance to Mexico City	Distance in kilometers between state capital city and Mexico City (4)
Distance to Border with US	Distance in kilometers between state capital city and border with US (4)

Sources and notes: (1) www.inegi.gob.mx, (2) 1994 Economic Census, (3) unpublished data, provided by INEGI, (4) provided by Jordaan and Sanchez-Reaza (2006). All variables are for 1993; all variables measured in logs, Mexican agglomeration variables exclude firms with less than 20 employees.

Extending from previous empirical studies, I distinguish between different sources of regional agglomeration economies: agglomeration economies from manufacturing, from commercial services and from financial services. If I find for instance a positive effect of a regional

agglomeration of manufacturing on the probability that a region is selected by new FDI, I can infer from this that the agglomeration is creating positive agglomeration economies for manufacturing firms.[4] In the present analysis, I expect a positive effect of regional agglomerations of manufacturing and commercial services, as both can generate positive agglomeration economies via input output linkages, knowledge spillovers and thick labor markets. I interpret commercial services as representing distributors that provide material inputs to manufacturing firms. In contrast, I expect that regions with an agglomeration of financial services are less likely to be selected by new FDI firms. FDI firms are part of multinational enterprises (MNEs) and are likely to use financial services from their mother companies instead of using local providers in host economies. At the same time, the regional presence of an agglomeration of financial services will make it more expensive to operate in such a region. In combination, whilst FDI firms would still have to pay the premium to operate in the agglomeration, they would not obtain benefits from the agglomeration. This makes it less likely that FDI firms will locate in a region with an agglomeration of financial services.

Importantly, in contrast to previous studies that have focused mainly on identifying whether the regional presence of an agglomeration of existing FDI manufacturing firms influences the probability that a region is selected (*e.g.* Head, Ries and Swenson, 1995, 1999; Guimarães, Figueiredo and Woodward, 2000; Crozet, Mayer and Muchielli, 2004), in the present study I distinguish between agglomerations of Mexican firms and FDI firms for manufacturing, commercial services and financial services. I measure the regional presence of agglomerations of Mexican firms by the number of Mexican firms in manufacturing, commercial services and financial services. Likewise, agglomerations of FDI firms are calculated by the number of foreign-owned firms operating in manufacturing, commercial services and financial services.[5]

[4] The identification of agglomeration economies is fraught with difficulties, especially as estimated relations between the size of regional industries and productivity are likely to be affected by endogeneity issues (see Ciccone and Hall, 1996). This is less of a problem when analyzing the location pattern of new FDI firms, as new firms can be seen as being exogenous to the existing regional distribution of economic activity. Therefore, findings that indicate that new FDI firms are attracted to regions with agglomerations of economic activity can be interpreted as evidence of the presence of agglomeration economies.

[5] For agglomerations of Mexican firms, I count only those firms that have at least 20 employees, as I do not expect that the location of micro and small firms

Finally, I include two variables to the regression model that capture regional distance to the main markets Mexico City and the US. Under trade liberalization, these two regions have become the main markets for most manufacturing firms. Given findings that indicate the importance of distance to these markets for regional growth (Hanson, 1996, 1997, 1998; Jordaan and Sanchez-Reaza, 2006), I expect that regional distance to these two main markets will have an independent, negative, effect on the probability that a region is selected by new FDI, even after controlling for the effects of regional demand, production costs and the regional presence of agglomerations of economic activity.

4. Empirical findings

4.1. *FDI location factors*

Table 5 presents the empirical findings from estimating several specifications of the regression model. The first column with findings contains the results from estimating the econometric model with only regional demand and the labor-related variables. Most of the estimated effects are as expected. The level of regional demand has a positive effect on the probability that a region is selected. The estimated effect of wages is negative, indicating that labor costs lower this probability.[6] The estimated effect of schooling is positive, as expected. The only variable with an estimated effect contrary to expectations is labor quality, which carries a negative coefficient.[7]

affects the location pattern of FDI. In preliminary regressions I experimented with a variable capturing the cross-regional variation of micro and small Mexican firms, but this variable is not significantly associated with the regional distribution of FDI firms.

[6] Initial estimations of the model with only regional demand and regional wages produced a positive effect of the wage variable, indicating that it is important that the regression model contains separate controls for schooling and labor quality to ensure that the wage variable does not pick up regional productivity effects.

