SPATIAL PATTERNS AND DETERMINANTS OF INDUSTRIAL REGIONAL GROWTH IN MEXICO, 1993-2003: IMPLICATIONS FOR REGIONAL PLANNING AND PUBLIC POLICY

by

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For Melba, my wife, and Elisa Margarita and Jesús Alejandro, our babies.

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ABSTRACT

SPATIAL PATTERNS AND DETERMINANTS OF INDUSTRIAL REGIONAL GROWTH IN MEXICO, 1993-2003: IMPLICATIONS FOR REGIONAL PLANNING AND PUBLIC POLICY

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This research investigates industrial regional growth and its determinants in Mexico from 1993 to 2003. Strategies of local economic development, usually based on industrial promotion, require knowing main determinants of industrial regional growth. The case study shows that there is no variable with a systematically strong effect for all industries which policymakers and planners might directly control. This finding warns us about generic policy designs uncritically based on outcomes from other experiences. Although these results show a complex problem in terms of regional policy, some recommendations for industrial spatial distribution may, however, be derived from this study. For instance, during this period and on average, industries work in favor of

geographical dispersion of manufacturing. This geographical dispersion provides a unique opportunity to combine endogenous growth variables such as Jacobs economies with current macroeconomic spatial effects to design a policy of regional industrialization in Mexico. Additionally, the allocation of resources from oil exports under economic and non-economic criteria facilitates this process with no critical decisions in terms of the equity/efficiency dilemma. Results obtained may be influenced by the level of aggregation of the data and the events in the period of study such the economic crisis and recovering and the free trade liberalization policy.

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CHAPTER 1

INTRODUCTION

1.1 Problem statement (framework, research questions, purpose and primary hypothesis)

Regional growth in general and industrial growth, in particular, is unevenly distributed in space. In the long run, regional inequalities may increase (spatial divergence) or decline (spatial convergence). The two dominant regional growth approaches, the convergence model and the divergence model, do not present conclusive results on the long-run spatial process of economic concentration or deconcentration. The issue is open to academic debate and calls for empirical studies. The convergence (exogenous growth or neoclassical) model predicts that, if all its conditions are met (*i.e.*, full mobility of factors, constant returns of scale, and exogenous technology), industrial growth spreads out from more developed regions to less developed regions. On the other side, the divergence (endogenous growth and New Economic Geography, NEG) model states that, once the process initiates, it becomes self-sustained and cumulative. In the divergence model, both economic factors (*i.e.*, information and knowledge spillovers) and non-economic factors (*i.e.*, social capital) increase regional inequalities because they create a circular process of cumulative causation or snow ball effect. Neither of these two models presents clear-cut empirical results. Studies for Latin America in general, and Mexico in particular, conclude that the economic activity does not fit the theoretical postulates in the neoclassical model (Serra *et al*. 2006, Chiquiar 2005). On the endogenous growth side, results on externalities are not conclusive in France (Combes 2000), USA (Glaeser et al. 1992), China (Gao 2004), and Sweden (Gustavsson 2003). Briefly, the discussion between the two dominant regional growth theories continues and requires further empirical study.

This research is an inquiry into economic and institutional determinants of local industrial growth in Mexico. Guided by current theoretical debate on regional growth, the study looks at Mexico and the industrial growth of its states during NAFTA's first decade (1993-2003).[1] During this period the country went under important changes such as a deep economic crisis in 1995, a period of economic recovery, and the replacement of the long-standing political party in power (PRI) in the year 2000. In this social context, planners and policy makers face three sequential research questions for designing or reformulating industrial regional growth policies in Mexico: Where does industry locate? Where does industry grow? And what determines industrial regional growth? While answers to the first two questions *describe* the spatial pattern of

[1] Liberalization of trade is a process, not an overnight outcome. NAFTA (North America Free Trade Agreement, signed in late 1993) is an important event in the process of liberalization of trade but it is not the only one. On the Mexican side, among previous actions were the *marquiladora* program and other country-based policies lowering trade barriers such as tariffs and import-license requirements by mid-eighties. On the American and Canadian side, there was the Canada-United States Free Trade Agreement (CUSFTA), signed in 1988. According to the economic geographer Peter Dicken (1998, 102), next steps after NAFTA would be the custom union (common tariff operated), common market (free factor movements), and economic union (broad policies harmonized and subject to supranational control).

It is opportune to highlight that the purpose of this study is to examine industrial growth IN the first decade of NAFTA. This research is NOT a study of the spatial effects of free trade. This last objective would imply a study before and after NAFTA which is beyond the aim of this research.

industrial growth, the answer to the third one *explains* such a pattern. Hence, the study focuses on the third question to formulate the primary hypothesis in this research:

> H1: Unlike predictions in the exogenous growth model, regional characteristics such as dynamic externalities, institutions, and other local conditions matter for regional growth and regional competitiveness creating a local environment that evolves in a self-organizing and self-reinforcing way, as predicted by new spatial economics (endogenous growth models and NEG). Results of tests for this hypothesis are to explain the industrial growth spatial pattern in Mexico from 1993 to 2003.

This hypothesis is formulated in terms of the divergent model because, as explained in Chapter 3, it is more realistic in its assumptions than the convergence model.

1.2 Procedures

The answer to the three research questions may be accomplished in two steps. The first step answers the two descriptive questions: where does industry locate? And where does industry grow? The first step depicts the current picture of the geographic pattern of industrial regional growth in Mexico by applying and evaluating results of descriptive statistics. It also uses the spatial adaptation of the weighted mean to calculate shifts in the industrial gravity center; the "Barro regressions" to identify if small regions grow faster; and a rank mobility index to correct the possible effect of small economies growing faster than bigger ones.

The picture of the regional pattern of industrial production reflects the development strategy of industries located in a region (or a state), which in turn has a major impact on its growth rate. Once the industrial regional pattern is described, the next step is to explain it. Since there are many ways to accomplish this task, the primary hypothesis provides the guidelines to answer the question, What determines industrial regional growth? The second step in this research disentangles the primary hypothesis into specific and empirically testable subgroups of hypotheses. To this end, the study formulates and applies an endogenous growth model to explain industrial regional growth (dependent variables) in the context of dynamic externalities, institutional environment, and natural advantages and local market conditions (independent variables). Chapter 4 provides all details on descriptive procedures as well as on the model, its variables and indicators.

1.3 Findings (preview of results)

Results for the Mexican case study show that traditional industrial poles have maintained their dominant position since 1970 but the industrial dynamics of additional states from the northern periphery create a shift in the industrial gravity center to the north. The industrialization of the North does not imply the deindustrialization of the South or a loss of the industrial primacy of Mexico City. The analysis of the 1970-2004 period shows that all southern states had a low industrial participation in the whole period.

On the other hand, the analysis of spatial patterns of industrial growth shows that there is no direct connection between the initial level of industrial Gross State Product (GSP) and its growth rate: bigger economies do not grow slower nor smaller ones faster. So, what does explain growth rate? The research hypothesis, in contrast with the exogenous growth model, assumes that regional characteristics (dynamic externalities, institutional variables, and other regional conditions) matter to explain industrial regional growth. The empirical test of the primary hypothesis shows that inter-industry (*JACOBS*) economies rather than intra-industry (*MAR* and *PORTER*) externalities dominate in models explaining industrial regional growth in Mexico. This lack of robust econometric results for dynamic externalities is not exclusive for the Mexican case study. Studies for France, China, USA, and Sweden report similar weak importance of dynamic economies (Gao 2004, Gustavsson 2003, Glaeser et al. 1992, Combes 2000). On the other hand, the effect of social capital (*SK*) and other regional variables explaining industrial growth is selective (it is only significant for some industries) and contradictory (they may be positive or negative, depending on the industry of reference). Similarly, different groups of states (border states, oil-producer states, traditional industrial centers, and the rest of the country) matter for industrial growth in a different way.

Briefly, results partially provide support to the primary hypothesis and suggest that a one-size-fits-all policy is unlikely to be either desirable or viable for all industries and all places. The contradictory influence of variables and the differential importance of regions call for a selective spatial policy of industrial growth.

Two economic processes may be affecting the results obtained. On one hand, the period of study includes years of crisis (1994-1995) and recovery (1996-2003). On the other hand, the free trade policies since the mid-eighties shifted the industrial activity from traditional economic centers to the northern periphery. The spatial effect on industrial growth may be more asymmetrical and have less influence in periods of crisis/recovery and free trade that those assumed in hypotheses formulated for more stable environments.

Although the empirical analysis in this research shows that there is no variable which policymakers and planners might directly control, one recommendation for an industrial spatial distribution policy can, however, be derived: endogenous growth variables such as Jacobs economies and macroeconomic spatial effects (reported in Chapter 6 and Chapter 7, respectively) may be combined to design a policy of regional industrialization in Mexico. Jacobs externalities (a variable statistically significant for the aggregate industrial activity) create conditions for a cumulative and self-sustained process. If an industrial policy combines them with current spatial trends, industrial growth may be encouraged in a previously selected urban system. Additionally, the allocation of resources from oil exports under economic and non-economic criteria facilitates this process with no critical decisions in terms of the equity/efficiency dilemma.

Finally, the study formulates a hypothesis for future research: no other subsystems of Mexican cities will grow faster than those articulated by NAFTA corridors and, among them, those linked to the Lázaro Cárdenas-Kansas City Transportation Corridor. Data on the industrial growth of Mexican states located on this road network and the high activity at the Laredo port support this assumption.

1.4 Relevance

Why Mexico? There are at least three reasons to study the industrial regional growth in Mexico:

(a) There have been similar studies on recent industrial spatial changes in Europe (Brülhart 2000), Asia (Amiti 1998, Gao 2004) and Mexico (Krugman and Livas 1996, Hanson 1998) that demand further academic research.

(b) In spite of the common administration, common institutions and free mobility of goods and factors within the country, Mexico is a mosaic of diverse economic, social and cultural characteristics that perfectly fit to the economic and institutional variables in the convergence model.

(c) Mexico provides an empirical laboratory to adapt current models for developed countries and test their hypotheses using traditional and new econometric techniques. The methodology proposed for the case study is robust, easy to interpret and could be applied to other contexts.

(d) Industrial regional growth in Mexico is a topic of interest by itself. It may be an indicative guidance for private and public sectors investments or provide a basis for public/private collaboration in Mexican regional development.

1.5 Unit of analysis

The concept of a “region” is difficult to operationalize. Economic, geographic, or political notions of region are common in literature, depending on the objective of the analysis. This research considers Mexican states as “planning regions” that correspond to units of political or administrative control (Richardson 1979, in Dawkins 2003, 134). For this reason, in the remaining of this study regions and states are used as interchangeable terms. However, the definition of a planning region as a political or administrative state presents advantages and disadvantages.

Advantages: While finer levels of geographical analysis, such as the metropolitan statistical area (MSA) exist, seven reasons precluded the consideration of any definition of region other than Mexican states. First, although states have boundaries that are politically determined, such political boundaries have implications for economic activity—tax rates, labor laws, and other traits are set at the state level. Second, Mexican states are more institutionally homogeneous than a diverse sample of municipalities within them (*i.e.*, those constituting a metropolitan area). Third, there is a relative abundance of data at state level. Detailed socio-economic and institutional data on traits that might affect industrial location choice often are not available at a more disaggregated level than the state. States are the best option to undertake regional comparative analyses because they provide "a consistent data set that measures economic growth, aggregate and by sector, for a reasonable set of regions and comparable national data" (Lever 1999, 1035). Fourth, since state borders are more or less political and politics are likely to shape economic borders to some extent, the analysis focuses on use of the statewide data to study the implications of regional growth theory. Fifth, due to the previous four reasons, most industrial location choice studies for the developed and underdeveloped countries also use a state level of analysis; thus, this research follows suit in making the various studies comparable. Sixth, in Mexico, the state is the most effective political unit with decision making power to influence federal policies or to design economic policy at the regional and local level. For this reason, results in this research may be useful for policy makers assessing economic policies at the state level from the federal or regional viewpoint.

Some researchers consider that metropolitan areas may be a better choice to study regional competitiveness because they are the basis of most regional economies. This option is discarded in this research because there are no metropolitan governments in Mexico, boundaries of metropolitan areas often change, and data have to be reconstructed back to the beginning of a study period (INEGI 2006, CONAPO on line, Sobrino 1993, Salazar y Negrete 1986). Finally, the use of state data has the advantage of capturing most economic spillovers across municipalities or metropolitan areas within a state (Partridge and Rickman 1999, 320).

Disadvantages. There are a number of problems that blur the results when data on Mexican two-digit industries are classified by states. Krugman (1991, 57) identified some of them in a similar study: First, some important data are missing because of information confidentiality. Second, the highly aggregated definition of some industries loses meaning when they represent both relatively modest and high-performance activities. Third, states might bias industry comparisons because they are very unequal in area, population, and production. Finally, the state is an administrative and not always an economic region.

The first disadvantage (missing data for confidentiality reasons) is not serious for the two-digit aggregation in Mexican states. The second limitation (losing meaning because of high aggregation of data) requires disaggregations and reaggregations of data with confidential information to make comparison meaningful. These tasks are only possible when there is a specific and special condition to get the appropriate information. Third, the bias problem may be partially corrected by weighting the statistical indicators. Finally, the drawback of using the state as the unit of analysis may be solved by introducing some "border effects."[2] It is possible to control for border effects "by using the spatially lagged dependent variable that allows externalities originated in a particular location to spill over onto other regions" (Pagnini 2003, 2).

1.6 Database

Most information comes from *Instituto Nacional de Geografía e Informática* (INEGI). The main database includes variables at the state level such as Gross State Product (GSP), infrastructure, and education, reported at INEGI's website (http://www.inegi.gob.mx/inegi/default.asp) and Mexico's *Statistical Yearbook* for different years scanned by the Economic Growth Center at Yale University (http://ssrs.yale.edu/egcdl/mxdl/index.jsp).

1.7 Period length

The choice of a decade as the time interval to study growth rate is partially due to the data available. However, some authors like Ó hUallacháin (1992, 53), in a study for US metropolitan areas, consider that a "nine year period is long enough to capture real structural change." Similarly, a recent empirical test shows that the time pattern of externality effects on growth can be represented by a bell-shape curve, reaching its *maximum* around a ten year period (Lamorgese 1998, 20).

Economic cycle literature supports this statement. Burns (1987) describes the three well known cycles in economic literature: Kondratieff, Juglar, and Kitchin cycles

[2] Border effects manifest when geographical units are defined according to some administrative needs and not according to some meaningful economic criteria.

that are fifty, nine, and three-years long, respectively.[3] Economic cycle scholars say that in a Juglar cycle, most citizens are affected by economic variations (changes in occupations, prices, income distribution). On the other side, the Kitchin cycle is too short; its peaks and troughs are only detected by statistical analysis. Finally, the fifty-year Kondratieff cycle can be referred to only by historians or long-wave theorists (Cardoso and Brignoli 1977, 226-28). Hence, the choice of a ten year interval seems to find some justification in the Juglar cycle. A 10 year period is long enough to register relevant variations in production, prices, employment, personal income, and many other aspects of economic life.

However, because of the possibility of disturbing influences on hypotheses formulated for stable environments, the research also includes the short run (1993-1998) analysis. Such influences may include technical characteristics of the industrial process of production in specific industries, technological alterations of the life cycle product, economic crisis, or spatial effect of the free trade macroeconomic policy.

1.8 Organization of the study

This research is organized in eight chapters. Chapter 1 is the introduction. It provides an overview of the study. It states the research problem in terms of unsolved discussion on the spatial evolution of economic activities in the convergence and divergence models, the two dominant approaches to regional growth. These models leave the topic open to debate, and call for empirical studies. The chapter explains the

[3] Maddison (1982) clarifies some confusion about length in these cycles and presents main findings from long-wave analysts after Kondratieff (Kuznetz and Schumpeter, and the “revitalists” Rostow and Mandel).

relevance of the case study and presents main steps to solve the research problem. Finally, the chapter concludes with an outline of the subsequent chapters and their contribution to the whole research.

Chapter 2 introduces industrial regional policy as a sectoral public policy ultimately justified by reasons of efficiency, equity, macroeconomic stability, or non economic factors. Considering that the industrial regional policy is at the core of most regional growth strategies, this chapter identifies the main strategies and instruments of regional intervention in four consecutive waves of local economic development.

Chapter 3 reviews current regional growth literature and selects the divergence model because its assumptions are closer to reality than those in the neoclassical model and its variables may be manipulated for policy making. The chapter considers that industrial regional growth is unevenly distributed in space and, once the process initiates, it becomes self-sustained and cumulative. The chapter focuses on the new spatial economics, including endogenous growth and new economic geography, and suggests that variables representing dynamic externalities and institutional factors better explain regional growth. The chapter stresses the relevance of these determinants because policy makers and planners need to identify controllable variables to guide regional growth.

Chapter 4 presents three research questions and the required primary hypothesis to identify, organize, and carefully define variables that may be evaluated and potentially used in regional growth policies. The chapter also includes the methodology in two parts to test the major hypothesis. The first part presents the statistical procedures required to measure the spatial patterns of regional growth from 1993 to 2003. The second part presents a stylized GSP (Gross State Product) growth model that illustrates the mechanism determining industrial regional growth. The model is a *quasi-function of production*[4] that explains regional growth (dependent variable). Explicative variables are grouped in three vectors: dynamic externalities (MAR, Porter, and Jacobs economies), institutional environment (*i.e.*, social capital, income inequality, government performance), and natural advantages and local market conditions (*i.e.*, infrastructure, FDI, market accessibility). The chapter concludes with a diagram that shows the logical relationships between variables and indicators in the model.

Chapter 5 answers the first two research questions to introduce the case study: in what states does industry locate? In what states does industry grow? Answers to these questions identify the spatial pattern of industrial regional growth. The chapter provides a regional taxonomy of industrial growth and highlights those states located on free trade transportation corridors.

Chapter 6 applies the model introduced in Chapter 4 to answer the question what determines industrial regional? This chapter, in order to apply the model, evaluates alternative indicators for each (dependent and independent) variable before selecting the final set. Then, the section carries out data analysis and discusses results and interpretations of the model. The chapter concludes remarking main findings and their policy implications.

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[4] The expression comes from Kowalski and Schaffer (2002, 429) to refer a function of production similar to the one used in this research.

Chapter 7 reviews and integrates results from all previous chapters into an industrial regional policy that combines the spatial effects of the current macroeconomic policy, endogenous growth factors and resources from oil exports. The chapter examines results of the regression analysis in Chapter 6 to find support to the primary hypothesis and confronts results with findings in other empirical studies. Then, the chapter suggests an urban strategy of regional industrialization consistent and complementary to the macroeconomic policy. The chapter concludes by making the case for a process of regional industrialization in Mexico with no critical decisions in terms of the equity/efficiency dilemma.

Chapter 8 presents concluding remarks. It summarizes main ideas in all previous chapters and evaluates major findings indicating their value for policy analysis and implications for policy design. It also highlights theoretical assumptions confirmed or questioned and reviews which variables, if any, may be considered for in regional planning and public policy. The chapter presents constraints of the study and contributions for current and future research. It concludes highlighting the importance of performing this kind of research to enhance decision making in regional planning at state level and suggests a future research agenda.

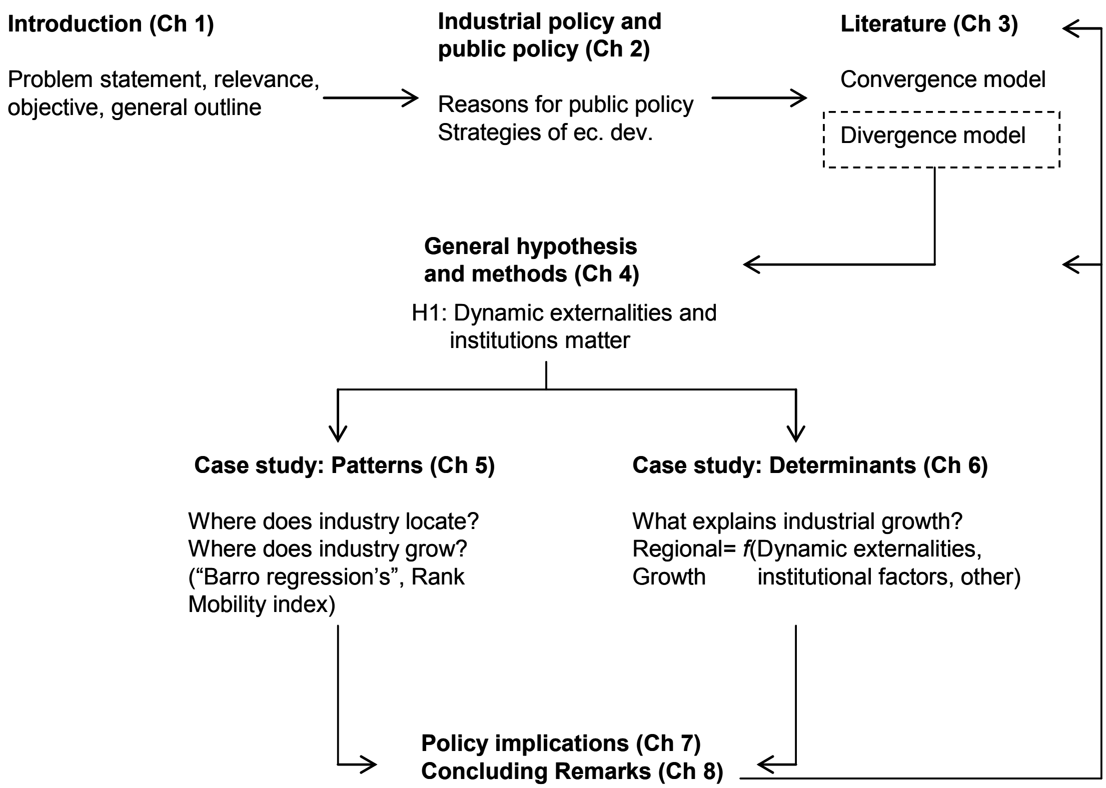

Figure 1.1 Research Scheme

CHAPTER 2

INDUSTRIAL REGIONAL POLICY AS PUBLIC POLICY

This research investigates industrial regional growth and its determinants in Mexico from 1993 to 2003. Since results in this research may be integrated into an industrial regional policy, it is opportune to clearly define industrial policy, recall main reasons for public intervention and review main strategies and instruments of economic development. To this end, the chapter has four sections. The first and second sections introduce industrial regional policy as a sectoral public policy ultimately justified by reasons of efficiency, equity, macroeconomic stability, or non economic factors. Considering that the industrial regional policy is at the core of most regional growth strategies, the third section identifies the main strategies and instruments of regional intervention in four consecutive waves of local economic development. Finally, the last chapter presents the chapter remarks.

