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Agglomeration economies, growth and the new economic geography in Mexico

ALEJANDRO DÍAZ-BAUTISTA¹

- **Abstract:** The present study of regional economic growth in Mexico is based on the new economic geography, where distance plays an important role in explaining urban regional economic growth. The results show that distance to the northern border of Mexico and labor migration between states within Mexico, after the passage of NAFTA, are important factors that explain the regional state growth and agglomerations in Mexico between 1994 and 2000. The results also indicate that job growth and FDI are not significant for the period of study.
- **Resumen:** El presente estudio sobre el crecimiento económico regional en México se basa en la nueva geografía económica, donde la distancia desempeña un papel importante para explicar el crecimiento económico urbano regional. Los resultados muestran que la distancia a la frontera norte de México y la migración en México, después de la puesta en marcha del TLCAN, son factores importantes que explican el crecimiento regional estatal y las aglomeraciones para el periodo 1994 a 2000. Los resultados también indican que el crecimiento del número de empleos por sector y la Inversión Extranjera directa no son significativos para el periodo de estudio.
- **Keywords:** Economic Growth, FDI, Agglomerations, Mexico.
- **JEL Code:** 04,R1

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■ *Introduction*

In this study, I address issues related to the fields of new trade theory, urban regional economic growth, agglomeration economies and location theory. Unlike traditional theories which tend to focus on exogenous comparative advantage or technological differences among regions as causes for trade, the new economic geography emphasizes the roles of increasing returns to scale in production, access of firms and consumers to markets for goods, and trade and transport costs based on distance as determining the locations of economic activities. Using the recent developments in economic geography, I will study Mexico's regional growth processes during the last decade, after the signing of the North American Free Trade Agreement (NAFTA).

The paper will argue that economies of agglomeration, migration and the distance to the Northern Border region are important factors driving Mexico's economic activity. After the signing of NAFTA, regional migration and increasing trade with the United States pushed industry away from the initial agglomerations (Mexico City), acting as a decentralizing force to the northern border regions after the opening of the economy.

■ *Literature Review*

Positive external effects are one important factor included in the phenomenon called agglomeration economies. The early concept of external economies based on partial equilibrium was introduced by Marshall and developed by Pigou. For Marshall, externalities are scale economies dependent on the general development of the industry.

Recent work on endogenous growth theory and new trade theory has renewed the interest in economic geography over the last decade. Geographical space is introduced as an important concept in mainstream economics. In the new perspective internal conditions, non external demand conditions in an economy are the most important growth stimulating factors. In these models, economies of scale exist in relation to capital, more specific in the production of human capital or knowledge and technology as in Romer (1986) and in Krugman (1991). In other words, the marginal product of capital grows as the stock of capital expands. The more we invest in knowledge, the more the economy will grow. With the development of technology and accumulation of knowledge, positive externalities are produced.

In the 1980's, new endogenous growth theories were developed which brought back the ideas of imperfect competition between firms, the role

of history and accidents, and the appearance of multiple equilibria in the markets. The existence of increasing returns for explaining sustained growth is supported and influenced by the research progress made in trade theory and industrial organization. Romer and Krugman defend endogenous economic growth and increasing returns to scale view from location and knowledge accumulation perspectives.

Innovative firms and related production systems are embedded in territorial entities like regions or nations. The development of economies of scale, in relation to knowledge production, technological spillover and institutional or spatial limits to the diffusion of such externalities, is therefore often connected to the functional and spatial context such systems operate in. Regions including dynamic industrial systems with scale economies in knowledge production would grow faster than regions not in command of such elements. As a result, spatial differentiation in economic growth would appear between regions.

Agglomeration economies as well as positive external effects are theoretical concepts that are difficult to study. There is no obvious empirical phenomenon, which corresponds to these theoretical concepts. As far as we know, no well functioning measuring instruments have been developed neither in the economics nor the economic geographical literature. Researchers have to use more or less suitable indicators as measurement of externalities or agglomeration economies. Physical proximity is a possible indicator, if it is considered to facilitate access to positive externalities produced either individually or collectively. If technological spillovers are mutually produced and shared, firms would be more open to invest in knowledge. If a firm feel safe that they will have some returns from sharing knowledge with a specific environment, this would advance investments in knowledge by all parties.

Krugman (1991) developed the model of economic geography, showing that a country can grow into an industrialized core and an agricultural periphery. This is an alternative approach to understanding the changing economic geography of development economies. The new economic geography models, unlike traditional international trade models, assume increasing returns to scale in production at the level of individual firms. Pecuniary externalities arise from the assumption that industrial firms both supply goods to and demand goods from other industrial firms. Large scale agglomerative forces result from these forward and backward linkages within the industrial sector. Fixed populations, on the other hand, provide a dispersive force for the regional economy because, with costly transport of goods, local firms can more easily meet demand within the local area. It should be

emphasized that the character of this system does not depend upon the existence of technological spillovers or even differences in production techniques between regions. Results are derived exclusively from market interactions between firms in imperfectly competitive markets.