[7] Following Hilber and Voicu (2010), I experimented with additional variables on labor relations, including the number of official strikes and the number of registered labor conflicts. The estimated effect of both these variables is insignificant. I also estimated for the effect of infrastructure, using infrastructure variables as in Jordaan (2008a). Although these variables carry positive coefficients, their estimated effect proved insignificant in the present analysis.

The next column presents the results from adding the various agglomeration variables of Mexican firms to the regression model. Although the magnitude of the coefficients of the other control variables change somewhat, the nature of their effect is robust to the inclusion of the additional variables. The exception is the labor quality variable, which now has the expected positive effect. Considering the agglomeration variables, there are two different types of effect. Agglomerations of Mexican manufacturing firms and Mexican distributors both have a positive effect on the probability that a region is selected. This suggests that both types of agglomeration generate positive agglomeration economies to FDI firms that outweigh any costs that are associated with operating in an agglomeration of activity. In contrast, the estimated effect of an agglomeration of financial services is negative. This difference in estimated effect is in line which what was discussed earlier, that FDI firms are more likely to use financial services from providers within the MNEs to which they belong. Therefore, FDI firms are less likely to benefit from agglomeration economies that are created in an agglomeration of financial services, whilst they would still have to pay the premium for locating in the financial services agglomeration. As a result, FDI firms are less likely to locate in regions with an agglomeration of financial services, all else equal. This effect has not been identified in previous FDI location studies which were unable to estimate for the separate independent effect of the regional presence of financial services. Column 3 presents the findings from adding the FDI agglomeration variables. Similar to the estimated effect of the agglomerations of Mexican firms, the regional presence of agglomerations of FDI manufacturing firms and foreign-owned distributors increase the probability that a region is selected, suggesting the presence of positive agglomeration economies from both sources. Again, the regional presence of an agglomeration of financial services lowers this probability.

The estimated coefficients in a conditional logit model closely relate to the elasticities of the probabilities of a region being selected with respect to the control variables (Crozet, Mayer and Muchielli, 2004).[8] Looking at the estimated β coefficients of the agglomeration

[8] As all variables are expressed in logs, the elasticity of the probability that for instance region b is selected with respect to the control variables is given by: $Eb{=}\partial\ ln\ Pb/\partial\ ln\ Xb{=}\beta(1{-}Pb)$. Rewriting gives: $\beta{=}Eb/1{-}Pb$. As FDI firms can choose between 32 regions, the average probability Pb that a region is selected is 1/32. This means that the estimated β coefficients are only slightly overestimating the actual elasticities. Irrespective of this, as all β coefficients are subject to the same bias, I can directly compare the coefficients.

variables that have a positive effect on the probability that a region is selected, the presence of an agglomeration of Mexican manufacturing firms has the largest effect. This finding is similar to Crozet, Mayer and Muchielli (2004), Guimarães, Figueiredo and Woodward (2000) and Boudier-Bensabaa (2005), who also find that agglomerations of domestic firms have the largest effect on the probability that a region is selected by new FDI firms.[9] The regional presence of FDI distributors has the second largest positive effect, suggesting that FDI firms find it important to locate in regions that contain an agglomeration of foreign-owned distributors of inputs. The estimated positive effect of the regional presence of Mexican distributors suggest that although FDI firms prefer to source from foreign owned distributors, they do perceive the presence of Mexican owned distributors as an additional small positive aspect.[10] In strong contrast to these findings, the magnitude of the estimated negative effect of the regional presence of domestic financial services indicates that this type of agglomeration has a strong deterring effect on new FDI.

Compared to the magnitude of the effects of agglomerations of Mexican manufacturing firms and foreign-owned distributors, the positive effect of the presence of an agglomeration of foreign-owned manufacturing firms is substantially smaller. A likely explanation for this is that although the presence of FDI firms is generating positive agglomeration economies, there can also be negative competition effects, whereby a regional agglomeration of FDI firms drives up prices of regional inputs. This could be the case for instance when there is a difference between Mexican and FDI manufacturing firms in terms of the types of labor that they demand. If so, an agglomeration of FDI manufacturing firms drives up prices of this regional input, lowering any positive agglomeration economies for new FDI manufacturing firms.