2.1 Industrial policy and public policy

Industrial policy and public policy are complementary terms. Regional policy usually is a reactive, rather than preventive, state action to reduce social and economic inequalities among regions. To accomplish this objective, the state uses different economic (sectoral) policies and, among them, the industrial policy. The main reason is that industry has less local ties than other economic activities such as agriculture, mining or services. Industrial policy has several meanings. While in some countries it is a mechanism of local economic development, in other countries is a macroeconomic instrument to generate national wealth. After reviewing several definitions of public policy, Jovanović (2001, 146) concludes:

> Industrial policy is an economic policy that shapes a country's comparative advantage. Its objective is to influence the change in national economic structure (reallocation of resources among sectors, industries, professions and regions) in order to enhance the creation and growth of national wealth [efficiency criteria], rather than to distribute it [equity criteria]. (Own square brackets)

Since many people would question the neglected issue of equity in previous definition of industrial policy, the next section reviews main reasons for public intervention in regional issues.

2.2 Reasons for regional intervention

The reasons for a regional industrial policy may be economic as well as non-economic. There are three main economic reasons that justify the intervention of government in regional matters: efficiency (market failure), equity, and macroeconomic stability (Pack 2002, Jovanović 2005, Raimondo 2001). The market fails when any of the following four conditions of *efficiency* is not met: exclusion and rival consumption (you pay for what you get and nobody else can consume it once you get it), perfect competence (the producer is "price taker" rather than a "price setter"), information symmetry (low cost of "shopping around"), and complete markets (there is a market if the cost of production is lower than the buyer wills to pay).

> The most obvious regional market failures would include the failure of capital to move to opportunities that increase returns or labor immobility that perpetuates high localized unemployment or poverty rates. One source of such failures might be inadequate information about alternatives. Externalities, both positive

> and negative, might also cause or result from market forces and result in too much or too little interregional mobility. (Pack 2002, 172)

When the market fails, the regional policy tries to restore efficiency through the reallocation of resources (allocation function).

Equity is the second reason justifying the existence of regional policy. Government acts to meet value-based standards established by the political process, such as a fair distribution of income and goods/services among people in different regions (provision of basic needs: adequate supply of affordable housing, minimum diet, or equal access to education and health). In the case of a technological revolution and/or free trade policy some firms relocate creating a loss of firms and population in the area as a result of two forces. First, lag regions tend to specialize in low skilled labor intensive processes. And second, as free trade expands the market size, firms take advantage of urban economies of scale (externalities). While areas taking advantage of the market expansion experience high growth rates, those specialized in low skill labor processes tend to fall behind the rest of the nation (Jovanović 2005, 620). These two processes create spatial imbalances that require instruments of interregional compensation because "the resulting relocations of population and industry may yield net benefits for the entire nation, but the persons in the areas losing population may be worse off" (Pack 2002, 175). Criteria of equity in regional policy seek to change market outcomes (redistribution function). Policies working on the equity side include policies of social stability such as regional transferences of funds from the higher-income to lower income areas, provision of basic health services or programs of education and training in depressed areas.

Macroeconomic stability. Government acts in the private market because no group or individual, as a buyer or seller, facilitates the trade between consumers and producers or insures full employment of human and physical resources, control inflation and stimulates economic growth. If left to the free market forces, sometimes the outcome works against these forces.

> [Regarding the stabilization (macroeconomic) policy], regional differences in rates of unemployment may reduce the opportunities to control inflation and introduce a stabilisation policy. The reduction of inflation in some regions may increase unemployment in others. This may not always be the desired outcome. Diversified regions with a variety of employment opportunities will be able to adjust in a less painful way than specialised regions with entrenched market rigidities. (Jovanović 2005, 621)

All these three economic reasons correspond to different functions of government at different territorial levels (Table 2.1 and Table 2.2). While efficiency relates to the question of what to produce and how to produce, equity is concerned with how to distribute the outcome. Efficiency refers to the allocation function of government shared with regional and local levels of government. Equity directly relates to the central government distribution function supported by regional governments. Finally, the macroeconomic policy only concerns itself with the national government.

There also are non-economic reasons justifying regional public intervention such as those based on political or social grounds. As an example, a labor union, based on purely political criteria, may push the national government to locate an oil-refinery plant in a specific area. In situations like this one, "the question is whether the inefficiency is understood and whether the magnitude of the trade-off is acceptable" (Jovanović 2005, 621).

Any element of public policy reviewed in the next lines may ultimately be addressed to any of these reasons for governmental intervention (efficiency, equity, macroeconomic stability, and non economic factors). At the same time, these economic and non-economic criteria guide public policy at the industrial and regional level.

Table 2.1 Reasons for Public Intervention

Idealized Private Market	**Forms of Market Failure**	**Public Sector Function and Sample Responses**
EFFICIENCY based on: ⇒	Market Inefficiency Caused by: ⇒	ALLOCATION FUNCTION
▪ Perfect Competition	▪ Failure of Competition	▪ Legal action against firms
▪ Information	▪ Costly or Misleading Information	▪ Truth in Advertising
▪ Complete Markets	▪ Incomplete or Non-existence of Markets	▪ Subsidized loans
▪ Exclusion Principle & Rival Consumption	▪ Public Goods and Spillovers	▪ Public Provision/Subsidy of Good/Service
EQUITY. Distribution based on: ⇒	Unacceptable Market Results: ⇒	REDISTRIBUTION FUNCTION
▪ Each individual's contribution to the production process	▪ To conform to an agreed upon fair or equitable distribution of goods/services or income	▪ Food Stamps ▪ Subsidize Rents ▪ Subsidize Medical Care
STABILIZATON based on: ⇒	Instability in the Macroeconomy: ⇒	STABILIZATION FUNCTION
▪ Efficient markets always adjust to avoid inflation and recession	▪ Using tax and expenditure policies to maintain full employment, stabilize prices, achieve a favorable balance of trade, and assure economic growth	▪ Change taxes and Expenditure Levels (*e.g.*, cut personal income taxes)

Source: After Raimondo (1991).

Table 2.2 Responsibility for Public Sector Activities

Public Sector Activity	**Level of Government**	
	Centralized (federal)	**Decentralized (state and local)**
Allocation	—Shared—	
How resources will be used and what goods and services will be produced?		
Distribution	Primary	Administrative assistance
How income will be distributed?		
Stabilization	Primary	None
How to use fiscal and monetary policy to improve the economy, at stable prices?		

Source: After Stevens (1993) and Raimondo (1991).

2.3 Strategies and instruments of regional intervention

All numerous policy instruments existing to enhance the local business environment and foster industrial regional growth may be part of any of the four main waves of local economic development (LED) identified by current literature. The purposes of LED, although they have changed through time, are to combine public, business and non-governmental sector resources to enhance community competitiveness, retain jobs and improve incomes.

First wave (before 1980) (Traditional approach or "smokestack chasing"). The first wave of LED policy considered that growth requires inward capital investment to develop local resources, utilize local labor, and create sales to non-local markets. The main focus was on industrial recruitment from high-cost to low-cost regions promising cheap labor, a friendly business milieu, and lax regulations (Glasmeier 2000, 561). Main promoting actors were local business organizations, such as Chambers of Commerce and real estate interests. The role of government was to provide infrastructure, especially residential, and to maintain a favorable local "business climate" by keeping taxes low. Incentives for the attraction of new firms could include various property tax abatements. In the USA (and from here to the rest of the world), in the late 1970s with relocation of jobs from the Northeast and Midwest to Silicon Valley and Route 128, LED officials began to recognize that business attraction required a new set of strategies (Glasmeier 2000, 561).

Second wave (1980s to mid 1990s, "entrepreneurial approach"). The second wave focused on the attraction, retention and growth of specific sectors or geographic areas combining supply and demand side elements. The supply-side focused on reducing the cost of doing business providing investments in infrastructure, technology transfer between public institutions (*i.e.*, government laboratories and universities) and cash grants or tax abatements (Clarke and Gaile 1992). The demand-side centered on how to create new markets for existing business by establishing export processing zones, export assistance programs and public procurement programs (Glasmeier 2000, 561). This wave has two main phases. The initial phase, covering the late 1970s and early 1980s, stimulated small business and technology-based firms to create new jobs. States became directly involved in the creation of firms that were presumed to pay off in new jobs and wealth creation. Results of the local entrepreneurial approach (also known as 'local industrial policy) by late the 1980s were disappointing and local economic developers sought new alternatives.

Third wave (mid 1990s to 2000, "public/private partnership"). In the USA, following previous New Public Management experiences in New Zealand, England, and

Australia, it was the time of Reinventing Government and the National Public Performance Review. Government acted as a broker leaving the private sector to provide development services. Programs were rigid and promoted the one-size-fits all solutions. They missed the point that the short-lived political cycles require immediate payoff through market-based solutions. In the early 1990s a close examination of expenditures for LED programs showed that they still reflected a bias toward industrial attraction (first wave) (Eisinger 1995). It seems that in the last half of the 1990s, political survival strategies resurrected first wave thinking. But this time the targets often were foreign companies. However, recent studies show that incentive packages are irrelevant for companies choosing two similar locations. Winners are winners and losers are losers, regardless of tax incentives.

The third wave sought the creation of new local enterprises through the active participation of local governments in partnership with the private sector. This partnership mode moved away from simple tax incentives (Bartik 1995, Fisher and Peters 1998).

Since the nineties are relevant in my period of study, it is opportune to illustrate the third wave with three examples from Mexico: the privatization of highways, the banking system, and Telmex (the formerly state owned phone company). The governmental rescue of privatized highways and of the banking system in Mexico illustrates the risk of the privatization strategy in particular, and the careless transplant of experiences from other countries in general. In the case of highways, the government had to rescue the private companies that were in technical bankruptcy by absorbing a large proportion of the original cost of construction. Regarding the banking system, the government rescue "was 22 times more costly than that of the toll road system, for it has involved in 1998 almost US$ 67 billion, which includes the original non-performing loans, plus interests." (Garza 1999, 168). Finally, the privatization of Telmex fits the usual criticism of New Public Management: privatization often meant transfer of a public monopoly to private monopoly without due returns to the state (Noordhoek and Saner 2005).

Fourth wave (since the year 2000, "clusters and local milieu"). There is a recent switch from the sectoral approach to the economic context. The recent strategy suggests building new institutional relationships and social networks to create an entrepreneurial environment. An emerging idea is to encourage non-market forms supporting industrial clusters. The main argument is that because of localization and urbanization economies the economic activity tends to be sectorally concentrated and spatially clustered (Glasmeier 2000, 564 and 565) . Current literature calls for a careful evaluation of environments targeted for industrial clusters:

> Cluster/complex models of development only apply to locations where a substantial accumulation of diverse economic activity already exists. . . . We may wish cluster development to be, but it only occurs where there are sufficient levels of economic activity to support the creation of new markets and to warrant the formation of industrial linkages. (Glasmeier 2000, 567)

Kresl and Fry (2005, 198) recommend similar caution: industrial clusters should be considered only *after* careful consultation with entrepreneurs of firms operating in the local sector.

Most industrial regional policies embedded in all four LED strategies are based on the criteria of economic efficiency. For this reason, some critics argue that regions and cities, when promoting LED policies, do not compete to meet human needs, but rather to maximize the investment returns of the local elites (Logan and Molotch 1987, 42). The rhetoric of regional economic development, however, usually appeals to social equity arguments such as reducing poverty and uneven development and creation of jobs. The naked truth is that "these policies are not designed to reconcile problems of deep poverty and economic abandonment." (Glasmeier 2000, 568).

2.4 Chapter remarks

This chapter presents economic and non-economic reason for an industrial regional policy. While economic reasons refer to efficiency, equity, and macroeconomic stabilization, non-economic factors include decisions based on cultural, political or social grounds. Since the industrial regional policy is at the core of local economic development strategies, this chapter reviews four main waves (Table 2.3): "smokestack chasing" (before 1980), "entrepreneurial approach" (from mid 1990s to 2000), "public/private partnership" (1980s to mid 1990s), and "clusters and local milieu" (since year 2000). Because this research covers the 1990s, the chapter illustrates some failures of the "entrepreneurial approach" for the Mexican case study. Most industrial regional policies in these four strategies are based on the criteria of economic efficiency.

Next chapter provides the theoretical bases for the main research questions and the primary hypothesis for the Mexican case study. The theoretical approach suggests that it is possible to design industrial regional policies in Mexico to improve efficiency with no critical decisions against regional equity. This issue is readdressed in Chapter 7 to present main results of the study and their policy implications in terms of the efficiency/equity dilemma.

Table 2.3 Main waves of Local Economic Development (LED)

Focus	**Tools**
Fist Wave. 1960s to early 1980s. Focus: attraction. Key actors: states only	
▪ Mobile manufacturing investment *attraction from outside* the area ▪ Big firm level *subsidies* ▪ Making *hard infrastructure* investments	▪ Large grants, tax breaks, subsidized loans for manufacturing investors ▪ Subsidized hard infrastructure investment ▪ Focus on lowering production costs through techniques such as recruitment of cheap labor
Second Wave. 1980s to mid 1990s. Focus: attraction, retention and growing of specific sectors/areas. Key actors: states driven	
▪ Retention and growing of *existing* local business ▪ Continued emphasis on inward investment attraction but usually more targeted to specific *sectors* or from certain *geographic areas*	▪ Direct payments to individual business ▪ Business incubators/workspace ▪ Technical advice, support and training for small-medium scale enterprises ▪ Business start-up support ▪ Hard and soft infrastructure investment
Third Wave. Mid-1990s to 2000. Focus: contracting out public services. Key actors: states, cities, private organizations (public sector-led, usually)	
▪ Public/private *partnerships* ▪ Leveraging private sector investments for public good ▪ Improving quality of life and security for communities and potential investors ▪ Highly *targeted inward* investment attraction, building on local area comparative advantage	▪ Integrated strategy providing a facilitative local business environment ▪ Stimulating local firm growth ▪ Cross-community networking and collaboration ▪ Developing collaborative business relationships ▪ Workforce development and soft infrastructure provision ▪ Supporting quality of life improvements ▪ Focus on service sector as well as manufacturing ▪ Initiating regional and locals economic development programs

Table 2.3 - continued

Fourth Wave. 2000 onwards (Focus: shift from sectors to the entire business *milieu*) (public sector-led, usually)	
▪ Making the *whole business environment* favorable ▪ "Soft" infrastructure investments (e.g., human resource development, knowledge sharing, regulatory rationalization)	▪ Facilitating economically-linked business *clusters* ▪ Encouraging firms producing intermediate goods for clustered final goods producers ▪ Building institutional and social networks

Source: After Swinburn (2006), Glasmeier (2000), and Blakely and Bradshaw (1999).

CHAPTER 3

THEORETICAL FRAMEWORK AND BASIC CONCEPTS

Economic growth does not take place everywhere at the same time and at the same rate. Once it occurs, it may take two directions: convergence with or divergence from the rest of the regions. There is disagreement in regional growth theories about the long-run spatial process. While some approaches suggest that the regional spatial evolution is *convergent* (neoclassical models), others say it is *divergent* (new spatial economics, NSE) or *episodic* (converge and diverge in different moments), depending of the needs of the capital (Marxist approaches) (Martin and Sunley 1998). Although these three approaches have a long tradition in regional science and economic geography they were absent in the research agenda of mainstream economics until early nineties. It is not that the spatial economics was uninteresting or that economists were unaware of the obvious spatial differences in the location and growth of economic activity. Schumpeter, Myrdal, and Arrow, for example, knew that innovations, economies of scale and learning-by-doing, respectively, had effects on the economy. These effects, however, did not fit into the assumptions of perfect competition and constant returns of scale of the dominant (neoclassic) theory. This omission in the main body of economic theory was not an obstacle for economists to respond to the pragmatic needs of regional policy (Nijkamp and Poot 1998).

Most regional policies come from the economic ideas of Albert Hirschman (trickle-down effects and backward and forward linkages), Gunnar Myrdal (cumulative causation and backwash effects) and François Perroux (growth poles), all of them developed in the 1950s. It was not until the 1980s that Romer (1986) and Lucas (1988) reintroduced the role of technology to emphasize knowledge spillovers (intellectual spillovers and human capital externalities). In these contributions "knowledge spillovers solved the technical problem in economic theory of reconciling increasing returns (which are generally needed to generate endogenous growth) with competitive markets" (Glaeser 2000). Once solved this contradiction, in early 1990s it was possible to introduce more realistic assumptions "such as increasing returns, production linkages (presence of intermediate goods and services), multiple equilibria (with centrifugal and centripetal forces) and imperfect competition" (Jovanović 2005, 608). The intellectual evolution in spatial economics simultaneously occurred with a revolution in computers. This revolution made possible to measure the "neighbor" or "spillover" effect using calculation-intensive indicators in complicated econometric models. Trevor Barnes, in his historical review of locational analysis, does not forget this point "Von Thünen handwrites and hand-calculates in his voluminous journals, Garrison [Brian Berry's mentor] has his students patch-wiring early computers, and Krugman goes everywhere with his laptop, 'a technology that lets me produce a paper—equations, simulations and all—in a hotel room over a weekend' [says Krugman]" (Barnes 2003, 91, square brackets added).

Both the convergence and divergence models dominate the empirics of current regional research. Next lines review these two models with especial emphasis on the divergence model that includes endogenous growth theory and the New Economic Geography (NEG). Since regional growth models are an umbrella of ideas, this research introduces possible spatial effects of free trade as an unifying research topic to set up hypotheses and select variables. Therefore, this literature review only includes those works that directly relate to the research questions.

In a separate section, considering their relevance in the divergent model, the chapter reviews and organizes diverse concepts of externalities to explain their role in regional growth. Next section reviews institutionalism, especially New Institutional Economics, which claims that actors, not only factors, also matter. Finally, the chapter introduces the convenience of isolating regional competitiveness as a component of regional growth to examine possible counterbalancing effects of dynamic and institutional variables on regional growth. The last section summarizes main ideas in this literature review.

3.1 Models of regional growth

This section reviews the two dominant regional growth theories and show that they leave free trade's spatial impact open to debate and call for empirical studies.

The convergence or neo-classical model assumes free trade, full mobility of factors of production, constant returns to scale, and exogenous information and knowledge spillovers. It asserts that growth spreads out from more developed regions to less developed regions. This process of diffusion of activities and factors of production continues until interregional trade equalizes factor prices in the regional system. Neoclassical equilibrium models predict a long-run convergence in regional growth and income in a self-correcting process. Borts and Stein (1964) and Williamson (1965) wrote the classical articles on long-run convergence. Recent "augmented" versions of the neoclassical model (*i.e.*, Barro 1991, Barro and Sala-i-Martin 1992, and Mankiw, Romer and Weil 1992), also known as "Barro regressions," state that regional per capita income growth rates are inversely related to the initial levels. The intellectual evolution of the neoclassical "rebirth" in early nineties was not smooth. Methodological problems were immediately detected and debated by Freedman (1992) and Quah (1993). Convergence theorists replied that convergence is conditional (hence *conditional* convergence rather than *absolute* convergence) on the structural characteristics of each economy, "such as societal preferences, technologies, rate of population growth and government policy" (Martin and Sunley 1998, 204). They also suggested that the regression models for these structural characteristics generate better results for similar economies (*i.e.*, OECD countries) or regions inside a country. Thus, the "revisited" version of the convergence model suggests that each region within a country has its own steady state; therefore, multiple equilibriums may exist in a regional economic system. These models usually report that human capital is the critical variable that slows speed of convergence. Recent adaptations of the neoclassical model include additional explicative variables to regional growth, such as infrastructure and population growth (Wang and Ge 2004), spatial dependence (Gezici and Hewings 2004) and structural change (Paci and Pigliaru 1997).

Free trade. Regarding trade liberalization, this model would sustain that "the peripheral regions and countries are expected to gain from trade liberalisation and integration in terms of an increased relocation of industries and trade. Ultimately, there would be a full equalisation in factor prices" (Jovanović 2005, 612-13). In other words, the convergence model assumes, if all its conditions are meet, a diffusion or relocalization of industries from current economic poles to the rest of the country.

The main problem with the *convergence* growth model is its unrealistic assumptions. It assumes perfect competition and exogenous technological progress. For this reason, it neglects factors that set the organizational and productive environment, such as sunk costs,[1] market imperfections (economies of scale or externalities), institutions or social and economic networks. With this omission, it neglects factors that hamper factor mobility and create increasing returns to scale such as the self-reinforcing "locked-in" effect created by agglomeration economies and/or path dependence. The key prediction in the neoclassical models that per capita growth rates inversely correlate with initial income levels seldom fit the observed pattern of economic growth. On the other hand, the liberal (non-interventionist) role of government is also unrealistic. Unrestricted market forces have unintended consequences not always acceptable to the society or to groups. Garret Hardin (1968) pointed out this problem in his famous essay *The Tragedy of the Commons*: "When each member of a community acts to maximize his or her short-term self-interest, the long-term consequence may be the destruction of values or purposes that the group held in common and did not, in fact, wish to destroy"

[1] Sunk costs "often cannot be used for other purposes than it was formed for and that it may become useless or even detrimental when the organization changes its activities" (Westlund 2006, 2).

(Gardner 1990, 97). Hence, even the *laissez-faire* governments may consider necessary government regulation. Any standard book of macroeconomics presents main reasons for government intervention: market failure (if conditions of perfect competition, information, complete markets, and exclusion and rival consumption are not met), equity, and macroeconomic stability (Raimondo 1991).

The divergence model places externalities (urban economies of scale[2]) at the core of its argument and assumes endogenous growth. The divergence model basically includes "endogenous growth theory" and the "new economic geography."[3] Endogenous growth models face an unsolved issue in neoclassical economics: how to deal with increasing returns. In endogenous growth theory,[4] human capital is not subject to the law of diminishing returns. It points out that investments in human capital create spillover effects or externalities that lead to the overall increase of productivity. In a similar way, technological change and innovations spread out form firm to firm through intermediate inputs increasing local growth as a consequence. Assuming technological change, innovation and human capital as endogenous variables, this model states that

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[2] Economies of scale may be internal or external to the firm. Urban economies of scale or *agglomeration economies* are external economies from which a firm can benefit from other firms located nearby.