Krugman and Livas (1996) are the first to view Mexico through the lenses of the new economic geography. They attempt to explain why so much population and industry is concentrated in Mexico City. Their basic set up is based upon the Dixit and Stiglitz monopolistically competitive market structure. There are three regions situated at the apexes of an isosceles triangle pointed upwards, the uppermost apex representing the United States and the lower two representing Mexican regions. Labor is mobile between the two Mexican regions. The cost of congestion in the more agglomerated region constitutes the dispersing force, not a partially dispersed output market.

The model's insight is that the high tariff barrier maintained by Mexico prior to 1986 may have played a role in promoting excessive agglomeration in Mexico City. Under free trade, firms would locate wherever they could serve the U.S. market more cheaply; but as it happened, given high trade barriers, they wanted to serve the Mexican market, which was to be found wherever Mexican firms had already located.

The standard literature has shown that the spatial distribution of activities is determined by the exogenous spatial distribution of natural resources and production factors. In the Heckscher-Ohlin world, location patterns resulted from the interaction between region and industry characteristics. The industries that intensively use a given production factor tend to locate in regions that are relatively abundant in this factor. New trade theories introduce returns to scale and explicitly consider the geographic distance between economic agents. The typical result of these models is that sectors with returns to scale tend to locate in regions with better access to the markets of their own products, such as the border region of Mexico with the United States after the passage of NAFTA. Under economies of scale, the average costs fall as the level of production rises, which causes producers to have an incentive to spatially concentrate their activities. That is why industries with increasing returns to scale tend to locate in border regions with large market potentials.

The insights of Krugman and Livas (1996) with others in the new economic geography are the cumulative logic of agglomeration. If there is to be agglomeration, it could just as well be in one region as in another. History plays an important role, and the dependence of the

actual equilibriums on the initial conditions of the model. Hanson (1998) studied the effect of Mexico's economic integration with the United States on state-industry employment growth. Hanson (1998) disentangles the effects of two opposing forces on regional labor demand: transport-cost considerations, which encourage firms to relocate their activities to regions with relatively good access to foreign markets, and agglomeration economies, which reinforces the pre-trade pattern of industry location. Hanson finds that trade liberalization has strong effects on industry location. Consistent with the transport-costs hypothesis, post-trade employment growth is higher in state industries that are relatively close to the United States. The results on agglomeration effects are mixed. Employment growth is higher where agglomeration in upstream and downstream industries is higher, but not where the agglomeration of firms in the same industry is higher. The results suggest trade liberalization has contributed to the decomposition of the manufacturing belt in and around Mexico City and the formation of broadly specialized industry centers located in northern Mexico, relatively close to the United States. The core periphery model of the new economic geography gives us some insights of what has happened, the process of an integration policy in Mexico with the United States. Regions in the periphery like the state of Guerrero can have a competitive advantage in production costs due to lower labor costs in comparison to the leading regional economies in the country, mainly what we refer as the core economies. If transportation costs are sufficiently high, due to a large distance from the United States border, it would be more advantageous to produce in both regions and no localization pattern would appear. If transportation costs are almost zero, it would be more advantageous to produce in the leading costs region, that is, the northern border states like Baja California Norte. But if transportation costs raise a little, they could erode the advantage in labor costs of the periphery and the core-periphery model would suggest the appearance of an equilibria of localization in the core regions. High tech industries will be localized due to other factors such as foreign direct investment (FDI), human capital and wages.

■ *Mexico's Economic Geography*

The size of the large agglomerations in Mexico is the result of self reinforcing policies. The Mexico City Metropolitan Area (MCMA) has forty-five percent of the country's industrial activity and 38 percent of its gross national product. The rapid growth of the city has been characterized both by planned urban and residential areas for the middle

and upper class, and by unplanned and illegal land appropriations by immigrants to the peripheral areas. The MCMA is one of the largest and most rapidly growing urban centers in the world, with an area of 3,773 square kilometers. In 1990, the population was officially estimated at 15 million people (low estimate) and exceeded 22 million by the year 2000 (INEGI). During the past 30 years, Mexico became an urban economy.

Table 1
Evolution of the Urban Population in Mexico, 1970-2000.

| | 1970 | 1980 | 1990 | 2000 |
|--|------------|------------|------------|------------|
| Urban Population | 22,730,000 | 36,739,000 | 51,491,000 | 65,653,000 |
| % of the population in Urban Centers | 47.1 % | 55.0 % | 63.4 % | 67.3 % |
| Rate of Urbanization | 2.0 % | 1.5 % | 0.8 % | 0.6 % |

(Source: INEGI, 2000)

In 1970, 47% of the population lived in urban agglomerations, by the year 2000, more than 67% of the population live in urban centers. The total population of Mexico in 2000 reached 97 million people, with a rate of annual demographic growth close to 1.8% .

