Spatial patterns of non-agricultural employment growth in rural Mexico during the 90s

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Abstract

We analyze the expansion of non-agricultural rural employment in manufacture and services in Mexican municipalities during the 1990s and explore the role of geographical features in explaining the local and regional supply of non-agricultural rural employment opportunities. We identify the presence of positive externalities from non-agricultural rural employment expansion in nearby areas. In addition, we find that proximity to urban centers with large services or manufacturing sectors is important in explaining rural employment growth outcomes. Alternatively, for municipalities faraway from urban centers, a larger proportion of the growth in non-agricultural employment (in particular in manufacture) comes from the interaction between a high-value agriculture and availability of roads.

1 Introduction

Despite the economic growth that Mexico experienced during the 90s, little was achieved in terms of poverty reduction. While real GDP per capita increased by 17% over the decade, the poverty headcount ratio decreased only from 39% to 38% and the extreme poverty headcount ratio from 14% to 13%. Poverty reduction was even less successful in the rural areas, where the headcount ratio was in 1998 at its 1989 level (49%) and the percentage of extreme poor increased from 23% to 24% (Banco de Mexico [7], CEPAL [2])[1]. The coexistence of positive numbers for economic growth and the persistence of poverty suggests that growth occurred through channels that the poor, and in particular the rural poor, could not access.

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[1] Data on poverty refers to changes between 1989 and 1998.

Non-agricultural rural employment plays a crucial role for income generation of rural households and hence, for rural poverty reduction (Reardon, et al., [15]). Labor is the most important asset that the poor own and non-agricultural jobs pay the highest wages in rural areas. Previous work that explored the individual determinants of access to non-agricultural rural employment in the Mexican *ejido* sector points towards the importance of secondary education as well as of the regional availability of non-agricultural jobs (de Janvry and Sadoulet, [6]).

In contrast, little research has been done to understand the determinants of the regional and local supply of non-agricultural rural employment opportunities. In explaining the spatial distribution of these opportunities, we believe that geographical aspects -such as proximity to cities, connectedness with the region, location with respect to borders and coasts, as well as potential for a dynamic agriculture- play a critical role. The goal of this paper is to explore the determinants of the local expansion of non-agricultural rural employment in manufacture and services in Mexico during the 90s from a geographical point of view.

Our findings indicate that there are positive externalities from non-agricultural rural employment expansion in the surroundings of a particular rural municipality. In particular, proximity to urban centers with a high density of employment is key for the expansion of non-agricultural jobs in rural areas. For municipalities that are distant from urban centers, most of the growth in non-agricultural rural employment comes from the interaction between a high-value composition of the agricultural output and the availability of federal roads as well as from local attributes (education, ethnicity, minimum wage regime, initial level of employment). We find that employment expansion in semi-urban municipalities as well as in the Mexico City area relies more heavily on proximity to urban centers while in small rural municipalities and those near the US border, it depends more on the ability to connect with others and on the quality of the regional context.

The paper is organized as follows. We start with a discussion of the relationship between non-agricultural employment and poverty in Mexico, as well as of the spatial distribution of these variables. Then, we review some related literature on the economics of agglomeration and regional spillovers. After that, we describe the data, set up a model of municipal employment growth, and discuss a set of criteria to characterize Mexico's dynamic economic centers. Finally, we discuss and analyze the results of the estimations.

2 Background

This section discusses the patterns of the regional distribution of non-agricultural employment across Mexico, as well as the relative importance of urban, semi-urban, and rural municipalities in the total distribution of population and employment.

Using 1990 data from Mexican municipalities, Figure 1 shows the existence of a negative correlation between the presence of employment in manufacturing and

services sectors and poverty. This negative correlation is constant across urban, semi-urban and rural municipalities[2]. Figure 1 also illustrates that as we move from urban to semi-urban and to rural municipalities, the cloud of observations shifts to the top and left side of the graph, i.e. towards higher levels of poverty and lower shares of employment in services and manufacture. Figure 2 shows maps of Mexican municipalities, distinguishing - among those where poverty is high - the ones with high and with low employment in manufacture and services. We see that among the municipalities where poverty is high, there are more that have a low share of non-agricultural employment than there are with a high share of it. These maps also suggest that there exist large contiguous areas along Mexico that have similar employment and poverty outcomes. The maps are illustrative of the regional nature of both phenomena: poverty and employment. For example, while the poverty is high in the Southern states of Chiapas and Oaxaca, the share of non-agricultural employment on total employment is low in that area.

The fact that manufacturing and services employment are denser in areas with larger agglomerations of people has been discussed in previous literature on urbanization and employment growth. Mexican data in Table 1 illustrate that in 1990, non-urban municipalities[3] where the largest locality was above the median in terms of population had a significantly higher participation of their labor force in employment in manufacture and services than those where the largest locality was below the median in terms of population. It also shows the importance of non-agricultural employment on total employment in rural Mexico. On average, more than 41% of the employment in non-urban municipalities where the largest locality was above the median size and more than 26% in those below the median, was in the non-agricultural sector.

Table 2 confirms that employment in Mexico is unequally distributed between cities of different sizes. It illustrates that municipalities where there is an urban center represent 75% of the country's population, but host 88% of employment in manufacturing and 89% of employment in services. The concentration of non-agricultural employment in urban areas is not completely driven by the capital city. If we exclude the municipalities in the Mexico City area (i.e. the Federal District), we find that the rest of municipalities with an urban city concentrate a share of the manufacturing jobs that is higher than their share in the national population. For services, their share in employment is slightly lower than in population. These numbers suggest that municipalities with at least one city of more than 15,000 people can be crucial in the process of expansion of non-agricultural rural employment.

Despite the large importance of non-agricultural employment in rural and semi-urban municipalities, in 1990, non-urban municipalities concentrated 25% of Mexico's population, but only 12% of its employment in manufacture and 11%

[2] Following the Mexican National Institute of Statistics (INEGI) cutoff values, a rural municipality is that where the largest locality has 2,500 persons or less, while a semi urban municipality has at least one locality with 2,501-15,000 persons.

[3] By non-urban, we mean rural and semi-urban (i.e. those where the largest locality has 15,000 people or less).

of its employment in services. Our focus is on the expansion of manufacturing and services employment during the 90s in these municipalities.

3 Related literature

The maps in the previous section suggest the presence of a regional pattern for employment and poverty outcomes. This type of pattern can result from the interaction between different factors. On the one hand, municipal assets that enhance growth (e.g. assets, human capital) are distributed heterogeneously on space. Similarly, region-specific geographic attributes (e.g. proximity to a border, access to ports) affect the potential for economic growth in a structural manner. Finally, growth generates spillovers that affect the surroundings of a municipality.

Disentangling the role of the regional context on economic outcomes is not a new interest of economists. In the early 70s, Johnson [10] recognized that integration between production and investment decisions in the cities and in the rural areas around them was one of the priorities of regional development. He used the expression "functional economic area" to describe a region where urban and rural interactions take place and emphasized on the role of the urban area in determining the incentives for production and investment decisions of those in the rural surroundings.

Different areas of economics have tried to understand how the neighbors and the attributes of the context around them affect individual outcomes. In the macroeconomics literature, there has been considerable work in estimating spillovers from regional growth outcomes. In the research on growth, the concept of agglomeration economies is used to model the concentration of population and of economic activity. The process of agglomeration occurs while returns to concentration are increasing, and it can be eventually reversed if a level of congestion is reached. The mechanisms through which increasing returns to agglomeration occur are many: lower transportation costs, availability of intermediate services, knowledge spillovers, and the presence of large local markets (Krugman [11]).

Empirical findings related to this literature are those of Desmet and Fafchamps [8], who using data from US counties, found that between 1972 and 1992, non-service employment moved away from areas with high concentration of economic activity, while services increasingly agglomerated in these areas. Conley, et al. [3] noticed that spillovers from local human capital are important in explaining the distribution of productivity across Malaysia. Looking at cross-country growth rates, Conley and Ligon [4] identified that spillovers from economies that are close to each other account for a significant amount of the variation in long term growth rates. They also reported that the magnitude of the spillovers is sensitive to the distance metric used to define proximity between countries.

The growth literature differentiates between static and dynamic externalities that lead to agglomeration economies. Static externalities are of two kinds: localization and urbanization. Localization externalities occur when firms in a

particular industry locate nearby their input supply. Urbanization externalities take place when firms decide to locate in areas where there is a large potential demand for their product. Dynamic externalities have broader implications and can explain location patterns of industries at different stages in their development.

Meardon [13] compared the work of economists who looked at issues related to agglomeration of economic activity back in the 60s and 70s like Perroux [14] to that of these more recent contributions in the area of economic geography. He suggested that the presence of externalities leading to agglomeration of economic activity, the existence of a steady state equilibrium with a diversity of city sizes and the role of initial conditions in determining further economic growth were suggested in this earlier work.

While most of the literature that studies the spillovers from regional growth focuses on the expansion of employment or economic activity in large urban areas, the main interest of this paper is to examine how employment diffuses in the rural and semi-urban areas. By focusing on the growth of non-agricultural rural employment, we explore the evolution of the economic opportunities for those who did not migrate to the cities. While the unit of analysis of the agglomeration literature are the cities, our study focuses on rural and semi-urban municipalities, and what role did their own attributes, as well as their interaction with their neighbors (among them, nearby cities) played in the expansion of the employment opportunities of their population.

4 Data

The municipal employment data comes from the Mexican 1990 and 2000 population censuses. Table 3 includes specific references as to the sources of the data, as well as the description of all of the variables[4]. Table 4 presents summary statistics.