[3] This research uses "new spatial economics" to refer to both "endogenous growth theory" and the "new economic geography"—or "geographical economics," as Fujita and Thisse (1996, 341) prefer—in the divergence model. None of these approaches should be confused with the "new urban economics" (NUE) of Edwin Mills and James MacKinnon (1973) and Harry Richardson's (1983). In the seventies, NUE searched for the optimal city based on the principle of utility maximizing in mono-centric cities employing linear-programming models.

[4] Indigenous and endogenous growth should not be confused. Endogenous growth, a term used by economists, addresses the key factors to growth (i.e., technology, human capital or externalities), as internal to the function of production rather than the regional economy. Indigenous growth, a term used by economic geographers, refers to localized policies aimed at stimulating local small-firm growth and technological innovation (Martin and Sunley 1998, 219).

countries and regions tend to diverge rather than converge. The reason is that sunk costs in fixed capital and R&D, learning by doing effects (*i.e.*, learning a computer program makes easier to learn or adjust to other software) and network and coordination effects (the more people use internet or mobile phones the greater is the utility of that to all network users) create local economies of scale. These externalities, in turn, unleash an increasingly circular process of cumulative causation or self-reinforcing snowball effect usually known as economies of scale or path dependency effects. On the other hand, the divergence model also includes the New Economic Geography (NEG) which maintains that regional inequality (divergence) persists because of factors such as agglomeration economies (Krugman 1991). NEG integrates unarticulated elements from economic geography (*i.e.*, Chauncy Harris' market potential and Alan Pred's cumulative process of growth in large scale economies) with those of increasing returns and imperfect markets in the new economic models (New Trade Theory and New Growth Theory). NEG dissents from endogenous growth models, the latter maintaining that dynamic externalities[5] are the *only* sources of uneven regional growth in the long-run (Glaeser *et al*. 1992, Henderson *et al*. 1995). Krugman (1991), for example, says that physical spillovers (rather than just knowledge or intellectual spillovers) also matter for regional growth. Input and output linkages among producers (Krugman and Venables 1995), or

[5] Dynamic externalities refer to knowledge spillovers of global or local knowledge transmitted through casual or formal communications that normally take some time (about seven years or more). The combination of dynamic externalities and institutional variables constitutes what Hartshorn (1992) would call "industrial development and urban growth," a third approach to regional development: (the other two approaches are the economic base theory and the growth pole theory). This speculation is based on the following conclusion: [after reviewing past authors, basically Leontief, Chenery, Perroux, Isard, Myrdal, Chinitz, Alonso, Berry, and Hirschman), an author concludes "what distinguishes present from past discussions of industrial clusters is the contemporary emphasis on non-market forms of interaction, including trust and non-traded interdependences." (Glasmeier 2000, 565)

high geographic labor mobility (Krugman 1991), generate pecuniary externalities creating a self-reinforcing process of agglomeration of production.[6] For instance, the presence of one firm lowers the transportation costs for a second. Others argue that empirical tests are not conclusive: while dynamic externalities are strong in a few cases, they are weak in a large number of industries (Ó'hUallachain and Satterthwaite 1992). On the other hand, some authors highlight the difficulty of isolating dynamic externalities effects from other location effects (Ellison and Glaeser 1997, Jaffe *et al.* 1993).

Free trade. New spatial economics (NEG specifically) expresses final results of free trade liberalization in relative terms: it disperses the industry as a whole but concentrates specific sectors. On one hand, there is possibility of deconcentration if forces of free trade imply industrial relocation from main industrial cores. It is important to note that both neoclassical and endogenous growth models suggest the possibility of industrial deconcentration under free trade, but under different rationales. In the neoclassical theory, industrial deconcentration is the result of a regional system with high factor mobility where the returns or prices will converge in the long-run as each region plays out its comparative advantage (Stough 1998, 2). In NEG centripetal forces (transport cost and increasing returns of scale) oppose centrifugal forces (exports and congestion costs such as high rent rates, pollution, and traffic congestion and daily trip delays). Based on numerical simulations, NEG suggest that free trade weakens

[6] Krugman (1991) borrows Scitovsky's (1954) term of "pecuniary externalities" to explain the agglomeration of workers and economic activities. Pecuniary externalities operate through the market connecting producers and consumers of intermediate and final products.

internal production linkages and firms have more incentive to relocate into the less congested periphery (Jovanović 2005, 632). However, there are centripetal forces (intra-industry linkages) operating for clusters of specific industries that overcome the centrifugal force of external markets and local congestion. Note that free trade in NEG disperses industry as a whole, regardless of market access concerns (De Robertis 2001, 353). In this sense, using the Mexican case of study to illustrate the dispersion forces of free trade is a very imperfect example due to the big US market influence, as recognized by Krugman and Livas (1996, 140). It is important to have in mind the imperfection of the Mexican case because otherwise it may be concluded that NEG unnecessarily uses complex simulations to predict dispersion under free trade. It may be argued that any local development practitioner may use the classical argument of markets access in old location theory to arrive to the same conclusion.[7] Discussing this point, a study concludes that the Italian case study confirms the NEG hypothesis not tested (or properly isolated) in the Mexican case: "Trade liberalization tends to shrink the industrial core, even if the periphery does not have better access to the foreign markets" (De Robertis 2001, 358). This study, however, did not find conclusive results on increasing regional specialization (concentration of specific industries), as suggested in

[7] Alfred Weber, the pioneer theorist of industrial location, identified two sets of location factors: primary or 'general' factors (transport costs and labor costs), and secondary or 'local' factors (agglomeration economies). His basic argument is that a firm would locate at the minimum transport cost point, once considered the weight characteristics of inputs and final product. He also considered that labor costs and agglomeration economies may offset the minimum transport cost location. Following these classic ideas in the context of free trade, a firm approaching the US market from the Mexican side (it can be a national or transnational company) would tend to locate in cities close to the US border. In this way all location factors work in the same direction rather than counterbalance each other: free trade facilitating the US market access, labor cost having no significant regional differences, and agglomeration forces operating in cities close to the border.

the NEG. For the purpose of this study, it is enough to consider that in a free trade period new spatial economics explains regional growth in terms of endogenous factors such as extra-market externalities (dynamic externalities). NEG in particular extends this idea and combines extra-market (specialization) and market externalities (pecuniary economies in the market of inputs) to explain regional growth.

Limits of endogenous growth theories. It is not certain that externalities alone are sufficient to induce increasing returns and sustained growth. There are a number of variables not included in the divergent model such as social values and networks, natural resources and market conditions. Critics emphasize that theories have not lent themselves to consistent and straightforward empirical testing. Additionally, endogenous growth models center on the supply-side of regional growth neglecting the possible effect of demand-side factors on regional employment and productivity trends. Some of the neglected demand-side factors ruled out are demand for exports and balance of payments constraints.

On the other hand, endogenous growth models assume close and self-contained regional economies, an unreal assumption nowadays.

Previous discussion leaves open the possibility that regional growth may occur because of the influence of natural advantages, local market factors or institutions that have nothing to do with knowledge and communication spillovers (dynamic externalities). As an example, “A sector located in a growing metropolitan area should grow faster than one in a declining city only because of the strong demand directed toward its product and not for reasons linked to technology improvement, diffusion or imitation" (Lamorgese 1998, note 8). For this reason, empirical tests in this study will include three vectors of variables: dynamic externalities (MAR, Porter, and Jacobs economies), institutional variables (*i.e*., social capital, income inequality, government performance) and other conditions (*i.e.*, infrastructure, FDI, market accessibility).

Reasons to choose the divergent model and its extensions for the case study. A basic regional policy task is to find out what region-specific factors explain regional growth and, among them, to figure out which ones could be controlled or manipulated as policy variables. Since the way the question is framed determines the answer (Skocpol 2004, 732), a necessary step is to identify the appropriate theoretical model. This is not an easy task because exogenous and endogenous factors are functionally inseparable. They are entwined and intermingled in regional economic systems. However, exogenous factors in the neoclassical model such as trade labor mobility and migration, knowledge or innovation diffusion, foreign exchange, business cycles and capital mobility are not substantially under the control of local efforts (Stough 2001, 17). Therefore, they do not permit identify variables for policy design. Endogenous growth theory, on the other hand, facilitates model building using as input a broad array of variables representing local forces that induce a significant part of economic growth. These variables include, for example, investments in hard infrastructure (roads, airports, water and waste systems) and soft infrastructure (institutions and and non-traditional economic factors such as education, learning, leadership, families, labor agreements, property rights, social capital and government action—*i.e.*, government spending and taxation) (Stough 1998, 2; Karlsson, Johansson and Stough 2001, 4 and 6; Marin and

Sunley 1998, 209). The divergent perspective contains the most important models (endogenous growth model and NEG) to identify variables that could be controlled at the regional level. The "endogenous" component in divergent models, unlike the neoclassical models, "implies that economic growth is influenced by the use of 'investment resources' generated by the economy itself" (Karlsson, Johansson and Stough 2001, 3). The possibility of manipulating local variables is very important for local politicians and planners because they "directly attempt to influence the rate of growth and the location of industry through mixes of tax incentives, land use regulations, and infrastructure provision policies" (Dawkins 2003, 146).

In current literature, there are some all-variable models mixing geography (weather, altitude, natural resources) and economics (static and dynamic localization and urbanization factors) (Gallup, Sachs, and Mellinger, 1999). The research for the Mexican case of study is clear on this aspect. Following the divergence model, the study considers that classical location factors (natural resources, transportation, markets) and static externalities (localization and urbanization economies) are important to initially set up activities. But dynamic externalities are the basis for a sustained regional growth. Once an economic activity agglomerates for whatever reason (*i.e.*, historical accident or accessibility to natural resources), it creates a path dependent self-reinforcing rather than self-correcting effect. It is necessary a technological revolution, a social disaster (internal revolution or an international war), or an extreme natural event (*i.e.*, earthquake, tsunami) to break up that inertia. Social processes that may break the self-sustained cumulative or snow-ball effect do not occur overnight. NAFTA (North

American Free Trade Agreement) and the European Union are the result of a long process of political or economic integration.

3.2 Note on externalities

Literature on the effect of proximity and links between firms continuously increases and with it the number of meanings for “externality”. The concept most connected to the “new spatial economics” approaches is that of externalities. Some of the most frequent terms in current literature are dynamic and static agglomeration economies, intra-market, quasi-market, extra-market externalities, communication externalities, information and knowledge spillovers, pecuniary and technological externalities, localization and urbanization economies, MAR, Porter, and Jacobs externalities. This section puts some order to these terms to delimitate the object of study and clearly identify research variables.

Basic concept. Laissez-fair economists (Friederich von Hayek and Milton Friedman) refer to externalities as “neighbor effect” or “spillovers.” Henry Sidgwick (1838-1900) introduced the idea of externality and Arthur C. Pigou (1877-1959) formalized its concept. An externality or spillover is a situation where an agent causes costs or benefits to other individuals or groups and no compensation is paid for benefits or costs created by his or her action. A textbook definition says that

> [. . . .] an externality is an unpriced interaction, and it can be positive or negative. A positive externality occurs when a person is not compensated for an action that benefits someone else. A negative externality occurs when a person does not pay for an action that imposes a cost on someone else. (O’Sullivan 2007, 166).

A positive externality is a "free lunch" such as the benefits a person gets from the view of her/his neighbor's beautiful garden, education in a community may decline its level of criminality and increase the level of civility. A negative externality would be the following case: "Suppose. . . .that the farmer's pesticide drifts onto neighboring properties and apparently kills other farmer's chickens" (Bosso 1987, 79). An example of both positive and negative externalities would be the US highway program approved in 1956:

> [T]he federal government's interstate highway program was designed to improve transportation and to serve domestic defense purposes. One effect of building highways, however, has been to make it easier for people to live in suburbs and work in the city. Consequently, these roads assisted in the flight to the suburbs of those who could afford to move. This, in turn, contributed to the decline of central cities, which created a need for the federal government to pour billions of dollars into urban renewal, Urban Development Action Grants, and a host of other programs for the cities. Although the inner cities would probably have declined somewhat without the federal highway program, the program certainly accelerated the process. (Peters 2004, 58)

What kind of externalities matter for economic growth? The very existence of agglomerations in space should tell us that proximity externalities (increasing returns of scale) exist (Krugman 1991, 5). So any study on regional economic growth calls for the study of externalities. The fuzzy idea of externalities, in turn, calls for clarity of definitions. Until early 1990's, it was hard to systematically express what externalities represent. For this reason, Johansson (1994) suggests distinguishing three aspects of externalities considering (i) *source*, (ii) *consequence*, and (iii) *economic nature*. These distinctions are illustrated in Figure 3.1. In this way one can avoid the contamination and eventual confusion when sources and consequences of an externality are mixed. Agglomeration means that firms can benefit from mutual proximity. Proximity is an externality *source* by affecting both transaction costs and by facilitating uncharged spillovers. Similar argument holds for link externalities.

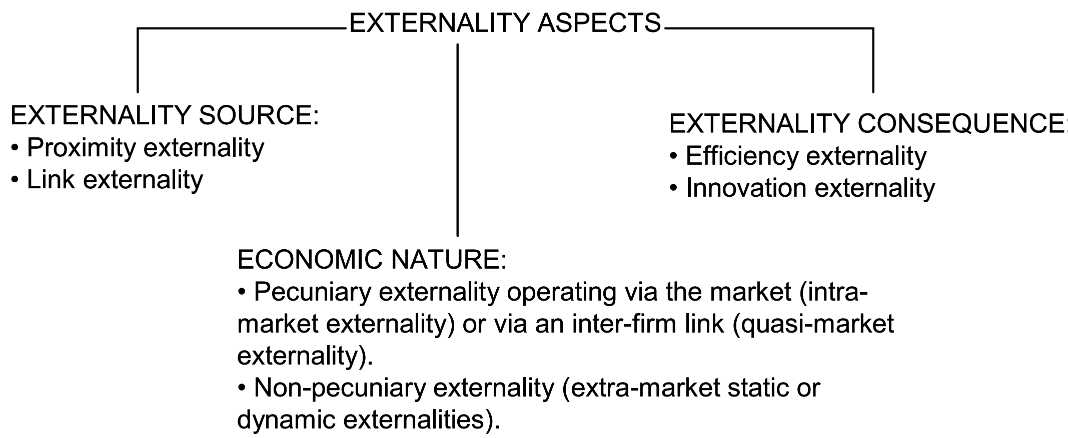

Figure 3.1 Sources, Consequences, and Economic Nature of an Externality

Source: After Johansson (2004)

An efficiency externality appears in the form of static differences between regions with regard to the productivity and the cost per unit output of a firm. An innovation externality is a dynamic phenomenon and appears as a change of economic efficiency (new routines) but also as a change of new products, increased product diversity and similar novelties. Both efficiency and innovation externalities are *consequences* of some economic process.

The *economic nature* of an externality manifests itself in two forms. In one form it operates via prices (pecuniary externality), and in the second it operates outside the market (non-pecuniary externality). In pecuniary externalities it is possible to identify both intra-market and quasi-market externalities. While intra-market externalities arise from ordinary market transactions, quasi-market externalities arise from transaction-links. In the case of *extra-market* externalities positive effects are free of charge and no compensation is given for negative effects. They arise via links, agreements, networks and other agreements of club type, and also information and knowledge spillovers (communication externalities).

On the other hand, in the framework of Scitovsky (1954), externalities are classified as either pecuniary or technological. The first category comprises externality phenomena that operate either via the market (price formation) or via a quasi-market (transaction links). In both these cases prices are influenced by the externality. The basic idea is that while pecuniary externalities arise through buying and selling in the market, technological externalities take place in ways other than through the market (Martin and Sunley 1996, 266). The non-pecuniary category involves external effects outside the market, which may be called extra-market externalities. This category *includes* information and knowledge spillovers, also termed technological or communication externalities (Fujita and Thisse 2002).

The distinctions between intra-market, quasi-market and extra-market externalities may involve ambiguities that should be removed. Essentially, the distinction is about how the externality is mediated. Since both intra-market and quasi-market externalities are mediated through the formation of market prices, they impact firm's transaction costs and productivity. On the other hand, extra-market externalities affect a firm's access to communication (information and knowledge spillovers). When communication spillovers are region specific they affect the relative costs and prices for the same commodity in a distinct way in each region.[8]

Intra-market, quasi-market and extra-market externalities (externality nature) are all influenced by proximity. Proximity would then be also essential for the emergence of links and networks (externality sources). Spillovers are assumed to be more intense inside than between regions. In this case one may also contemplate research districts and other concentrations (clusters) of creative interaction and economic efficiency (externality consequence).

Current literature notes that extra-market externalities may be static or dynamic (McDonald 1997, 340-341):

> Static agglomeration economies mean that the *level* of some agglomerative factor is associated with some *level* of industry output. For example, a larger urban area has better and cheaper air transportation. . . . [that] creates a one-time increase in. . . . [the agglomerative factor] and a one-time shift downward in the industry's cost curves. . . . In contrast, a dynamic agglomeration economy means that the *level* of the agglomerative factor is associated with an *increase* in industry output that *continues* through time. For example, a larger urban area has more inventive inventors, who in turn create a continuous stream of technical change that is larger than in smaller urban areas. The size of the urban area. . . . causes technology. . . . to increase continuously. . . .
> . . . .
> Dynamic agglomeration economies mean that the level of the agglomerative factor creates continuous reductions in costs for the industry.

[8] Henderson (2001, 251) notes that some knowledge accumulations are entirely local: "Localities accumulate a stock of local trade secrets that a firm only can learn in a reasonable period of time by joining the location, and which may or may not of use if a firm exits and takes that knowledge elsewhere." This trade secrets, the author continues, include "who to buy inputs from locally, how to deal with local regulators, perhaps who to bribe at what price, how to negotiate tax and regulatory breaks, what consultants to hire, etc., [all of them] are really location specific knowledge, that gets built up over time." (Henderson 2001, 251)

Dynamic externalities imply a lagged rather than just current scale effects: "there may be a testing period where others watch if the idea works out. So it is not today's scale of information flows, but last year's, the year before's, and so on that matters as information goes through a transmission and filtering process" (Henderson 2001, 251).

Taxonomies always are approximate because reality does always fit to models or classificatory boxes. Static externalities initially attracting firms interact with dynamic externalities creating stronger agglomeration economies, initiating, maintaining or increasing a self-sustained process. This interaction often makes both types of externalities impossible to differentiate for a period of time. The key characteristic in this classification is that static externalities have not implications for the long run unless continuous technological progress, specialized know-how, or inter-firm exchange interacts with them to generate regional effects over time (Gao 2004, 103).

It is important to remember that in industry location, although the concept goes back to Alfred Marshall (1842-1924), there is agreement to keep Hoover's (1937) classification to refer static externalities (McDonald 1997, 37-38): (1) *localization economies* that result from the firms in the same industry clustering or co-locating in the same area, and (2) *urbanization economies*, which result from the co-location of firms that belong to different types of industries. Since the external benefits from localization and urbanization economies tend to increase with the number and output of co-locating firms, they are usually referred to as *external scale economies* or *agglomeration economies*. Each static externality has an equivalent dynamic externality. As explained in next lines, while specialization economies (Marshall 1898-Arrow 1962-Romer 1986, MAR externalities) are dynamic externalities equivalent to localization economies, competition (Porter 1990, and Jacobs 1969) and diversification (Jacobs 1969) economies are dynamic externalities equivalent to urbanization economies.

This research focuses on extra-market externalities (externality nature) and how they contribute to the emergence of new combination of production factors in a regional context. More precisely, it investigates what role dynamic externalities, social capital and other institutional factors play in regional growth and what role policies can play in these processes. Since the interest in this research is regional *growth* rather than *level* of regional production, next section provides a detailed explanation on dynamic externalities and their equivalences with static externalities.

Dynamic externalities. Most leading scholars in "new spatial economics" agree that external economies arising from knowledge spillovers are critical to the productivity level or the rate of economic growth. At the heart of regional *growth* are dynamic agglomeration economies and, at the core of the later, the production and use of knowledge. This is not an absolute statement. On one hand, in the New Economic Geography (NEG), Krugman (1991) suggests that labor market and intermediate input markets are also important (McDonald 1997, 343). On the other hand, in the Neo-Institutional Economics (NIE), North (1991) claims endogenous growth models should also include institutional factors.

Regardless the length of the list of factors explaining dynamic externalities, scholars agree that external economies arising form knowledge are decisive for regional growth. But one thing is the concept of knowledge and other the idea on how to actually measure it. Because of its intangibility "the general idea of knowledge is too vague to generate hypotheses that can be tested" (McDonald 1997, 343). Current literature identifies three main theories providing more details on how spillovers work that may be suitable for empirical analysis (McDonald 1997, 344-347).

The first theory sustains that knowledge spillovers mainly occur *within* a local industry (*specialization* externalities or MAR economies, so called after Marshall 1898, Arrow 1962 and Romer 1986). The economic effect is similar to that of localization economies but with a mechanism for *continued* reductions in costs in a place. Main idea in MAR externalities is that an agglomeration of firms belonging to the *same* industry brings about improvements in existing products, and innovations in products and production processes. Main force behind these changes is the agglomeration of human capital (more skilled and highly trained people) focused on improvements within a particular industry. The argument is that highly trained people are more productive if they are around and new knowledge flows faster from one firm to another one if they are close. Briefly, in MAR externalities firm benefits from knowledge among other firms in the same industry, where local imperfect competition dominates. The two most common measures of MAR externalities are the logarithm of the initial level of Gross State Product of a specific industry *i* ($Ln\ GSP_{0i}$) (Mano and Otsuka 2000) and the well known Hoover-Balassa index of specialization (Glaeser *et al*. (1992).

The second theory centers on the effect of market structure on technical change (*competition* externalities). Two opposing viewpoints dominate this discussion: the first one sustains that imperfect markets (monopoly or oligopoly) foster technical change because only they can afford the costs of R&D. On the other hand, the second viewpoint argues that competitive industries generate technical change because the competitors are always seeking to gain a competitive edge. Endorsing the imperfect market viewpoint, Schumpeter (1947) and John Kenneth Galbraith (1956) believed that imperfect markets such as oligopoly or monopoly favor growth and foster innovation. MAR also shares this viewpoint. In contrast, both Jacobs (1969) and Porter (1990) believe that competition stimulates innovation. While Jacobs and Porter agree on market structure (monopoly favors technical change and diffusion of innovations) they disagree on the industrial regional composition. On one side, Porter believes that knowledge spillovers in *specialized* geographically concentrated industries enhance growth. In contrast, Jacobs thinks diversification stimulates innovations and facilitates their adoption. This disagreement leads to a third theory on knowledge spillovers.