Mexico City increased in size during the 1970's, during the rise of import substituting industrialization policies in Mexico. As transportation costs became less important in the economy, the economy begins a process of regional decentralization as it liberalizes trade. By the passage of NAFTA, the economic linkages change to the foreign markets and it becomes profitable to relocate the industry close to the international ports and borders with the United States or to the foreign markets. Since 1994, the export-oriented manufacturing sector started to be the main economic growth engine. In terms of trade growth, NAFTA allowed for an increasing integration between Mexico and the U.S. Historically, the U.S. have always been the main trading partner of Mexico. The integration process has been particularly relevant in the case of Mexican exports, which, added to their increasing orientation toward the U.S., increased from 34 billion in 1991 to around 150 billion in 2000. Industries find it optimal to vertical de-integrate to save the costs of urban agglomeration. After the passage of NAFTA, manufacturing is mainly localized in the Northern Border of Mexico.

Table 2
Total Population in Mexico (2000)

| <i>Region</i> | <i>Total</i> | <i>Men</i> | <i>Women</i> |
|---------------------|--------------|------------|--------------|
| National Level | 97,361,711 | 47,354,386 | 50,007,325 |
| Aguascalientes | 943,506 | 454,477 | 489,029 |
| Baja California | 2,487,700 | 1,249,062 | 1,238,638 |
| Baja California Sur | 423,516 | 215,255 | 208,261 |
| Campeche | 689,656 | 342,900 | 346,756 |
| Coahuila | 2,295,808 | 1,135,143 | 1,160,665 |
| Colima | 540,679 | 266,442 | 274,237 |
| Chiapas | 3,920,515 | 1,931,495 | 1,989,020 |
| Chihuahua | 3,047,867 | 1,511,660 | 1,536,207 |
| Distrito Federal | 8,591,309 | 4,987,523 | 4,503,786 |
| Durango | 1,445,922 | 705,853 | 740,069 |
| Guanajuato | 4,656,761 | 2,221,365 | 2,435,396 |
| Guerrero | 3,075,083 | 1,484,415 | 1,590,668 |
| Hidalgo | 2,231,392 | 1,075,930 | 1,155,462 |
| Jalisco | 6,321,278 | 3,057,820 | 3,263,458 |
| Estado de México | 13,083,359 | 6,377,630 | 6,705,749 |
| Michoacán | 3,979,177 | 1,901,475 | 2,077,702 |
| Morelos | 1,552,878 | 746,972 | 805,906 |
| Nayarit | 919,739 | 454,268 | 465,471 |
| Nuevo León | 3,826,240 | 1,900,158 | 1,926,082 |
| Oaxaca | 3,432,180 | 1,647,550 | 1,784,630 |
| Puebla | 5,070,346 | 2,435,584 | 2,634,762 |
| Querétaro | 1,402,019 | 677,254 | 724,756 |
| Quintana Roo | 873,804 | 445,091 | 428,713 |
| San Luis Potosí | 2,296,363 | 1,114,723 | 1,181,640 |
| Sinaloa | 2,534,835 | 1,257,681 | 1,277,154 |
| Sonora | 2,213,370 | 1,104,391 | 1,108,979 |
| Tabasco | 1,889,367 | 929,347 | 960,020 |
| Tamaulipas | 2,747,114 | 1,352,258 | 1,394,856 |
| Tlaxcala | 961,912 | 468,484 | 493,428 |
| Veracruz | 6,901,111 | 3,338,141 | 3,562,970 |
| Yucatán | 1,655,707 | 813,600 | 842,107 |
| Zacatecas | 1,351,207 | 650,459 | 700,748 |

Source: INEGI: "Censo General de Población y Vivienda 2000" y

"Censo de Población y Vivienda 1995".

NAFTA also contributed to the integration of several Mexican and U.S. sectors. A few sectors of Mexico's economy have become of critical importance to increasing the competitiveness of the U.S. manufacturing sector. The electronics, automobile and auto parts sectors, as well as garments and textiles sectors, represent more than 70% of total Mexican exports and have become an integral part of the U.S. economy. These export-oriented Mexican activities in North America are based on cheap labor force and geographical proximity. Thus, NAFTA integration resulted in an important growth of intra firm and intra-industry trade.