After cleaning the data for outliers, there were 1,883 non-urban municipalities with complete data (out of 1,940). The dependent variables used in the

[4] There are three other methodological issues related to the data:

- New municipalities: Within the period of study, 40 new municipalities were created in Mexico. These new municipalities were basically sub-divisions of old ones due to different political and administrative reasons. Since they did not exist in 1990, we do not have comparable maps of Mexico for the two data points. In order to solve this problem, we aggregated the 2000 employment data for the municipalities that were created within the decade of the 90s to replicate the 1990 map. We were able to match 39 out of the 40 new municipalities to their origin so we are doing this analysis based on a 1990 map of the municipalities of Mexico.
- Employment in services: The data grouped as services includes the following sectors: construction, commerce, and other services.
- Other sectors: The population that is not employed in services and manufacture and that is part of the employed economically active population sectors belongs to the following sectors: agriculture, mining, provision of electricity and water, and the group "other".

estimations to describe the expansion of non-agricultural employment are the changes in the level of employment in manufacturing and in services between 1990 and 2000, divided by 1990 population. The reason for the normalization of the change in levels of employment with respect to the initial population is that, as illustrated in Figure 3, it poses an advantage over other measures of expansion such as the rate of growth and the change in levels. Figure 3 shows trend lines for three types of measures of expansion of employment in relation to municipality population size: the rate of growth($\frac{L_1-L_0}{L_0}$), the change in levels ($L_1 - L_0$) and the per capita change in levels ($\frac{L_1-L_0}{P_0}$). Both graphs show that the rate of growth has a strong negative correlation to the size of the municipality in terms of population, and the opposite is observed for the change in levels of employment. However, the per capita change in level with respect to initial population does not have such a strong bias in either direction. This measure has one additional advantage. Areas that are successful in creating employment attract more migrants over time and thus their population grows faster. By normalizing the change in employment levels with respect to the population at the initial period, the dependent variable focuses exclusively on the change in the density of non-agricultural employment, independently of the response it may have created in terms of migration.

5 Model and estimations

5.1 Model

The economy is divided in municipalities (i), which allocate their labor force between different sectors of economic activity (s). For any sector s, the equilibrium municipal employment level L_{is} is such that the local wages w_{is} equal the value of the marginal product of labor:

$$w_{is} = f'(L_{is}, L^0_{is})p_{is}(\cdot) \tag{1}$$

where $f(\cdot)$ is the sectoral production function that depends on current employment L_{is} as well as on past conditions of the local labor market L^0_{is} and $p_{is}(\cdot)$ are the prices of the sector's output. Local prices can be expressed as a function of the level of employment L_{is} and marginal costs m_{is}:

$$p_{is}(\cdot) = p(L_{is}, m_{is}) \tag{2}$$

and by substituting 2 into 1 and inverting 1, we have an expression for the equilibrium level of employment in sector s at location i, L_{is} :

$$L_{is} = L(L^0_{is}, w_{is}, m_{is}) \tag{3}$$

Since we do not observe wages or sectoral marginal costs at the municipality level, we will proxy them with variables that describe municipal characteristics that affect productivity, some of which are structural to the municipality, like

geographic characteristics g_i, and others that change over time, such as the local assets, h_i. Thus, 3 can be rewritten as:

$$L_{is} = L(L^0_{is}, g_i, h_i) \tag{4}$$

We are interested in modelling the expansion of employment in a particular municipality over time. Thus, assuming that 4 has a linear form and adding time subscripts, we can subtract L^0_{is} from both sides of 4:

$$L^1_{is} - L^0_{is} = \alpha_s + (\beta_s - 1)L^0_{is} + \gamma_s g_i + \delta_s h^1_i + \varepsilon_{is} \tag{5}$$

where ε_{is} is an error term. In order to avoid the problem that arises since current levels of attributes h^1_i could be both cause and effect of employment growth, we will use initial levels of these variables (h^0_i) in the estimation of equation 5.

Among the municipality level attributes that affect employment allocation and growth, we focus on four kinds: *own attributes, connectedness, proximity to an economic center*, and the *regional context* around the municipality.

There are *own attributes* of the municipality that affect its potential for growth. For instance, firms will be more likely to locate in areas with more human capital or larger labor markets. Similarly, a dynamic agricultural sector will generate linkages with other sectors of the economy. Moreover, people will prefer to live in areas where they can find jobs. Thus, the municipality's own attributes have direct and indirect effects on employment expansion.

Similarly, the capacity of a municipality to connect to its surroundings - that we will call *connectedness*- affects employment growth both through firms' allocation decisions as well as through consumers' and workers' preferences. In the estimations, we characterize connectedness with variables that describe road availability as well as travel time to markets.

A third element that affects employment growth is *proximity to an economic center*. Since our focus is on non-urban municipalities, we believe that their economies are particularly sensitive to spillovers from nearby urban, large centers. On the one hand, members of rural households that are close to these centers can commute to work in the nearby towns. On the other hand, firms can subcontract with small enterprises in the nearby region for the provision of particular goods and services. And also firms may move towards less urban areas in the surroundings of larger cities, where labor is cheaper and prices for land lower than in the cities.

The fourth type of municipal characteristic that affects local employment in our model is the *regional context* where the municipality is located. The region is characterized by observable geographical features, and by unobservable institutional and cultural elements. Geographic features affect the allocation of employment directly. For example, location near a waterway or in a particular ecological area has a direct effect on productivity as it may determine the availability of raw materials. Geography also affects the distribution of employment indirectly through preferences, because people will choose to live in areas that are more hospitable and markets will develop where the people decide to be. Later on, we will discuss in more detail the role of the unobservable regional attributes on local employment growth.

5.2 Local economic centers

As part of our attempt to analyze the expansion of employment in non-urban municipalities, we are interested in quantifying the effects on employment growth of municipal attributes, connectedness, the regional context, and proximity to urban centers. This section focuses on the latter.

We defined an economic center of employment as a municipality that, in 1990, had a city of at least 250,000 people and where the share of employment in either services or manufacture on total employment was in the highest 33 percentile when compared to all other Mexican municipalities. These criteria resulted in 56 economic centers (49 for manufacture and services and 7 for services only). For the rural and semi-urban municipalities, we identified which one was the closest center as well as the distance to it[5]. Table 5 lists the names of the municipalities that were classified as economic centers.

To illustrate the importance of these few municipalities on the Mexican economy, and especially in the services and manufacturing sectors, we estimated that in 1990, the 56 economic centers concentrated 54% of the total national employment in manufacture, 55% of the national employment in services, and 38% of the national population. However, over the decade of the 90s, employment decentralized out of these locations in relative terms. By 2000, 50% of the total national employment in manufacturing and services was located in these 56 municipalities.

Table 6 has more data on the evolution of population and employment on the economic centers during the 90s. It presents separate numbers for the centers in the Federal District (FD) area and for all the others. While the FD seems to be reaching levels of congestion for manufacturing employment, the growth of employment in services and in manufacture among the other centers has been quick and of a magnitude that is larger than their population growth. Employment in manufacture decreased in the centers around the FD, but it grew in all the other. In services, all centers had a positive growth, but those out of the FD surroundings did it at a rate twice as large. Not only employment, but also population growth was faster in the centers out of the FD. Although the FD is still the heart of economic activity in the country, these patterns confirm the increasing importance of other cities for the country's economy.

Figure 4 shows the expansion of non-agricultural employment across Mexican municipalities during the 90s. The darker municipalities are the economic centers. Municipalities where employment expansion was in the top 33 percentile have a lighter shade. The figure illustrates that many of the municipalities in the vicinity of the centers had high rates of non-agricultural employment growth. Although of the 56 economic centers, 12 cluster around Mexico City and 15 around Guadalajara and Monterrey (the three largest cities of Mexico), there are other 29 relatively decentralized locations throughout the country that were defined as economic centers.

[5] For all of the estimations that involve distances between municipalities, we calculated geographic distances using the geographic coordinates of the municipality heads (the main city) to describe the location of the municipality.

Factors that make locations evolve as economic centers are both related to their geographic attributes that enhance productivity (e.g. climate, access to the ocean, closeness to a border) and to a sequence of historic accidents. (Sachs, et al. [9], Desmet, et al. [8]). Table 7 presents a probit estimation where the probability of being an economic center is regressed against a set of geographic variables. This confirms what has been said about the importance of size of the municipality, proximity to borders, having access to the coast, and regularity of the terrain as geographic characteristics that enhance employment in the manufacturing and services sectors. In addition, there is also a history of institutions, policies and interactions that shape the distribution of economic activity within a country throughout history and that is not contemplated in this simple estimation.

5.3 Estimations

Equation 5 could be estimated using ordinary least squares (OLS). However, the results are unreliable when the data has a spatial structure. This is often the case of employment outcomes, which are the result of relations between agents and markets distributed heterogeneously on space and who interact with one another. Spatial correlation occurs when the error terms of the OLS estimations are correlated between observations that are locationally proximate (Anselin [1]). In order to test and correct for spatial correlation, we need to establish some assumptions on the meaning of proximity and how does its effect decay with distance.

We first test for the presence of spatial correlation in the residuals of OLS estimations of equation 5 using three different tests: the Moran I, the Lagrange Multiplier with spatial error tests, and a Likelihood-ratio test, which are described in Table 8. Table 9 shows the results of these tests[6]. They were performed with four weighting matrices to evaluate their robustness to different definitions of geographical proximity. The first weighting matrix gives a non-zero weight equal to 1/distance to all pairs of observations. The second, third, and fourth weighting matrices focus only on the closest 500, 200, and 100 neighbors, respectively, and each of the neighbors within the interval is weighted by 1/distance, while the rest receive a zero weight[7].

The tests reject the null hypothesis of no spatial correlation on the residuals of the OLS estimations. This finding is robust across all specifications of the weighting matrix for the three tests.

In order to account for spatial correlation, we compare the results of three types of corrections, each based on different assumptions on the form of the spatial dependence process: a spatial errors model, a spatial autoregressive

[6] These tests were implemented using the Spatial Econometrics Matlab Functions Library by LeSage[12].

[7] The reason why we chose to use number of neighbors as opposed to distance levels for the cutoff criteria is the very wide distribution of distances in a country like Mexico where there are states with very large and distant municipalities -like the Northern ones- and others -like Oaxaca- with dozens of small municipalities.

model, and a correction of the standard errors of the OLS coefficients for serial dependence.

The spatial-errors model (SEM) accounts for correlation in the unobservables among neighboring observations and has the form:

$$L = \alpha + x'\beta + W\varepsilon\rho + u \tag{6}$$

where $u \backsim N(0, \sigma_u^2)$ and W is the spatial weighting matrix.

Alternatively, the spatial autoregressive model (SAR) includes as an explanatory variable the dependent variable of the neighbors, weighted by some measure of proximity:

$$L = \alpha + x'\beta + WL\lambda + \nu \tag{7}$$

where $\nu \backsim N(0, \sigma_u^2)$ and W is the spatial weighting matrix. Tables 10a and 10b present results for these two models.