Empirical literature usually assumes that competitive conditions that Porter suggests will prevail in regions with smaller firms than the national average. Therefore, local/national ratios measuring the number of small firms or the average local size of industries are common to see if local knowledge spillovers and productivity growth are higher than in the rest of the country.

The third theory stresses that knowledge spillovers take place *across* different industries and lines of work (*diversification* externalities). Jane Jacobs (1969) contends that diversity of industries rather than specialization stimulates innovations. She added that firm benefits from historical diversity if there exists local competition. Regarding measurement of diversity, there is a long empirical tradition in regional analysis to measure industrial regional diversification including the Hirschman-Herfindahl index (*HHI*) and the Gini index (several alternative indices to measure diversification are explained in detail in section 4.2.2.2 in Chapter 4).

Summarizing. Regarding market conditions, while MAR favors monopoly, Porter defends competence as a condition for regional growth. However, both agree that specialization fosters regional growth. On the other hand, while Porter favors specialization, Jacobs endorses diversification. However, both Porter and Jacobs agree that competence encourages regional growth (Table 3.1, Table 3.2, and Figure 3.2).

These three types of externalities (specialization, competition and diversification) reduce production costs such as costs of inventory management, costs of risk and uncertainty, or costs of searching for inputs. On the other side, there are diseconomies associated with economic concentration counterbalancing such as traffic congestion costs and daily trips delays or higher price of land. Firms continue concentrating in certain areas if benefits of concentration offset the negative effect agglomeration.

Table 3.1 Types of Externalities

	Internal to the Firm	External to the Firm		
Variable in terms of:		Internal to the industry	External to the industry	
Level	Internal Economies	Localization Economies	Urbanization Economies	Static Externalities
Growth Rate	Internal Economies	MAR	Porter Jacobs	Dynamic Externalities

Table 3.2 Source of Externality and Type of Market

Source of externality	Type of market	
	High competition	Low competition
Intra-industry (Specialization)	Porter externalities Porter (1990)	MAR externalities Marshall (1890) Arrow (1962) Romer (1986, 1990)
Inter-industry (Diversity)	Jacobs externalities Jacobs (1969)	—

Source: After Lucio, Herce, and Goicolea (2002).

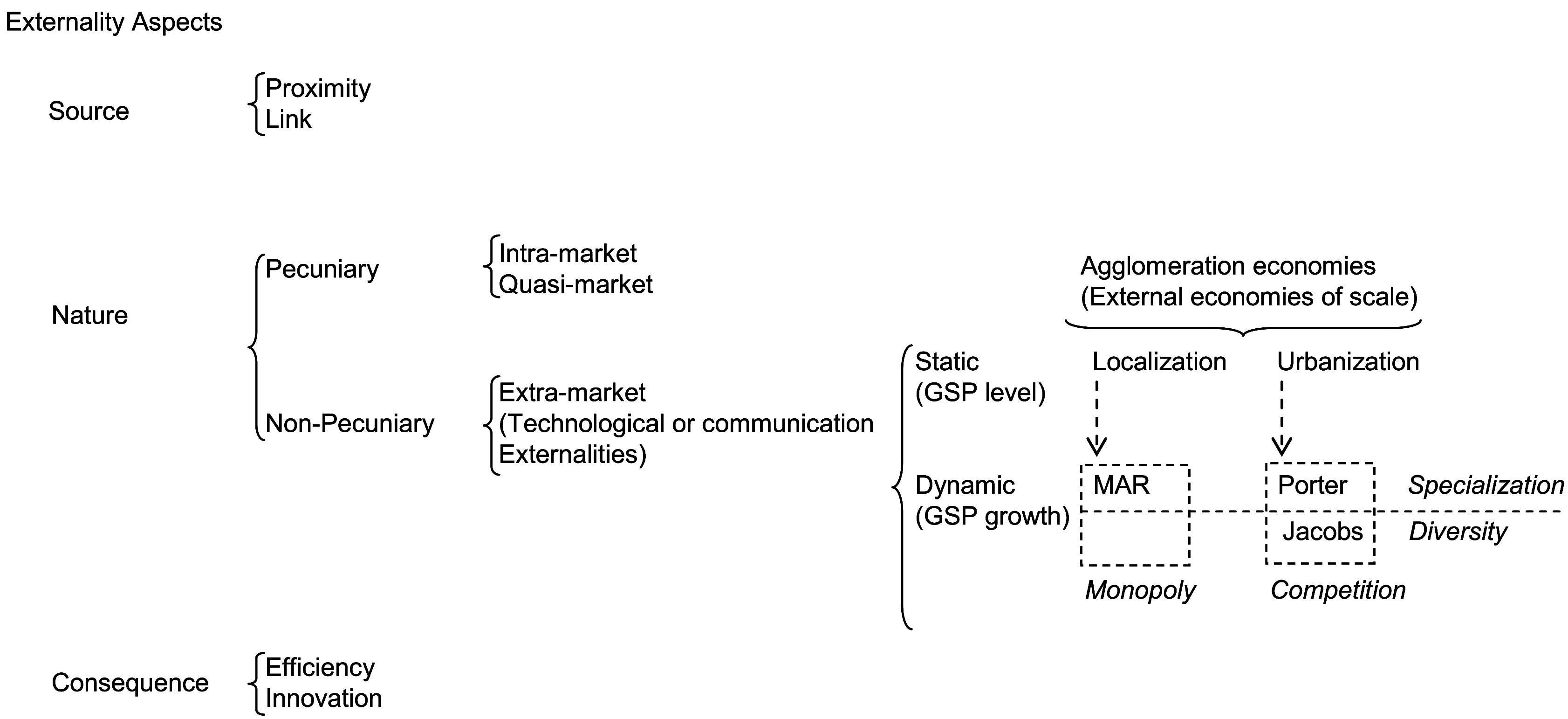

Figure 3.2 Taxonomy of Agglomeration Economies and Their Role in Industrial Regional Growth

3.3 Institutions

There is no one best way or approach to understand and provide guidelines for regional growth. Recent literature suggests that endogenous models including extra-market dynamic externalities should be extended to incorporate institutions, including social capital (Malecki 1998, North 1991, and Raco 1999).

Table 3.3 Definitions of Institution According to Diverse Authors

Author(s)	Definition of institution(s)
Larson and Ingram (1997, 76)	*Persistent* patterns of relationships and interactions including legislatures, courts, administrative agencies, nongovernmental organizations, and the like.
Harrington and Ferguson (2001, 52)	*Collectively* held beliefs, values, mores, and social *formal and informa*l rule structures with associated standing *patterns of behavior* and procedures such as property rights, provision of infrastructure (private vs. public), management practices, governance, the role of markets, and so on.
North, Douglass C. (1991, 97)	Informal *constraints* (sanctions, taboos, customs, traditions, and codes of conduct) and formal *rules* (sanctions, laws, property rights) that structure political, economic and social interaction.
Parsons (1951), in Przeworski (2003).	*Rules* (previously announced or learned inductively) which people expect *to be followed* (in a centralized or decentralized manner) by sanctions in case of deviations.
Giddens (1995, 41-42)	*Persisting* interactions regularized as social practices.

Diverse authors agree that institutions are persistent patterns of formal (*i.e.*, property rights or laws) and informal (*i.e.*, codes of conduct, taboos, traditions) interactions (Table 3.2). Once created, "institutions tend to take on a life of their own through institutional cultures and routines" Larson and Ingram (1997, 76). Sometimes, institutions are "confused with organizations, *e.g*., universities *vs*. higher education; government rather than governance; associations *vs*. influence circles or structures; and companies *vs*. markets or competition" (Stough 2001, 18). Unlike institutions, organizations are tangible groups or entities: "Organizations have particular interests and supporting institutions, including a collectively held belief in their *raison d'être*" (Harrington and Ferguson 2001, 52). Organizations are often referred to as "institutions" which generates considerable confusion in literature. This research considers institutions in the very general sense. They refer to rules of structured social interaction common in any society, not necessary as specific organizations.

Institutionalism, as classified by Hall and Taylor (1996), has a very-well established tradition in political science (historical institutionalism), economics ("new-institutional economics" and public choice institutionalism) and sociology, especially in organization theory (sociological institutionalism).[9] Since industrial regional growth is about economics, it is opportune to remember that there are two general approaches to institutional economics: Original (or "old" or "radical") Institutional Economics (OIE) based on the tradition of Veblen, Ayres, Commons, and Mitchell; and New Institutional (or "Neo-institutional" or "liberal") Economics (NIE) "based on Ronald Coase's theory of transaction costs. NIE is known as the North-Williamson school, and it has extended its theoretical developments to different areas such as property rights economics (Demsetz, and Alchian), Public Choice (Olson, and Mueller), and the theory of the firm (Schotter, and Shubik)" (Parada 2002, 43). Recent literature reviews reject any possibility of building bridges between the two approaches (Parada 2002). The possibility of

[9] Neo-institutional economics (NIE) dominates the relatively limited influence of new institutionalism in planning. Lai (2005), providing a long list of studies using NIE concepts in planning literature, asserts that NIE is in its infancy in planning study. Main reason is that "few economists are planners. . . . many ideas and concepts from economics must first be 'translated' before they can be applied to planning analysis" (Lai 2005, 13). Regarding other types of new institutionalism, Patsy Healey, drawing on Giddens and Habermas, considers that her institutionalism in "collaborative planning" fits better to sociological institutionalism (2006, 326).

dialogue seems more feasible between OIE and critical Marxists (Dugger and Sherman 1994). On the other hand, NIE has nothing in common with OIE, critical Marxism or official Marxism (the version of Marx held by the USSR and all Communist parties during the Stalin era, 1928-1953). It is important to bear in mind these differences to avoid "wrong" or incompatible combinations in eclectic theoretical frameworks. As an example, a recent article suggests to elaborate regional analyses drawing from OIE and NIE, "as well as the variety of sociological and political insights encapsulated in regional-science" (Harrington and Ferguson 2001, 55). The position in this dissertation is that this task is not possible because OIE and NIE viewpoints on fundamental relations (class conflict, relationship between class, technology and ideas, role of the individual) and dynamics (social evolution and historicity in social sciences) are not only divergent but contradictory (Dugger and Sherman 1994, and Parada 2002).

A review of most accepted journals shows that the NIE perspective dominates all regional studies including institutions in endogenous growth models. NIE, headed by Douglass North, notes that institutions not only matter to reduce transaction costs but they also are endogenous (Przeworski 2003). Considering institutions as endogenous hardly is a new claim:

> Montesquieu as well as Rousseau, the latter in his folkloric description of Poland, claimed that particular institutions can function only if they correspond to cultures, mores, religions, or geographic conditions. J. S. Mill considered the issue of endogeneity in the first chapter of Considerations, entitled 'To What Extent Forms of Government are a Matter of Choice.' What is new is the combination of these two propositions [that institutions matter and are endogenous]. (Przeworski 2003, footnote 2)

Once mentioned that there are two different and irreconcilable types of institutional economics (OIE and NIE), it is convenient to provide further details on the NIE perspective (the dominant institutional approach in regional models) and social capital, one of the most polemic institutional component recently added in local growth analysis.

Neo-institutional economics (NIE). In early nineties, North (1991, 97) reintroduced the idea that institutions, expressing and increasing the benefits of long-term formal and informal cooperation, reduce uncertainty in exchange and, therefore, reduce transaction costs.[10] In regional economics, "it is argued that strong local institutional relations may act as a prelude to regional economic success" (Raco 1999, 951). Both convergence and divergence models agree that social and institutional factors matter for regional growth. Early versions of the convergence model introduced the effect of institutional factors (property rights) on economic growth (Barro 1991 and Barro and Sala-i-Martin 1995). However, NIE complains that endogenous growth and NEG models reduce local social, cultural and institutional factors to 'variables of control'. New Spatial Economics (NSE) models, NIE authors say, fail to consider them as the real source of local advantages (Amin 1999, 368). Some authors suggest that NSE models may be easily extended to include parameters on formal and informal relations (Harrington and Ferguson 2001, and Stough 2001). In fact, this is not a new idea in economics. Myrdal (1957) suggested that non-economic factors, social relations and political processes also had a feedback effect in local growth. Lall and Ghosh (2002) subscribe to the relevance of non-economic factors in the Mexican industry. They say that in addition to Arrow's "learning by doing," Mexican firms are "learning by dining." Sharing this idea, Storper and Venables (2004) suggests that the localization of economic activity in places with strong "relational assets" or "untraded interdependencies" is consistent with the globalization age. However, this emphasis in face-to-face learning environments based on mutual trust and understanding has some limitations (*i.e.*, they tend to neglect "the relational proximity provided by global links of reciprocity, such as the

[10] Transaction costs occur in any economic exchange. The payment of commissions to the real estate agent when buying or selling a house is an example. In general, "they include the costs of competition, information, measurement, contract formation, and contract enforcement under a specific institutional arrangement. They also include the costs of establishing and demolishing a particular institutional arrangement." (Lai 2005, 9).

networks of transnational corporations, that also constitute a rich resource of learning). Before been seduced by institutional explanations, it is opportune to remember that economic growth is about economics. Therefore, a theoretical model of industrial regional growth must keep a balance between economic and institutional variables.

Social Capital are features of social organization, such as trust, norms and networks that promote cooperation between two or more individuals and can improve the efficiency of society (Putnam 1993, 167; and Fukuyama 1999). It has two distinct but intertwined meanings. The first one is *network* (*bridging* or *inclusive*) *social capital*, which focuses on the supportive and instrumental resources present within social networks. This definition recognizes that access to diverse social ties of different strengths provides access to a broad range of supportive resources. The second definition, *bonding* (or *exclusive*) *social capital*, broadly encompasses norms of trust and measures of collective action and group cohesion.[11] The central argument for regional growth is that social capital facilitates market transactions in three ways (Malecki 1998, 11): (a) it creates a system of generalized reciprocity, (b) it provides sorted and evaluated information and knowledge, and (c) it institutes norms and sanctions substituting costly and legalistic arrangements in market transactions. Additionally, social capital reinforces shared values and trust-based relationships that strengthen reciprocity beyond market transactions and create conditions for a 'virtuous circle'.

Patsy Healey, justifying the institutional element in collaborative planning, describes how social capital works at the community level:

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[11] While social capital is often used in a positive context, it is important to recognize that it is not inherently positive. High levels of bonding social capital can exclude outsiders and repressively restrict and isolate insiders. Network social capital can provide access to deviant communities and resources that can be used to harm oneself and others (Fukuyama 1999, Putnam 2000).

On the other hand, social capital should not be confused with human capital (acquired by education or training) nor be reduced to civil engagement (one feature of social capital).

> Some company managers will spend much of their time yearly life traveling the globe, discussing with counterparts in other parts of a multinational company. When they come back to their household base, they may be required to negotiate parenting activities with their partner and their children, while pursuing leisure activities with family or friends which (*sic*) may take them traveling again. They may go to football matches of play golf with a friend or neighbor who works in a local authority, whose yearly life is spent with other council officials and, perhaps, working with residents. Some of these residents may be like the nomadic company manager, while others may rarely venture beyond the world of the estate where they live" (Healey 2006, 57-58, italics added).

Westlund (2006, 3-4) states that "the 'right' social capital facilitates or even spurs [information and knowledge] spillovers, learning and innovation processes, whereas 'wrong' social capital is like sand in a complicated machinery." In the institutionalist perspective both factors and actors matter: regional growth is no longer dependent of the only combination of production factors but also of local social capital and other institutions (Westlund 2006, 13; Malecki 1998, and North 1991).

Empirical studies classify and measure social capital in diverse ways. The most common classifications are Putman-type social capital (*i.e.*, total number of bowling centers, public golf courses, membership sports and recreation clubs, civic and social associations, religious organizations) and Olson-type social capital (*i.e.*, labor organizations, business associations, professional organizations, and political organizations) (Goetz, and Freshwater 2002, Knack and Keefer 1997). Some studies expand this classification to include Granovetter-type social capital (*i.e.*, group membership; social networks) and Durkheim-type social capital (*i.e.*, crime rate and suicide rate) Micucci and Nuzzo ND).

3.4 Regional growth and its components

While most studies focus on regional growth, few studies isolate main components of regional growth and their determinants. It is important to isolate or "decompose" total regional growth because different dynamic externalities may differently affect the mix (or composition) of industries that the affect the growth of *all* existing industries. For example, assume industry agglomeration [MAR externalities] attracts fast growing industries, while industry diversity [Jacobs externalities] raises growth for *all* existing industries. Examining total growth only gives the aggregate effect neglecting the counterbalancing forces of MAR and Jacobs externalities on regional growth (Partridge and Rickman 1999, 320).

Briefly, this research is about components and sources of industrial regional growth. By components the study means the parts of the total regional growth representing national forces, the region-specific industrial mix, and region-specific characteristics. Chapter 3 presents the method to decompose total regional growth and evaluate the statistical relevance of each component in the case study. By sources the study means regional growth determinants such as factor endowments (institutions included) and dynamic external economies introduced in previous sections in this chapter. Using the appropriate conceptual model, sources may be applied to explain total regional growth or each one of its components.

3.5 Chapter summary

Industrial regional growth is unevenly distributed in space. Once the process initiates, it becomes self-sustained and cumulative. Free trade and economic integration modify this trend. The new spatial economics, including endogenous growth and new economic geography, suggests that variables representing dynamic externalities and institutional factors better explain regional growth. Policy makers and planners need to identify which of these variables are controllable to promote regional growth or regional competitiveness (one of its components). Next chapter presents main research questions and the required hypothesis to identify, organize, and carefully define variables that may be evaluated and potentially used as instruments of regional planning and public policy.

CHAPTER 4

HYPOTHESES AND METHODS

This chapter presents three linked research questions and formulates a primary hypothesis to identify, organize, and carefully define variables that may be evaluated and potentially used as regional growth instruments. The chapter also includes the methods in two parts to test the research hypothesis. The first part presents indicators to describe the current pattern of industrial location in Mexico. Once the spatial pattern of industries is identified, the next step is to explain it. The second part presents a stylized GSP (Gross State Product) growth model to explain industrial regional growth. The model is a *quasi-function of production* that explains regional growth and regional competitiveness (dependent variables) in terms of dynamic externalities, institutional environment, and natural advantages and local market conditions (independent variables). The chapter concludes with a diagram that shows the logical relationships between variables and indicators in the model.

4. 1 Research questions and primary hypothesis

Industrial regional growth is the result of firms initiating, expanding, reducing or closing operations. Industrial activity also increases when firms arrive from abroad or declines when they leave the region. *A spatial pattern trend or evolution is the final geographic expression of growing or declining activities in a period of time* (Figure

4.1). The current industrial location pattern in a country results from the previous spatial distribution, evolving at differentiated growth rates in terms of industries and space. The final industrial spatial pattern may be more concentrated, more dispersed or similar to the initial distribution (Figure 4.1). This research focuses on three linked and sequential questions that planners and policy makers face for designing or reformulating industrial regional growth policies in Mexico: where does industry locate? Where does industry grow? And what determines industrial regional growth in general and regional competitiveness, in particular? While answers to the first two questions *describe* the spatial pattern of industrial growth, the answer to the third one *explains* such pattern identifying controllable variables for regional planning and public policy. Therefore, the study focuses on the third question (what determines industrial regional growth in general and regional competitiveness, in particular?) to formulate the major guiding hypothesis in this research:

> H1: Regional characteristics such as dynamic externalities, institutions, and other local conditions matter for regional growth and regional competitiveness. They create a local environment that evolves in a self-organizing and self-reinforcing way, as predicted by new spatial economics (endogenous growth models and NEG). Results of tests for this hypothesis are to explain the industrial growth spatial pattern in Mexico from 1993 to 2003.

In this hypothesis, independent variables representing dynamic externalities are industrial specialization, competition, and diversification (MAR, Porter, and Jacobs economies, respectively). Social capital, income inequality, and ethnicity are some of the variables representing institutions. Finally, transportation, human capital, and market accessibility are examples of other regional conditions. Section 4.2.2.2 and Table 4.3 explain in detail all variables and indicators used to test this hypothesis.

The way to answer the research question embedded in the hypothesis depends on how it is framed (Rein and Schön 1996; and Skocpol 2004, 732). Both convergence and divergence models may answer the question on determinants of regional growth, though arriving at different conclusions. However, the literature review advices the answer to the research question formulating the hypothesis H1 in terms of the divergent model because it is more realistic in its assumptions compared to the neoclassical model. Tests for this hypothesis are guided by and contrasted with the theoretical *predictions* in the new spatial economics (NSE) presented in the literature review (Chapter 1).

The next two sections present methods and indicators to empirically test the formulated research hypothesis. The first section presents indicators to describe the spatial pattern of industrial regional growth and its trends in the first decade of NAFTA. The second section presents a model of regional growth and the theoretical and empirical definition of variables.