■ *NAFTA Openness and the
New Economic Geography in Mexico*

By creating a new legislation, combined with a nondiscriminatory treatment and access to the North American market, the NAFTA agreement promoted the installation of transnational corporations in the region that centered their production and investment opportunities within the countries of North America. NAFTA was controversial in the United States due to the new dimension of economic integration with Mexico. The signing of an agreement with a developing country with low wages magnified the related questions of labor loss and reduction of wages in the industrialized country. The NAFTA agreement is the first example of a comprehensive economic integration between an industrialized country and a developing country. The breach of economic development between the United States on the one hand, and Mexico on the other, is much greater than the breach of the original members of the European Community with the recent members of the periphery like Spain, Portugal and Greece. After a unilateral reduction of tariffs and the elimination of the import permits, Mexico became a member of the GATT in 1986 (now WTO), and a member of the OECD in 1994. Since the eighties Mexico had a very ambitious commercial and trade agenda in the regional and bilateral scope. In the 1990's, Mexico entered an era characterized by the signing of various commercial and trade agreements.

During the first half of the Fox administration, Mexico had 11 free trade agreements, which covered a total of 32 countries that produced 60% of the world income and a preferential access to a potential market of over 870 million consumers. The impulse caused by the opening of the economy and the signing of the NAFTA had a positive effect in the growth of regional and municipal northern border economies of Mexico. The maquilador sector is one of the main motors of economic growth in the Northern Border of Mexico. In almost all the regions of the North

Table 3
Trade Agreements Signed by Mexico (1992-2002).

| <i>Name of the Agreement</i> | <i>Member Countries</i> | <i>Date</i> |
|---|--|-----------------|
| Acuerdo de Complementación Económica | Mexico, Chile | January 1, 1992 |
| NAFTA Agreement | Mexico, United States and Canada | January 1, 1994 |
| Trade Agreement with the European Union | Mexico, France, Germany, Netherlands, Belgium, Luxembourg, Italy, Sweden, Spain, Portugal and Austria. | January 1, 2000 |
| Trade Agreement México-Israel | Mexico and Israel | January 1, 2000 |
| Acuerdo de Cooperación Económica | Mexico and Uruguay | January 1, 1995 |
| Tratado de Libre Comercio del Triangulo del Norte | Mexico, Guatemala, Honduras y El Salvador | January 1, 1995 |
| Trade Agreement | Mexico and Costa Rica | January 1, 1995 |
| Trade Agreement | Mexico, Colombia, Venezuela | January 1, 1995 |

Sources: SE and INEGI.

Border of Mexico, a process of economic growth is observed, and the impulse due to the commercial opening is apparent. The exporting sector is a one of the most dynamic sectors of the Mexican economy. Since the signing of NAFTA, the growth of exports has contributed to at least half of the growth of the national product of Mexico. More than half of the 3.5 million jobs created in Mexico since August 1995 are related to the exporting sector and to activities linked with foreign direct investment. By the year 2000, the companies that exported more than 80% of their production had 62% higher wages than other types of companies. In that same year, the maquiladora sector had wages 5 times greater than the average national minimum wage. Similarly, Mexico has diversified its base of export. In 1987, petroleum and related products represented 30% of the national exports. By the year 2000, companies producing manufactured goods made 87% of the export sales in Mexico. In one decade, the liberalization of trade and the macroeconomic policies in Mexico have increased exports from 41 trillion USD in 1990 to 166 trillion USD in the 2000. Similarly, Mexico increased its imports by 310% from

1990 to 2000. From the creation of NAFTA in 1994 to 2004, the North American regions are seen as one of the most integrated commercial regions in the world. The regional proximity of the NAFTA partners is a factor that increases the dynamic performance of North America in terms of economic growth. By the year 2000, the members of NAFTA carry out one third of the total trade of the region. Similarly, NAFTA has increased the trade flows between Mexico, Canada and the United States. During the last few years, Mexico's trade with its NAFTA partners tripled, getting to be near \$275 trillion USD in 2000.

Table 4
Trilateral Trade in the NAFTA Region (Trillion USD).

| | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 |
|------------------|-------|-------|-------|-------|-------|-------|-------|-------|
| Trilateral Trade | 301.1 | 352.1 | 391.6 | 435.2 | 495.2 | 527.9 | 588.8 | 659.2 |
| México-USA | 85.2 | 104.3 | 115.5 | 140.5 | 167.9 | 187.8 | 215 | 263.5 |
| México-Canadá | 4.1 | 4.9 | 5.3 | 6.2 | 7.0 | 7.4 | 9.3 | 12.1 |

Sources: Banco de México y INEGI.