The last strategy to account for spatial correlation corrects the standard errors of the parameters of an OLS estimation for serial dependence between observations that are locationally close to each other following Conley [5]. This approach does not impose any additional parametric assumption on the error terms. The standard errors corrected for spatial dependence are estimated as weighted averages of sample autocovariances. The weights decline linearly with distance and are non-zero for all observations. Results for this correction are reported in Table 11.

We first focus on the results from the SEM and SAR models in Tables 10a and 10b. The signs and magnitudes of the coefficients are overall consistent across the two corrections and across the different specifications of the weighting matrices. In addition, the parameters of the correction term (ρ, λ) are positive and in most cases significant, suggesting a robust pattern of positive externalities from employment outcomes of neighbors.

The main findings from the estimations are discussed next. The variables that describe the regional context suggest that over the period 1990-2000, employment in manufacture grew more in the Altiplano[8] as well as in flatter areas. On the other hand, employment in services experienced an expansion in municipalities on the coast and on the US border.

The variables that describe the attributes of the municipalities illustrate that growth of manufacturing and services employment was higher in municipalities with more adults with some secondary education. However, the education variable loses its significance in the SEM correction for the two smaller definitions of neighborhood (100 and 200 closest neighbors). Employment in manufacture grew faster in areas with a large indigenous population, while ethnicity played opposite roles on the services employment estimations between the two corrections (negative for SEM and positive for SAR). A larger initial employment in manufacturing resulted in a larger expansion of this sector, suggesting concentration. This was not the case for employment in services. Finally, employment in services grew slower in municipalities where legislation mandated

[8] Altiplano, or high plateau.

higher minimum wages (although this is only significant in the SAR correction). Also, manufacturing employment growth was higher in regions where there was a dynamic composition of agricultural activities.

The variables that describe connectedness have robust results across all the estimations. They show that places where more people had access to roads experienced a faster expansion of manufacturing and services employment over the 90s.

The coefficients of the variables which describe the proximity of these municipalities to the local economic centers are consistent with the presence of positive externalities from regional economic activity. Growth of employment in manufacture and services was positively associated to proximity to a center. The total effect of the interaction between proximity to a center and its size is positive for both manufacturing and services, although there are some variations on significance of each of the variables across specifications. Finally, the estimations show that proximity to more than one economic center with a large initial employment base was also positively associated to the expansion of employment in services over the 90s. Interestingly, this variable is negative and significant for the SAR correction in the growth of manufacturing employment regressions, but it is positive across the SEM correction (and significant for one of the distance matrices).

If we compare the fit between specifications, we find that for each pair of estimations that uses the same weighting matrix, the adjusted R-squared is higher for the SEM than it is for the SAR correction. In addition, the fit improves as the focus is on smaller definitions of neighborhood. The SAR model includes as an explanatory variable the rates of growth of a municipality's neighbors weighted by distance and thus poses a potential problem as the neighbors' growth outcomes may be correlated to unobservable regional attributes captured in the disturbance. For the above reasons, for the analysis of the results we will refer to the coefficients in the SEM corrections and given the better fit achieved at smaller definitions of neighborhood, to the specification that gives a non-zero weight of 1/distance to all pairs of observations among the 100 closest neighbors (abbreviated SEM100).

Table 11 reports results for the correction of the OLS standard errors for serial dependence. The overall magnitude and signs of the coefficients are consistent with the previous corrections. A few differences are found in terms of significance. Compared to the SEM100 correction for employment in manufacturing, in this specification we find that the positive effect of adult education on employment growth is also significant. In terms of growth of employment in services, there are more discrepancies between this and the SEM100 corrections. Three variables that are significant after the correction on the standard errors are not with SEM100: a negative effect from the Altiplano dummy, the positive effect from the agricultural variable, and the a negative effect on the minimum wage dummy. Perhaps more problematic is the fact that ethnicity appears in this correction with a positive and significant sign (i.e. consistent with the SAR, but not the SEM specifications of the employment in services estimation).

5.4 Role of the centers

Using the results from the estimations that suggest that proximity to an economic center has an important effect on non-agricultural rural employment growth, we explore the interaction between size of the closest center and distance to it. Figure 5 depicts this relationship for fixed levels of municipal employment growth (labeled $g1, g2$, and $g3$ $s.t. g1 < g2 < g3$). Dotted lines are included at the mean values of the variables in the axis. The figure on the left refers to the expansion of manufacturing employment. It illustrates that manufacturing employment expands faster near centers as well as when the closest center has a larger initial manufacturing employment. The convexity of the lines suggests that an additional unit of initial manufacturing employment in the closest center has a larger effect on employment growth the closer the rural municipality is to the center.

The figure on the right hand side shows that for services, there are two different relationships between the interaction of proximity to a center with its initial size and subsequent employment growth. The first pattern, on the bottom left hand side of the graph, describes 94% of the municipalities in the sample, which are farther than 28.6 km away from their closest economic center. For this group, local services employment growth is larger as proximity to a center and its initial services employment increase. The concavity of the lines suggests that an additional unit of initial services employment in the closest center has a larger effect on growth the more distant the municipality is from its closest center.

For a small group of municipalities that are very close to a center (6% of the sample, in the top right hand side of the graph), local employment growth is higher as distance from the closest center increases and initial size of services employment in the closest center decreases. Convexity indicates that the effect of a decrease in the initial size of services employment in the closest center leads to higher growth the closer the rural municipality is to the center.

The existence of these two patterns for services employment growth is consistent with the presence of an economic center that generates positive employment externalities, but where the negative effect on employment from the higher commuting costs that people in the rural outskirts face is larger than the effect of the spillovers.

5.5 Relative importance of own and regional attributes

The linear framework of the estimations allows to classify the explanatory variables in order to compare the relative importance of different types of factors in explaining the variation in local employment growth. The idea is to decompose the total explained variance of the dependent variable (i.e.$Var(\widehat{\beta}x)$) in n components:

$$Var(\sum_{i=1}^{n}(\widehat{\beta}x)_i)) = \sum_{i=1}^{n} Var(\widehat{\beta}x)_i + \sum_{i=1}^{n}\sum_{\substack{j=1 \\ j\neq i}}^{n} Cov((\widehat{\beta}x)_i(\widehat{\beta}x)_j) \qquad (8)$$

where $i = 1...n$ refers to each of the groups of variables. The components of 8 can be normalized by dividing the right hand side by $Var(\sum_{i=1}^{n}(\widehat{\beta}x)_i))$. This decomposition is acceptable when the "indirect" terms (i.e. $\sum_{i=1}^{n}\sum_{\substack{j=1 \\ j\neq i}}^{n} Cov((\widehat{\beta}x)_i(\widehat{\beta}x)_j))$ are small compared to the "direct" ones $(Var(\widehat{\beta}x)_i)$.

We want to compare the relative importance of own attributes, the regional context, connectedness and proximity to economic centers in explaining the variation of employment growth.

Table 12 gives the decomposition of the explained variance into these groups of variables using the coefficients from the SEM100 model[9]. Most of the explained variation in the dependent variable comes from the "direct" terms. connectedness is the only component for which the "indirect" terms are large compared to the "direct" ones and this is due to the covariance between connectedness and proximity to centers (for manufacture) and own attributes (for services).

The decomposition in Table 12 illustrates that a municipality's proximity to economic centers and other contextual variables explain at least 50% of the variation of non-agricultural employment growth. The variables play different roles in explaining the expansion of services and manufacturing employment. For instance, while own attributes (which includes agriculture) are not very important for manufacture, they play a much more important role for services employment. On the other hand, connectedness with other places has a more important role for manufacture than it does for services. Being near an economic center seems crucial for both sectors, but slightly more important in explaining growth of manufacturing employment. Finally, the other contextual variables play a larger role in explaining the variation in growth of manufacturing employment than they do for services.

Using the same methodology, we compare how different types of variables affect employment growth across subsamples of the data. Table 13 summarizes the results. For comparison, in the first row it also reproduces the numbers for the whole sample presented in Table 12. Overall, within a given subsample, the relationship between the magnitudes of the shares for manufacturing and services remain similar to those of the complete sample so our comments will focus on the differences across subsamples.

A first partition of the data compares municipalities by population size. We divided the sample into two groups: rural and semi-urban municipalities. We find that variation of employment growth among semi-urban municipalities is driven by the role of proximity to a center, more than it is for the rural ones. Similarly, connectedness and the context play a more important role in explaining variations in employment growth of small rural municipalities.

The next two partitions focus on regions that play key roles in the Mexican economy: the surroundings of Mexico City (Federal District, FD) and the border

[9] The variables in the regional context include also the part of the error term that represents variables that are unobservable to the econometrician, but are correlated among geographically close observations and are relevant in explaining the expansion of non-agricultural employment (term $W\varepsilon\rho$ in equation 6).

with the United States. We find that proximity to an economic center drives the variation in employment growth for those municipalities whose closest center is in the FD. However, connectedness and the context explain a higher share of the expansion of employment for the ones that are not in that area. Interestingly, we also find that within those municipalities whose closest center is in the FD, the economic center explains a larger share of variation in services employment than in manufacturing (contrary to what is observed for all other partitions of the data). This is consistent with the pattern of congestion of manufacturing and agglomeration of services in the area around the FD that we had observed before.

Finally, when we look at municipalities whose closest economic center is on the US-Mexico border[10], we find that the regional context plays a more important role than any domestic economic center. For those near the US border, the own attributes explain more of the variation in employment growth than for those faraway from the border, especially for manufacture.

5.6 Agriculture vs. proximity to a center

So far, the results point to the importance of proximity to urban centers for the expansion of non-agricultural rural employment. This section compares the regional importance of two channels through which non-agricultural rural employment expands: linkages to the economic centers and agriculture.

To characterize the regions where agriculture and proximity to a center contributed with a large proportion of the predicted employment outcomes, for each of the i municipalities in the sample, we estimated the share of the predicted growth that was explained by agriculture and by proximity to a center[11]. Then, we ranked the municipalities according to their predicted growth coming from the role of agriculture or their proximity to an economic center and selected the top third. As our focus is the expansion of the non-agricultural sector, we limited this exercise to the subsample of municipalities with a positive predicted employment growth.

Figure 6 plots these municipalities and distinguishes the cases where agriculture, the center or both factors explained a high proportion of the growth outcome of the municipalities. The left hand side map refers to manufacturing employment and the right hand side one to services.

