Growth in Cities: Mexico's Case Study

An Honors Thesis for the Department of Economics

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Abstract

Theories of economic growth have emphasized the importance of economies of agglomeration in generating growth. The physical proximity between firms increases productivity through input sharing, labor pooling, matching and knowledge spillovers. Jacobs (1969), Porter (1990), and Marshal-Arrow-Romer (1890-1962-1986) have stressed the importance of knowledge spillovers in an urban agglomeration as dynamic externalities that generate economic growth. However, these theories differ in the role of local competition, city specialization and diversity in generating growth. Glaeser et al. (1992) tested the different theories of dynamic externalities using U.S. data and found that city diversity and local competition generate growth. Replicating the Glaeser et al. (1992) model and data from 56 Mexican metropolitan areas, I find that city diversity and local competition have a positive effect on growth, whereas geographic specialization hindered job creation in Mexico.

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Introduction

Economists generally agree suggest that a positive correlation exists between urbanization and economic development. Economists recognize that urbanization is fundamental to the structural transformation that low-income rural societies undergo as they modernize and become middle-and high-income countries. Countries with more developed economies have experienced a transition from traditional rural societies to urban societies characterized by sustained growth with increased accumulation of human and physical capital. In particular, cities, where several agents interact and communicate, are the most natural context in which to understand the mechanics of economic growth (Lucas 1993).

Throughout the last half of the twentieth century, numerous developing countries experienced structural transformation. In Mexico, between 1950 and 2000, the rural share of the country's population fell from 58 to 26 percent. This transition from rural to urban society in Mexico led to the creation of large urban agglomerations. In 2009, Mexico accounted for 56 metropolitan areas with 55.7 percent of the total population, and 71.7 percent of total employment. The population of the metropolitan area of Mexico City, the country's center of political and economical activity, grew from 3 million in 1950 to about 21 million in 2009.

The development of urban agglomerations in Mexico has been of real interest for development, political and urban economists. Economists Edward Glaeser and Alberto Ades (1994) have argued that political power structures such as dictatorships

are the main determinant for the creation of disproportionate large urban centers. Paul Krugman (1999) and Raul Livas Elizondo and Krugman (1995) have argued that the role of trade and geography are the main determinants for urban agglomeration in Mexico.

Mexico's economic development and urbanization process have had both positive and negative implications for Mexican society. The disadvantages of urbanization are manifested in the high land rents and wages, and the congestion and pollution within cities. However, the urbanization process has continued as firms and industries continue to establish themselves in Mexican cities. This pattern can be attributed to the positive effect of agglomeration, which is also known as agglomeration economies. Agglomeration economies are defined as the benefits that firms obtain by locating next to each other, which include economies of scale, labor pooling, labor matching and knowledge spillovers.

The effects of agglomeration economies can be traced back to Marshall (1920), who emphasized information overflows and technological spillovers from one firm to another, which create positive externalities that lead to growth. Such positive externalities might help explain why firms continue to locate in Mexican cities. Lucas (2004) asserts that the only compelling reason for the existence of cities is the presence of increasing returns to agglomerations of resources, which make these locations more productive. However, other scholars have differed in their assessment of the source of the agglomeration economies.

Growth in Cities by Glaeser et al. (1992) tested the 'theories of dynamic externalities' as the source of agglomeration economies. The theories of dynamic

externalities focus on technology spillovers; whereby, one firm's innovation increases the productivity of other firms. The theories of dynamic externalities they tested include those of Jacobs (1969), Porter (1990), and Marshal-Arrow-Romer (1890-1962-1986). Glaeser et al. (1992) find that the cluster of industries, firms and individuals in an urban agglomeration foster positive externalities such as knowledge spillovers; thus, creating a positive impact within the economy.

In this paper I replicate the model used by Glaeser et al. (1992) to test the hypothesis that urban agglomeration in Mexico creates positive externalities; ultimately, leading to economic growth. I test the models of knowledge spillover and growth presented in Glaeser et al. (1992) using a new data set on geographic concentrations and competition of industries in 56 Mexican cities. I ask which industries in which cities have grown fastest between 1999 and 2009 and why. The theories of dynamic externalities focus on knowledge spillovers, but differ in the identification of the source of the externalities and what specifically makes the capture of these externalities most effective. By empirically testing which cities' industries grow fastest as a function of geographic specialization and competition, we can learn which, if any, externalities are important for growth.

Section I of the paper presents the concept of agglomeration economies and a review of the available literature on theories of dynamic externalities. Section II exhibits the core model of this paper: The Glaeser et al. (1992) *Growth in Cites* model, which tests the different theories of dynamic externalities. Section III elaborates on Mexico's urban development history. Section IV describes the data and Section V presents the

results for the growth of city-industries in Mexico. Lastly, Section VI presents conclusions.

Overview of Agglomeration Economies

Several authors have argued that agglomeration economies are a determining factor for the emergence of cities. Agglomeration economies are characterized by benefits that arise from social interactions and shared inputs when people and firms locate near one another in cities and industrial clusters (Glaeser 2010). These benefits are often translated into transportation and production cost reductions in addition to increasing returns to scale.