Trilateral trade in NAFTA reached 659 trillion USD in 2000, or 128.2 % more than in the year of 1993. From 1994, commercial trade between the member countries of NAFTA increased at an annual average rate of 11.8%, whereas the worldwide annual average rate of growth in trade was around 7%. The opportunities of trade for Mexico and Canada within NAFTA have increased in the last few years. Mexico became the fourth more important commercial partner for Canada, whereas the bilateral commerce between Mexico and Canada tripled, reaching 12 trillions USD in 2000. Mexico is the third most important buyer of Canadian products. Cornett (2001) has shown that the integration of the intra industry trade is extremely high within NAFTA and shows how the region integrated not only in commercial terms but also in terms of the productive systems of the region. The NAFTA region has created new opportunities of investment and trade for the companies of all 3 countries. In the NAFTA region, 50% of the direct foreign investment is between trade partners. For Mexico, the United States is the main source of direct foreign investment. From 1994 to 2000, U.S. companies invested 40.3 trillion dollars, whereas Canada invested near 2.8 trillion dollars.

NAFTA has also contributed to the economic growth of the northern border. The Northern Border of Mexico contributes to more than 20% of the National Product of Mexico. The asymmetry between the product of the northern border regions of Mexico and the United States is also

important. In 1994, the gross national product (GNP) of the United States is approximately 18 times greater than the GNP of Mexico. In some border regions like in the County of San Diego, the gross regional product was almost 14 times greater than the one in the Municipality of Tijuana by 1996. Although the asymmetry of Mexico and the United States is less clear in the border regions, the inequalities are still important.

In spite of the economic asymmetry between the Northern Border of Mexico and the rest of the country, the border economy had a great dynamism since the signing of NAFTA due to the development of key sectors like the industry assembly plant sector, commerce and tourism. The development of the industry assembly plant in the Mexican border cities promoted the rate of growth of the industry and the regional product during periods of expansion and economic contraction.

There has been an increase in the concentration of maquiladoras in the border area. By 1995, more than 85% of the maquiladora workers were employed in one of the six Mexico-U.S. border states: Chihuahua, Baja California Norte, Sonora, Coahuila, Nuevo León and Tamaulipas. In 1995, the cities of Ensenada, Tecate, Tijuana and Mexicali, all located in Baja California Norte, had a firm arriving or expanding at a rate of more than one a week.

During 2001, the Mexican economy underwent a slowdown that lowered the rate of GDP growth to an estimated -0.3% . Mexico avoided a devaluation, in part, because the Bank of Mexico followed a contractionary monetary policy to control inflation and part due to the flows of foreign direct investment (FDI), estimated at US\$23 billion in 2002 (of which US\$13 billion came from the sale of the Banamex Bank to Citicorp). Since the passage of NAFTA, FDI reached record levels in Mexico. From 1994 to 2001, FDI increased from 15,045.2 to 25,221.1 millions of dollars.

Between 1994 and 2001, Mexico received more than US\$ 10 billion in new and long-term FDI in plants and equipment in the automotive industry. The manufacturing facilities established in Northern and Central Mexico have contributed to the modernization and economic growth of those regions. Highly specialized clusters have also been developed around the major auto industrial plants through the establishment of hundreds of new regional suppliers that promote vertical integration and strengthened supply chains.

FDI is the investment decision of profit-maximizing firms facing world-wide competition and where significant differences in cost structures justify cross-border investment and production. Institutional features of the host country and economic factors such as the trade and

Table 5
Gross National Product in Mexico's Northern Border by State (1994-2000)
(thousand pesos with 1993 prices)

| State | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 |
|--|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| Baja California | 34,564,015 | 32,726,727 | 35,229,542 | 39,452,448 | 41,252,702 | 43,226,867 | 48,157,432 |
| Coahuila | 34,873,364 | 34,633,813 | 37,125,403 | 40,334,408 | 42,757,805 | 44,227,705 | 45,975,854 |
| Chihuahua | 47,869,331 | 44,789,564 | 48,336,760 | 52,109,000 | 56,263,540 | 60,398,960 | 66,008,627 |
| Nuevo León | 78,141,213 | 73,103,840 | 76,669,201 | 83,572,386 | 89,573,370 | 94,372,681 | 101,688,958 |
| Sonora | 32,277,310 | 31,499,518 | 32,696,080 | 34,647,187 | 36,792,672 | 38,918,375 | 40,457,627 |
| Tamaulipas | 34,694,384 | 32,756,334 | 34,637,915 | 36,572,894 | 39,451,068 | 41,998,268 | 44,792,600 |
| GNP of Mexico's Northern Border | 262,419,617 | 249,509,796 | 264,694,901 | 286,688,323 | 306,091,157 | 323,142,856 | 347,081,098 |
| Percentage contribution of the Northern Border in the National Product | 21.8% | 22.0% | 22.2% | 22.6% | 22.9% | 23.3% | 21.5% |
| Baja California as a percentage contribution of the Product in the Northern Border | 13.2% | 13.1% | 13.3% | 13.8% | 13.5% | 13.4% | 13.9% |