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[9] In contrast, Head, Ries and Swenson (1995, 1999) find that the regional presence of foreign-owned firms is the most important agglomeration variable. An explanation for their finding is that they study the location behavior of Japanese firms. It is well established that FDI firms from Japan attach great value to locating in proximity to other Japanese owned firms within a host economy (see Friedman, Gerlowski and Silberman, 1992).

[10] This finding is in strong contrast to other studies (*e.g.* Guimarães, Figueiredo and Woodward, 2000) that find a strong positive effect of the regional presence of agglomerations of domestic service firms. The likely explanation for the different findings of the present study is that I distinguish between distributors of material inputs and financial services, provided by either foreign-owned or domestic firms.

Table 5

Empirical findings on FDI *location factors*

Control variables	*1*	*2*	*3*	*4*	*5*	*6*
Market demand	1.10	0.52	1.30	0.65	-0.17	0.39
	(0.04)a	(0.16)a	(0.23)a	(0.25)a	(0.25)	(0.29)
Wages	-0.21	-2.24	-1.71	-0.83	-0.74	-0.93
	(0.10)b	(0.17)a	(0.18)a	(0.17)a	(0.18)a	(0.20)a
Schooling	0.48	0.57	0.39	0.25	0.11	0.28
	(0.02)a	(0.03)a	(0.03)a	(0.03)a	(0.03)a	(0.03)a
Labor quality	-1.23	0.98	0.78	0.77	1.58	0.71
	(0.11)a	(0.18)a	(0.22)a	(0.25)a	(0.20)a	(0.28)a
Agglomeration Mexican		1.22	1.55	1.48	1.22	1.03
manufacturing firms		(0.08)a	(0.18)a	(0.17)a	(0.12)a	(0.21)a
Agglomeration Mexican		-0.65	-1.32	-0.61	-0.67	-0.78
financial services firms		(0.16)a	(0.17)a	(0.17)a	(0.17)a	(0.28)a
Agglomeration Mexican		0.07	0.06	0.06	0.06	0.05
distributors		(0.01)a	(0.01)a	(0.01)a	(0.01)a	(0.01)a
Agglomeration foreign-owned			0.47	0.17	0.30	0.06
manufacturing firms			(0.07)a	(0.08)b	(0.11)a	(0.10)

Table 5

(*continued*)

Control variables	*1*	*2*	*3*	*4*	*5*	*6*
Agglomeration foreign-owned financial services firms			-0.04 (0.01)a	-0.05 (0.01)a	-0.02 (0.004)a	-0.01 (0.009)a
Agglomeration foreign-owned distributors			0.79 (0.10)a	0.35 (0.10)a	0.05 (0.01)a	0.50 (0.12)a
Distance to Mexico City				-0.03 (0.01)a	0.15 (0.03)a	-0.02 (0.004)a
Distance to US border				-0.02 (0.003)a	-0.02 (0.004)a	-0.03 (0.004)a
Inclusive value nested logit						0.42 (0.05)a
Log likelihood	-7852.8	-7783.7	-7593.4	-7587.2	-5164.1	-7543.2
Number of choices	32	32	32	32	30	2,30
Number of investors	3 492	3 492	3 492	3 492	1 928	3 492

Notes: Standard errors in parentheses. *a* and *b* indicate significance levels of 1 and 5%. Column 5 presents findings from omitting FDI firms locating in Mexico City. Column 6 contains findings from a nested logit estimation. Firms first choose between Mexico City and the rest of the country, after which they select a state in one of the two broad regions. The inclusive value of the nested logit estimation is for this tree structure of Mexico City *versus* the rest of the country.

Finally, column 4 presents the findings from the full regression model, including the controls for regional distance to Mexico City and the US. The estimated effect of both distance variables is small, but negative and significant. This suggests that distance to the main markets is an additional separate regional characteristic that influences the location decision of FDI firms, even after having controlled for the effects of regional demand, labor costs, labor quality and the various agglomeration economies variables. As such, this finding is in line with previous findings that identify distance to the main markets as an independent factor influencing regional growth (*e.g.* Hanson 1997, 1998; Jordaan and Sanchez-Reaza, 2006).[11]