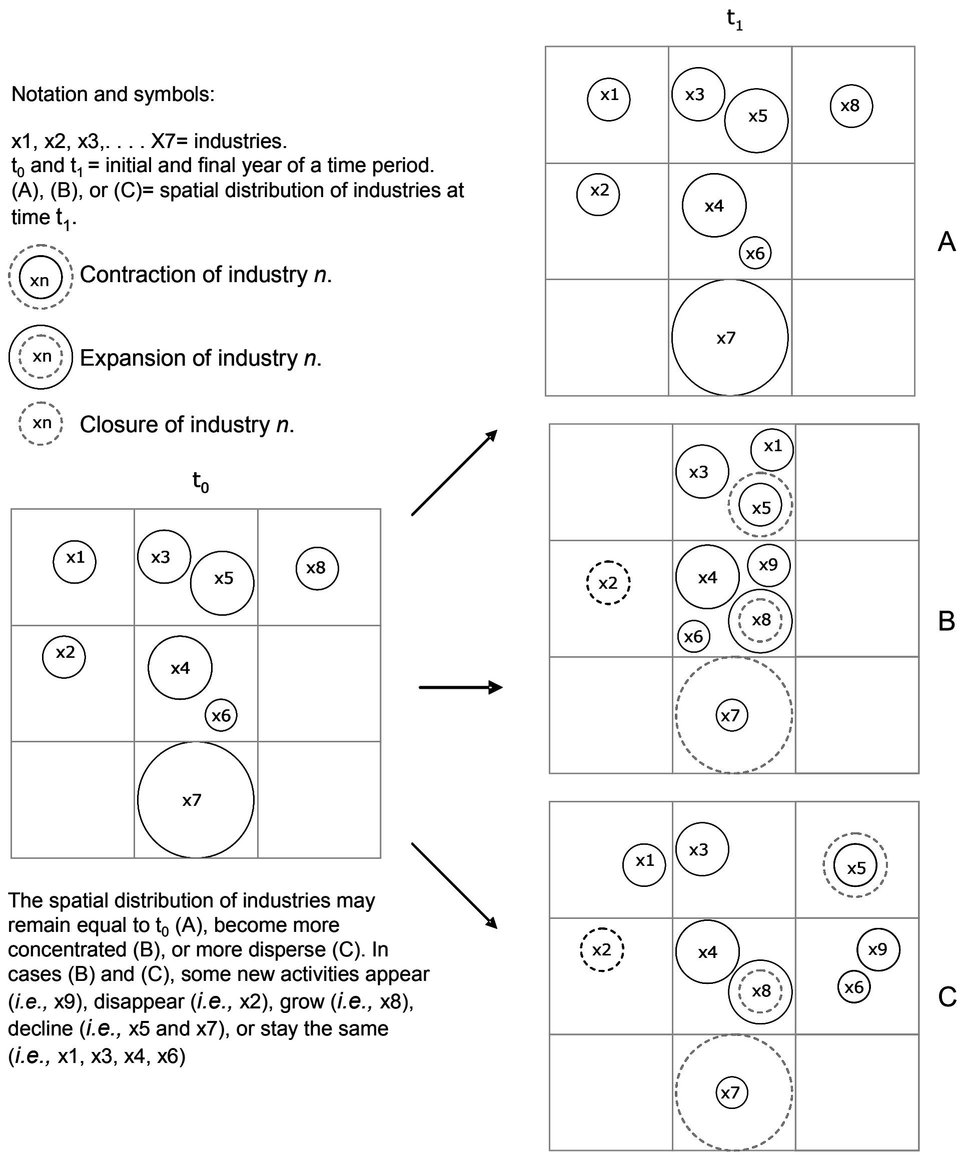

Figure 4.1. Possible Evolutions of a Spatial Distribution of Industries in a Nine Region Geographic Space, from t_0 to t_1.

4.2 Models, variables, and indicators

The answer to the three research questions may be accomplished in two steps. The first step answers the two descriptive questions: where does industry locate? And where does industrial growth occur? The first step depicts the current picture of the geographic pattern of industrial regional growth in Mexico. This picture provides the spatial context to the main research question assessed in the second step: what determines industrial regional growth? Once a primary hypothesis has been outlined to answer this question, the second step disentangles it into specific and empirically testable subgroups of hypotheses. To this end, the study suggests a *quasi-function of production*—using Kowalski and Schaffer (2002) terminology—to explain regional growth in general and regional competitiveness in particular (dependent variables) in the context of dynamic externalities, institutional environment, and natural advantages and local market conditions (independent variables) (Table 4.1). Because of its descriptive character, the analysis of the spatial pattern comes first.

4.2.1 Patterns of industrial location and regional growth

The evolution of the regional pattern of industrial production reflect the development strategy of industries located in a region (or a state), which in turn has a major impact on its growth rate. The descriptive character of the industrial location pattern requires a decision on what elements the study wants to emphasize. Indicators describe the geographic distribution of industries in different moments or years like a still photo. These “photos” review the geographic evolution of manufacturing in Mexico since 1970, emphasizing the industrial spatial pattern in the first decade of NAFTA.

This first step mainly uses descriptive statistics to indicate if the growth rate of a particular state is above or below the national average. These measures are simple and do not require further details. However, the study also uses three measures that deserve some explanation: the spatial adaptation of the weighted mean to calculate shifts in the industrial gravity center; the "Barro regressions" to identify if small regions grow faster; and a rank mobility index to correct the possible effect of small economies growing faster than bigger ones.

Gravity Center. The weighted mean center (WMC) is a cartographic measure of the gravity center considering the different degree of industrial importance of each state. It borrows the weighted mean concept from classical statistics. It may be calculated by

$$(4.1) \qquad (\bar{x}_{wmc\_t}, \bar{y}_{wmc\_t}) = \left(\frac{\sum_{i=1}^{n} w_{it} x_i}{\sum_{i=1}^{n} w_{it}}, \frac{\sum_{i=1}^{n} w_{it} y_i}{\sum_{i=1}^{n} w_{it}} \right),$$

Where,

$\bar{x}_{wmc}$ and $\bar{y}_{wmc}$ are the coordinates of the weighted mean center and w_i is the industrial GSP for state *i* in year *t* =1970, 1980, 1993, or 2003. Values of coordinates *x* (longitude) and *y* (latitude) correspond to the centroid of each state. In the case study, coordinates *x* and *y* are generated by Luc Anselin's software *GeoDa*^{TM}. The research uses the *Avenue* scripts for *ArcView 3.X* in Wong and Lee (2005) to graphically display the WMC center.

"Barro regression's." It is the equation of *absolute* convergence[1] in the neoclassical model used by Barro (1991) and Barro and Sala-i-Martin (1992), hence "Barro regression's". It is used to test if small economies (in terms of Gross State Product, GSP) grow faster than bigger ones. This equation is as follows:

$$(4.2) \quad \frac{1}{T}\ln\left(\frac{y_{ij,t+T}}{y_{ij,t}}\right) = a - \beta \ln\left(y_{ij,t}\right) + u_{ij,t,t+T}$$

where, $y_{ij,t}$ is the value (gross state product, GSP) of industry j of state i in year t, T is the period length, and $u_{ij,y,t+T}$ is the error term. If small states grow faster, the β–coefficient would be negative indicating that industrial growth in Mexican states is negatively related to its initial level of production. If the β–coefficient is negative and statistically significant, it is possible to conclude that the regional system tends to converge. Briefly, by using equation (4.2) the study is able not only to test if larger economies at the beginning of the period grow slower than the smaller ones, but also, as a by-product result, if industrial regional growth meets the absolute convergence assumption of the neoclassical model.

Rank mobility index (M). This index rescales the original rank of states to prevent the possible effect of small economies growing faster than bigger ones. It is defined as follows (Marshall 1989, 40):

(4.3) $M=(R_0-R_1)/(R_0+R_1)$,

---

[1] The neoclassical model distinguishes between *absolute* and *conditional* convergence. Absolute convergence occurs if results meet the assumption of convergence in the equation. There is conditional convergence when the assumption of convergence in the equation is conditioned to including other regional characteristics such as human capital, infrastructure, and/or institutions (Barro and Sala-i-Martin 1995).

Where, R_0 and R_1 represent the state's rank at the beginning and the end of a given time period, respectively. The result is positive if the state rises and negative if it falls. The theoretical limits of the index are -1 and +1, with a value of zero signifying no change in rank. A negative index does not necessarily mean loss of industry in absolute terms. A state may be growing yet fall in rank when overtaken in size by other places growing more quickly.

4.2.2 Determinants of industrial growth

Once the spatial pattern of industrial growth is identified, the next step is to explain it. There are many ways to accomplish this task. The approach in this research is to identify main determinants of regional growth and regional competitiveness (the main component of regional growth). Based on the new spatial economics (NSE), this research tests H1 by suggesting that variables representing dynamic externalities, institutional factors, and other local conditions better explain industrial regional growth. The two main reasons to choose the NSE approach are: (a) its assumptions are closer to reality, and (b) it opens the possibility of manipulating local variables to directly influence the rate of growth and the location of industry. The base model can be described as follows:

$RATE_{t,0} = f(DE_0, INST_0, OC_0, DUM)$, or expressed in the equation form:

(4.4) $\mathrm{Ln}(GSP_{ijt}/GSP_{ij0}) = \alpha_0 + \Sigma\beta_k\, DE_{i0} + \Sigma\gamma_k\, INST_{i0} + \Sigma\delta_k\, OC_{i0} + \Sigma\theta_k\, DUM + \varepsilon_{ijt}$

Where, *RATE* stands for industrial growth in *i* state for industry *j* from the initial year *0* (1993) to the final year *t* (2003); *DE* for dynamic externalities (MAR, Porter, and

Jacobs economies); *INST* for institutional variables (*i.e.*, social capital, government performance, income inequality); *OC*, for other economic conditions (*i.e.*, accessibility to markets: centrality, distance to Mexico City, and distance to USA); and *DUM* for dummy variables capturing the effect of the economic structure of groups of states. This third set is not common in new spatial economics. The study decides to include it because in reality dynamic and static agglomeration economies are intertwined with natural and market conditions. [2]

Model (4.4) captures the effect of independent variables on regional growth by combining both logarithmic (log) and non-logarithmic (non-log) variables. Why to combine both types of variables? Models use natural logs (ln) for appealing reasons (Wooldrige 2002, 184): (a) the slope coefficients of variables expressed in logarithms are invariant to rescaling, therefore, we do not have to worry about the units of measurement; (b) models having a positive dependent variable (logs cannot be used in variables taking on zero or negative values) often satisfy the Classical Linear Model assumptions if it is expressed in logs than using its level; (c) logs can mitigate, if not eliminate, common problems of heteroskedasticity or skewness in strictly positive variables that often have conditional distributions; (d) logs usually narrow the range of the variable, in some cases by a considerable amount. This makes estimates less

[2] Because of database restrictions, economies of scale *internal* to the firm are excluded from the analysis. Although it is theoretically desirable to include variables representing economies of scale internal to a firm, they do not provide "particular justification for making the industry the target of public economic development efforts" (McDonald 1997, 427). In fact, as a recent study states, "there is nothing inherently spatial in this concept [internal economies of scale] other than that the existence of a single large firm in space implies a large local concentration of factor employment" (Frenken, van Oort, Verburg, and Boschma 2004, 9). Therefore, it is still acceptable to only keep regional variables in this analysis.

sensitive to outlying (or extreme) observations on the dependent or independent variable.[3] If logs are so appealing, why not to use only logs in model? Because the econometric specification combining both log and non-log variables distinguishes their quantitative effects and facilitate their theoretical interpretation. As an example, "if the model were specified only in logarithms, the specialization [MAR economies] effect could not be identified from the initial sectoral GSP effect" (Combes *et al*. 2004). One important drawback to using logs and non-logs variables is that the interpretation of percent changes expressed by the regression coefficients is not straightforward (Wooldrige 2002, 184). This is not a problem in this research because the study will approach the statistical significance of regression coefficients rather than make adjustments to correctly interpret the impact of changes of independent variables on the dependent variable. Main focus in this research is on the theoretical basis behind each variable to assist its interpretation, especially in those expressing effects in opposite directions, as it is explained in the theoretical justification in next lines.

Before explaining each variable, it is worth noting that the dependent variable, the average growth rate over the period 1993-2003, is regressed on explanatory variables at the *start* of the period (around 1993). Measures for all independent variables refer to the initial date, 1993 or close to it. This reflects the idea that dynamic

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[3] Wooldrige (2002, 185) suggests some rules of thumb for taking logs: (a) When a variable is in large integer values such as positive dollar amount, population, total number of employees or school enrollment. (b) Variables measured in years—such as education, experience, tenure, age and so on—usually appear in their original form.

Some additional cautions are need when using logs. On one hand, it is necessary to be aware that the original model predicting a dependent variable log(y) needs to turn it into a prediction for y. On the other hand, it is *not* legitimate to compare R^2 from models where log(y) is the dependent variable in one case and y is the dependent variable in the other.

externalities have a continuous and lasting effect on industrial location and regional growth.

Table 4.1. Main Research Questions in a Nutshell

Research questions	Description
(1) Where does industry locate? (2) Where does industrial growth occur?	Description of spatial patterns of industrial location and growth by statistical inspection *without* specifying why industrial regional growth occurs.
(3) What explains industrial regional growth?	Explanation of industrial regional growth in terms of three sets of variables: $RATE_{ij} = f(DE_0, INST_0, OC_0, DUM)$, Where $RATE_{ij}$: growth rate of GSP in industry *j* in state *i*; DE_0: Dynamic externalities (MAR, Porter, Jacobs) ; $INST_0$: Institutional variables (*i.e.*, social capital, government performance, income inequality); OC_0: Other regional conditions (*i.e.*, accessibility to markets: centrality, distance to Mexico City, and distance to USA). All independent variables measured at the beginning of the period. *DUM*: Dummy variables for groups of states.

4.2.2.1 Dependent variable and components of local growth

Literature suggests "decomposing" the total regional growth rate into its parts or components to see how regional characteristics separately affect them. This section uses different versions of the shift-share analysis to separate or isolate different components of industrial regional growth. Typical versions of the shift-share method, following the ''region'' and ''country" accounting, decompose total regional growth into changes in the sector composition of overall regional economy (intersectoral, industry mix or *structural* effect) and changes in sector-intensity (intrasectoral, differential or *competitive* effect). The structural effect expresses "what the region does" in terms of maintaining a position in, or moving into (structural shift), faster- and slower-growing industries *relative to* their respective national growth rate.

> A positive (negative) result is indicative of a favourable (unfavourable) regional industry mix. The origin of a positive structural effect is twofold: either the region benefits initially from an activities portfolio consisting mostly of activities that have recorded a positive national growth, or the opposite occurs and the region is characterized by a portfolio including the relatively few industries that have suffered from severe economic losses at the national level. (Meunier and Mignolet 2005, 4)

On the other hand, the competitive effect refers to "how-regions-do it" in terms of *comparing* the regional growth rate in each industry with its respective growth rate at the national level. A negative residual effect is therefore indicative of a region-specific lack of growth performance (Meunier and Mignolet 2005, 4). The "how-regions-do it" supporters stress that the real source of regional growth is agglomeration economies in production (dynamic localization and/or urbanization economies) and policies that support them such as physical infrastructure or human capital (Maplezzi, Seah, and Shilling 2004, 265).

Different versions of the shift-share analysis include two additional components: a static component, the "*national* growth effect," to capture the influence of the change in total economic activity nationally on regional growth (McDonald 1997, 358-359). They also include an interaction term, *allocative* component or cross-product effect (Maplezzi, Seah, and Shilling 2004) or *adaptation* effect (Laursen 1999). There are no rules on the number of components included. Some studies use four-component versions because they either include all four components (Wilson, Chern, Ping, and Robinson 2005, Peh and Wong 1999, Bowen and Pelzman 1984) or, omitting the national component, they decompose the adaptation component in two subcomponents (Montobbio and Rampa 2005, and Laursen 1999). Some others prefer the three-component version that includes the national share, the industrial mix, and the regional share (Sousa and Cabral 2001, McDonald 1997, Rones 1986) or the one that includes the industrial mix, the regional share and the allocative component (Maplezzi, Seah, and Shilling 2004, Esteban 2000, O'Leary 2003). Finally, there are studies preferring to keep the two-component version (Meunier and Mignolet 2005, Mayerhofer 2005, Hummels, Ishii, Yi 2001, Liu and Yao 1999). Recent adaptations extend these versions to include the spatial or "neighbor's" effect (Nazara and Hewings 2004, Mitchell, Myers and Juniper 2005, Mayor and López ND), to simultaneously use two-categories (i.e., employment and value added) rather than one (Mulligan and Molin 2004) or to measure spatial inequality in a specific year (Benito and Ezcurra 2005).

Regardless the shift-share version selected, the main points to bear in mind is that (a) a regional growth rate may be broken down in diverse growth components, (b) these components have unequal influence in the total regional growth rate, and (c) the regional growth rate and its components mat be explained by factors previously identified in regional growth theories.

Three decomposition versions of local industrial growth. The traditional method of decomposition (TMD) of the local growth rate, similar to that presented by Peh and Wong (1999), weights both the regional competitiveness component and the mix component by the share of each sector in the region. The TMD calculation creates "a bias toward finding that industry mix matters" (Malpezzi, Seah and Shilling 2004, 272). Scholars have suggested different alternatives to this drawback. One option uses national weights to calculate regional competitiveness, regional weights to calculate the regional mix component, and a difference of both national and regional weights to calculate the interaction component (Malpezzi's version). A second alternative reformulates the traditional version to correct "industry mix bias" highlighting the explicit economic interpretation of the residual terms (Fagerberg and Sollie 1987, 1572). This second alternative, originally applied to international trade analysis under the name of constant market analysis (CMA), has been recently applied by Laursen (1999) to study patenting activities and Montobbio and Rampa (2005) to analyze the impact of technology on export performance. A third option uses a weighted variance analysis (Jayet 1993). It has been recently used to measure world trade competitiveness (Cheptea, Gaulier, and Zignago 2005) and the influence of agglomeration economies in US metropolitan growth (Malpezzi, Seah and Shilling 2004). The study will call it Malpezzi's version.

<u>The traditional method of decomposition (TMD)</u>. In Peh and Wong's (1999) formulation, the local growth rate may be decomposed as follows:

$$
\begin{aligned}
x_t^j - x_0^j &= \sum_i x_0^{ij}\left(\frac{X_t}{X_0} - 1\right) && \Rightarrow \textit{Overall Growth or Share Effect} \\
&+ \sum_i x_0^{ij}\left(\frac{X_t^i}{X_0^i} - \frac{X_t}{X_0}\right) && \Rightarrow \textit{Industry Mix Effect} \\
&+ \sum_i x_0^j \frac{X_0^i}{X_0}\left(\frac{x_t^{ij}}{x_0^{ij}} - \frac{X_t^i}{X_0^i}\right) && \Rightarrow \textit{Regional Effect} \\
&+ \sum_i \left(x_0^{ij} - x_0^j \frac{X_0^i}{X_0}\right)\left(\frac{x_t^{ij}}{x_0^{ij}} - \frac{X_t^i}{X_0^i}\right) && \Rightarrow \textit{Interaction Effect}
\end{aligned} \tag{4.5}
$$

Where

x^{ij} = *GSP in activity i in state j*

x^j = *GSP for all activities in state j*

X^i = *GSP in activity i in the country*

X = *GSP for all activities in the country*

Subscripts *0* and *t* stand for the initial and final year, respectively.

Malpezzi's Version. The local growth rate, as presented in Malpezzi, Seah and Shilling. (2004) may be decomposed in three components:

(4.6) $r_{ij} = \Sigma W\mu$ Competitive Effect (COM)

$+ \Sigma Y\eta$ Industrial Mix Effect (MIX)

$+ \Sigma(Y\text{-}W)\mu$ Interaction Effect (INT)

Where

$$r^j = \frac{\Sigma x_t^i}{\Sigma x_0^i} - \frac{\Sigma X_t^i}{\Sigma X_0^i} \qquad \mu = \frac{x_t^i}{x_0^i} - \frac{X_t^i}{X_0^i} \qquad \eta = \frac{X_t^i}{X_0^i} - \frac{\Sigma X_t^i}{\Sigma X_0^i} \qquad W = \frac{X_0^i}{\Sigma X_0^i} \qquad Y = \frac{x_0^i}{\Sigma x_0^i}$$

Notation has been changed to make it compatible with that in the traditional version. Variables as previously defined.

Constant market analysis (CMA). In the CMA formulation, the basic idea is to decompose the growth rate, in such a way that the spatial differential growth of industries gets isolated. It is then possible to say something about whether a rise (or fall) of a state's share in the country is due to (i) *the market share effect* (*MSE*); *i.e.*, whether the rise (or fall) is due to the fact that the state has gained shares of markets, assuming that the structure is the same in the two periods in question; (ii) *the structural market effect* (*SME*), *i.e.*, having the 'right' ('or wrong') specialization pattern in the initial year; (iii) *the market growth adaptation effect* (*GAE*), *i.e.*, a movement into sectors with fast-growing (or stagnating) industries; and finally (iv) *the market stagnation adaptation effect* (*SAE*), *i.e.*, a movement out of sectors with generally stagnating market activity (or fast-growing). As described by Laursen (1997), the decomposition can be conducted for growth in market shares as follows:

$$(4.7) \qquad \Delta x_j = \underbrace{\sum_i \left(\Delta x_{ij}\, y_{ij}^{t-1}\right)}_{\text{Market share effect}} + \underbrace{\sum_i \left(x_{ij}^{t-1} \Delta y_{ij}\right)}_{\text{Structural market effect}} + \underbrace{\sum_i \left(\Delta x_{ij} \frac{\Delta y_{ij} + \left|\Delta y_{ij}\right|}{2}\right)}_{\text{Market growth adaptation effect}} + \underbrace{\sum_i \left(\Delta x_{ij} \frac{\Delta y_{ij} - \left|\Delta y_{ij}\right|}{2}\right)}_{\text{Market stagnation adaptation effect}} ,$$

Where:

$x_j = \sum_i X_{ij} \Big/ \sum_i \sum_j X_{ij}$, (a state's aggregate share of Mexico's industrial GSP)

$x_{ij} = X_{ij} \Big/ \sum_j X_{ij}$, (a state's share of a given industry in terms of industrial GSP)

$y_{ij} = \sum_j X_{ij} \Big/ \sum_i \sum_j X_{ij}$, (an industry's share of total industrial GSP in Mexico)

Where X denotes industrial GSP by firms situated in state j in industry i.

In this version, *MSE* represents regional economic competitiveness. A positive *MSE* effect occurs when the rates of growth in GSP of various industries in a state are higher than Mexico's overall GSP growth in these industries, and vice versa for a negative regional effect.