Table 6
FDI in Mexico (In Millions of Dollars)

| | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 |
|-------------------------------|----------|---------|---------|----------|----------|----------|----------|----------|
| TOTAL | 15,045.2 | 9,646.2 | 9,941.6 | 14,146.3 | 12,028.4 | 12,767.2 | 15,317.7 | 25,221.1 |
| Reinvestment | 2,366.6 | 1,572.0 | 2,589.7 | 2,150.0 | 2,864.0 | 2,303.2 | 3,783.4 | 3,673.1 |
| Accounts with other Companies | 2,038.8 | -250.4 | -350.2 | -116.1 | 1,178.7 | 2,425.1 | 2,160.0 | 806.8 |
| Maquiladoras | 894.8 | 1,366.3 | 1,416.5 | 1,680.3 | 2,110.5 | 2,778.0 | 2,983.0 | 2,172.2 |

Source: Secretaría de Economía. Dirección General de Inversión Extranjera

investment regime, the degree of openness, and the characteristics of the labor force such as education play a role in the regional investment decision.

In the early neoclassical works, FDI was based on capital arbitrage (capital flows that resulted from interest rate differentials) and the beneficial effects for the host country arise from a larger capital stock, increased tax revenues, increased labor income (or employment) and favorable externalities (diffusion of technology and training). In the tradition of Solow and given diminishing returns to physical capital, FDI affects only the level of income and leaves the long-run growth unchanged. Long run growth can only arise because of technological progress and/or population growth both considered exogenous in the model. FDI will only be growth enhancing if it affects technology permanently and positively.

In recent endogenous growth models, FDI can affect growth endogenously if it generates increasing returns in production via externalities and productivity spillovers. Moreover, policy changes might induce permanent increases in output growth by providing incentives to host FDI. Regional FDI is thought to be an important source of human capital accumulation and long run economic growth in endogenous models.

In order to understand the sources of regional growth in the Northern Border and in Mexico as a country, the growth model by states in Mexico is developed to determine which factors contributed to the economic growth of Mexico.

■ *The Empirical Model*

The model of economies of agglomeration for Mexico is based on the role of distance as a determining factor of regional economic growth. The empirical model tries to explain economic growth (ΔY_{jt}) for the region j at time t , with respect to urban agglomeration (A), distance to the main markets (D) and regional FDI (n) shown by the following equation,

$$\Delta Y_{jt} = \beta_0 + \beta_1 A_{jt} + \beta_2 D_{jt} + \beta_3 n_{jt} + \beta_4 X_t + u_{jt} \quad (1)$$

Distance plays a crucial role in determining if the centripetal or centrifugal forces will dominate. Distance is an important variable because it might help or hurt an economy by giving consumers access to places where they can engage in income-generating activities, consume other goods and services, or engage in leisure and social activities. In the

case of manufacturing, improving transport and lowering the distance to the consumer centers may lower input prices and production costs and facilitate technological diffusion. Distance is measured by the number of kilometers on the road from the capital of a state to the nearest border crossing with the United States. Another distance variable is included and constructed by the number of kilometers on the road from the capital of a state to Mexico City.

The level of agglomeration in the economy is measured by the population density per squared kilometer in each state of Mexico. Other variables (X) that may affect foreign direct investment, urban agglomeration and regional economic growth are human capital and internal migration between states, in response to attraction and repulsion forces. An example of internal migration would be from a rural southern state to a more urban northern state in Mexico. Another variable is constructed by the number of businesses in the commercial, services or manufacturing sector per state. The migration variable is measured by the net balance migration per state in Mexico provided by INEGI. The human capital variable is an indicator of the educational characteristics of the population in each state. It includes the percentage of the population 15 years of age or older that have more than elementary studies in each state of Mexico.

The regional economic growth is measured by the percentage annual increase in income per capita in the period 1994-2000. The initial level of income used in the study is the one provided by INEGI in 1994. Foreign direct investment is constructed from the data provided by the Ministry of the Economy in Mexico from 1994 to 2000. The econometric technique must take into account the endogeneity argument suggesting the relationship between agglomerations and the economic growth rate. The problem of correcting for the endogeneity of right hand side variables implied by simultaneous equations is solved by applying two stage least squares as the method of estimation. The next table shows the empirical regression results using the variables described in table 7.