Agglomeration economies can occur from different sources that include intermediate input sharing, labor market pooling and knowledge spillovers. In an urban cluster, firms have access to several specialized inputs and suppliers enjoy economies of scale; thereby, reducing the input-unit price for their customers. In a pooled labor market, there exists better matching between workers and firms, higher specialized labor, and higher flexibility in each individual firm's employment in response to a firm-specific idiosyncratic shock (Bun Song Lee 2009). Spatial proximity among firms also increases the interaction with workers from other firms; thus, increasing the likelihood of knowledge spillovers between these firms.

Agglomeration economies can be divided into localization economies and urbanization economies. The former relates to external economies resulting from regional specialization. Benefits arise from spatial proximity of firms within the same industry. In contrast, urbanization economies are associated with benefits that occur from the interaction of different firms and dissimilar industries in an urban cluster. Urbanization economies are therefore derived from the economic activity that occurs

within an urban area. Several economic theorists have disagreed on the exact conditions that cause agglomeration economies to occur. Accordingly, there has been an on-going debate regarding what types of economies are relevant for economic growth.

An Overview of the Theories of Dynamic Externalities

Economic growth models stress the role of dynamic externalities and more specifically, knowledge spillovers for economic and urban growth. According to these models, cities grow because the interaction between people fosters a learning environment given that individuals within cities are able to pick up knowledge without paying for it. In urban agglomerations, the proximity of people enhances these knowledge spillovers. Theories of city growth differ in the following ways: First, they differ regarding their interpretation of whether or not knowledge spillovers originate within the industry or from other industries. Second, the theories differ in their predictions of how local competition affects the impacts of these externalities on growth.

The Marshal-Arrow-Romer (MAR) externalities theory focuses on knowledge spillovers between firms within an industry. This theory was applied to cities by Marshal (1890), formalized by Arrow (1962) and presented by Romer (1986), and suggests that the concentration of an industry in a city helps facilitate knowledge spillovers between firms; and therefore, positively influences the growth of that industry and city. Knowledge accumulated by one firm tends to benefit another firm's technology. For example, in the city of Puebla automotive manufacturers learn from each other because products can be reverse engineered and employees move between firms taking

knowledge with them. Physical proximity facilitates the free transmission of information and industries that are regionally specialized benefit from it. Consequently, cities that have few large industries should grow faster.

The MAR theory also implies that local monopolies are better for growth because they allow the externalities to be internalized by innovative firms. Innovators realize that some of their ideas will be imitated and improved; hence, the lack of intellectual property rights causes innovators to slow down their investment in research and development. If there were little or no local competition, innovation and growth would rise. The MAR model suggests that whereas local competition hinders growth, local concentration is good for growth because it supports innovators in internalizing positive externalities.

Similarly to MAR, the Michael Porter (1990) theory also argues that knowledge spillovers in specialized geographically concentrated industries stimulate growth. However, Porter's model stipulates that local competition promotes growth due to incentives for the rapid adoption of innovation. Although such competition reduces the return to the innovators (as MAR suggests), it also increases the pressure to innovate. Firms need to innovate because if they do not advance technologically, innovative competitors will bankrupt them. In the Porter model, competition between local competitors leads to the rapid adoption of innovations and to their improvements; thus, generating industry and city growth.

MAR and Porter agree that knowledge spillovers and economic externalities occur internally within industries. Thus, both theories suggest that regional

specialization is good for economic growth. However, MAR argues that local monopolies are good because they permit the internalization of externalities. Conversely, Porter reasons that local competition is good because it fosters further innovation.

Jacobs (1969) also stresses the importance of knowledge spillovers to explain growth. The author argues that the most significant knowledge transfers are external to the core industry. Jacobs' idea is that the crucial externality that exists within cities is the cross-fertilization of ideas across different lines of work. Consequently, diversity and a variety of industries within an urban cluster promote innovation and growth. Economists like Scherer (1982) have presented evidence that indicates that the majority of the inventions in a given industry are used outside of that industry. Jacobs' theory suggests that industrial variety rather than specialization is conductive to growth because in diversified cities there is an increased interchange of ideas.

With respect to competition, Jacobs favors local competition. Like Porter, Jacobs argues that local competition stimulates firms to spend more in R&D, and to continue to develop new innovations. Jacobs believes that monopolies create economic inefficiencies, which are harmful to city growth and economic development.

Growth in Cities model

Glaeser et al. (1992) test theories of dynamic externalities (see part II) that deal with technological externalities within the context of a developed country; whereby, innovation and improvement occurring in one firm increases the productivity of other firms without full compensation. The findings of Glaeser et al. in *Growth in Cities* are consistent with Jacobs' (1969) theory and suggest that important knowledge spillovers might occur between industries that are located in the same cluster.