4.1.1. Robustness checks: export-oriented firms and nested logit

To check the robustness of the findings, I estimate the regression model on a restricted sample, omitting firms that locate in Mexico City. I do this for two reasons. First, Mexico City is a unique region among the set of Mexican regions, constituting the main political and financial centre of the country. This means that this region may be selected by FDI firms for reasons that are entirely different from the regional characteristics that the regression model controls for. Second, the sample contains both FDI firms that enter Mexico to produce for the Mexican market and FDI firms that are export oriented. Many of these export-oriented firms participate in the Maquiladora program. As indicated in table 2, firms that participate in this program do not locate in Mexico City. As it seems fair to assume that there will be structural differences between firms that produce for the domestic or international market, there may be structural differences in their location behavior as well. By omitting FDI firms that locate in Mexico City from the sample, I can identify location factors of those FDI firms that are most likely to produce for international markets.

[11] The estimated effects of the control variables may be affected by over-dispersion, when groups of firms face similar choices and regional characteristics leading to the presence of group fixed effects (see Guimarães and Lindrooth, 2007). This would lower standard errors, which means that the significance of the estimated effects needs to be interpreted with some caution. At the same time, this is a problem in particular when the set of choices is very large (Guimarães and Lindrooth, 2007), which is not the case in the present analysis. Also, the fact that the variables listed in column 5 have significant effects whereas all the other variables that I experimented with carry insignificant coefficients suggests that the regression model does contain the main important location factors.

The main findings from estimating the regression model on the sample that omits FDI firms that locate in Mexico City are presented in column 5. Comparing the results with the findings for the full sample, there are some important differences. First, the estimated effect of regional demand has become insignificant, indicating that for FDI firms that are most likely to produce for international markets, regional demand is not an important location factor. This suggests that regional demand is particularly important for FDI firms that locate in Mexico City, which represents the main domestic market. As for the estimated effect of the other non-agglomeration variables, the nature of the estimated effect of schooling is the same, but the magnitude of the effect has decreased considerably. In contrast, the estimated effect of labor quality has doubled in size. This suggests that labor quality of manufacturing employees is a more important location factor for export-oriented firms than the overall schooling level of the regional labor force.

Turning to the agglomeration variables, the results are markedly similar. The regional presence of an agglomeration of Mexican manufacturing firms is the most important regional characteristic enhancing the probability that a region is selected. The presence of an agglomeration of Mexican owned financial services lowers this probability.[12] The presence of an agglomeration of FDI manufacturing firms also enhances this probability, although the magnitude of this effect is small. One important difference is the strong decrease in the magnitude of the effect of the presence of FDI distributors. Although the estimated effect of this variable is positive, the magnitude of the effect is much lower compared to the findings for the full sample. Export-oriented firms may source more of their inputs from the US, making the regional presence of distributors (irrespective of nationality) less important. Finally, the distance variables show that FDI firms actually put a premium on locating far away from Mexico City, confirming the feature that export-oriented firms stay away from Mexico City as a location. The small negative effect of regional distance from the US border persists.

Finally, I address the possibility that the main assumption that allows for the estimation of the conditional logit model to identify FDI location factors may not hold. This concerns the assumption of independence of irrelevant alternatives (IIA). This property implies that

[12] This indicates that the estimated negative effect of the regional presence of an agglomeration of financial services that I obtain with the full sample is not generated by some sort of "Mexico City effect", caused by the fact that Mexico City is the main financial centre of the country.

the relative probability of choosing between two alternative locations does not depend on the availability or characteristics of other alternatives. A violation of this property will lead to biased estimates (see, *e.g.*, Head, Ries and Swenson, 1995; Disdier and Mayer, 2004). This assumption is unlikely to hold if FDI firms select a location following a nested structure. In particular, it may be the case that new FDI firms that locate in Mexico first choose whether or not to locate in Mexico City, after which they select a region in either Mexico City or the rest of Mexico. If so, the assumption of IIA will not hold.[13]

The findings from estimating the nested logit specification are shown in column 6. The inclusive value is significant and lies between 0 and 1, indicating that the assumed hierarchy in the location decision process is important. The findings show that regional demand is insignificant. This indicates that new FDI firms do not consider regional demand, once they have decided between locating in Mexico City and the rest of the country. The explanation for this finding is the large difference in the level of regional demand between Mexico City and the rest of the country. The level of GDP in Mexico City is about 7 times higher than the average for the rest of the country, suggesting that the estimated positive effect of regional demand in the earlier regressions may have been caused by this large difference in regional demand.[14]