The empirical results are very interesting. The distance from the border is statistically significant as well as internal migration. The economic geography of Mexico seems to accord with the first assumptions of the model. The southern region has little or no industrial activity. Modern industries for the most part tend to concentrate in the central region or in regions with good access to larger markets (Northern region). Internal regional migration is an important determinant of economic activity and regional agglomerations in Mexico. The regression results show a fairly average R^2 with some of the variables being statistically significant

Table 7
Economic Growth, Urban Agglomerations and FDI Regression per
State of Mexico during the period 1994-2000
Dependent Variable: Growth of Income per capita 1994 2000
Method of Estimation: TSLS with instrumental variables

| <i>Variable</i> | <i>Coefficient</i> | <i>Error Est.</i> | <i>t-stat.</i> | <i>Prob.</i> |
|--------------------------|--------------------|--------------------|----------------|--------------|
| C | 42.993 | 15.236 | 2.821* | 0.010 |
| Agglomeration | 0.3251 | 0.1879 | 2.129* | 0.098 |
| Distance from Mexico | -0.0009 | 0.0020 | -0.454 | 0.654 |
| City CBD | | | | |
| Distance from the Border | -0.0079 | 0.0029 | -2.716* | 0.012 |
| FDI1994 2000 | -0.0001 | 0.0012 | -0.0917 | 0.927 |
| Migration | 1.9752 | 0.6377 | 3.097* | 0.005 |
| Human Capital | -0.6105 | 0.3929 | -1.5537 | 0.135 |
| Commerce | -0.0032 | 0.0026 | -1.2526 | 0.224 |
| Services | 0.0031 | 0.0032 | 0.9882 | 0.334 |
| Manufacturing | 0.0009 | 0.0010 | 0.9142 | 0.371 |
| R-Squared | 0.654 | Mean dependent var | | 25.30 |
| R-Squared Adj. | 0.490 | S.D. dependent var | | 9.830 |
| S.E. of regression | 7.017 | Sum squared resid | | 1034.24 |
| Prob(F-statistic) | 0.003 | | | |

Note: * Statistically Significant.

(at the 10% significance level). The significance of the TSLS model is shown by the F statistics, which are greater than the critical value. The F statistic shows that at least one of the coefficients in the model is significant.

Regional patterns of job creation and job destruction are also thought to have an effect on regional economic growth. In recent years, macroeconomists have begun to pay more attention to developments at the regional micro level. Job creation is observed by employment and a growing number of establishments, plants and firms in the primary, commercial, service and industry sectors, and dying and shrinking establishments, plants and firms with a reduction of employment as job destruction. A striking regional feature in Mexico is that the data by states is marked by a high rate of job creation in the industry sector. Job creation tends to be concentrated at regions that experience large changes in employment, which are associated with firm startups. The data used for the change in the number of establishments in the primary, commercial, service and industry sectors and the number

of jobs created in the primary, commercial, service and industry sectors between the year 1995 and 2000 come from the “Banco de Información Sectorial, Establecimientos y Empleo” published by the Ministry of Economy.

The assumption that transport costs incorporates a fixed value of time and a multicenter model, requires the construction of a wage gradient for the period of study. A wage gradient $W(t)$ must exist for each region and vary directly with the marginal cost of transport. The wage gradient for the study is constructed from the general minimum wages by state and wage zones in Mexico provided by the Comisión Nacional de los Salarios Mínimos. Wages are estimated in U.S. dollars taking into account the dollar peso exchange rate from the period of 1994 to 2000.

The next table shows the empirical regression results, including the wage gradient and the job growth variables described above:

Table 8
Economic Growth, Urban Agglomerations and FDI Regression per
State of Mexico during the period 1994-2000
Considering a Wage Gradient and Job Creation and Destruction
Dependent Variable: Growth of Income per capita 1994 2000
Method of Estimation: TSLS with instrumental variables

| <i>Variable</i> | <i>Coefficient</i> | <i>Std. Error</i> | <i>t-Statistic</i> | <i>Prob.</i> |
|---------------------------|--------------------|--------------------|--------------------|--------------|
| C | 6.878 | 31.636 | 0.2174 | 0.8302 |
| Human Capital | -0.162 | 0.3122 | -0.5191 | 0.6096 |
| Distance from Mexico City | -0.002 | 0.0022 | -1.2359 | 0.2315 |
| Distance from the Border | -0.0005 | 0.0040 | -0.1296 | 0.8982 |
| FDI 1994 2000 | 0.0010 | 0.0013 | 0.7264 | 0.4764 |
| Agglomeration | 0.0880 | 0.1856 | 0.4741 | 0.6408 |
| Migration | 2.3654 | 0.6107 | 3.8732* | 0.0010 |
| Wage Gradient | 8.0722 | 11.038 | 0.7312 | 0.4735 |
| Job Growth Commercial | -0.0003 | 0.0001 | -2.4677* | 0.0233 |
| Job Growth Primary | 0.0007 | 0.0010 | 0.7135 | 0.4842 |
| Job Growth Service | 7.33E-05 | 0.0001 | 0.4804 | 0.6364 |
| Job Growth Industrial | 0.0001 | 6.07E-05 | 1.7938 | 0.0888 |
| R-squared | 0.7392 | Mean dependent var | | 25.30263 |
| Adjusted R-squared | 0.5745 | S.D. dependent var | | 9.830890 |
| S.E. of regresión | 6.4121 | Sum squared resid | | 781.1891 |
| Prob(F-statistic) | 0.001 | | | |

Note: * Statistically Significant.