The Glaeser et al. (1992) model uses a production function where each firm at a given location has a production function of $At\, f(l_t)$ where A is the overall level of technology and $f(l_t)$ is a function of labor at t time. This production function does not take into consideration capital accumulation nor does it have a measure of productivity. Note that by disregarding capital inputs in the production function, this will not capture the innovation and technology spillovers that may happen from physical capital accumulation.

The overall level of technology in a city-industry includes local and national components and is considered to grow at an exogenous rate that depends on technological externalities that may exist in the city:

$$\log\left(\frac{A\text{local, t+1}}{A\text{local,t}}\right) = g(specialization, competition,\ diversity, initial\ condistions) + e_{t+1}$$

The growth of the overall level of technology depends on the various technological externalities present in each city-industry. The source of these externalities is represented by the independent variables: *specialization, competition* and *diversity. Specialization* is a measure of concentration of the biggest industry and is measured by the fraction of the city's employment that is employed by the largest industry, relative to the share of the whole industry within overall national employment. The *Growth in Cities* findings indicate that *specialization* has a negative correlation with growth; therefore, geographic specialization reduces growth.

Competition is measured by the number of firms per worker in the specific industry in the city relative to the number of firms per worker in the industry in the country. Glaeser et at (1992) finds that relative to the national average, more firms per worker within a city-industry leads to higher growth in that city's employment.

Diversity is the measure of the variety of industries operating within the city, but outside of the industry in question. It is measured by using the fraction of the city's employment in the largest five industries other than the industry in question. In the Glaeser et al. (1992) model, higher *diversity* is positively correlated with growth. The findings of *Growth in Cities* indicate that high diversity of industries in an urban cluster leads to employment growth; and thus, economic growth.

According to the model used by Glaeser et al. (1992) growth in industry employment is assumed to capture the changes in technology as shown in the production function. Then, the equation that measures the technology spillovers effect in the employment is:

$$\alpha \log\left(\frac{l_{t+1}}{l_t}\right) = g(specialization, competition, diversity, initial\ conditions) + e_{t+1}$$

The model assumes that knowledge spillovers are consistent over time. Accordingly, the model implicitly assumes that technology spillovers affect young and mature industries in a similar fashion. The model ignores the fact that industries and firms have different life cycles and that externalities are more important at inflection points. However, the empirical work includes many young and mature industries so the model does not reject life cycle models.

Growth in Cities uses a data set constructed by the authors with information on employment, payroll, and number of establishments produced by the U.S. Census Bureau between 1956 and 1987. Glaeser et al. (1992) was able to create a data set of 170 U.S. cities, which included the six largest two-digit industries. Size was measured by 1956 payroll. Consequently, the model is able to measure the impact of agglomeration economies in a developed country.

A numerous amount of scholars have cited and used the Glaeser et al. (1992) model has in order to estimate the effect of localization, urbanization and local competition in different contexts, such as developing economies. For instance, economist Bun Song Lee (2009) used parts of the Glaeser et al. (1992) model to measure the effects of agglomeration economies in the manufacturing industry in Korea. Lee's findings were extremely relevant because they were able to control factors that affect labor productivity such as R&D spending and years of schooling. Moreover, it found that the nature of agglomeration economies in a Korea differs from the previous findings of

Glaeser et al. (1992). Lee (2009) finds that specialization, diversity, and local competition enhance productivity due to the external benefits of agglomeration.

The literature on the effect of agglomeration economies in Mexico includes the work of scholars like Mendoza (2002), Grether (1999), Joordan and Rodriguez-Oriegga (2012) and Hernandez-Rodriguez and Montlavo-Corzo (2012). Mendoza (2002) and Grether (1999) explore the effect of urban agglomeration for the manufacturing sector. Joordan and Rodriguez-Oriegga (2012) explain how foreign direct investment after the Mexican trade liberalization promoted urban growth. Lastly, Hernandez-Rodriguez and Montlavo-Corzo (2012) argue that cluster policies increase agglomeration economies, competition and technology spillovers. However, non of these scholar explore the effects of urban agglomeration for the country and the economy as a whole. Thus, this paper tests the effects of agglomeration economies by measuring the effect of specialization, competition and diversity on labor growth in Mexico.

Mexico's Urban Development

The urbanization process in Mexico can be traced back to the 1940s after the Mexican revolution. After years of violent conflict, Mexico began to experience rapid economic growth and urbanization under the presidency of Lazaro Cardenas (1934-1940). Economists Luis Unikel (1968) studied the level of urbanization in Mexico between 1940 and 1960, and noted that not only was it increasing at unprecedented rates, but that also Mexico had achieved an urbanization level comparable to those of developed countries. Yet, Unikel (1968) notes that the vast majority of the urbanization process was taking place in Mexico City.