Interestingly, the other non-agglomeration variables carry significant coefficients of similar magnitude and with signs similar to the earlier regressions. As for the effects of the agglomeration variables, there are two important differences. The estimated effect of the presence of FDI manufacturing firms has become insignificant, suggesting that the regional presence of FDI firms is particularly important in the first stage of deciding between the two broad regions within Mexico. The regional presence of foreign-owned distributors has a much larger positive coefficient. This indicates that FDI firms do prefer to locate in regions with a large presence of these foreign-owned distributors, after having decided to locate in either Mexico City or the rest of the country. Finally, the estimated effect of the two variables capturing distance to the main destination markets is similar to the findings for the full sample from the original regressions, confirming that regional proximity to destination markets is important.

[13] See the appendix for a formal explanation of the nested logit specification.

[14] See Crozet, Mayer and Muchielli (2004) for a similar explanation of their findings from nested logit models on FDI location decisions in France concerning the dichotomy between Paris and the rest of the country.

4.2. *Inter-regional effects of regional demand and agglomeration economies*

One potential shortcoming of the analysis conducted so far is that the econometric model does not allow for the possibility that the effects of regional demand and agglomeration economies transcend regional borders. An indication that spatial externalities can be important in the Mexican economy is provided by Jordaan (2008b), who estimates FDI spillovers for Mexican regions at the 2-digit manufacturing industry level and finds that FDI spillovers do materialize between regions. Another example is Jordaan (2009), who estimates conditional convergence regression models to identify drivers of regional growth in Mexico from the late 1980s to the mid 2000s. The findings indicate clearly that agglomeration economies transcend regional borders (see Jordaan, 2009; also Jordaan and Rodriguez-Oreggia, 2010). As for spatial effects from regional demand, as discussed earlier, there is considerable evidence that regional growth is influenced by regional distance to Mexico City and the US, suggesting that the effects of regional demand can have an inter-regional reach (Hanson, 1997, 1998; Jordaan and Sanchez-Reaza, 2006).

Considering the location factor of regional demand, the inclusion of the inter-regional variation of regional demand can be incorporated as follows (Harris, 1954):

$$Marketpotential\ (i) = GDP(i) + \sum W\ GDP(k);\quad where\ k \neq i$$

W is a distance matrix containing spatial weights which I label wik, capturing the relation between geographical space and inter-regional demand flows between regions i and k (see Anselin, 1988). One of the key decisions when using such a spatially-adjusted control variable is how to measure inter-regional distance. One interpretation is to define wik as $1/dik$, representing the inverse of the distance between regions i en k (*e.g.* Head and Mayer, 2004; Crozet, Mayer y Muchielli, 2004). This gravity-like specification relates inter-regional effects to the distance decay effect in a continuous fashion. The other interpretation is the contiguity assumption, where inter-regional effects are assumed to only occur between regions that share a border. This specification entails that the wik's take the value of 1 when two states share a border and 0 otherwise.

I estimate the regression model trying out both distance decay

specifications.[15] The reason for doing so is that it is not clear a priori what type of relationship inter-regional demand and agglomeration economies have with geographical distance. Considering agglomeration economies, these externalities can be generated through knowledge spillovers, thick labor markets and input-output linkages between firms. As these different mechanisms may be affected by geographical space in a different way, it is important to try out different distance decay specifications in empirical estimations (Bode, 2004; Jordaan, 2011a).

As with the demand variable, I can control for inter-regional effects from agglomeration economies as follows:

$$Agglomeration\ (i) = Agglomeration\ (i) + \sum W\ Agglomeration(k);\quad where\quad k \neq i$$

I calculate the spatially-adjusted agglomeration variables for all six types of agglomeration in the regression model.