The maps show a regional clustering in terms of the importance of agriculture and proximity to a center on employment growth. Very clearly for manufacture, proximity to a center alone explains most of the growth in municipalities around the largest cities of the country, in central Mexico, Monterrey and Guadalajara. The same pattern is observed for services, although it is slightly more spread North, towards Zacatecas and Durango. Agriculture alone explains a high share

[10] Including those centesr in Baja California, Chihuahua, Nuevo León (i.e. Monterrey), Sonora, and Tamaulipas.

[11] $\widehat{\beta} x_i^{ag} / \widehat{y}_i$ and $\widehat{\gamma} x_i^{c} / \widehat{y}_i$, where x_i^{ag} refers to the agricultural variable, and x_i^{c} is the group of variables that characterize proximity to centers of economic activity from Table 3.

of manufacture and services employment growth in the Southern states of Guerrero, Oaxaca and Chiapas, as well as in parts of Veracruz and towards the North, in Zacatecas, Sonora, and Chihuahua. Finally there are municipalities where both agriculture and proximity to a center explained a high share of their growth outcome. For manufacturing, these are mainly along the South Pacific coast of Mexico (Michoacán, Guerrero, Oaxaca and Chiapas) or South of the states that border with the US, along Durango, Zacatecas, San Luis Potosí and Nuevo León. For services employment growth, these municipalities look more clustered into three groups: one in the South (Oaxaca) and two in the North (East: Nuevo León and Tamaulipas; and West: Sonora, Durango, and Chihuahua).

The same classification was used to compare the municipality characteristics across groups (Table 14). The differences in the attributes of these three groups of municipalities are consistent across the manufacturing and services sectors. The highest rates of expansion of non-agricultural employment are found where a high proportion of employment growth was explained by the center only, while the lowest rates are found where both agriculture and the center explain a high share of employment growth. The municipalities where a high proportion of non-agricultural employment growth was explained by proximity to a center were in the Altiplano, in the flattest areas, with the highest education and lowest indigenous population. They also had large initial levels of non-agricultural employment and were better served by roads. On the other hand, those whose non-agricultural employment growth came in a high portion from agriculture were more likely to be in the coast.

But perhaps the most interesting result of this table is that the municipalities where both agriculture and proximity to a center had a high contribution to their employment growth outcome are also different from the ones where the channel of growth was only one of these two factors. The mean value of most of their characteristics is in the interval between the means of the values of the other two groups. However, they have the lowest levels of education, the most indigenous (for services only), the smallest initial non-agricultural employment and are the worst served in terms of roads. The smaller endowments of this group in terms of infrastructure, assets and initial employment, as well as the higher indigenous population, corresponds to the municipalities with the lowest rates of expansion of services and manufacturing employment.

5.7 Importance of agriculture for isolated municipalities

Figure 7 depicts a kernel smoothing of the per capita expansion in employment over the 90s on the distance to the closest economic center. Consistent with our previous findings, there is an inverse relationship between employment growth and distance to a center. However, the decreasing effect of distance on employment dies out after 100 km for manufacture and 150 km for services. Therefore, in order to explore the role of agriculture in municipalities near and far from an economic center, we will use these as cutoff points to define which municipalities belongs to each subgroup.

For the two subsamples of municipalities, we repeated the SEM100 estima-

tions and added an interaction term between the agricultural variable and the availability of state roads (Table 15). The results of these estimations present some differences compared to the ones in Tables 10a and 10b, but we will focus on the differences in the coefficients of municipalities near and faraway a center.

For employment in services, the coefficients of the estimations over the two subsamples are very similar. As expected from the partition into these subsamples, the variables that describe proximity to a center are only significant for the municipalities near a center. On the other hand, having a coast and access to federal roads has a positive and significant effect on growth only for the municipalities faraway from a center, while the Altiplano dummy is negative and significant only for the municipalities near a center.

In the manufacturing estimations, we find more differences between the two subsamples. Perhaps the most interesting one is that while the initial size of municipal manufacturing employment has a negative and significant effect on growth of manufacturing employment for municipalities far from a center, it is positive and significant for those near one. This suggests concentration in municipalities near a center and dispersion out of isolated areas. In addition, not being on the coast but in the Altiplano, having a dynamic agricultural output as well as educated population and access to state roads, being in a municipality with a higher minimum wage, closer to a semi-urban town and with a large center nearby has a significant effect on growth of employment in manufacture only for municipalities near a center. Alternatively, the variables that affect manufacturing employment only in municipalities far from a center are the size of the indigenous population, the interactions between federal roads and agriculture and between distance to a center and its size, as well as the total size of all other centers weighted by distance to them.

With the coefficients from the above estimations, Figure 8 illustrates the interaction between the composition of agricultural output and availability of state roads, for fixed levels of employment growth ($g1, g2, g3$, and $g4$ $s.t. g1 < g2 < g3 < g4$). Dotted lines show the mean values of the variables in the axis.

The top row refers to municipalities far from a center and the bottom one to those near a center. The figure on the top right illustrates services employment growth in municipalities far from a center and shows that for a given composition of agriculture, a higher availability of roads leads to more growth of services employment. Similarly, for a given level of roads, a higher-value agricultural output leads to higher expansion of employment in services. The convexity of the lines indicates that an increase in the value of the agricultural output has a larger positive effect in services employment growth the higher the road availability.

The top left-hand-side figure refers to manufacturing employment and shows two types of patterns: one for high and one for low levels of road availability. The first pattern that occurs when the percentage of people with access to a state road is above the mean is similar to the one for services employment: higher-value agriculture and more roads lead to more services employment; and for a given level of growth, the relationship between the two variables is convex. However, when the availability of roads is low, the pattern differs. While higher

road availability is still associated with more growth, given a low level of roads, an increase in the composition of agricultural output leads to lower growth of manufacturing employment. In addition, the concavity of the lines is showing that an additional unit in the value of agricultural output has a larger negative effect on manufacturing employment growth the lower the road availability.

The figures corresponding to the municipalities faraway from a center suggest that roads and agriculture complement each other for the creation of services and manufacturing employment. Moreover, at low road availability, without an adequate increase of state roads, an improvement in the value of the agricultural output can lead to a decrease in the rate of expansion of manufacturing employment.

On the other hand, the figures on the bottom suggest that for the municipalities near a center, having a dynamic agriculture and access to state roads are both positively related to employment growth. The difference between the two figures is the shape of the lines. The concavity of the growth curves for manufacturing suggests that an increase in the value of agricultural output has a smaller positive effect on manufacturing employment growth the larger the road availability. Alternatively, an increase in the value of agricultural output has a larger positive effect on services employment growth the higher the road availability.

Finally, Table 16 replicates the decomposition of variances with the coefficients from these last estimations (Table 15) and includes, as a separate category, the agricultural and federal roads variables as well as their interaction. For the municipalities far from a center, by construction, proximity to a center explains less of the variation in the predicted dependent variable. We find that for manufacture and for services, the joint effect of agriculture and federal roads as well as the municipality's own attributes explain more than 50% of the variation in employment growth outcomes for municipalities that are faraway from a center. For those near a center, we find that proximity to a center and the context explain more of the variation in manufacturing employment growth, while for employment in services, own attributes and connectedness are much more important for those far from a center than for municipalities nearby one.

6 Conclusions

This paper explores how the changes in non-agricultural rural employment in Mexican municipalities over the 90s were related to local attributes, the context, connectedness and proximity to economic centers. Our findings suggest the presence of positive externalities from the regional expansion of non-agricultural rural employment. Specifically, proximity to dynamic urban centers with large manufacturing and services sectors is key for the expansion of non-agricultural rural employment. The size of the employment base at the closest center has a larger effect on growth of employment in manufacture the closer the rural municipality is from the center. On the contrary, for employment in services, center size has a higher impact on the more distant rural municipalities.

We find that most of the variation in employment expansion is explained by proximity to a center. Also, local attributes are more important for services than they are for manufacturing employment growth, while connectedness as well as the regional context matter more for employment growth in manufacture than for services. Further partitions of the sample demonstrate that the local context and connectedness explain more of the variation in employment growth of small rural municipalities, as well as of those whose closest center is on the US-Mexico border and of the ones whose closest center is not on the Mexico City region than they do for semi-urban municipalities or for those away from the border or in the area of the capital city, for whom, in turn, proximity to a center is more important.

By distinguishing between municipalities close and faraway from centers on economic activity, we find that agriculture and roads have a relation of complementarity in their role on employment growth. Specifically, the interaction between a high-value agricultural output and state roads availability is positively associated to services employment growth and to manufacturing employment growth among municipalities with a high availability of roads. However, for municipalities far from a center and with low road availability, an improvement in the value of the agricultural output alone has a negative impact on manufacturing employment. In addition, for both manufacturing and services, in municipalities that are faraway from economic centers, it is agriculture in interaction with availability of state roads, as well as municipal attributes such as education, ethnicity, wages and initial levels of employment which explain most of the variation in non-agricultural rural employment growth outcomes.

The above findings have concrete policy implications as they illustrate the heterogeneity in the channels through which decentralized urban economic activity effectively affects the expansion of non-agricultural rural employment. Two themes that deserve to be explored further are the channels of interaction between agriculture and non-agricultural rural employment, as well as how the poor have been affected by these changes in the landscape of rural labor markets.