Table 1.0

Urban vs. Rural population (1940-2000)								
	1940		1950		1990		2000	
	Total	%	Total	%	Total	%	Total	%
Urban Population	6,896,111	35.1	10,983,483	42.6	57,959,721	71.3	72,406,270	74.6
Rural Population	12,757,441	64.9	14,807,534	57.4	23,289,924	23.7	24,608,597	25.4
Total	19,653,552	100	25,791,017	100	81,249,645	95	97,014,867	100

To explain why the largest city in so many developing countries is often disproportionately larger than the second-largest city, the literature has focused on two arguments: protectionist trade policies and political and institutional factors. Ades and Glaeser (1994) argue that political and institutional factors appear to be at the root of the primacy phenomenon. Ades and Glaeser (1994) found strong evidence of a positive

association between unstable and undemocratic regimes and urban primacy. They argue that political forces, as opposed to economic forces, drive urban centralization. More specifically, dictatorships and political insatiability cause concentration within a single metropolis. Mexico remained under what Mario Vargas Llosa termed 'the perfect dictatorship' from the end of the Mexican Revolution until the year 2000 when Vicente Fox and the PAN party came to power. According to Glaeser and Andes (1994), the rule of the *Partido Revolución Institucional* (PRI) for over 70 years explains the initially centralized process of urban development in Mexico.

Conversely, Krugman and Livas (1995) explain that the trade policies of developing countries influence the country's tendency to develop huge metropolitan centers. Between 1940 and the mid 1980s, Mexico's trade policy was shaped by a series of import substitution industrialization policies. As a result, roughly 40% of the national manufacturing workforce was employed in Mexico City by 1980. The model developed by Krugman and Livas (1995) argues that trade liberalization reduces urban primacy because it allows all cities to import differentiated goods from abroad. This equalization of market potential reduces the tendencies for the agglomeration of manufacturing in a single core city. Indeed, the import subsided industrialization economic model that hindered trade led to the creation of a centralized urban center in Mexico City and it was not until the country began a liberalization process that new urban and economic centers began to develop.

In the late 1980s, Mexico experienced economic and political liberalization that culminated in the North American Free Trade Agreement (NAFTA) with the U.S. and

Canada in 1994, and the end of the PRI regime in 2000. As a result of the liberalization process, Mexico became an export oriented manufacturing hub. Krugman and Livas (1995) argued that as a result of that, Mexico's urban development dramatically changed. Similarly, Mendoza (2002) argues that the trade liberalization and integration of the Mexican economy with that of the U.S. shifted employment concentrations from Mexico City to the northern states of the country. Due to export oriented economic growth, the northern border cities of Mexico, such as Monterrey and Cuidad Juarez, have experienced a vast expansion in their manufacturing activities, which is attributed to the advantages that are provided by their geographic proximity to the U.S., Mexico's main trading partner.

This empirical work contributes to the literature by testing the theories of dynamic externalities in a less developed economy. Secondly, this paper contributes to the understanding of the effects of urban agglomeration for the specific case of Mexico.

Case for Mexico Model

Construction of the Data Set

The data set was constructed from the 1999 and 2009 Economic Census editions produced by the *Instituto Nacional de Estadistica y Geografia* (INEGI). The year 1999 was chosen because it was the first year that comprehensive data was reported electronically. 2009 was the last year available. The data gathered by the INEGI includes information on employment, payroll, and number of establishments by 19 different two-digit industries. INEGI presents the data for all 1,024 Mexican municipalities.

The observation level of the data gathered by INEGI pertains to states and municipalities. However, metropolitan areas do not represent the political boundaries that are used in the INEGI recompilation. In most cases, an SMA contains several municipalities across different states. Since this paper focuses on SMAs rather than municipalities, I aggregated data across the 1,024 municipalities in Mexico into metropolitan areas using the INEGI 2009 definition.[1] By aggregating the municipalities, I created a data set that contains information on employment and the number of establishments (firms) for 56 metropolitan areas in Mexico. For each city constructed through aggregating municipalities, I use data on the six largest two-digit industries,

[1] *INEGI* defines a metropolitan statistical area as: a) The group of two or more municipalities, in which a city with a population of at least 50,000 is located whose urban area extends over the limit of the municipality that originally contained the core city incorporating either physically or, under its area of direct influence, other adjacent predominantly urban municipalities. b) A single municipality, in which a city of a population of at least one million is located and fully contained. c) A city with a population of at least 250,000 that forms a conurbation with other cities in the United States.

where 1999 salaries measure size in order to measure regionally specialized industries. However, this choice excludes small industries, and thus, creates a bias. Yet, the theories of externalities that are tested do not exclusively apply to small and young industries.

In some cases, for political and confidentiality reasons, INEGI does not reveal the number of establishments and/or the employment in an industry of certain municipalities. The INEGI did not provide information on the number of firms for the electrical and gas, healthcare services, corporates and construction industries. To construct the data set, I had to address the problem of missing variables, which was particularly severe when these industries appeared within the six largest industries of a given city. To remedy that problem, I had to eliminate all the data from those industries. If exact data was missing for a city-industry, I omitted that industry from the sample and replaced it with the next largest industry in that city for which data was available. This procedure yielded a data set that contains information on the employment, salaries, and establishments for the six largest industries in the 336 city-industries in 1999 and 2009.