Relevance of local growth components. This research compares all three versions to decompose local growth and selects the one providing better results. The regional importance of each component in the total growth rate may be tested with three simple OLS regressions. Each model determines the variance in r_{ist} due to overall growth, industry mix and the competitive term. Taking the TMD version as a reference (may be any of the three versions) the variation of r_{ist} is the cross-sectional variance across all states for 1993-2003 according to the following equations (Esteban 2000, Malpezzi, Seah and Shilling 2004, and Cheptea, Gaulier, and Zignago 2005):

(4.8)
$$r_{ist} = a_\mu + b_\mu \mu_i + e_\mu$$
$$r_{ist} = a_\pi + b_\pi \pi_i + e_\pi$$
$$r_{ist} = a_\varphi + b_\varphi \varphi_i + e_\varphi$$
$$r_{ist} = a_\theta + b_\theta \theta_i + e_\theta$$

Where, μ is the overall growth component, π the industry mix component, φ the competitive component, and θ the interaction effect. As usual, e_μ, e_π, e_φ and e_θ are random error terms. These equations are an econometric operation to identify what percent of the variation in r_{ist} can be explained separately by μ, π, φ and θ, as measured by R^2. To accomplish this task, the study saves the R^2 as R_A^2 for each regression. This gives us the proportion of variation in r_{ist} that is explained separately by μ, π, φ and θ. Regression analysis requires the region a GSP growth that can be decomposed into μ, π, φ and θ. If μ, π, φ and θ are independent, then the R^2s from these regressions will sum to one. If, on the other hand, μ, π, and φ are correlated, then R^2s from these regressions need not sum one. The remaining cross-sectional variation in r_{ist} may be attributed to the correlation among these three terms.

4.2.2.2 Independent variables

Literature review identifies three main sets of explicative variables: dynamic externalities, institutional variables, and other regional conditions.[4]

Dynamic externalities. New spatial economics (NSE) identifies three types of dynamic externalities: specialization, competence, and diversification (MAR, Porter, and Jacobs economies, respectively). In NSE, these externalities are the key for knowledge spillovers and regional growth in general. On the other hand, considering that regional competitiveness, as measured by shift-share or constant market analysis, is the component of total regional growth experiencing dynamic externalities (McDonald 1997, 358), it is expected to find MAR, Porter and Jacobs economies statistically significant for both regional competitiveness and total industrial growth.

> The literature takes the view that externalities such as knowledge spillovers or learning by doing are the driving force for long-run economic growth. To the extent that such externalities have geographic limits, they have implications for regional economic growth. There is evidence that some knowledge spillovers are geographically localized. . . . This implies that regions with a larger agglomeration of firms grow faster because regional concentration of firms facilitates knowledge spillovers. (Gao 2004, 102)

Catch up/MAR externalities. Some studies consider that the absolute level of GSP in industry *i* is a better proxy for MAR externalities (or dynamic localization economies) than is its relative level *(i.e.*, share of GSP of industry *i* in state *j)* because MAR externalities arise from the absolute size of the industry rather than from the

[4] Considering this combination of economic and institutional independent variables, Swyngedouw (2000, 550) would say they are part of a heterodox model.

relative size of the industry compared with other industries (Mano and Otsuka 2000, 195). In neoclassical theory the initial level of *GSPi* will have a negative sign representing regional convergence. It will simply tell us that states with higher GSP in industry *i* grow slower, smoothing the current spatial patter towards a convergent pattern. On the other hand, in cumulative causation (Myrdal 1957, Krugman 1991) and path dependent theories (Arthur 1989), the initial level of *GSPi* will have a positive sign expressing positive effects of MAR externalities. In this case, states with higher levels of *GSPi* grow faster concentrating even more the initial spatial pattern. If this theoretical distinction is not clear, possible negative correlation between initial conditions and other measures of MAR externalities may be seen as confusing. Note that if large base period GSP partly captures congestion specific to the particular industry (*e.g*., decreased availability of favored land and required labor), the coefficeint for MAR externalityis can be negative if they do not compensate the negative effect of congestion costs.

Indicator. Logarithm of the initial level of GSP ($Ln\ GSP_0$). However, for the shake of comparison with most related literature (Glaeser *et al*. (1992), the study also includes the Hoover-Balassa index to measure MAR externalities. This index measures how specialized a state is in an industry relative to what one would expect if GSP in that industry was scattered randomly across Mexico. Its formal expression is *Specialization* = $100^* L_{ij}^{HB}$, where L_{ij}^{HB} is the Hoover (1936)-Balassa (1960) index of "revealed comparative advantage":

$$(4.9) \qquad L_{ij}^{HB} = \frac{S_{ij}}{\sum_i S_{ij}} \Bigg/ \frac{\sum_j S_{ij}}{\sum_i \sum_j S_{ij}},$$

Here, S_{ij} is the size of industry i in state j, expressed in terms of GSP. L_{ij}^{HB} is non-negative, and a value greater/smaller than one means the share of industry i is larger/smaller in state j than the average over all regions. It may be noticed that MAR externalities focus on one industry rather than the entire regional economy. The study assumes that MAR externalities measured as $Ln\ GSP_{i,0}$ or L_{ij}^{HB} have a positive impact on industrial regional growth.

Porter economies. Porter (1990) argues that local competition fosters innovation, new ideas and the diffusion of information. On the other hand, some authors suggest that monopoly, rather than competition, favors new ideas (Schumpeter 1947, Galbraith 1956). In this debate,

> The first key question is how to measure competition. A natural measure of the amount of competition is just to measure the number of firms in the [state]-industry. . . . In order to distinguish competition from scale, the number of firms is sometimes divided by the size of the industry in the area (measured by the number of workers or the amount of output). The resulting variable can be interpreted as the number of firms per worker or per unit output, which seems like a natural competition measure. However, this measure is also the inverse of the average firm size so anything that we attribute to competition may actually be a function of smaller firms. (Glaeser 2000, 93)

Hence, it is expected that in the regions where firms are smaller than the national average (with respect to the market), competitive conditions will prevail and therefore knowledge spillovers and productivity growth will be higher.

Indicators. For comparative reasons with other studies, this research includes two indicators suggested by Glaeser (2000): the relative firm size and the relative number of small firms.

(4.10) $SIZE = \dfrac{\dfrac{F_{ij0}}{W_{ij0}}}{\dfrac{\Sigma F_{ij0}}{\Sigma W_{ij0}}}$, Where, F_{j0} = number of firms in state *j* and industry *i* in year *0*,

and W_{j0} = number of workers in and state *j* and industry *i* in time *0*.

(4.11) $SMALL = \dfrac{\dfrac{SF_{j0}}{F_{j0}}}{\dfrac{\Sigma SF_{j0}}{\Sigma F_{j0}}}$, Where, SF_{j0} = number of small firms in state *j* in year *0*, and

F_{j0} = total number of firms in and state *j* in time *0*.

These two measures of local competition assume that competition is more intense if there are a large number of small firms. Empirical studies assert that monopoly has adverse effects on regional growth and claim for specific policies stimulating small firms (Carree and Thurik 1998). Main argument in these studies is that small plants stimulate the creation of local externalities when they look for cooperation and integration with other local firms. This probability is lower for large firms because they are more vertically integrated and, therefore, less connected to local networks. The interpretation that a larger presence of small firms means more competition and entrepreneurship has been recently questioned contending that these measure of competition may be really expressing diseconomies of scale (Combes 2000) or local industrial organization (Rosenthal and Strange 2003). This study calculates *SIZE* and/or *SMALL* for reasons of consistency with dominant literature (Glaeser *et al.* 1992, and Henderson *et al.* 1995) and assume that they positively relate with industrial regional growth.

Jacobs economies. Jacobs (1969) claimed that the urbanization economies or the extent of the diversification of manufacturing industries favors state growth. The particular hypothesis to test is if dynamic urbanization economies (the diversification of industries in a particular state) have played a significant role in industrial growth.

Indicators. This study examines two alternative indices. The first one is the inverse of the global specialization index (*GSI*).[5] The global specialization index (*GSI*) is defined by:

$$(4.12) \quad GSI = \frac{\Sigma \left| \frac{GSP_{js}}{GSP_{jMx}} - \frac{GSP_{jMx}}{GSP_{Mx}} \right|}{2}$$

Where, GSP_{js} is the value of industry j in state s, GSP_{jMx} is the national value of industry j. GSP_s and GSP_{Mx} are the values for all industrial activity in state s and Mexico, respectively.

GSI shows whether a geographical area that is specialized in a few activities, which do not necessarily coincide with those being analyzed, grows faster. Its inverse

[5] When they are weighted, the global specialization index (focusing across regions) and the global localization index (focusing across industries) are "identical and equal" (Mulligan and Schmidt 2005, 569).

$\frac{1}{GSI}$ indicates that a less-specialized environment (more diversified) results in higher regional growth (Costa-Campi and Viladecans-Marsal 1999, 2090-2091).

The second indicator is the Hirschman-Herfindahl index (*HHI*). This study evaluates three different adaptations of this measure. The first one is its inverse version as in Combes (2000).[6] It is computed on the GSP shares of a given sector located in the same state. Then, it is divided by the same indicator computed at the national level,

$$(4.13)\quad VAR = \frac{\dfrac{1}{\Sigma\left(\dfrac{GSP_{i,s}}{GSP_s}\right)^2}}{\dfrac{1}{\Sigma\left(\dfrac{GSP_{i,Mx}}{GSP_{Mx}}\right)^2}}$$

Where, $GSP_{i,s}$ and $GSP_{i,Mx}$ are the gross state product of industry i located in state s and Mexico, respectively. GSP_s and GSP_{Mx} are the total for industries in sate s and the country as a whole, respectively.

The second adaptation, HF_j, normalizes the *HHI* to make its values ranging from 0 to 1 according to the following formulas (Caniels 1997):

$$(4.14)\quad HF_j = 1 + \frac{\sum_{i=1}^{n} S_{ij}^2}{\ln n}$$

, Where S_{ij}^2 is the share of industry j in the state i out of the total industry j in Mexico. A value of 1 represents total concentration and 0 equal distribution (Caniels 1997).

6 This index is called "Simpson's index" in ecology.

The third adaptation, *UNCTAD* H_j, is also a normalization of *HHI* and comes from UNCTAD (1995):

$$(4.15)\quad UNCTAD\ H_j = \frac{\sqrt{\sum_i^n \left(\frac{x_i}{X}\right)^2} - \sqrt{\frac{1}{n}}}{1-\sqrt{\frac{1}{n}}} = \frac{\sqrt{\sum_i^n \left(\frac{x_i}{X}\right)^2} - \sqrt{\frac{1}{9}}}{1-\sqrt{\frac{1}{9}}},$$

The fourth adaptation, *SUNDRUM* H_j, is similar to *UNCTAD* H_j and comes from Sundrum (1990, 45):

$$(4.16)\quad SUNDRUM\ H_j = \frac{\sqrt{\sum_i^n \left(\frac{x_i}{X}\right)^2 - \frac{1}{n}}}{\sqrt{\frac{n-1}{n}}} = \frac{\sqrt{\sum_i^9 \left(\frac{x_i}{X}\right)^2 - \frac{1}{9}}}{\sqrt{\frac{8}{9}}}$$

In this formula, the numerator $H = \left(q^2 - \frac{1}{n}\right)^2$ is standardized dividing it by its maximum possible value: $\left(\frac{n-1}{n}\right)^{\frac{1}{2}}$, where *q*= observed proportion of GSP (or $\sum_i^n \left(\frac{x_i}{X}\right)^2$) in the various activities *n*.

In *SUNDRUM* H_j and *UNCTAD* H_j , x_i is the value of *GSP* of industry *i* in state *j*, $X = \sum_1^9 x_i$ and 9 is the number of *n* industries at the two-digit SITC.

Unlike measures of specialization which focus on one industry, this index considers the industry mix of the entire regional economy. The largest value for *HHI* (in any of its versions *VAR*, HF_j, *SUNDRUM* H_j or *UNCTAD* H_j) is when the entire regional economy is dominated by a single industry. Thus, a higher value of *HHI* means a lower level of economic diversity. For a more intuitive interpretation, *HHI* is subtracted from unity (Lall and Chakravorty 2003). Therefore,

(4.17) $JACOBS_j=1-HHI$

This study evaluates all these measures of diversification and assumes that variety positively relates with industrial regional growth.

All dynamic externalities together. Each type of dynamic externality (MAR, Porter and Jacobs) assumes to have a positive influence on regional growth, but under different market circumstances. It is opportune to recall main theoretical assumptions of these three perspectives when the type of market is included in the analysis: While MAR and Porter agree that specialization favors regional growth, they disagree in the market type. On one hand, Porter supports competence as a condition for regional growth; On the other hand, MAR think monopoly is the best market structure for regional innovation and progress. Jacobs agrees with Porter about the type of market (competence) but asserts that diversification rather than specialization matters for regional growth (Table 4.2).

Table 4.2 Hypothesized Relations of Dynamic Economies and Type of Market with Economic Growth

	MAR	Porter	Jacobs
Concentration	Positive	Positive	Negative
Diversity	Negative	Negative	Positive
Competition	Negative	Positive	Positive

Source: After van Oort (2006).

Institutional factors. Dominant thinking in New Spatial Economics sustains that dynamic externalities are the *only* sources of uneven regional growth in the long-run (Glaeser *et al*. 1992, Henderson *et al*. 1995). There are diverse dissenting views. Krugman (1991), for example, says that physical spillovers (rather than just knowledge or intellectual spillovers) also matter for regional growth. Input and output linkages among producers (Krugman and Venables 1995), or high geographic labor mobility (Krugman 1991), generate pecuniary externalities creating a self-reinforcing process of agglomeration of production. As an example, the presence of one firm lowers the transportation costs for a second. Others argue that empirical tests are not conclusive: while dynamic externalities are strong in a few cases, they are weak in a large number of industries (Ó'hUallachain and Satterthwaite 1992). On the other hand, some authors highlight the difficulty of isolating dynamic externalities effects from other location effects:

> The most difficult problem confronted by the effort to test for spillover-localization is the difficulty of separating spillovers from correlations that may be due to a pre-existing pattern of geographic concentration of technologically related activities (Jaffe *et al.* 1993, 579).

In reality, natural advantages and local market conditions (*i.e.*, quality of labor, telecommunications, or transportation) interact with dynamic externalities. The resulting effect is often indistinguishable or observationally equivalent (Gao 2004, 103). The only way to distinguish dynamic externalities from other interacting effects is to identify those having long-run implications (McDonald 1997, 341-344). This alternative, however, is not clear-cut. Recent empirical tests for the US cities show that dynamic externalities are more important in the short- and medium-run than in the long-run:

> [F]or manufacturing sectors, local growth is favoured in the long run by better skill composition of the pool of workers, pecuniary externalities and supporting services. Knowledge spillovers play an important role in the short- and medim-run but their influence tends to fade away over time according to the standard timing of diffusion of innovation. (Lamorgese 1998, 3)

Finally, institutionalists, particularly those of the New Institutional Economics headed by Douglass North, argue that institutions are endogenous and also matter for regional growth. Previous discussion leaves open the possibility that regional growth may occur because of the influence of natural advantages, local market factors or institutions that have noting to do with knowledge and communication spillovers (dynamic externalities). As an example, "A sector located in a growing metropolitan area should grow faster than one in a declining city only because of the strong demand directed toward its product and not for reasons linked to technology improvement, diffusion or imitation" (Lamorgese 1998, note 8). For this reason, Model (4.4) not only includes dynamic externalities but it also adds institutional variables (social capital, ethnicity, income inequality, election attendance, and government performance) and other economic conditions in recent literature on regional growth.

Social capital . Definitions of social capital are many and diverse. The definition introduced in Chapter 2 is that social capital is "features of social organization, such as trust, norms and networks that promote cooperation between two or more individuals and can improve the efficiency of society." It is clear that this definition includes a broad group of concepts such as social ties, horizontal associations among people, networks of civic engagement, trust, institutions, cultural practices, norms and political contexts at different levels (Boschma 2005). Rather than embrace further refinements in definitions and variables, I empirically approach social capital following previous studies. Results from case studies suggest that social capital positively influences regional economic growth by facilitating market transactions. These results include experiences using countries (Knack and Keefer 1997 or Temple and Johnson 1998), and cities and regions (Putnam 1993, Narayan and Pritchett 1999, Helliwell and Putnam 1995, Rupasingha *et al*. 1999, 2000, and 2002) as units of analysis. Scholars warn, however, that not all social capital is good for economic development:

1) Social capital can be negative when it excludes outsiders or places excessive demands on members (Portes 1988).

2) Stronger civic organizations "open possibilities for local economic development that markets and political institutions otherwise cannot offer" (Rupasingha *et al*. 2002, 142). However, "social capital and local institutions are relatively immobile yet they help to induce development in some regions but not others" (Malecki 1998, 1).

3) Institutions are not necessarily developed to be efficient but to serve dominant interest embedded in formal and informal norms and values (North 1990, 16).

4) Definitions of social capital include "distributional coalitions" or "rent-seeking" organizations that prevent growth because they are "oriented to struggle over the distribution of income and wealth rather than to the production of additional output" (Olson 1982, 44). These coalitions slow decision-making with crowded agendas and multiple decisions in barging tables. This process impedes the quick adoption of new

technologies and the reallocation of resources, and therefore reduces the rate of growth (Olson 1982, 62 and 65).

Considering previous observations, the hypothesis in this research is that social capital may have either a positive or negative effect on industrial regional growth.

Indicators. Rupasingha, Goetz, and Freshwater (2002) propose classifying social capital indicators in the two groups previously suggested by Knack and Keefer (1997): (a) Putman type: total number of bowling centers, public golf courses, membership sports and recreation clubs, civic and social associations, religious organizations, and (b) Olson-type: labor organizations, business associations, professional organizations, and political organizations per 10,000 persons. While Putnam indicators facilitate social interaction, Olson indicators include rent-seeking organizations. In the case study, I use number of units of commercial, professional, and labor force associations (Activity 9250) for Olson type and number of political, civil, and religious organizations (Activity 9220) for Putnam type. This information comes from the Census of Services.[7] Expected sign: (+) for Putnam type and (-) for Olson type indicators.

Income distribution (*INCOME*). The rationale of this index is that income inequality affects regional growth. If, for example, income inequality is high, there may not be a spread of development of industries in the area or region because there is no real demand of good and services. If, however, income inequality is low a large number of families will demand domestically and regionally produced goods and services. This may have a positive impact on the location of firms and industries closer to the

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[7] I thank Luisa Decuir -Viruez for her email exchange and orientation on these particular indicators.

domestic market. A large real market resulting from the combination of large population (large market) with a high quality of life (low marginality) favors industrial regional growth (Jovanović 2005, 664). Another version considers that inequality retards economic growth because increases the possibility of social conflict that, in turn, creates instability in economic policies. This instability depresses investment and thus economic growth (Larraín and Vergara 1997). On the other hand, recent studies report "a negative relationship between inequality and growth for low per-capita GDP countries and a positive relationship for high per-capita GDP countries" (Bhatta 2001, 336). For this reason the hypothesis in this research is that income distribution may have either a positive or negative sign.

Indicators: Gini and Theil indices of income distribution for every state. Expected sign: (+/-).

Ethnicity (*LNETHNIA*). Researchers argue that ethnicity is a source of polarization that may impede economic progress. "The most general assertion is that higher levels of ethnic diversity result in less trusting societies" (Rupasingha, Goetz, and Freshwater 2002, 141). A recent literature review reports that ethnic diversity, expressed as ethnolingustic diversity or ethnic fractionalization, reduces the level and rate of investment and has a direct negative effect on economic growth (Montalvo and Reynal-Querol 2005). Olson probably provides the best economic argument in early eighties:

> [. . . .] the individual as a consumer, employer, or worker finds it costly to discriminate. The consumer who discriminates against stores owned by groups he finds offensive has to pay higher prices or suffer a lesser selection by shopping elsewhere. The employer who discriminates against workers of a

> despised group has higher labor costs, and his business may even bankrupt itself competing against other firms that do not let prejudice stand in the way of profit. Similarly, the worker who does not accept the best job irrespective of the group affiliation of the employer essentially is taking a cut in pay. A similar logic applies to individual social interactions of other kinds. The fact that *individuals* find discrimination costly means that, if individuals are free to undertake whatever transactions they prefer, there will be a constraint in the extent of discrimination. (Olson 1982, 164, italics in the original)

Indicator: Percentage of population (5 years old and more) that speaks an ethnic language from the Census of Population of 1990. This indicator may also express that states with higher indigenous presence have been less exposed to the process industrialization and technological modernization. Expected sign: (-).

Election attendance (*LNATTEND*). Participation in political activity indicates people's general connectedness with society and social trust (Pollitt 2001). A high level of generalized trustworthiness, in turn, implies higher levels of "good" social capital favorable for economic growth. Election attendance is one of the several indicators that Putnam (2000) provides for citizen participation in social networks (other indicators include voting in elections, participation in political meetings, collaboration in election campaigns and making a speech).

Indicators. The electoral turnout is an indicator of civic duty, democratic awareness and active participation in public issues (Putnam 1993, 93-94). This research uses electoral turnout in the Presidential election in 1994. Expected sign: (+).

Government Performance (*GPI*). It refers to institutional quality combining bureaucratic quality and provision of public services. Good government performance is necessary to take over protection and enforce property rights, shackle arbitrary conducts in public management, and be accountable to the citizens (North 1991, 109).

Indicator. Governmental Performance Index (*GPI*) from Ibarra, Sandoval, and Sotres (2005). It condenses 48 indicators classified in four sets: fiscal (fiscal capacity, fiscal effort, and outcome), finances (debt, financial dependence, and state government operative basis), management (no subdivided) and service provision (physical and human infrastructure and service availability). All variables refer to 1997. Expected sign: (+).

Other Conditions (OC): Natural advantages and local market conditions, and FDI. Literature asserts that while static externalities explain the level of production, dynamic externalities are relevant for regional growth. Traditional localization factors (Market, natural resources, and transportation costs), on the other hand, explain the initial localization of activities. In reality, the initial motivation to set up activities in a place does not vanish once the firm is located nor static and dynamic effects can be clearly separated. All these three localization factors are intertwined. In this situation, recent literature on regional growth, besides dynamic externalities, also includes institutions and other conditions. Since previous sections present the first two sets of variables, next lines introduce nine explanatory variables to incorporate the effects of natural advantage and local market conditions, and Foreign Direct Investment (FDI) (Gao 2004).

Transportation (*LNROAD*). Transportation is a basic element of the physical infrastructure that facilitates the exchange of information's flows, inputs and final goods needed for the creation of externalities and long-run growth. Considering that distances are significant in Mexico, a good road infrastructure allows entrepreneurs to adopt new technologies and generate economic growth (Batisse 2001, 14). Literature assumes that transportation, measured as the density of highway networks, also reflects the development of social infrastructure such as health services or schools (Mano and Otsuka 2000, 196).

Indicator. Ratio of total distance of major paved roads to total area of state. Expected sign: (+).