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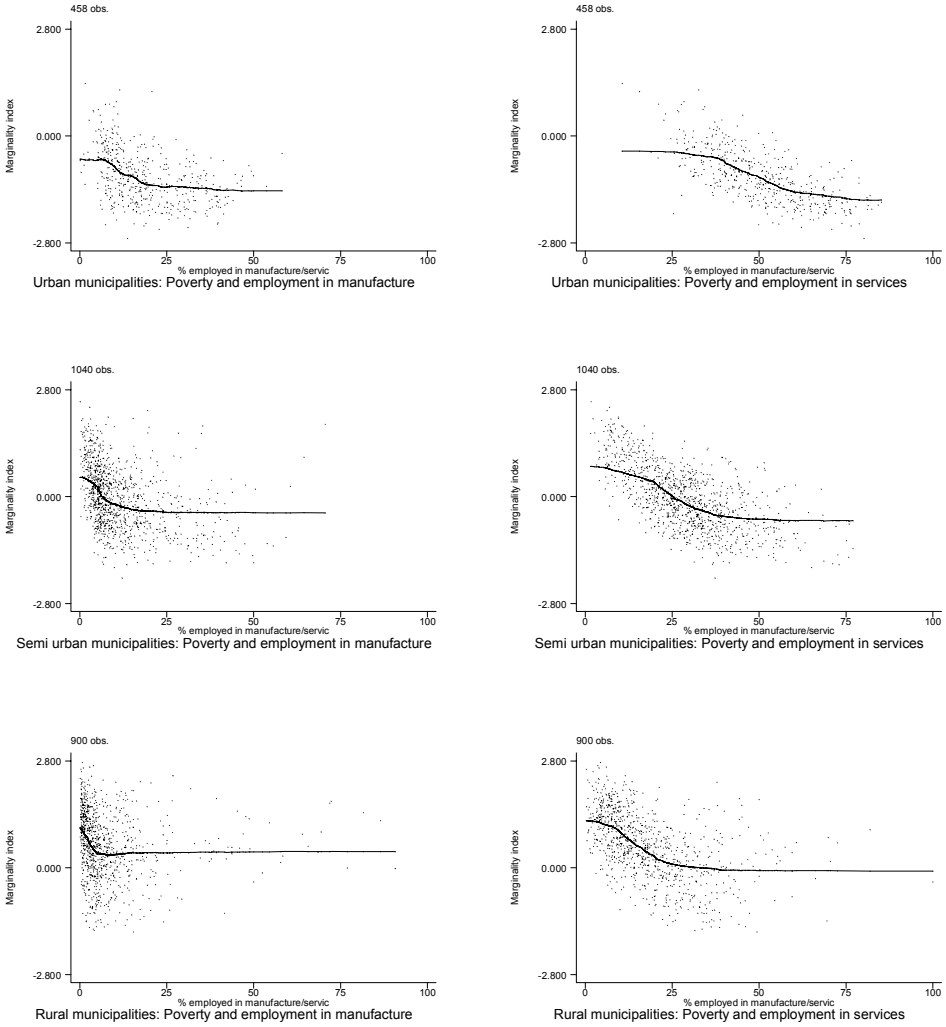
7 Figures

Figure 1: Poverty and employment outcomes[12]



[12] These tables use the CONAPO marginality index at the municipality level. This index is based on 1990 census data. It is constructed using principal components from the following variables: adult illiteracy, adults with incomplete primary school, availability of sewerage, piped water and electricity, dwellings with soil floor, persons in overcrowded dwellings, persons in localities with less than 5000 people and employed population that earns up to 2 minimum wages.

Figure 2: Poverty and share of non-agricultural employment
(high refers to top third)

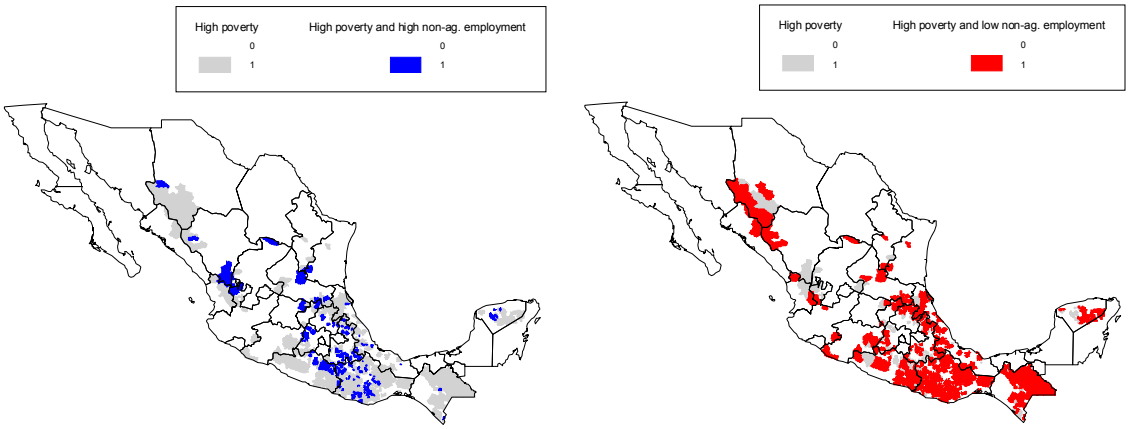


Figure 3: Comparison between three measures of employment growth

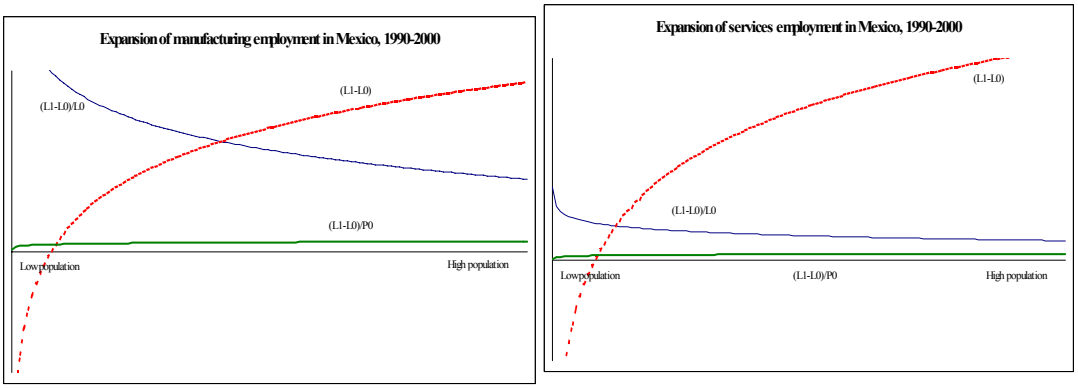


Figure 4: Expansion of manufacturing (left) and services (right) and economic centers
(high refers to top third)

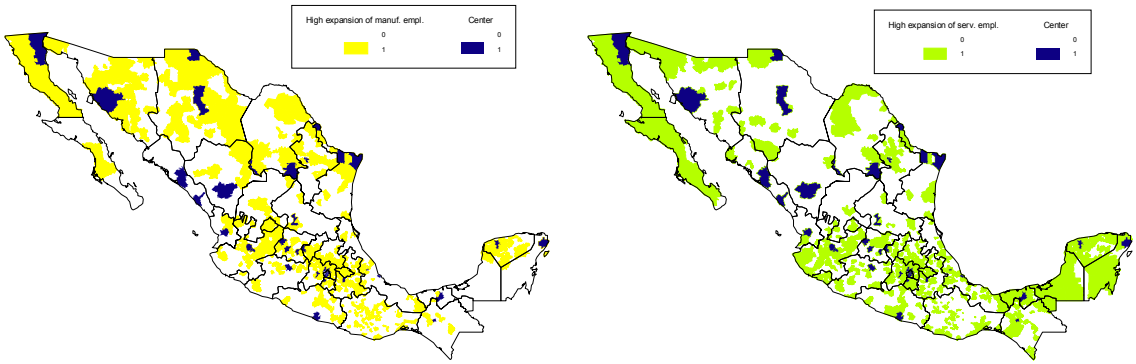


Figure 5: Role of proximity and size of the economic center on municipal
employment growth
(with coefficients from SEM model for 100 closest neighbors)

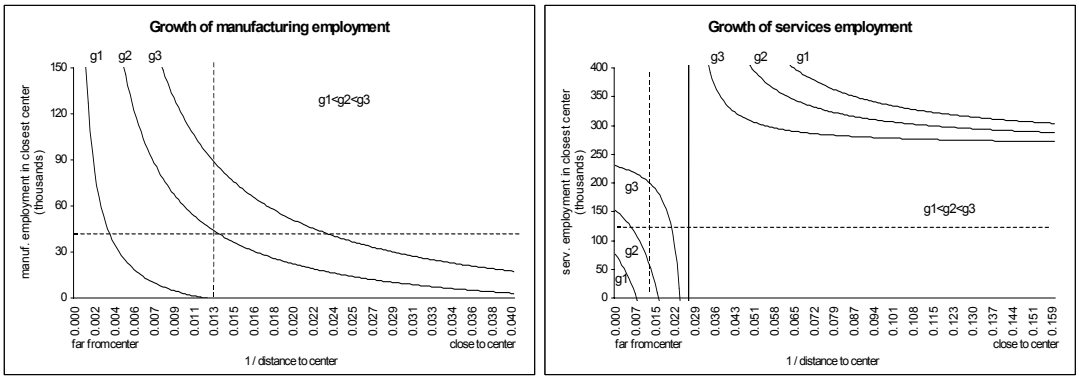


Figure 6: Rural municipalities where the center and agriculture explain the highest shares of the growth of manufacturing (left) and services(right) employment

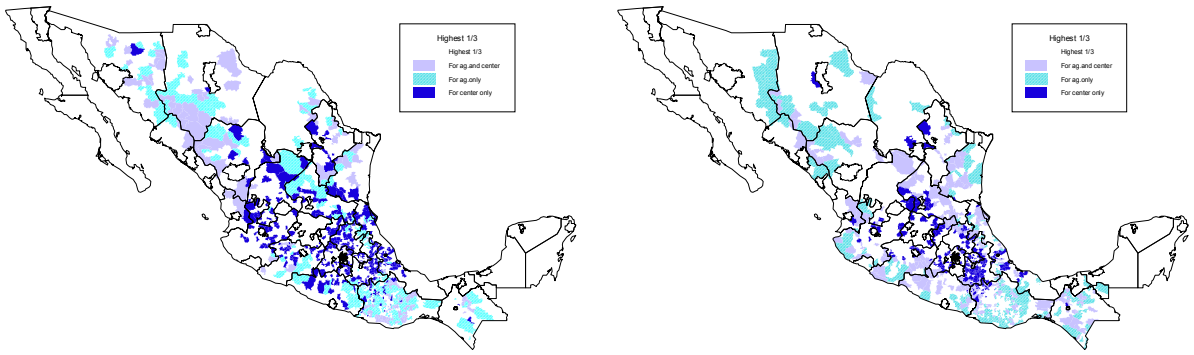


Figure 7: Growth of manufacturing (left) and services (right) employment as a function of distance to closest economic center