Table 6 presents the findings from estimating the regression model with the spatially-adjusted demand and agglomeration variables. The inclusive value of both spatially-adjusted regression models is significant and lies between 0 and 1, confirming the tree structure in the location decision process of the FDI firms. Looking first at the findings from using the specification that inter-regional effects can only materialize between regions that share a border, the non-importance of regional demand is confirmed. This indicates that the probability that a region is selected by FDI firms is not affected by the level of regional demand of the region itself or by the level of demand in neighboring regions. As for the effect of the variables capturing agglomeration-economies, the estimated coefficients are significantly larger than those obtained with the non-spatial regression model, indicating that the spatial dimension of agglomeration economies is important. More particularly, the confirmation of this spatial dimension indicates that geographical proximity is important, as the estimation assumes that spatial agglomeration economies only occur between regions that share a border. As for the relative importance of the various agglomeration variables, the findings confirm that an agglomeration of Mexican owned manufacturing firms is the most

[15] I measure distance between regions as the number of kilometers between state capitals.

important location factor, followed by the negative effect of the presence of Mexican owned financial services. Another interesting feature is that the agglomeration of foreign-owned distributors has become much more important. The regional presence of an agglomeration of FDI manufacturing firms now also carries a significant coefficient again. This indicates that FDI firms attach importance to locating in regions that contain or are located close to agglomerations of both foreign-owned manufacturing firms and distributors. The significance of the estimated effect of the presence of an agglomeration of FDI manufacturing firms contrasts with the findings from the non-spatial nested logit model, which finds that this agglomeration variable has an insignificant effect. This indicates that it is important to include spatial effects in the regression model, as the findings from the non-spatial regression model lead to the conclusion that an agglomeration of FDI manufacturing firms is not an important location factor.

Table 6
Spatial effects of regional demand and agglomeration economies on FDI location

Control variables	*No spatial effects*	*Contiguity*	*Inter-regional distance*
Market demand	0.39 (0.29)	0.01 (0.19)	0.11 (0.27)
Agglomeration of Mexican manufacturing firms	1.03 (0.21)a	1.57 (0.32)a	1.57 (0.21)a
Agglomeration of Mexican financial services firms	-0.78 (0.17)a	-2.80 (0.28)a	-0.29 (0.18)
Agglomeration of Mexican distributors	0.05 (0.01)a	0.52 (0.13)a	0.52 (0.06)a
Agglomeration of foreign-owned manufacturing firms	0.06 (0.10)	1.55 (0.15)a	0.47 (0.14)a
Agglomeration of foreign-owned financial services firms	-0.01 (0.009)a	-1.53 (0.34)a	-1.32 (0.14)a
Agglomeration of foreign-owned distributors	0.50 (0.12)a	1.32 (0.15)a	1.57 (0.21)a
Inclusive-value nested logit	0.42 (0.05)a	0.58 (0.02)a	0.62 (0.03)a
Log likelihood	-7543.2	-7547.8	-7473.7

Table 6
(*continued*)

Control variables	*No spatial effects*	*Contiguity*	*Inter-regional distance*
Number of choices	2,30	2,30	2,30
Number of investors	3 492	3 492	3 492

Notes: Standard errors are in parentheses, *a* and *b* indicate significance levels of 1 and 5%. Contiguity refers to distance matrix based on first order contiguity; inter-regional distance refers to distance matrix based on the inverse of the distance between state capitals. Column labeled "no spatial effects" is a replication of column 6 from table 5. The estimated regression model also contains wages, schooling, labor quality and regional distance to Mexico City and the US. Regression models are estimated using nested logit specification, where firms first choose between Mexico City and the rest of Mexico, after which they select a region within these two broad regions. Distance matrices are row standardized.

The next column presents the findings from estimating the regression model with the distance decay specification based on inter-regional distances. Again, the findings indicate that regional demand is unimportant. Also, the results confirm that the presence of an agglomeration of Mexican owned manufacturing firms has the largest positive effect on the probability that a region is selected by new FDI. Interestingly however, the findings from this regression model indicate that regional proximity to foreign-owned distributors is as important as the presence of Mexican manufacturing firms. In contrast, the estimated effect of an agglomeration of foreign-owned manufacturing firms is positive, but the magnitude has decreased. Again, this could indicate that an agglomeration of FDI manufacturing firms generates additional costs, where positive agglomeration economies in such an agglomeration are lowered as competition effects increase prices of regional inputs that are used specifically by foreign-owned manufacturing firms. Having said this, the significance of the estimated effect of this agglomeration variable confirms the importance of incorporating spatial agglomeration economies into the regression model. Finally, the findings from using this particular specification of the relation between distance and spatial agglomeration economies indicate that, in addition to the fact that geographical proximity appears to be important, there is also a more continuous negative relation between geographical distance and inter-regional agglomeration economies.