Description of the Data

This paper presents a new data set, so it is helpful to present a description of the data. Table 2.0 and graphs 1.0 and 1.1 depict the importance of urbanization for Mexico. Table 2.0 shows the number of establishments and employees of MSA and the rest of the country for both 1999 and 2009. The percentage of employment and the number of establishments in MSAs has not changed significantly. In 1999, MSA represented around

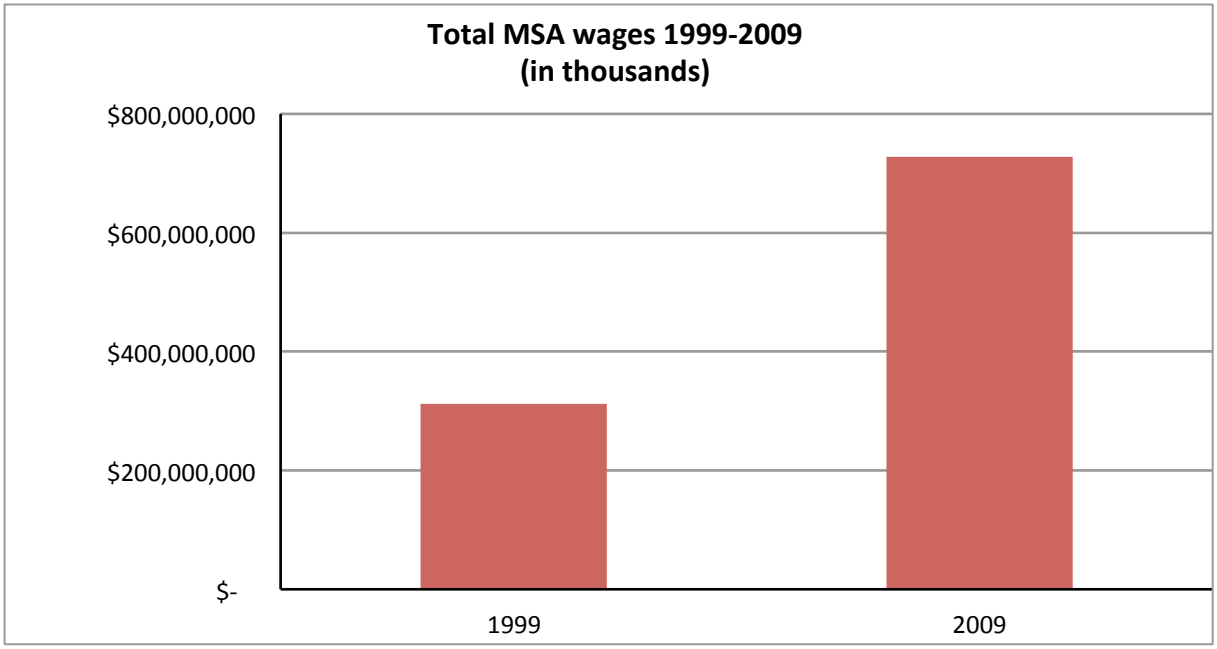
60% of the total number of establishments in the country employment and 72% of employment. In 2009, SMA represented 59% of the total number of establishments and 70% of national employment.

Table 2.0

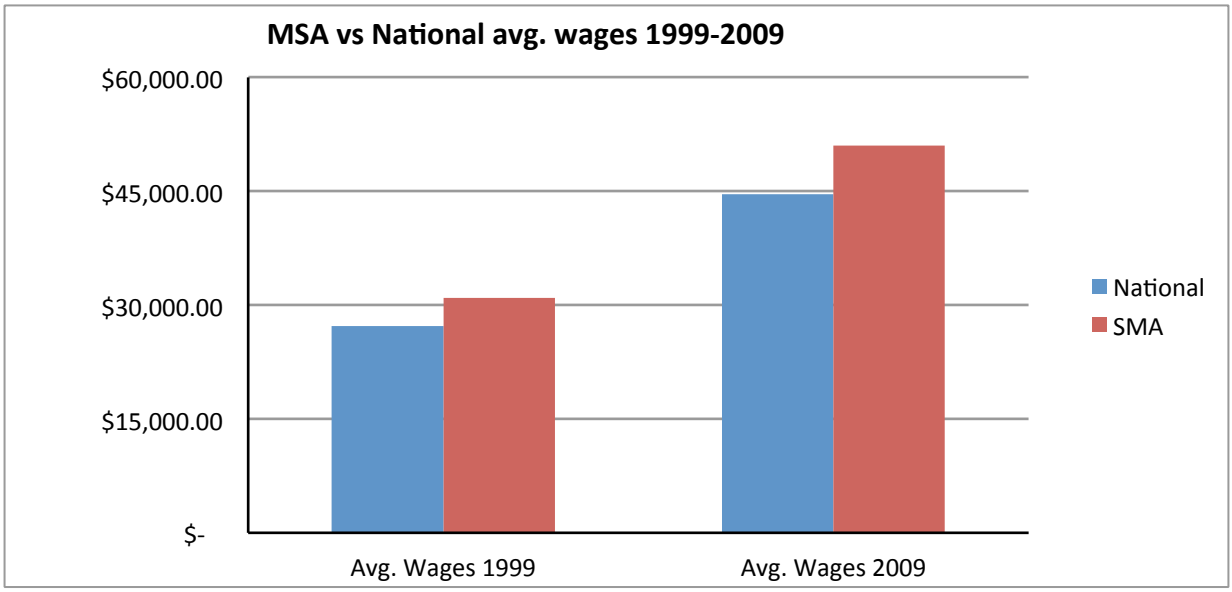
	Establishments				Employment			
	1999		2009		1999		2009	
National	2,804,984	100%	3,724,019	100%	13,827,025	100%	20,116,834	100%
Total MSA's	1,717,749	61.24%	2,200,167	59.08%	10,052,249	72.70%	14,257,421	70.87%
Rest of the country	1,087,235	38.76%	1,523,852	40.92%	3,774,776	27.30%	5,859,413	29.13%