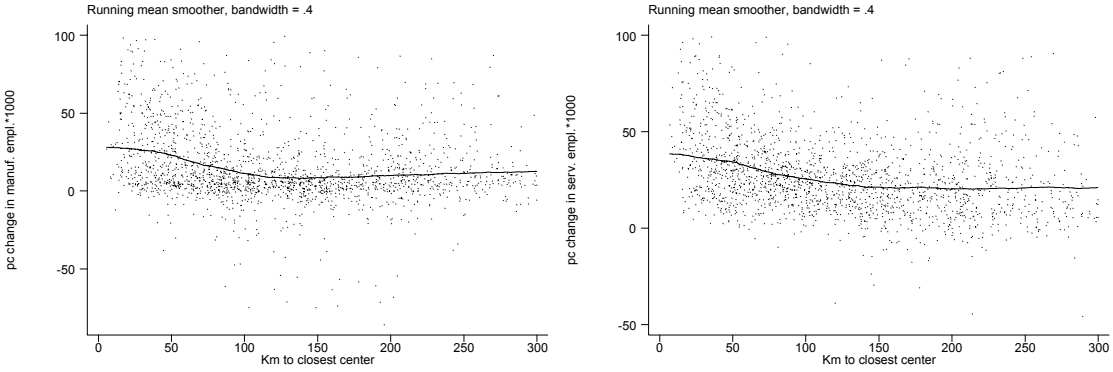
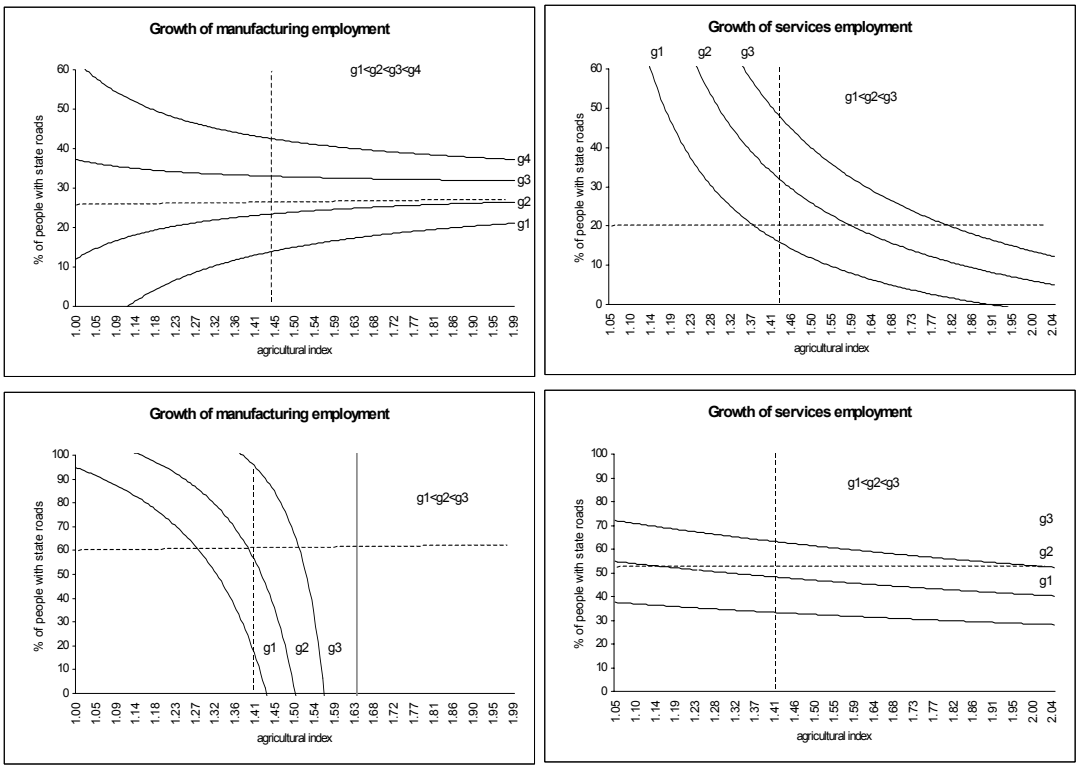


Figure 8: Role of agriculture and federal roads on municipal employment growth (coefficients from SEM model for 100 closest neighbors, top pair refers to municipalities faraway from a center and bottom pair to those near a center)



8 Tables

Table 1: Non-agricultural employment in non-urban municipalities by size of largest town

% of employment	Below median	Above median	Diff.
in manufacture	8.1	11.9	***
in services	18.3	29.6	***
Obs.	970	969	

Significantly different at 1% ***, 5% **, 10% *

Table 2: Distribution of the population
by type of municipality

		Employment			Obs.
	Popul.	Total	Manuf.	Serv.	
Rural	5%	4%	2%	2%	900
Semi-urban	20%	18%	10%	9%	1,044
Urban	75%	78%	88%	90%	458
Excluding FD	66%	66%	75%	63%	442

Table 3: Variables

Variable	Description	Source
Context		
Per capita change in employment	Normalized by population in initial period	a
Coast	1 if municipality is on coast	b
Northern border	1 if municipality is on US border	b
Altiplano dummy	1 if avg. altitude in municip. >= 1,500 meters	c
Standard deviation of altitude in meters	Standard deviation of all localities in mun.	c
Own attributes		
Composition of agricultural output**	Weighted sum of 1991-2000 rate of growth of national value of production for 9 crops (w=municipality % of land with each crop)	d
% Adults with 9th grade or more	Weighted sum of localities in municipality (w=population), adults are 16 or older.	a
% who speak an indigenous language	Among those 5 and older.	a
Higher minimum wage group*	1 if municipality belongs to groups A or B	g
Initial level of employment in sector	Sum of sector for all localities in municip.	a
Connectedness		
% Population served by a state road	Road at 4km from locality, weighted sum of localities in mun. (w=population)	e
% Population served by a federal road	Road at 4km from locality, weighted sum of localities in mun. (w=population)	e
Mean minutes to closest semi urban town	Accounts for dist., topogr., road quality	f
Proximity to centers		
Distance to closest center in Km.	Calculated from geographic coordinates	a
Initial sectoral empl. in closest center	Sum of sector for all localities in municip.	a
Sum (sect. empl. in center i / dist. to i)	Sum of sector in all centers, weighted by 1/distance between municip. and center	a

a: INEGI, Population Census 1990 and 2000.

b: Map of Mexico, Instituto Nacional de Ecología

c: The Global Land Project One-Km. Base Elevation, 1999

d: INEGI, Banco de Información Económica, 2002 and 1991 Agricultural Census.

e: Progresa-CONAPO data set 2000.

f: Cimmyt-CIAT, Accessibility Modelling in ArcView3, by A. Farrow and A. Nelson.

g: Mexican Secretaría del Trabajo y Previsión Social website: http://www.stps.gob.mx

*: Refers to municipalities where, by law, firms pay higher minimum wages (up to 20% higher).

**:The nine crops are: beans, coffee, corn, rice, safflower, sesame, sorgum, soy, and wheat. We calculated the 90-00 rate of growth of the total value of production at the national level and aggregated these rates of growth weighting them, for each municipality, by the number of hectares planted with each of the crops.

Table 4: Summary statistics of the non-urban municipalities

	Mean	St.dev.
Per capita change in manufacturing jobs 90-00 × 1000	15.4	24.9
Per capita change in services jobs 90-00 × 1000	26.5	20.3
Context		
Coast	0.07	0.25
Northern border	0.01	0.1
Altiplano dummy	0.49	0.5
Standard deviation of altitude in meters	164.3	141.1
Own attributes		
Composition of agricultural output	1.42	0.28
% Adults with 9th grade or more	3.1	2.7
% who speak an indigenous language	25.1	35.7
Higher minimum wage groups	0.02	0.14
Total employed in manufacture in 1990 (thousands)	0.27	0.4
Total employed in services in 1990 (thousands)	0.71	0.98
Connectedness		
% Population served by a state road	40.4	41.2
% Population served by a federal road	37.5	40.6
Mean minutes to closest semi urban town	205.4	143.7
Proximity to centers		
Distance to closest center in Km.	131.1	80.5
Total employed in manufacture in center in 1990 (thousands)	41.6	40.6
Total employed in services in center in 1990 (thousands)	112.7	51.3
Sum i (manuf. employment in center i / distance to i)/1000	7.4	5
Sum i (serv. employment in center i / distance to i)/1000	20.3	13.4
Observations	1,883	

Table 5: Names of the economic centers for manufacture and services

State	Municipality	State	Municipality
Baja California Norte	Mexicali	Mexico	Cuautitlan Izcalli
Chiapas	Tuxtla Gutierrez	Mexico	Ecatepec
Chihuahua	Juarez	Mexico	Atizapan de Zaragoza
Chihuahua	Chihuahua	Mexico	Tlalnepantla
Coahuila	Torreon	Mexico	Naucalpan
Coahuila	Saltillo	Mexico	Nezahualcoyotl
Coahuila	Durango	Mexico	Chimalhuacan
DF	Gustavo A Madero	Mexico	Toluca
DF	Azcapotzalco	Michoacan	Morelia
DF	Miguel Hidalgo	Morelos	Cuernavaca
Df	Cuauhtemoc	Nayarit	Tepic
DF	Venustiano Carranza	Nuevo Leon	Monterrey
DF	Iztacalco	Nuevo Leon	San Nicolas de los Garza
DF	Benito Juarez	Nuevo Leon	Guadalupe
DF	Iztapalpa	Puebla	Puebla
DF	Alvaro Obregon	Queretaro	Benito Juarez
DF	Coyoacan	Queretaro	Queretaro
DF	Xochimilco	San Luis Potosi	San Luis Potosi
DF	Tlalpan	Sinaloa	Culiacan
Durango	Mazatlan	Sonora	Hermosillo
Guanajuato	Leon	Tabasco	Centro
Guanajuato	Irapuato	Tamaulipas	Nuevo Laredo
Guanajuato	Celaya	Tamaulipas	Reynosa
Guerrero	Acapulco de Juarez	Tamaulipas	Matamoros
Jalisco	Zapopan	Tamaulipas	Tampico
Jalisco	Guadalajara	Veracruz	Xalapa
Jalisco	Tonala	Veracruz	Veracruz
Jalisco	Tlaquepaque	Yucatan	Merida

Table 6: Summary statistics of the economic centers 1990-2000

	All centers vs. FD centers		
	FD	All other	Difference
Growth of employment in manufacture	-17.6	36.8	***
Growth of employment in services	27.8	52.5	***
Population growth (persons 12 and older)	3.2	30.2	***
Observations	12	44	

FD= Federal District, i.e. Mexico City metropolitan area.
Significantly different at 1% ***, 5% **, 10% *.