5. Summary and policy implications

In this paper, I estimate conditional logit models to identify regional characteristics that influence the location decision of inward FDI in Mexico. For this, I use a dataset containing the location decisions of almost 3 500 new foreign-owned manufacturing firms that located in Mexico during the period 1994-1999, following the creation of NAFTA. I pay particular attention to estimating the effects of the regional presence of agglomeration economies, given the structural changes that have occurred in the Mexican economy whereby new agglomerations of economic activity have developed in Mexico's northern states.

The main findings can be summarized as follows. First, estimating conditional logit models with the full sample of firms indicates the importance of various regional characteristics. The level of regional demand enhances the probability that a region is selected by new FDI firms, as do the regional level of schooling and labor quality. The regional level of wages lowers this probability. Looking at the effects of agglomeration economies, the regional presence of agglomerations of manufacturing firms and distributors both increase the probability that a region is selected. Regional agglomerations of Mexican manufacturing firms and foreign-owned distributors have the largest positive effect. In contrast, the regional presence of an agglomeration of Mexican-owned financial services has a strong deterring effect on new FDI. This latter finding has not been found in previous studies on FDI location decisions. Finally, increased regional distance from Mexico City and the US also lowers the probability that a region is selected by new FDI firms.

In extension of this, findings from estimating the location model for those FDI firms that do not locate in Mexico City indicates that regional demand is not an important location factor for export-oriented firms. This indicates that regional demand is only a location factor for those firms producing for the Mexican market. By and large, the nature of the estimated effect of the various agglomeration variables is the same for FDI firms producing for international markets. These findings are confirmed by the estimation of a nested logit location model that controls for the feature that foreign-owned firms may first choose between locating in either Mexico City or the rest of the country, after which they select a region within one of these two broader regions within Mexico.

Finally, I estimate a spatially-adjusted nested logit location model to assess whether the effects of regional demand and agglomeration economies transcend regional borders. Using two different specifications of the possible relation between geographical distance and

spatial demand and agglomeration economies, I find that regional demand is not an important location factor. In contrast, the estimated coefficients of the various agglomeration economies variables are larger than those obtained with the non-spatial regression model, indicating that agglomeration economies have a spatial dimension. This does not change the main features of the estimated effects of the various agglomeration variables: the regional presence of Mexican manufacturing firms and foreign-owned distributors of material inputs have the largest positive effect on the probability that a FDI firm selects a given region, whereas the regional presence of an agglomeration of Mexican owned financial services lowers this probability.

The findings carry several policy implications. First, the location behavior of FDI firms has clearly contributed to the marked spatial changes that the Mexican economy had undergone following the introduction of trade liberalization. The estimated positive effect of several of the agglomeration economies variables indicates that a majority of FDI firms have concentrated in the limited number of agglomerations of activity that have developed in the last two decades. As such, it is likely that the regional distribution of economic activity is characterized by a process of cumulative causation. New FDI firms contribute to the growth of an agglomeration, which in turn is likely to attract more new FDI firms, strengthening the dominance of the agglomerations in the north of Mexico and Mexico City. Furthermore, the findings suggest that this process of agglomeration of FDI firms is accompanied by regional specialization. In particular, FDI firms are attracted by the regional presence of manufacturing firms and material input providers, whereas the presence of financial services deters new FDI firms. In combination, this points to a process whereby agglomerations are subject to specialization in manufacturing and related material input supply.

Second, the findings indicate that although there is scope for regional governments to implement policies to influence FDI location behavior, the important role of agglomeration economies limits the extent to which such policies can be successful. For instance, the estimated significant effects of labor costs and labor quality indicate that regional policies that influence the cost and quality of the regional labor force can affect the location choice of FDI firms. However, it seems much more difficult to design and carry out effective policies that aim to change regional agglomeration economies. As discussed earlier, the development of agglomerations of economic activity within Mexico is the outcome of structural changes following the introduc-

tion of trade liberalization, fostering increased economic activity in the north of Mexico. Other states with smaller scales of economic activity that want to attract new FDI firms may have to offer some form of compensation to new FDI firms, as such firms would miss out on benefitting from agglomeration economies in the north and center of the country. At the same time, the finding that the effects of agglomeration economies appear to transcend regional borders suggests that FDI firms may also locate in regions close by regions containing large agglomerations of economic activity, opening up possibilities for regions in proximity to such agglomerations to attract new FDI firms.