Graphs 1.0 and 1.1 show nominal wages for MSAs and the rest of the country between 1999 and 2009. The graphs show that wages in metropolitan areas are usually higher. General economic theory suggests that the wage difference may explain the reason for urban growth since people migrate to cities searching for higher wages. According to the neoclassical school of thought, firms locate where labor is cheap and demand is high. Accordingly, the increase wages in metropolitan areas may incentivize firms to locate in other parts of the country.

Graph 1.0



Graph 1.1



Tables 3.0 and 3.1 describe the five largest and the five smallest cities in the sample in 1999, their employment in 1999 and 2009, and the six largest industries in each of them. Note that the largest city, Mexico City, has employment of 3 million, and the smallest city, Rio Verde-Cuidad Fernandez, has fewer than 10,000 employees. The MSA definition provided by the INEGI allowed the data to account for fairly small cities. The table also shows that there is no significant variety of top industries across cities. In the five largest cities, the main industries are manufacturing and retail.

Table 3.0

Largest Cities in 1999			
City	**Employment 1999**	**Employment 2009**	**Largest Industries**
Mexico City	3,424,462	4,741,328	Manufacturing, Retail, Wholesale, Business support services and waste management and remediation services, Hospitality, Other-non governmental
Monterrey	822,835	1,156,840	Manufacturing, Retail, Wholesale, Business support services and waste management and remediation services, Construction, Other-non governmental
Guadalajara	755,517	1,094,851	Manufacturing, Retail, Wholesale, Construction, Other-non governmental, Business support services and waste management and remediation services
Puebla-Tlaxcala	380,575	542,309	Manufacturing, Retail, Other-non governmental, Wholesale, Hospitality, Education Services
Juarez	375,191	396,911	Manufacturing, Retail, Hospitality, Other-non governmental, Wholesale, Mass Media

Table 3.1

Smallest Cities 1999			
City	**Employment 1999**	**Employment 2009**	**Largest Industries**
Rio Verde-Cuidad Fernandez	9,718	15,133	Retail, Manufacturing, Hospitality, Other-non governmental, Wholesale, Healthcare services
Acayucan	9,720	14,423	Retail, Wholesale, Hospitality, Manufacturing, Other-non governmental, Tranportation-logistics-warehousing
Tecoman	13,471	20,860	Retail, Manufacturing, Hospitality, Wholesale, Other-non governmental, Agriculture
Moroleon-Uriangato	19,574	26,104	Manufacturing, Retail, Wholesale, Hospitality, Other-non governmental, Professional, scientific and techincal services
Ocotlan	19,931	24,019	Manufacturing, Retail, Other-non governmental, Hospitality, Wholesale, Construction

Tables 4.0 and 4.1 describe the ten largest city-industries in the sample in 1999 and 2009. Mexico City's manufacturing sector was the largest city-industry with over 800,000 employees in 1999 and Mexico City's retail was the largest city-industry with over 1 million employees in 2009. Monterrey and Guadalajara's manufacturing industries were the third and fourth largest city-industries in 1999, and in 2009 both city-industries were the seventh and eight largest, respectively. This table demonstrates the importance of Mexico City for the country. Mexico City appears 7 times in the 10 largest city-industries in both 1999 and 2009. Guadalajara appears 1 and 2 times in 1999 and 2009, and Monterrey appears once in both 1999 and 2009.

It is important to note the changes in the manufacturing industry since technological progress is more rapid in manufacturing than in services. Mendoza (2002)

argued that the manufacturing firms relocated to the northern cities to meet American demand. However, our data shows that the jobs in the manufacturing industry have declined in Mexico City and increased in both Guadalajara and Monterrey only at marginal levels. Furthermore, Mexico City has become more diversified as jobs in the retail industry, business supports services, and financial services have increased. Mendoza (2002) makes a model Research on the specific characteristics of the manufacturing industry in Mexico. This paper intends to shed the light on the sources of technological spillovers and the type of agglomeration economies that affect the Mexican economy.