Table 7: Pr(municipality = economic center)

	Coef.	St. Err.
Area in km.^{2}	.00004**	.00
Coast dummy	.425*	.22
Northern border	.809***	.29
Mean altitude in meters	.0003***	.00
St.dev. of altitude in meters	-.003***	.00
Constant	-2.19***	.16
Pseudo R^2	.08	
Observations	2,394	

Significant at 1% ***, 5% **, 10% *.

Table 8: Tests for spatial dependence

Test		Description
Moran's I	$MI = \frac{e'We}{e'e}$	e =vector of ε_i residuals W =matrix of spatial weights
LM error[a]	$LMe = (1/T)[(e'We)/\sigma^2]^2$	$LMe \sim \chi^2(1)$ $T = tr(W + W').\times W^*$
LR test[a]	$LR = (\ln L_{SEM} - \ln L_{OLS})$	$LR \sim \chi^2(1), L$ =log likelihood

* .$\times$ denotes element by element multiplication

a: based on likelihood ratio estimation of a spatial errors model SEM

Table 9: Results of the tests

	Moran		LM error		Likelihood ratio	
	Manufacture	Services	Manufacture	Services	Manufacture	Services
All neighbors	1/d		1/d		1/d	
Statistic	0.035	0.056	161.72	416.95	92.54	166.74
P-value	0.000	0.000	0.000	0.000	0.000	0.000
500 closest neighbors	1/d		1/d		1/d	
Statistic	0.047	0.075	169.38	441.75	105.97	208.29
P-value	0.000	0.000	0.000	0.000	0.000	0.000
200 closest neighbors	1/d		1/d		1/d	
Statistic	0.064	0.093	205.23	430.30	123.81	212.44
P-value	0.000	0.000	0.000	0.000	0.000	0.000
100 closest neighbors	1/d		1/d		1/d	
Statistic	0.080	0.110	211.56	403.84	130.85	211.50
P-value	0.000	0.000	0.000	0.000	0.000	0.000

Table 10a: Estimations - manufacture

	All neighbors		500 closest		200 closest		100 closest	
Context								
Coast	-0.64	-1.10	-0.56	-1.04	-0.94	-1.20	-1.15	-1.08
	0.29	0.51	0.25	0.48	0.42	0.56	0.51	0.50
Northern border	7.77	7.60	7.21	6.85	6.18	6.81	5.17	6.96
	1.34	1.32	1.24	1.19	1.07	1.19	0.89	1.22
Altiplano dummy	4.88***	5.79***	4.61***	5.77***	4.27***	5.70***	4.29***	5.54***
	3.73	4.91	3.45	4.91	3.14	4.87	3.11	4.76
St.dev. of altitude in meters	-0.01**	-0.01**	-0.01**	-0.01**	-0.01**	-0.01**	-0.01**	-0.01**
	2.18	2.37	2.12	2.35	2.03	2.29	1.96	2.38
Own attributes								
Composition of agricultural output	6.22***	5.41***	6.57***	5.37***	6.67***	5.34***	6.35***	5.49***
	2.97	2.67	3.11	2.66	3.14	2.66	2.96	2.74
% adults with 9th grade or more	0.49*	0.62***	0.45*	0.64***	0.40	0.59**	0.35	0.53**
	1.94	2.57	1.76	2.63	1.59	2.43	1.37	2.21
% who speak indigenous language	0.05***	0.05***	0.05***	0.05***	0.06***	0.05***	0.06***	0.05***
	2.82	3.39	2.80	3.42	3.07	3.38	3.24	3.36
1 if higher minimum wage group	6.86	5.54	6.91	5.16	7.01	4.88	7.48	5.15
	1.54	1.34	1.48	1.25	1.46	1.19	1.54	1.26
Initial employment in sector (thousands)	3.95***	3.69***	3.97***	3.65***	4.02***	3.89***	4.04***	3.93***
	2.67	2.59	2.66	2.57	2.70	2.75	2.71	2.79
Connectedness								
% of population served by state road	0.07***	0.07***	0.07***	0.06***	0.07***	0.06***	0.07***	0.06***
	4.45	4.46	4.10	4.09	4.10	4.18	4.10	4.24
% of population served by federal road	0.06***	0.05***	0.06***	0.05***	0.06***	0.05***	0.06***	0.05***
	3.80	3.67	3.86	3.60	3.97	3.67	4.03	3.75
Mean minutes to closest semi urban town	-0.003	-0.002	-0.003	-0.002	-0.004	-0.001	-0.004	-0.0007
	0.56	0.42	0.64	0.46	0.86	0.33	0.82	0.16
Proximity to centers								
1/Distance to closest center	74.33	103.16*	59.07	102.62*	66.45	107.23**	84.37	122.2**
	1.23	1.92	0.96	1.91	1.05	2.01	1.30	2.31
Initial sectoral empl. in closest center (thous.)	0.01	-0.01	0.01	-0.01	0.003	-0.01	0.0002	-0.01
	0.29	0.48	0.45	0.53	0.10	0.62	0.01	0.45
*(1/Distance to closest center)	5.33***	4.99***	5.31***	5.03***	5.29***	4.96***	5.23***	4.55***
	4.61	4.86	4.48	4.90	4.33	4.86	4.19	4.46
Sum(sector empl. in center i / dist. to i)/1000	0.23	-0.28*	0.38*	-0.34**	0.40	-0.41***	0.35	-0.42***
	1.11	1.90	1.65	2.34	1.61	2.79	1.39	2.90
Constant	0.25	-18.31***	-8.34	-15.82***	-8.92**	-14.07***	-8.84**	-13.07***
	0.01	4.96	1.39	4.24	1.87	3.84	2.03	3.60
Rho	0.97		0.89***		0.82***		0.73***	
	-		17.87		15.69		14.93	
Lambda		0.92***		0.80		0.72***		0.64***
		17.37		11.07		11.60		11.74
Spatial correlation correction	sem	sar	sem	sar	sem	sar	sem	sar
Weighting matrix	1/d	1/d	1/d	1/d	1/d	1/d	1/d	1/d
Observations	1883	1883	1883	1883	1883	1883	1883	1883
R-squared	0.23	0.23	0.24	0.23	0.25	0.24	0.26	0.25
Adjusted R-squared	0.23	0.22	0.24	0.23	0.25	0.24	0.25	0.24

t-stats below coefficients

Significant at: *** 99%, ** 95%, * 90%.

Table 10b: Estimations - services

	All neighbors		500 closest		200 closest		100 closest	
Context								
Coast	4.18***	4.51***	3.73**	4.62***	3.59**	4.41***	3.54***	4.36***
	2.67	2.90	2.39	2.96	2.28	2.84	2.23	2.82
Northern border	14.86***	12.68***	15.87***	12.30***	15.60***	12.83***	15.59***	13.96***
	3.66	3.11	3.94	3.00	3.87	3.14	3.86	3.44
Altiplano dummy	-0.59	-0.03	-0.33	0.02	-0.29	0.18	-0.22	0.24
	0.65	0.04	0.36	0.02	0.30	0.21	0.23	0.29
St.dev. of altitude in meters	0.003	0.001	0.003	0.001	0.003	0.0003	0.003	-0.0003
	0.86	0.38	1.10	0.30	1.01	0.10	0.89	0.09
Own attributes								
Composition of agricultural output	2.15	1.947	2.21	1.727	2.06	1.647	1.73	1.799
	1.48	1.36	1.51	1.20	1.40	1.15	1.16	1.27
% adults with 9th grade or more	2.21***	2.24***	2.19***	2.26***	2.18***	2.22***	2.17***	2.17***
	12.24	12.79	12.16	12.87	12.07	12.66	11.91	12.44
% who speak indigenous language	-0.01	0.02**	-0.02*	0.03**	-0.02*	0.02**	-0.02*	0.02*
	0.82	2.18	1.80	2.36	1.77	2.10	1.67	1.91
1 if higher minimum wage group	-4.33	-6.67**	-2.85	-6.43**	-2.68	-6.71**	-2.72	-6.63**
	1.38	2.27	0.87	2.18	0.79	2.28	0.79	2.27
Initial employment in sector (thousands)	0.03	-0.24	0.08	-0.30	0.06	-0.23	0.07	-0.18
	0.07	0.56	0.19	0.70	0.13	0.55	0.15	0.42
Connectedness								
% of population served by state road	0.06***	0.05***	0.06***	0.05***	0.05***	0.05***	0.05***	0.05***
	5.10	4.67	4.84	4.55	4.63	4.68	4.51	4.70
% of population served by federal road	0.06***	0.07***	0.06***	0.06***	0.06***	0.06***	0.06***	0.06***
	5.94	6.42	5.76	6.30	5.67	6.27	5.61	6.34
Mean minutes to closest semi urban town	0.002	-0.001	0.003	-0.001	0.003	0.00003	0.004	0.001
	0.60	0.39	1.01	0.39	1.01	0.01	1.06	0.31
Proximity to centers								
1/Distance to closest center	268.68***	320.74***	251.78***	321.81***	254***	317***	255***	325***
	3.90	5.03	3.61	5.04	3.56	4.98	3.49	5.14
Initial sectoral empl. in closest center (thous.)	0.02*	0.02*	0.03*	0.02*	0.03*	0.02**	0.03*	0.02**
	1.82	1.68	1.94	1.78	1.87	1.97	1.77	2.17
*(1/Distance to closest center)	-1.12*	-1.11**	-1.20*	-1.02*	-1.08*	-0.90	-0.96	-0.98*
	1.85	2.01	1.95	1.83	1.72	1.63	1.51	1.78
Sum(sector empl. in center i / dist. to i)/1000	0.46***	0.17***	0.53***	0.13***	0.52***	0.10***	0.50***	0.08**
	8.86	4.55	9.12	3.49	8.32	2.66	7.45	2.15
Constant	298.49	-20.29***	1.88	-14.01***	-4.09	-11.42***	-3.12	-10.10***
	-	6.54	0.19	4.49	0.99	3.81	0.88	3.46
Rho	1.00		0.96***		0.87***		0.79***	
	-		24.69		23.57		21.47	
Lambda		0.91***		0.69***		0.60***		0.55***
		16.53		11.35		11.82		12.51
Spatial correlation correction	sem	sar	sem	sar	sem	sar	sem	sar
Weighting matrix	1/d	1/d	1/d	1/d	1/d	1/d	1/d	1/d
Observations	1883	1883	1883	1883	1883	1883	1883	1883
R-squared	0.43	0.41	0.44	0.41	0.45	0.41	0.45	0.42
Adjusted R-squared	0.43	0.41	0.44	0.40	0.44	0.41	0.44	0.41

t-stats below coefficients

Significant at: *** 99%, ** 95%, * 90%.