Human capital (*LNSCHOOL*) is the *quality of labor.* There are many ways to measure this variable such as share of population with a university education, literate rate or average schooling. Main argument is that well educated or skilled labor generates new ideas for production and thus fosters local growth.

> A significant number of papers confirm the connection between the initial level of human capital in an area and the later growth of that area. Regardless of whether human capital is measured as years of schooling, the percentage with high school degrees, the percentage of college educated, or a measure of education based on the occupational mix, there is a strong, steady connection between growth and initial skills in the area. (Glaeser 2000, 90).

Indicator. Average schooling (in logarithms). Expected sign: (+).

Labor supply (*LNEAP*). It directly relates to the cost of labor which is one of the classic location factors (the others are markets, raw materials and transportation costs). Because labor is required in any economic production, it is a variable always included in regional growth models. The case study measures this possible effect by inserting an indicator of the volume or size of labor force. Such an indicator is given by the participation rate of the population between 12 and 65 years old in the total population (Economically active population, EAP).

Indicator. Ln(*EAP*) as in Chiquiar (2005). Expected sign: (+).

Local market size (*LNPOP*). According to traditional trade theory demand bias in favor of a particular good will tend to cause net import of this good, since production structures are solely determined by relative prices and supply factors. New trade theory predicts more or less the opposite: a demand bias in favor of a particular good creates a large home market for this good and the interaction of economies of scale and trade costs typically lead to net export. It would be expected, *ceteris paribus,* that the industries characterized by the more significant scale economies to be the more concentrated ones. Thus, scale-sensitive industries will locate in the region with best market access. This is a generic result of models with increasing returns, monopolistic competition, and trade costs (Krugman 1980). Markets of inputs and final goods impulse regional growth because firms save transportation and communication costs.

> In general, firms prefer to locate near their suppliers and customers to economize on transport costs. Moreover, firms also benefit from sharing labor markets and better communicating with suppliers and customers in the situation of industrial agglomeration. (Gao 2004, 102)

Indicator. Ln(State population) (Henderson 1997, 467). Expected sign: (+).

Sectorial comparative advantage (*LNSERVICE*). The regression coefficient for *SERVICE* will be positive if market and non market linkages show that services and manufacturing are complementary. The coefficient would be negative if services substitute manufacturing. Considering that in general manufacturing loose comparative advantage in favor of services, I expect a negative coefficient, therefore, a negative effect of *SERVICE* on industrial regional growth (Mano and Otsuka 2000, 196).

Indicator. Ratio of the service sector to the manufacturing sector. This ratio is calculated for every state *i* as follows:

$$SERVICE_i = \frac{GSP\ in\ services / total\ GSP}{GSP\ in\ manufacturing / total\ GSP}$$

Expected sign: (-).

Foreign Direct Investment (*FDI*). This variable represent investment that brings advanced technology and efficient management (Batisse 2001), an opportunity of learning and create global links of reciprocity (Amin 1999), an element of pressure on local firms to be more efficient (Gao 2004), and local attractiveness to transnational firms.

Indicator. Ln(*FDI*). Expected sign: (+).

Urban population (*LNURBAN*). Urban population in a state can act in two ways (Coughlin *et al*. 2000): as a proxy for urbanization economies (network externalities) or as a proxy for land costs. If it acts as a proxy for network externalities, it is expected a positive relationship between urban population and regional growth. In practice one expects a positive effect on local industrial growth when a larger population density implies a higher local demand and the availability of a wider supply of local public services. The closeness of buyers may have a dynamic effect (network externality) related to the fact that this may facilitate early perception of market needs.

On the other hand, if density acts as a proxy for land costs, I expect a negative between density and growth because of the high costs involved in locating a new plant.[8] In this case, density may imply diseconomies of scale setting in when congestion effects prevails giving rise to pollution and higher competition on the factor markets meaning

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[8] Some authors who consider population density as a proxy for land costs are Figueiredo *et al.* (2002), Guimarães et al. (2000), and Bartik (1985).

higher factors costs (Arauzo 2005). If urban congestion, cheap land and labor are important for locating new establishments in less urbanized areas the coefficient for *URBAN* will be negative (Mano and Otsuka 2000). Results from previous empirical research are mixed. Population density has a mainly positive effect on location (List 2001; Woodward 1992; Guimarães *et al*. 2000), a mainly negative effect (Figueiredo *et al*. 2002), or a mixed effect (Coughlin *et al*. 2000).

Indicator. Percentage of population in areas of 15,000 inhabitants or more. Some authors suggest using demographic or economic density in areas where industries are located (Ciccone and Hall, 1996). The closest variable available for Mexico is resident population in metropolitan areas per km^2, but it only exists for year 2000, almost at the end of the period of study (CONAPO on line). Therefore, I use the percentage of total population living in areas of 15000 inhabitants or more as a proxy measure of demographic density. Expected sign: (+/-).

<u>Neighbor effects (*Wy*)</u>. This variable represents inter-regional externalities[9] or "neighbor effect," as suggested in recent studies (Anselin 2002, and Gezici and Hewings 2004). Inter-state externalities are close to the concept of *edge effects* in statistics:

> These arise where an artificial boundary is imposed on a study, often just to keep it manageable. The problem is that sites at the edges of the study area only have neighbors toward the center of the study area. Unless the study area has been defined very carefully, it is unlikely that this reflects reality, and the artificially produced asymmetry in the data must be accounted for. (O'Sullivan and Unwin 2003, 34).

[9] In this research I distinguish inter-regional externalities or inter-state influences from intra-regional externalities of specialization (MAR), competition (Porter), and variety (Jacobs) externalities.

In other words, "neighbor effects" arising because of spillovers beyond the state limits may be statistically treated as "edge effects" and solved using spatial autocorrelation. Spatial autocorrelation occurs when similar (high or low) values for a random variable tend to cluster in space (positive autocorrelation), or locations tend to be surrounded by neighbors with very dissimilar values (negative spatial autocorrelation). In statistical inference, a spatial autocorrelated variable implies a loss of information than an uncorrelated counterpart. For this reason, advances in econometrics introduced by the Belgian economists Jean Paelinck in the 1970's and Luc Anselin in the late 1980s, request that all models referring location in space check for a test of spatial autocorrelation.

The existence of spatial autocorrelation in the dependent variable (y) may be solved including its spatial lag term (Wy) in the regression. In spatial autocorrelation, the "spatial lag term" stands for the value of the variable y in its neighbor units (W). Similar procedure is recommended for the error term. Since Wy may create problems of simultaneity, the spatial equation must be estimated using the maximum likelihood procedure or a set of dummy variables (Anselin 2002, 4).

Spatial autocorrelation may be present either in the dependent or independent variables, and the error term. Diagnostic tests center on spatially lagged dependent variables (Wy) and spatially lagged error terms (Wu). Theoretical reasons must justify including and testing for spatially lagged explanatory variables (WX). Because main focus in my research is to identify possible effects of intra-regional externalities, I will only include Wy to account for the "neighbor effect," if the diagnostic tests justify it.

Accessibility to the home market and US market (*CENTRAL, DISTMC, DISUS*).

Three final indicators include differences in growth performances related to geographical localization.

Centrality (CENTRAL). It is considered that

> [R]egions with a large internal market potential have an absolute advantage in finding a diversified specialization. Moreover, when a region has a large internal as well as external market-potential the competitive advantage increases even further. (Karlsson, Johansson and Stough 2001, 10)

I follow Brülhart (2000b) to calculate the following centrality measure:[10]

$$CENTRAL_{ct} = \frac{1}{N} * \left[\left(\sum_d \frac{\Sigma GSP_d}{\delta_{cd}} \right) + \frac{\Sigma GSP_c}{\delta_{cc}} \right] t, \quad c \neq d \ ,$$

where c and d denote states, N is the number of Mexican states, and δ stands for geographical distance. This definition takes account of each state's own economic size (in terms of GSP) and area as well as of its distance from other markets. Bilateral distances δ_{cd} are defined as the distances between capital cities. Intra-state distances δ_{cc} are computed as one third of the radius of a circle[11] with the same area as the state in question, *i.e.* $\delta_{cc} = \left[\left(Area_c / \pi \right)^{0.5} \right] / 3$. I adjust this index to the scale from 0 to 100. Expected sign: (+).

Distance to Mexico City (DISMC) and Distance to the US border (DISTUS). These indicators represent the access to the two biggest markets especially relevant for two groups of states. The first group is composed of the six states bordering the United

[10] This index expresses Harris (1954) "market potential" concept. Head and Mayer (2001) examine several alternatives to measure centrality.

[11] Remember that for a circle Area=(πr^2). Therefore, $r = \sqrt{area / \pi}$. The "one-third of the radius" represents the average distance between two points in a circular country.

States (Baja California, Coahuila, Chihuahua, Nuevo Leon, Sonora, and Tamaulipas), which have strongly benefited of the open-door policy. They tend to be more integrated into NAFTA and global trade (Serra *et al* 2006). The rest of Mexican states compose the second group closer to the main domestic market, including its agglomeration economies: Mexico City. Expected sign for both *DISMC* and *DISUS*: (-).

Dummy variables (*BORDER*, *POLES*, *OIL*, and *REST*). I include four dummy variables to capture the effect of different regional economies on industrial growth. These economic structures may be favorable or adverse to industrial growth. *BORDER* represents five northern states (TAM, COA, CHIH, SON, and BC), main receivers of *maquiladora* industry (greenfield investment) and close to the US market. For this reason it expected their economies favor industrial growth. The dummy variable *POLES* identifies states containing the traditional industrial cities of Mexico City, Monterrey, and Guadalajara (DF and state of Mexico, NL, and JAL, respectively). Experience has demonstrated that states in this group have an economic structure that fosters industrial growth. The dummy variable *OIL* identifies oil producer states (CAM and TAB). Since most of regional resources are committed to an extractive rather than a manufacturing activity, it is considered that *OIL* negatively affects industrial growth. Finally, the fourth group (the benchmark category) includes the rest of states not included in previous groups. No sign is expected for this group; it will be the comparison group. Similar criteria to classify Mexican states is used by Banister and Stolp (1995), Chiquiar (2005), Rodríguez-Pose and Sánchez-Reaza (2005), and Rodríguez-Oreggia (2005).

Indicator: The state receives 1 if it belongs to the group in question, otherwise zero. Expected sign. *BORDER* (+), *POLES* (+), *OIL* (-).

4.2.3 Empirical test strategy

I follow five main steps to empirically test Model (4.4). The first step evaluates alternative dependent variables using different versions of the shift-share technique. The second step filters out, if possible, variables and organizes the database. It introduces each variable for the case study and examines alternative indicators for a same variable (*i.e.*, variables for MAR economies have two indicators, *lnGSPi* and specialization). The third step correlates all selected variables in previous step with industrial regional growth and verifies if coefficients have the expected sign. The null hypothesis (H_0) is that the two variables under consideration are unrelated and the observed value of the coefficient differs from zero only by chance. I expect to reject H_0 at a reasonable level of probability and conclude that the two variables are associated and have the sign expected from literature review (Table 4.3). However, establishing that a correlation exists between two variables is not the ultimate goal in my research. Therefore, the fourth step uses factor analysis to reduce the number of variables for a multiple regression analysis in the last step. Finally, the fifth step, guided by Model (4.4), uses results from previous variable reduction procedure to conduct a regression analysis and identify which variables, if any, explain regional growth.

4.3 Chapter remarks

This chapter has two main sections. First section presents main research question: what determines industrial regional growth? Following the convergence model, it also formulates the primary hypothesis to answer it: dynamic externalities, institutions, and other local conditions matter to explain regional growth.

Second section introduces the research methodology in two parts. The first part presents main procedures to describe main spatial patterns of industrial location and growth in Mexico. These procedures include descriptive statistics, weighted mean center, "Barro regression's," and an Index of Rank Mobility. Finally, the third part presents a heterodox model (a *quasi-function of production*) to explain regional growth (dependent variable) in terms of dynamic externalities, institutional variables, and other regional conditions (independent variables). This third part provides theoretical details for each variable, alternative empirical indicators, and expected sign in the model. Everything is summarized in Table 4.3 at the end of this chapter. The chapter closes with a chart that shows the logical relations between variables in the model (Figure 4.2).

Table 4.3. Variables and Indicators in the Regional Growth Model

Variables	Concept and indicator. Expected sign in brackets
Dependent variables	Industrial regional growth and regional competitiveness
GSP growth (RATE)	*Indicator*: Growth rate as a measure of production, not productivity or quality of life.
Regional competitiveness (RC)	*Indicator*: Competitive component, from different versions of the shift-share analysis or the constant market share technique. It identifies industries experiencing dynamic externalities.
Independent variables	Dynamic externalities (DE), institutions (I), and other conditions (OC)
1. Dynamic Agglomeration Economies (DE)	New Spatial Economics, NSE (Endogenous growth models and New Economic Geography, NEG). (Do not confuse it with Richardson's New Urban Economics or reduce it to Krugman's NEG).
Intra-industrial economies	Externalities that lie within the firm's own industrial activity (MAR externalities or Porter external economies). Assumption: Most learning and knowledge spillovers take place within individual sectors.
MAR externalities: Index of partial specialization (*SPEC*)	Regional advantages (trained labor force, existence of regional industrial atmosphere) that manifest themselves in more efficient establishments and, as such, ones with more capacity for competition. *Indicators*: Index of partial specialization and/or $lnGSP_{i,\ t-1}$. (+)

Table 4.3 - continued

Porter externalities: Competition (*COMP*)	Indicates that a firm located in an area where firms of other industrial activities have high competitiveness can receive spillovers from these other companies. It represents the advantage of being located near some infrastructure network. It attempts to show whether a region that is specialized in a few activities achieves a more competitive position. *Indicators*: Percentage of small firms and/or relative size of units in local industry *i*. (+)
Inter-industrial economies	Externalities that lie within the region where the firm is located (Jacobs externalities). Assumption: Most significant spillovers come from outside the individual sector.
Variety (*JACOBS*) (Jacobs externalities)	Effect of the economies of urbanization (availability of a large and diversified quantity of resources that increases the industrial productivity). *Indicators*: Unweighted index of global specialization and/or normalized Hirschman-Herfindahl Index. (+)
2. Institutional factors	New Institutional Economics claims that institutions are endogenous and matter for regional growth
Social capital (*OLSON* and *PUTNAM*)	Capacities of social organization such as trust, norms & networks *Indicators*: OLSON (rent-seeking groups). (-) PUTNAM (community-building groups). (+)
Income inequality (*INCOME*)	It may be adverse for regional growth if it creates social instability or significantly affects the real demand of goods and services. However, studies report that it favors regional growth in high per capita areas. *Indicators*: Gini coefficient (+/-)
Ethnicity (*ETHNIA*)	Possibility of ethnic discrimination. *Indicator*: Percentage of population (5 years old & +) that speaks an ethnic language. (-)
Election attendance (*ATTEND*)	People's general connection with society and their active role shaping it. *Indicators*: Electoral turnout in the Presidential election in 1994. (+)
Governmental performance (*GPI*)	Institutional quality combining bureaucratic quality (administrative performance) and efficiency in the provision of services. *Indicator*: Governmental Performance Index from Ibarra, Sandoval, & Sotres (2005). (+)
3. Other conditions (OC)	Natural advantages and local market conditions, and FDI
Transportation (*ROAD*)	Facilitates the exchange of information's flows, inputs, and final goods. It also reflects the development of social infrastructure (*i.e.*, hospitals and schools). *Indicator*: Ratio of total distance of major paved roads to total area of state. (+)
Human capital (*HC*)	Quality of labor *Indicator*: Average schooling in years (ln). (+)
Labor supply (*LS*)	Labor cost. *Indicator*: Ln(Economically Active Population). (+).
Local market size (*LMS*)	Firms locate near their suppliers and consumers to save transport costs and facilitate communication and information's flows. *Indicator*: State population (ln). (+)
Services (*SERVICE*)	Indicates if services substitute or complement manufacturing *Indicator*: Ratio of the service sector to the manufacturing sector. (-)
Urban population (*URBAN*)	Represents either network externalities or labor cost. *Indicator*: Percentage of population in areas of 15,000 inhabitants or more. (+/-)

Table 4.3 - continued

Foreign Direct Investment (*FDI*)	Opportunities of learning, contact with new technologies and effective management, and global links.
	Indicator: ln(FDI) (+)
Spillover or Neighbor effects (WY)	NSE suggests that industrial output in neighboring states may favor regional growth and competitiveness. It measures the spatial effect of industrial output in neighbor states.
	Indicator: Space-lag vector of industrial GSP growth rate. (+)
Accessibility	NSE predicts a close relationship between regional growth and easy access to large markets.
—Centrality (*CENTRAL*)	*Indicator:* Index of centrality. (+)
—Dist. to MC ($DISTMC_j$)	*Indicator*: kms. to Mexico City (ln). (-)
—Distance to the US border ($DISTUS_j$)	*Indicator*: kms. to the nearest US border city (ln). (-)
Dummy variables	
—BORDER	*Indicator*: TAM, COA, CHIH, SON, and BC= 1. Otherwise= 0. (+)
—POLES	*Indicator*: MEX, DF, JAL, and NL= 1. Otherwise= 0. (+)
—OIL	*Indicator*: CAM and TAB= 1. Otherwise= 0. (-)

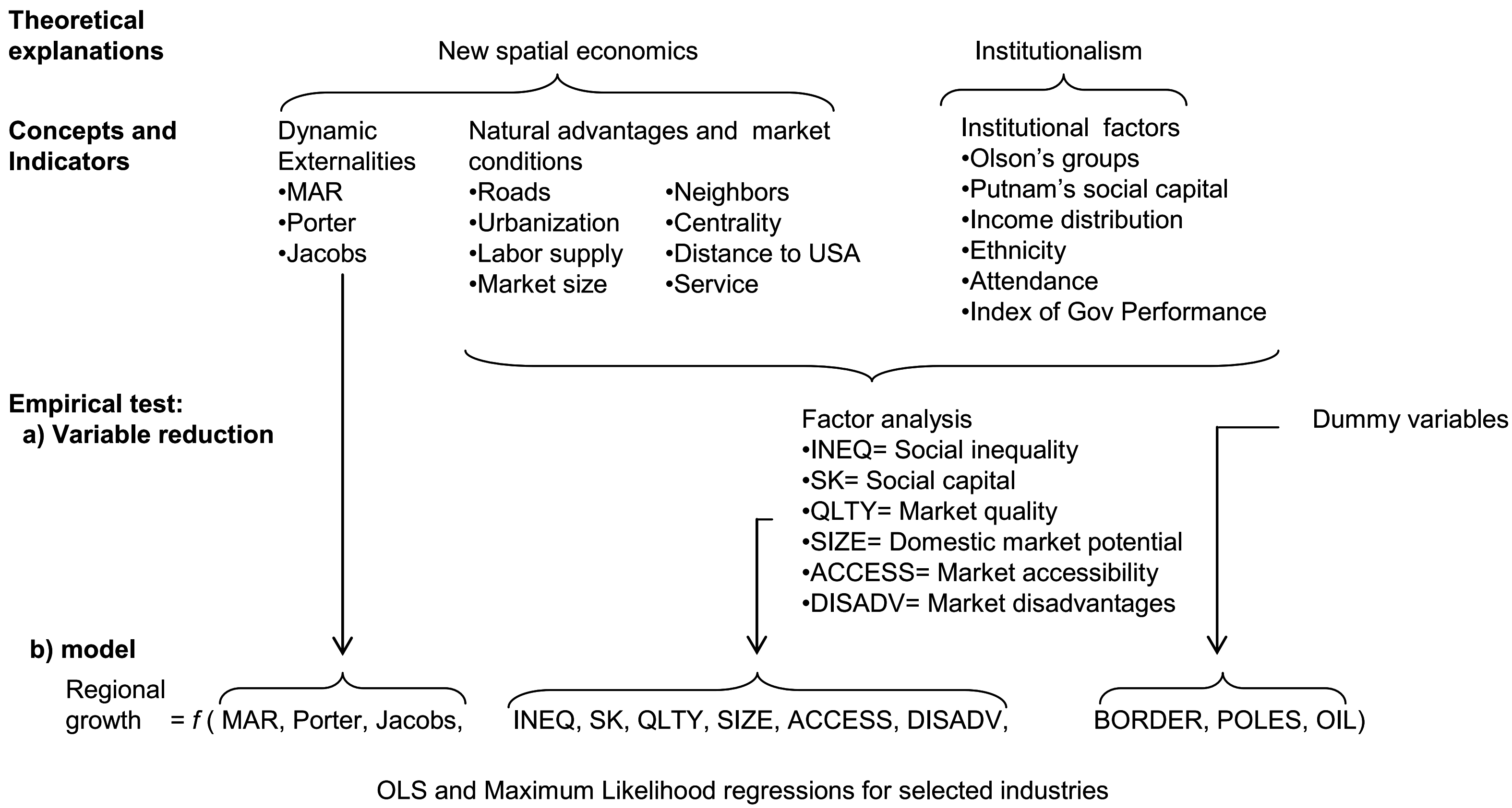

Figure 4.2 Theories, Concepts and Indicators to Empirically Test the Industrial Regional Growth Model

CHAPTER 5

INDUSTRIAL LOCATION AND GROWTH

This chapter describes the location and growth of industries in three sections. First section introduces the historical regional patterns of industrial location in Mexico. This section reviews how national strategies of economic development until mid-eighties favored industrial concentration in three cities: Mexico City (Mexico and DF), Monterrey (Nuevo León), and Guadalajara (Jalisco).

Second section centers on the spatial patterns of industrial growth to answer the research questions Where does industry locate? and Where does industry grow? This section describes the spatial distribution of industries and provides a regional taxonomy of industrial growth highlighting those states located on the free trade transportation corridors.

The last section presents the chapter remarks.