Table 4.0

10 Largest City-Industries 1999

City	Industry	Employment
Mexico City	Manufacturing	851,002
Mexico City	Retail	655,521
Monterrey	Manufacturing	298,971
Guadalajara	Manufacturing	258,404
Juarez	Manufacturing	239,794
Mexico City	Wholesale	233,915
Mexico City	Business support services and waste management and remediation services	208,421
Mexico City	Hospitality	203,438
Mexico City	Other, non-governmental services	195,224
Mexico City	Transportation, logistics, warehousing	192,723

Table 4.1

10 Largest City-Industries 2009

City	Industry	Employment
Mexico City	Retail	1,040,163
Mexico City	Manufacturing	781,977
Mexico City	Business support services and waste management and remediation services	544,917
Mexico City	Financial services	346,660
Mexico City	Hospitality	343,678
Monterrey	Manufacturing	327,925
Guadalajara	Manufacturing	302,306
Mexico City	Wholesale	272,309
Mexico City	Other, non-governmental services	261,242
Guadalajara	Retail	247,338

Results

According to the theories of dynamic externalities, externalities caused by urban agglomeration are important for growth. The clearest way to observe these effects is by analyzing the growth rate in employment in different sectors within various cities. Hence, we look at the growth rate in the city-industries as a function of technological spillovers. The sample includes observations of the top six industries in 336 city-industries between 1999 and 2009. Table 5.0 describes the variables. The mean in employment growth is 28, indicating that on average the city-industries experienced considerable growth.

Table 5.0

Variable Means and Standard Deviations			
Variable	Mean	Standard Deviation	Num. of Observations
Log(Employment 2009/Employment 1999) in city-industry	0.28	0.5	336
Log(Employment 2009/Employment 1999) outside city	0.36	0.22	336
Employment in city-industry 1999	8.78	1.39	336
Salaries in city-industry in 1999	17.1	0.86	336
Specialization	1.56	1.04	336
Competition	1.07	0.63	336
Diversity	0.83	0.16	336

Theories of dynamic externalities suggest that employment growth in an industry-city may depend on the specialization of that city, local competition in the city-industry, and the city's diversity. Table 6.0 shows the results in different regressions using specialization, local competition, and diversity as the interest variables.

Specialization is a measure of concentration of the biggest industry. It is measured by the fraction of the city's employment that is employed by the largest industry relative to the share of the whole industry in national employment. This variable measures how specialized a city is in a specific industry relative to the rest of the country. A high value means that the biggest industry in the city employs a higher share of labor relative to rest of the industry employment in the country. The mean of this variable is 1.56.

Competition of an industry in a city is the measure of the number of firms per worker in the specific industry in the city relative to the number of firms per worker in the national industry. A value higher than one means that the industry has more firms relative to its size in the city than it does at a national level. Accordingly, a value that is higher than one means that the industry is more competitive in the city relative to the rest of the country. The mean of this variable is 1.07 meaning that most city-industries have local competition.

Diversity is the measure of the variety of industries in the city excluding the industry in question. It is measured using the fraction of the city's employment that the largest five industries other than the industry in question account for. A low ratio

indicates that all industries excluding the industry in question employ most of the labor force; consequently, cities are more diversified. The mean of this ratio is 0.83, so the cities are not very well diversified.

For control variables on the regressions, the model includes the *initial conditions* variables that include the initial log of employment and salaries in 1999 and the national employment growth per industry. These control variables are used to correct the potential move of firms to cities due to lower wages in different cities and demand shifts that are a determinant for employment growth. The national employment change is used to control for the change in employment in an industry in the country as a whole. The initial log of wages and employment are insignificant. However, the control variables indicate that employment in an industry city grows faster when employment in that industry grows at the national level.

The initial results produce some noteworthy findings. Equation (a) in table 6.0 shows the effect of specialization in employment growth. The result of this equation contradicts MAR theory and concurs with Glaeser et al. (1992) findings. The negative sing in the coefficient demonstrates a negative correlation between *specialization* and labor growth. Equation (a) determines that if the measure of *specialization* is raised by 1 percent, cumulative employment growth decreases by roughly 8 percent, on average. Similarly, if one standard deviation is increased in the measure of *specialization*, employment decreases by 0.075 standard deviations. The result is not consistent with the MAR theory, which suggests that geographic specialization should increase growth.

The result is statistically significant; however, the low elasticity suggests that the economic impact of this variable is not very high..

In equation (b) in table 6.0, the coefficient of the competition variable is positive and statistically significant at a 10 percent level. The result in this equation shows that increasing the measure of *competition* by 1 percent increases the employment growth rate by 9 percent, on average. The variable has a low elasticity, pointing again to a relatively low economic significance of this effect. An alternative way to assess the economic impact of the variable is by noting that a one-sample standard deviation increase in *competition* raises employment growth by 0.146 standard deviations, a small but not trivial amount. These results support Porter and Jacobs hypotheses on the effect of competition, while they are inconsistent with the MAR model; thereby, suggesting that local competition contributes to growth, since firms are incentivized to innovate in order to stay in business.