Table 11: Results for cross sectional OLS corrected for spatial dependence

	Manufacture		Services	
	Coef.	tstat CSD	Coef.	tstat CSD
Context				
Coast	-0.47	0.22	4.84***	8.96
Northern border	8.42	1.59	13.15***	8.10
Altiplano dummy	5.19***	3.88	-1.94*	1.73
St.dev. of altitude in meters	-0.01***	5.84	-0.00002	0.00
Own attributes				
Composition of agricultural output	4.83***	6.25	2.15***	2.91
% adults with 9th grade or more	0.53***	3.95	2.20***	6.65
% who speak indigenous language	0.07***	4.13	0.03***	2.22
1 if higher minimum wage group	5.11***	2.71	-8.04***	4.73
Initial employment in sector (thousands)	3.31***	3.21	-0.03	0.09
Connectedness				
% of population served by state road	0.10***	11.07	0.08***	5.89
% of population served by federal road	0.06***	6.41	0.07***	8.49
Mean minutes to closest semi urban town	-0.002	0.75	-0.004	1.36
Proximity to centers				
1/Distance to closest center	138.92***	3.27	319.04***	9.39
Initial sectoral empl. in closest center (thous.)	-0.003	0.35	0.02***	3.26
*(1/Distance to closest center)	5.73***	8.67	-0.65	1.05
Sum(sector empl. in center i / dist. to i)/1000	-0.28*	1.74	0.24**	2.29
Constant	-5.17**	2.48	1.81	0.90
Observations	1883		1883	
R-squared	0.19		0.37	
Adjusted R-squared	0.18		0.36	

tstat CSD comes from standard errors corrected for spatial dependence

Significant at: *** 99%, ** 95%, * 90%.

Table 12: Decomposition of variance
(with coefficients from SEM model for 100 closest neighbors)

Manufacture

	Own attributes	Connectedness	Prox. to center	Context	TOTAL	Direct	Indirect
Own attributes	0.08	0.00	0.00	-0.01	0.06	0.08	-0.01
Connectedness	0.00	0.13	0.07	0.04	0.24	0.13	0.11
Prox. to center	0.00	0.07	0.34	0.01	0.41	0.34	0.07
Context	-0.01	0.04	0.01	0.25	0.28	0.28	0.00

Services

	Own attributes	Connectedness	Prox. to center	Context	TOTAL	Direct	Indirect
Own attributes	0.22	0.06	0.08	-0.01	0.34	0.22	0.12
Connectedness	0.06	0.06	0.04	0.01	0.17	0.06	0.11
Prox. to center	0.08	0.04	0.37	-0.11	0.39	0.37	0.01
Context	-0.01	0.01	-0.11	0.22	0.11	0.11	0.00

Table 13: Decomposition of variance, multiple partitions of the sample
(with coefficients from SEM model for 100 closest neighbors)

		Own attributes		**Connectedness**		**Prox. to center**		**Context**	
	Obs	man.	ser.	man.	ser.	man.	ser.	man.	ser.
All municipalities	1883	0.06	0.34	0.24	0.17	0.41	0.39	0.28	0.11
Rural municipalities	877	0.01	0.30	0.29	0.22	0.28	0.27	0.42	0.21
Semi urban municipalities	1006	0.07	0.31	0.19	0.13	0.47	0.47	0.28	0.08
Closest center not in DF	1740	0.05	0.37	0.25	0.19	0.38	0.25	0.32	0.19
Closest center in DF	143	0.09	0.29	0.19	0.10	0.49	0.59	0.23	0.01
Closest center not in US border	1665	0.06	0.35	0.24	0.17	0.43	0.39	0.27	0.10
Closest center in US border	218	0.16	0.39	0.23	0.20	0.22	0.19	0.39	0.23

Table 14: Characteristics of rural municipalities where center and agriculture have a high contribution on employment growth

	High contribution to manufacturing				High contribution to services			
	(1)	(2)	(3)		(1)	(2)	(3)	
	Both	Center only	Ag. Only	Diff.[1]	Both	Center only	Ag. Only	Diff.[1]
Predicted employment expansion	4.57	22.6	7.69	***	13.4	28.7	17.3	***
Context								
Coast	0.06	0.01	0.14	***	0.02	0	0.11	***
Northern border	0.003	0	0		0	0	0	
Altiplano dummy	0.23	0.77	0.26	**	0.57	0.81	0.37	***
St.dev. of altitude in meters	245	138	230	**	198	164	223	***
Own attributes								
Composition of agricultural output	1.49	1.30	1.61	***	1.48	1.36	1.61	***
% adults with 9th grade or more	1.68	3.36	2.14	***	0.82	2.15	1.7	***
% who speak indigenous language	29.8	6.83	38.1	***	52.5	8.84	35.6	***
1 if higher minimum wage group	0	0.003	0.003		0.01	0	0.03	*^
Initial employment in manufacture (x1000)	0.13	0.33	0.15	**	0.09	0.35	0.13	***
Initial employment in services (x1000)	0.38	0.81	0.54	***	0.17	0.92	0.36	***
Connectedness								
% of population served by state road	15.3	55.4	14.4	**	7.53	56.5	20.1	***
% of population served by federal road	15.8	36.9	26.8	***	8.69	22.1	24.1	*
Mean minutes to closest semi urban town	272	144	296	**	275	160	272	**
Proximity to centers								
Distance to closest center	104	37.5	150	***	146	42	146	**
Initial manufact. empl. in closest center (x1000)	40.6	81.2	16.5	***	50.4	68.5	21.9	***
Initial services empl. in closest center (x1000)	112	156	90.8	***	126	139	93.0	***
Sum(manu. empl. in center i / dist. to i)/1000	6.76	12.7	4.71	***	6.23	12.8	4.54	***
Sum(serv. empl. in center i / dist. to i)/1000	18.6	34.1	13.1	***	17.2	34.5	12.5	***
Observations	317	294	294		377	234	234	

1: *** if the three numbers to the left are significantly different from one another at 95%,
** if column 1 is different from 2 and 2 is different from 3, but 3 is not different from 1,
*^ if column 2 and 3 are significantly different, but no other pair of columns is.
* if column 1 is different from 2 and from 3,
no stars if no significant difference is found.

Table 15: Estimations for municipalities faraway from a center

	Municipalities far from a center[1]				Municipalities near a center[1]			
	Manufacture		Services		Manufacture		Services	
	Coef.	t-stat	Coef.	tstat	Coef.	t-stat	Coef.	tstat
Context								
Coast	1.86	0.68	8.40***	3.52	-10.19***	2.52	-1.98	0.87
Northern border	3.44	0.52	13.31**	2.30	3.60	0.32	19.11***	3.18
Altiplano dummy	1.47	0.83	2.75	1.58	7.95***	3.63	-1.91*	1.65
St.dev. of altitude in meters	-0.002	0.44	0.005	0.95	-0.003	0.39	0.0001	0.04
Own attributes								
% adults with 9th grade or more	0.45	1.31	2.46***	7.41	0.71**	1.93	1.97***	9.07
% who speak indigenous language	0.07***	3.02	-0.01	0.34	0.02	0.52	-0.03	1.57
1 if higher minimum wage group	-1.34	0.25	-5.25	0.99	22.56***	2.61	-5.53	1.33
Initial employment in sector (thousands)	-13.20***	4.59	1.85	1.60	9.79***	5.77	0.13	0.28
Connectedness								
% of population served by federal road	0.05***	2.56	0.07***	3.71	0.051***	2.49	-0.02	0.43
Mean minutes to closest semi urban town	-0.004	0.75	-0.003	0.69	-0.02*	1.76	0.01	1.40
Proximity to centers								
1/Distance to closest center	-376	0.56	1215	0.61	100	1.36	282***	3.90
Initial sectoral empl. in closest center (thous.)	-0.11	1.40	0.07	0.85	0.09**	2.16	0.04**	2.24
*(1/Distance to closest center)	22.32*	1.87	-14.84	0.91	1.42	0.94	-1.14*	1.81
Sum(sector empl. in center i / dist. to i)/1000	-1.59***	2.65	0.14	0.52	0.24	0.82	0.58***	8.51
Agriculture and state roads								
Composition of agricultural output	-4.47	1.16	2.10	0.58	15.35***	2.87	-0.32	0.12
% of population served by state road	-0.11	1.16	-0.11	1.20	0.18*	1.67	0.06	1.14
*Composition of agricultural output	0.15**	2.29	0.12*	1.87	-0.11	1.45	0.05***	4.00
Constant	22.07***	2.70	-3.96	0.33	-22.73***	2.72	-2.54	0.53
Rho	0.66***	5.96	0.59***	5.11	0.91***	15.63	0.89***	23.84
Weighting matrix	1/d, 100 closest		1/d, 100 closest		1/d, 100 closest		1/d, 100 closest	
Observations	1083		699		800		1184	
R-squared	0.13		0.32		0.38		0.49	
Adjusted R-squared	0.12		0.31		0.37		0.49	

1: For manufacture, municipalities far from a center are the ones more than 100 km away from the closest center (150 km for services) and municipalities near a center are that have a center at 100 km or less (150 km for services).

Table 16: Decomposition of variance, municipalities faraway from center
(with coefficients from SEM model for 100 closest neighbors)

	Obs	Own attributes[1]	Connectedness2	Prox. to center	Context	Ag.& state roads[3]
Manufacturing						
Municipalities far from a center	1083	0.22	0.10	0.17	0.22	0.29
Municipalities near a center	800	0.22	0.10	0.29	0.35	0.03
Services						
Municipalities far from a center	699	0.61	0.19	0.00	0.11	0.10
Municipalities near a center	1184	0.27	0.03	0.51	0.12	0.06

1: Excludes composition of agricultural output.

2: Excludes % served by state roads.

3: Includes composition of agricultural output, % served by state roads and an interaction term.