In relation to this, the findings from the present study indicate that more research is called for on the relationships between agglomeration and FDI spillovers. Existing evidence for Mexico indicates that FDI spillovers are most pronounced at the regional level, and that agglomeration may actually enhance the level of spillovers that foreign firms can generate. Given the finding that FDI firms gravitate towards agglomerations of economic activity within Mexico, the relationships between agglomeration and FDI spillovers become very relevant to investigate. The process of cumulative causation that underlies the build-up of agglomerations will only be strengthened by the positive effects of agglomeration on FDI spillovers. These spillovers enhance the overall level of positive productivity effects in these agglomerations, making the agglomerations more attractive for future FDI.

Furthermore, regional governments that try to attract FDI firms into regions with smaller agglomerations of economic activity face difficult decisions. As discussed above, they have to compensate foreign-owned firms for the agglomeration economies that they miss out on by not locating in Mexico City or the northern states. Moreover, they also need to consider that the level of spillovers that these foreign firms can generate will be smaller than would have been created had these firms located in larger agglomerations. Therefore, not only will it be more costly to attract FDI firms into a region with a smaller scale agglomeration, it is also likely that the positive spillover effects that these firms can generate will be limited by the size of the agglomeration.

Finally, the findings that identify spatial dimensions to agglomeration economies indicate that there likely to be important differences between the private (intra-regional) and societal (multi-regional or national) returns to regional policy making. For instance, regions that are located close to regions with large agglomerations are more likely to attract new FDI firms. In fact, it may be the case that such

regions become increasingly more attractive, as FDI firms do not have to pay the premium of locating in a region with a large agglomeration of economic activity, whilst they can still benefit from agglomeration economies spilling over from the region with the large agglomeration. This may create a situation where regional governments of regions with large agglomerations lower their local investments, as part of the benefits of these investments spill over into other regions. If so, this can have a direct detrimental effect on the level of positive agglomeration economies in the main agglomerations of economic activity, lowering positive productivity effects. Subsequently, this may also affect regions located close to these main agglomerations in a negative way as they will also experience a decrease in the level of positive spatial agglomeration economies. To prevent such situations from arising, multi-regional or federal policymaking and coordination is required. More generally, this also applies to the design and implementation of policies that try to attract new FDI firms into any given region, as the success of such policies partly depends on characteristics of other regions located in proximity to the region.

Appendix: Nested logit location model

Suppose that a country contains a number of broader regions $I = (1, 2, ...i)$ and $J = (1..., j...ni)$ is the set of regions belonging to region I. The profit associated with being located in region j is:

$$\pi ij = Vij + \varepsilon ij \tag{1}$$

where Vij is a function of observable characteristics of region j:

$$Vij = bXij + \alpha Yi \tag{2}$$

As the equation indicates, the profit of region j belonging to country I depends on characteristics of region $j(X)$ and characteristics of the broader region $I(Y)$. The probability that region I is selected becomes:

$$Pi = e^{\alpha Yi + \beta iIi} / \sum_{m=1}^{l} e^{\alpha Ym + \beta m\mathrm{Im}} \tag{3}$$

Define Ii as:

$$\ln\left(\sum\nolimits_{ksi} e^{bXik}\right) \tag{4}$$

This is the inclusive value indicating the maximum profit expected from locating in region I. Then, the probability of choosing location j is conditional on locating in region I and becomes:

$$Pj|i = e^{bXij} / \sum_{k=1}^{ni} e^{bXik} \tag{5}$$

This means that the probability that region j, located in region I, is chosen by a firm amounts to:

$$Pij = Pj|iPi = \frac{e^{bXij}}{eIi}(e^{\alpha Yi+\beta iIi} / \sum_{m-l}^{l} e^{\alpha Ym+\beta m\mathrm{Im}}) \tag{6}$$

The coefficient β indicates whether the location choice of a firm does indeed occur in this two-step manner. If this coefficient equals 1, the probability that region j is selected amounts to the standard conditional logit model. If β equals 0, then the location decision process consists only of the first step, where a firm only chooses between the broader regions within a country.

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