The econometric results show that the economic variables that were significant in the last regression have the expected sign in table 8 and are significant. The joint test of significance on all the economic variables as a group (F test) for table 8 indicates that the null hypothesis is rejected at a high level of significance. The proxy for human capital is not significant. The FDI variable is not significant, but has the correct sign. The results on agglomeration effects and regional growth are not conclusive when job growth is included. Job growth is only significant for the commercial sector.

None of the variables of job creation are significant. The results indicate that after NAFTA, export-led job growth undermined job growth in the Primary, Service, Industrial and Commercial Sectors in the domestic market. The wage gradient is not statistically significant. Average regional real wages in Mexico in dollar terms are actually lower than they were ten years ago. For most Mexicans, more than half of whom live in poverty, basic commodities has gotten even more expensive. Today the Mexican minimum wage buys less than half the tortillas it bought just after the passage of NAFTA in 1994. As a result, hundreds of thousands of Mexican Migrants continue to risk their lives crossing the border to get low-wage jobs in the United States or settling near the border region. This could explain in part the positive significant coefficient for migration in the regression.

The change in the number of establishments, plants and firms in the primary, commercial, service and industry sectors for the period 1995-2000 are incorporated in the next regression.

The results show that FDI has a positively insignificant effect on regional growth. As in the early neoclassical view, following the tradition of Solow and given diminishing returns to physical capital, FDI affects only the level of income and leaves the long-run growth unchanged. Migration and distance from the border remain significant. The measures of a growing number of establishments, plants and firms in the primary, commercial, service and industry sectors are not statistically significant.

■ *Conclusions*

The existence of both forward and backward economic linkages creates positive externalities that drive Mexico's regional economic growth. Mexico's recent history can be characterized as a tension of centripetal forces that tend to pull population and production into urban agglomerations in Mexico, including the forward and backward linkages (distance and transportation costs), and centrifugal forces like migration that tend to break up the urban agglomerations.

Table 9
Economic Growth, Urban Agglomerations and FDI Regression per
State of Mexico during the period 1994-2000
Considering a Wage Gradient and Growth in the Service, Commercial,
Industrial and Primary Sectors
Dependent Variable: Growth of Income per capita 1994 2000
Method of Estimation: TSLS with instrumental variables

| <i>Variable</i> | <i>Coefficient</i> | <i>Std. Error</i> | <i>t-Statistic</i> | <i>Prob.</i> |
|---------------------------|--------------------|--------------------|--------------------|--------------|
| C | 36.254 | 43.519 | 0.8330 | 0.414 |
| Human Capital | -0.0334 | 0.2920 | -0.1144 | 0.910 |
| Distance from Mexico City | -0.0013 | 0.0026 | -0.4992 | 0.623 |
| Distance from the Border | -0.0074 | 0.0035 | -2.1021* | 0.048 |
| FDI 1994 2000 | 0.0003 | 0.0016 | 0.1820 | 0.857 |
| Migration | 1.9831 | 0.6127 | 3.2363* | 0.004 |
| Agglomeration | 0.0011 | 0.0118 | 0.0991 | 0.922 |
| Wage Gradient | -0.4892 | 17.465 | -0.0280 | 0.977 |
| Industry Growth | 0.0013 | 0.0017 | 0.8089 | 0.428 |
| Primary Sector Growth | -0.0022 | 0.0207 | -0.1108 | 0.912 |
| Services Growth | 0.0006 | 0.004846 | 0.123918 | 0.9026 |
| Comercial | -0.0021 | 0.002799 | -0.750416 | 0.4617 |
| R-squared | 0.6081 | Mean dependent var | | 25.3026 |
| Adjusted R-squared | 0.3926 | S.D. dependent var | | 9.83089 |
| S.E. of regression | 7.6612 | Sum squared resid | | 1173.89 |
| Prob(F-statistic) | 0.0211 | | | |

Note: * Statistically Significant.

The interesting results seem to be the economies of agglomeration and the distance from the border are statistically significant, while job growth and FDI don't seem to play a part in explaining regional economic growth from 1994 to 2000.

The recent advances in the field of new economic geography have increased our understanding of spreading and agglomerating forces in the Mexican economy. Empirical testing, however, is difficult, due to the lack of specific regional data. In this paper, one of the main objectives was to try to find evidence whether or not new economic geography models are in principle able to describe the spatial characteristics of the Mexican economy. The task was in part successful, showing that migration, spatial location and distance to the northern border are important characteristics in the new economic geography of Mexico.

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