Equation (c) in table 6.0 shows that employment grows faster in cities where there is a diverse range of industries. The positive coefficient indicates that if the share of employment taken by the five largest industries other than the one in question is increased, the growth rate of employment decreases; hence, suggesting that *diversity* is negatively correlated with employment growth. However, the results are neither statistically nor economically significant.

Equation (d) in table 6.0 uses all measures of externalities simultaneously. The results become similar to those of Glaeser et al. (1992). The variable of *specialization* has a negative coefficient. The effect is still statistically significant, and its economic

significance is higher. An increase in one standard deviation for the measure of *specialization* decreases employment by 0.08 standard deviations. This serves as evidence against the MAR and Porter theories, which suggest that technological spillovers within industries are the source of economic growth. The positive coefficient in the variable of *competition* validates Porter and Jacobs' argument that local competition increases growth; yet, *competition* has a marginally less economic impact. The most notable result is the coefficient in *diversity* variable. The statistical significance of this effect is remarkably higher. The variable is statistically significant at the 17% level. Likewise, the variable becomes economically more significant. In equation (d) and increase in one standard deviation (0.16) on the share of employment that the main industry has, in fact, decreases employment by 2.41 standard deviation. The negative coefficient suggests that having a greater variety of industries in the city helps growth.

The new results in equation (d) make *diversity* much more qualitatively and statistically significant and they concur with the Jacobs theory, which indicates that diversity in cities helps growth. Additionally, the result of *specialization* and *competition* do not have significant variation. The results oppose the MAR and Porter theories of geographical specialization and demonstrate that local competition enhances growth.

Table 6.0

City-Industry Employment Growth Rates				
	Log(Employment 2009/Employment 1999) in City-Industry			
Dependent Variable	(a)	(b)	(c)	(d)
Constant	0.439	-0.243	-0.839	1.97
	(0.0693)	(0.615)	(.900)	(1.23)
Log(Employment 2009/Employment 1999) outside city	0.762***	0.846***	0.859***	0.726***
	(0.134)	(0.130)	(0.130)	(0.136)
Employment in city-industry in 1999	0.007	0.011	-0.008	0.016
	(0.022)	(0.025)	(0.023)	(0.025)
Salaries in city-industry in 1999	-0.022	0.001	0.046	-0.101
	(0.043)	(0.042)	(0.043)	(0.061)
Specialization	-0.078***	…	…	-0.092***
	(0.028)			(0.033)
Competiton	…	0.092*	…	0.086*
		(0.049)		(0.050)
Diversity	…	…	0.105	-0.386
			(0.247)	(0.285)
R-squared	0.145	0.135	0.126	0.155
Observations	336	336	336	336

Conclusion

Economists have stressed the link between theories of urbanization and economic growth, and have recognized that urbanization is fundamental to the structural transformation that low-income rural societies undergo to modernize and become middle and high-income countries. Mexico's urbanization process is strongly aligned with its political economic history. In the 20th century, the import-subsided-industry model and the authoritarian regime of the PRI heavily influenced the urban development of the country. Due to the democratization and economic liberalization process that began in late 20th century, Mexico experienced another shift in its urban development process.

In addition to urban development, economic growth models have emphasized the role of dynamic externalities; and more specifically, knowledge spillovers for economic growth. The link between economic and urban growth is reflected by so-called agglomeration economies. Agglomeration economies are defined by the positive impacts that manifest when people and firms locate near each other in cities and industrial clusters. One of the sources of these benefits is the technology spillover that occurs when many firms locate in the same city. There has been lot of debate regarding the cause of technology spillovers in a city as reflected by the existence of various theories of dynamic externalities, which include MAR, Porter and Jacobs.

This paper tests the different theories of dynamic externalities using data on 56 Mexican metropolitan areas to demonstrate the determinants for the creation of technology spillovers and the effects of agglomeration economies in Mexico. The results

presented in this paper allow for some tentative conclusions. At the city-industry level, diversity and competition enhance employment growth while specialization negatively impacts employment growth. These results suggest that urbanization economies are more important to growth than localization economies. The spillovers and adoption of innovation across different industries and competition enhance labor growth in Mexico. The completed empirical work produces similar results to that of Glaeser et al. (1992) found in the U.S. economy. Though, it appears that the impact of technological spillovers in employment growth is not as strong in Mexico.

Measuring industry growth using employment growth as a proxy has its caveats. Measuring labor growth is quite difficult since there are a lot of variables that affect it; hence, having and omitted variable bias. For an example, years of schooling and the age of population can also be determinant for labor growth. The findings of this empirical work only shed light on the importance of agglomeration economies for labor growth in Mexico. Further research may be able to control other factors that might potentially affect labor growth, such as the average education of workers. Using productivity as growth proxy would be a better measure.

The results of this empirical work may have important implications for public policy. Evidence suggests that the interchange of ideas across industries enhances growth; therefore, local policy makers may seek to incentivize firms from different industries to locate in a specific city. Additionally, federal policymakers should focus the education agenda on developing educational programs aimed at training young

professionals to acquire transferable skills across industries in order to enhance the interchange of ideas.

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