5.1 Spatial effect of the national strategies of development until mid-eighties

The Mexican strategy of industrial development before 1970 (import substitution industrialization and “stabilizing development,” ISI) focused on substituting imports of final consumption goods. This model was relatively successful until early seventies. The ISI protected domestic industry that did not required large investments or complex technology. As a result, the country became dependent on imports of intermediate inputs and equipment and technology needed for industrial production. An unintended consequence of this strategy was the concentration of industries in three main cities: Mexico City, located in the Valley of Mexico that includes the Federal District and the sate of Mexico; Monterrey, Nuevo León, in the northeast; Guadalajara, Jalisco, in the northwest; and Veracruz, in the Gulf of Mexico. Three factors explain this process of industrial concentration (Trevino 1985, Hernández 1985). First, national industry, protected by high barriers to imports for final consumption goods, mainly set up operations in the three biggest cities and enjoyed the captive domestic market they represented. Second, the physical condition of roads and communication technologies, both controlled by the Mexican government, required industries to locate close to the market (the major cities). Third, the political power of national entrepreneurs created a policy of economic incentives to locate industries in places where they were going to locate anyway.[1] These incentives included special tax abatements and subsidies to key inputs such as gas, electricity, and water. These three factors, combined with other agglomerative forces such as concentrated market of inputs and skill labor, reinforced the industrial concentration process in Mexico City, Monterrey and Guadalajara. An author concludes that "the Mexican import-substitution policy had, as its unintended byproduct, the expansion of the capital city because of production linkages and economies of scale" (Jovanović 2005, 584).

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[1] A clear example of this political power is the loan that the Mexican government granted in 1982 to ALFA, a national industrial group. Pedro Zorrilla, a former governor of Nuevo León, the state where ALFA locates its headquarters, latter declared: "the governmental support to ALFA was the result of conditions that the circles of power exert on the State. . . . [that] in current economic circumstances is favorable to the big firms" (Pedro Zorrilla Martínez, *Uno más Uno*, Tuesday 23, 1982.

The power of regional entrepreneurs to shape their local space is studied in Logan and Molotch (1987) and other literature reviewed by Swyngedouw (2000).

The ISI strategy by mid-seventies, with the discovery of new oil deposits and the international market favorable to oil producer countries, evolved into an oil export strategy of development. The weakness of the oil export strategy became evident in the economic crisis of 1982 and by mid-eighties the economy switched towards a liberalization of trade strategy. In 1985, Mexico signed as a member of the General Agreement on Tariffs and Trade (GATT). At this point, an author concludes, the highly concentrated pattern of Mexican industrialization had not solution:

> By 1985 it was clear that. . . . [the] efforts to decentralize industrial production in Mexico had failed. In 1970, 55.7% of national production came from four regions: the Valley of Mexico including and surrounding Mexico City, and the states of Jalisco, Veracruz, and Nuevo León. In 1985, the proportion remained essentially the same at 55.8%. The population was also highly concentrated in these areas, with 43% of the total, and 52% of the urban population. While some decentralization had taken place to the states on the northern border due to the extraordinary dynamism of the *maquila* in-bond assembly plants, this was not enough to offset the effects of three decades or more of centralization. (Bannister and Stolp 1995, 678-679)

Recent literature suggests that free trade reforms after 1985 made more accessible the US market and “broke-down” the spatial pattern dominated by Mexico City (Hanson 1996, 1998). This chapter examines the spatial evolution of industrial GSP (gross state Product) to explain its main sources of growth in the most recent period of the free trade strategy, the first decade of NAFTA (1993-2003). Does recent industrial growth reinforce the highly concentrated spatial pattern of industries or, as the new spatial economy (NSE) suggests, there is a spatial shift of manufacturing to the northern states? What are main determinants of industrial growth reproducing/counterbalancing the current pattern of industrial location? These questions define the content of the next section.

5.2. Where does industry locate? Where does industry grow?

Classical literature on industrial location since Alfred Marshall and Alfred Weber observes that industries in states or regions grow at a different rate, as a country develops. Some states grow faster than the average moving to higher ranks while others are left behind, falling to lower ranks. There are several ways to approach the evolution of the industrial regional activity in a country. The most common alternative is to directly compare the percentage of each region at the beginning of a certain period with its own growth rate (Serra *et al.* 2006 or Silva 2005). This comparison shows that Mexico and DF, the two states including Mexico City, concentrate more than a third (38.2%) of the national industrial GSP in 1993 and grows at a positive rate of 2.1% and 1.3% in period 1993-2003, respectively (Table 5.1). The two remaining industrial poles grow faster than Mexico City. They are Nuevo Leon (Monterrey) and Jalisco (Guadalajara), with a share in manufacturing of 8.6 and 7.4 per cent in 1993, respectively.

Most dynamic industrial economies, either with low or medium share in manufacturing, grow at the amazing rate of 6% or higher. These states are Baja California Sur (BCS), Coahuila (Coa), Guanajuato (Gto), Querétaro (Qro), and Aguascalientes (Ags) (Figure 5.1). All of them are to the North of Mexico City.

On the other hand, states with low share in manufacturing and the lowest or negative growth states are Nayarit (Nay), Hidalgo (Hgo), Tabasco (Tab), and Chiapas (Chis) (Table 5.1).

Table 5.1 Industrial GSP 1970-2003 (Percentages) and Growth Rate 1993-2003

	1970	1980	1993	2003	Growth Rate 1993-2003
COUNTRY	100.00	100.00	100.00	100.00	0.031
AGS	0.28	0.40	1.26	1.92	0.066
BC	2.05	1.75	2.64	3.58	0.045
BCS	0.17	0.14	0.09	0.14	0.060
CAM	0.28	0.22	0.10	0.12	0.014
COA	2.92	3.11	4.75	6.51	0.062
COL	0.17	0.16	0.14	0.17	0.025
CHIS	0.75	1.25	0.48	0.36	-0.009
CHIH	1.75	1.85	4.05	4.74	0.030
DF	32.20	29.46	20.85	15.97	0.013
DGO	1.04	0.94	1.19	1.23	0.033
GTO	2.80	2.38	3.26	5.05	0.074
GRO	0.49	0.40	0.45	0.61	0.027
HGO	1.50	2.19	2.17	1.69	0.003
JAL	6.89	6.66	7.42	6.83	0.019
MEX	17.51	18.07	17.39	14.69	0.021
MICH	1.05	1.29	1.39	1.46	0.039
MOR	0.81	1.05	1.65	1.51	0.013
NAY	0.58	0.63	0.34	0.25	-0.016
NL	9.53	9.11	8.65	8.74	0.043
OAX	0.77	0.95	1.10	1.31	0.021
PUE	3.14	3.78	3.77	4.93	0.053
QRO	0.92	1.41	2.09	2.82	0.065
QR	0.06	0.06	0.22	0.22	0.021
SLP	0.98	1.37	2.16	2.19	0.032
SIN	1.24	1.03	0.82	0.85	0.026
SON	1.29	1.28	2.34	2.36	0.017
TAB	0.36	0.54	0.40	0.37	-0.001
TAM	1.72	1.80	2.72	3.50	0.052
TLA	0.38	0.48	0.71	0.80	0.036
VER	5.07	5.27	4.36	3.74	0.013
YUC	1.05	0.84	0.83	1.10	0.046
ZAC	0.22	0.14	0.20	0.25	0.031

Source: Own calculations based on Table D.2 and Table D.5.

Figure 5.1 Mexico Political Division

Regional taxonomy. States within a country may be classified using the initial level of industrial GSP and its growth rate.[2] If the level of industrial GSP in 1993 is in the *x*-axis and the growth rate 1993-2003 in the *y*-axis, their intersection at the point of the national average for each indicator creates a typology of four groups of states (Figure 5.2): Winners (Quadrant I), Winners on the move (Quadrant II), Stagnated states (Quadrant III), and Recessing states (Quadrant IV).

[2] Unless otherwise indicated, this dissertation employs this procedure that has been recently used to classify regions within six Latin American countries (Silva 2005). Similar idea is used by Kowalski and Schaffer (2002) and Begg, Moore, and Altunbas (2002).

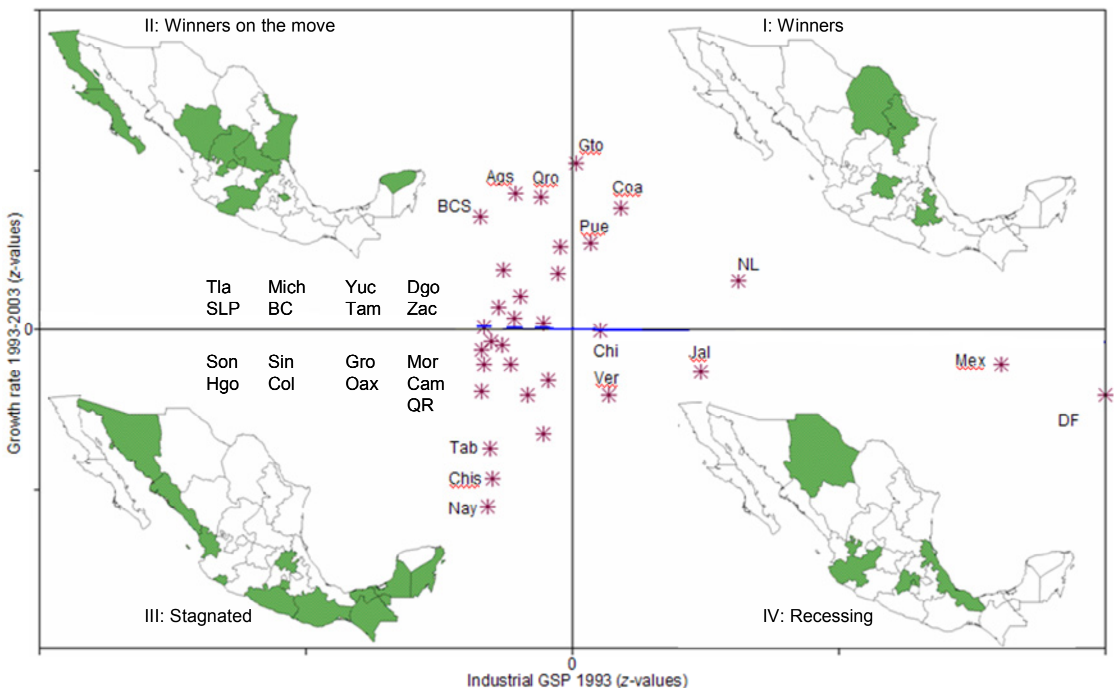


Figure 5.2 Taxonomy of Mexican States.

Source: Own elaboration in this research.

Table 5.2 Industrial Importance of Four Groups of Mexican States

Quadrant	Group	Number of states	Share of group's industrial GSP in total industrial GSP in 2003(%)
I	Winners	4	25.98
II	Winners on the move	11	18.07
III	Stagnated	12	8.53
IV	Recessing	5	47.41
	Total	32	100.00

Source: Own elaboration in this research.

Winners (Quadrant I). Dynamic states with high industrial GSP in 1993. These states have benefited from recent economic changes. Their level and growth rate of industrial activity is above the respective national average. There are only four winner states: Guanajuato (Gto), Coahuila (Coa), Puebla (Pue) and Nuevo León (NL). All together, these states produce about a quarter of the industrial GSP (26%, in Table 5.2) and are strategically located in relation to national and international markets. There are three interrelated reasons to support this argument.

First, winning states locate at or near the Mexico-US border. The Laredo-Reyosa-Matamoros urban axis is the closest international port for 26 out of the 32 Mexican states (Table 5.3). Second, almost 60% of the US-trade with Mexico is through the order in this urban axis (Table 5.4 and Figure 5.3). And third, closely related to the two previous points, wining states locate on the road network connecting main US markets of the Mid-West, the East Coast and main Canadian cities (Toronto and Montreal) (Figure 5.4 and Figure 5.5).

Table 5.3 Distance to the Closest US Border and Mexico City

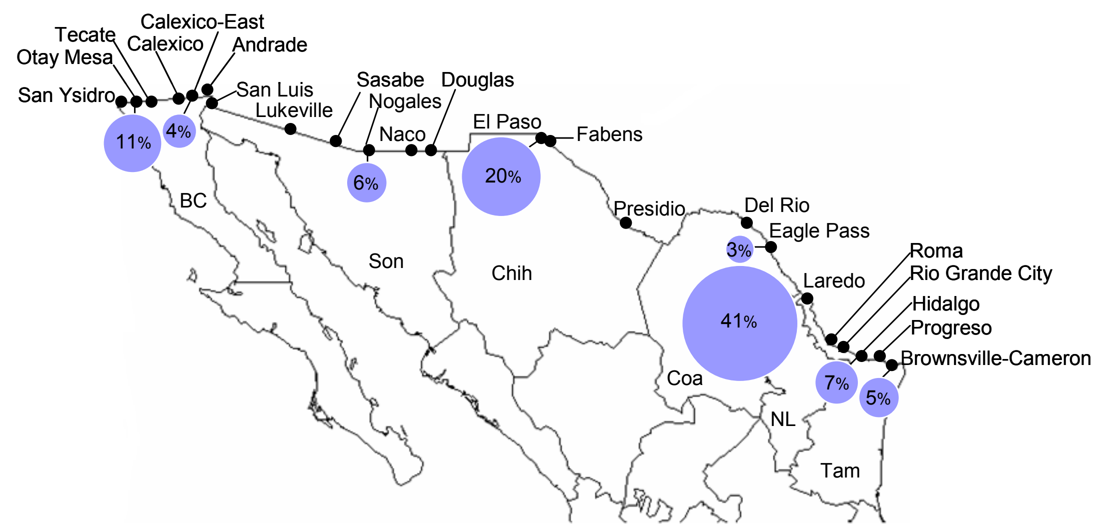
State (Capital city)	Closest Mexican city at the US border	Distance to US (Kms.)	Distance to Mexico City (Kms.)
Ags (Ags)	Reynosa	703	511
BC (Mexicali)	Mexicali	0	2644
BCS (La Paz)	Tijuana	1441	4309
Cam (Campeche)	Matamoros	1647	1154
Coah (Saltillo)	Reynosa	310	828
Col (Colima)	Nuevo Laredo	1133	693
Chis (Tuxtla Gutiérrez)	Matamoros	1689	974
Chih (Chihuahua)	Cd. Juárez	375	1468
DF (México City)	Reynosa	1024	0
Dgo (Durango)	Piedras Negras	813	920
Gto (Guanajuato)	Matamoros	868	365
Gro (Chilpancingo)	Matamoros	1416	275
Hgo (Pachuca)	Matamoros	838	88
Jal (Guadalajara)	Reynosa	1002	546
Edo Méx (Toluca)	Matamoros	992	64
Mich (Morelia)	Nuevo Laredo	1007	302
Mor (Cuernavaca)	Reynosa	1109	89
Nay (Tepic)	Matamoros	1131	762
NL (Monterrey)	Reynosa	225	925
Oax (Oaxaca)	Matamoros	1299	454
Pue (Puebla)	Matamoros	925	123
Qro (Querétaro)	Matamoros	772	215
QR (Chetumal)	Matamoros	2055	1360
SLP (SLP)	Matamoros	658	423
Sin (Culiacán)	Nogales	966	1261
Son (Hermosillo)	Nogales	275	1949
Tab (Villahermosa)	Matamoros	1396	773
Tam (Cd. Victoria)	Matamoros	312	702
Tlax (Tlaxcala)	Matamoros	912	113
Ver (Xalapa)	Matamoros	1040	306
Yuc (Mérida)	Matamoros, Reynosa	2039	1332
Zac (Zacatecas)	Reynosa	683	617

Source. Elaboration based on tables of distances in *Guía Roji*.

Table 5.4 US-Mexico Transborder Freight Data. Total for All Surface Modes of Transportation, 2002

TEXAS		NEW MEXICO		ARIZONA		CALIFORNIA	
Port	%	Port	%	Port	%	Port	%
Brownsville-Cameron, TX	5.32	Santa Teresa, NM	0.41	Douglas, AZ	0.29	Calexico-East, CA	4.35
Progreso, TX	0.07	Columbus, NM	0.02	Naco, AZ	0.04	Calexico, CA	0.00
Hildago, TX	6.56			Nogales, AZ	5.59	Tecate, CA	0.49
Rio Grande City, TX	0.09			Sasabe, AZ	0.00	Otay Mesa Station, CA	10.56
Roma, TX	0.08			Lukeville, AZ	0.00	San Ysidro, CA	0.03
Laredo, TX	41.05			San Luis, AZ	0.50		
Eagle Pass, TX	3.14			Andrade, CA	0.00		
Del Rio, TX	1.38						
Presidio, TX	0.10						
Fabens, TX	0.00						
El Paso, TX	19.91						
TOTAL	77.71		0.44		6.42		15.44

Source: Own calculations based on Table D.7.



Source: Table 5.4

Figure 5.3 US Ports and US-Mexico Transborder Freight Activity, 2002

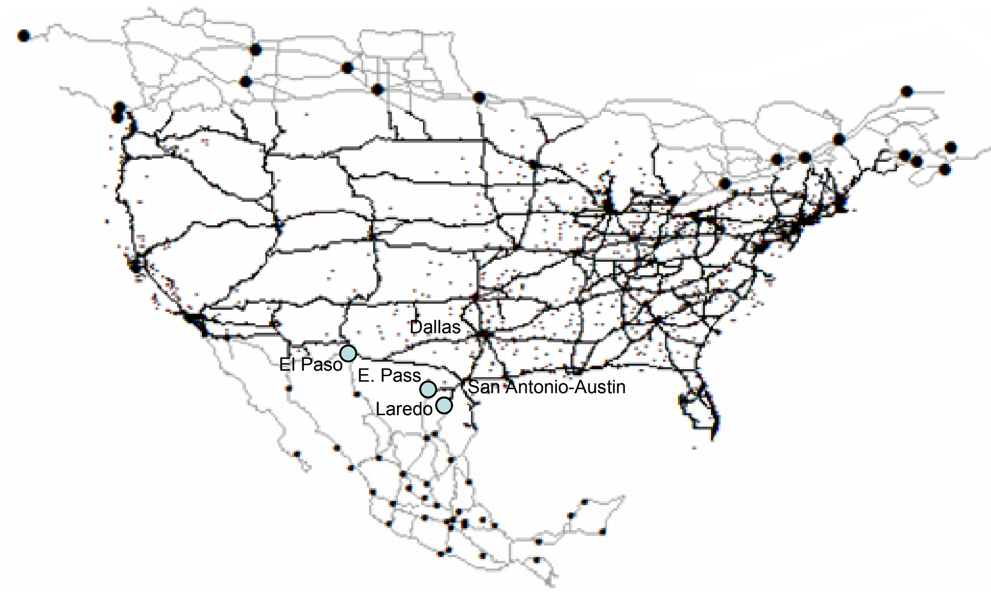


Figure 5.4 Location of the Three Main Ports of US-Mexico Transborder Freight Activity in the NAFTA Road Network.

Source: Own drawing using road data files in *ArcView* 3.1 and information in Table D.7.

Note: Only US cities are scaled 1:1000000. Points for Mexican and Canadian cities are indicative. The three circles represent the three main ports of US-Mexico transborder freight activity: Laredo, Eagle Pass, and El Paso.

Notice that Dallas is the main transportation hub between East and West and North and South. Most trade from Mexico going through Eagle Pass and Laredo converge in San Antonio-Austin and meets that from El Paso at Dallas. Form the Mexican geographic viewpoint, the El Paso port is more appropriate for products going to/coming from the US West Cost-Valley of Mexico and El Bajío Region (check main ports for California).

Mexican industries exporting to the Mid-West, the East Cost and Canada are better located anywhere between Mexico City and the north and northeast of the Mexico-US border (*i.e.*, Querétaro, Guanajuato, San Luis Potosí, Coahuila, Nuevo León, or Tamaulipas).

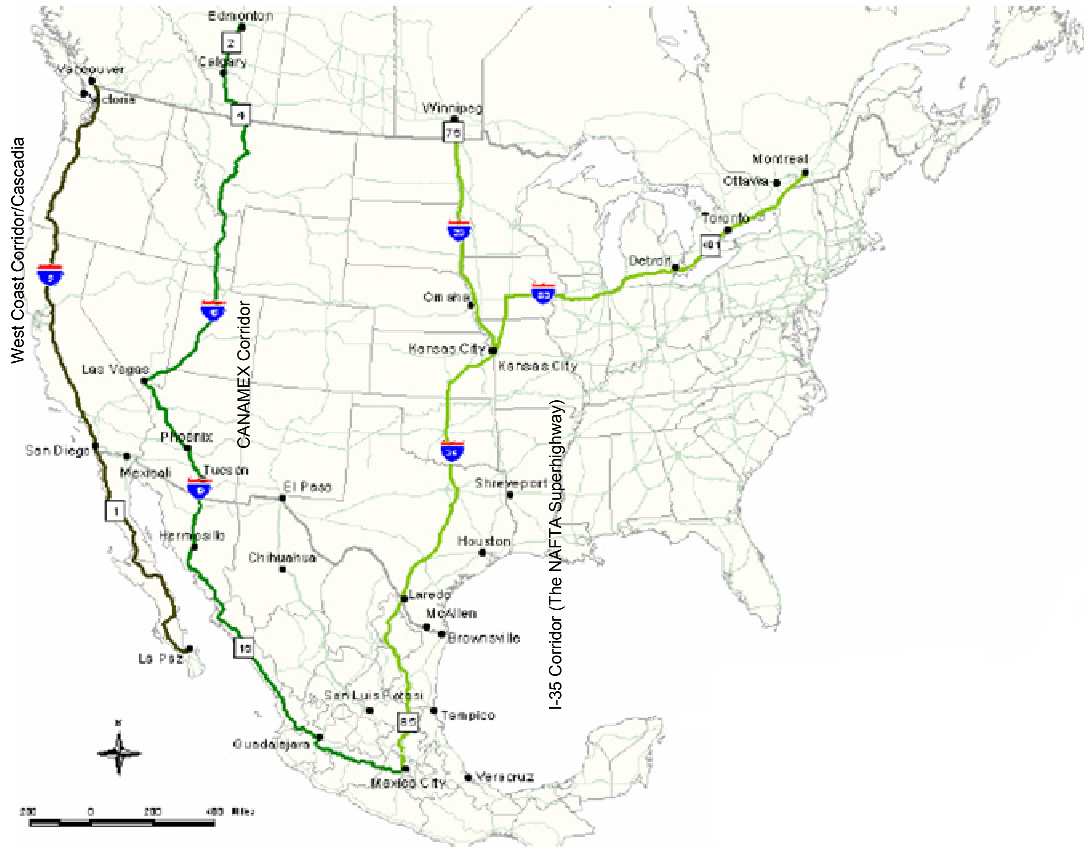


Figure 5.5 NAFTA Transportation Corridors

Source: After Ang-Olson, Jeffrey and Bill Cowart (N. D.)

Winning states on the move or rising stars (Quadrant 2). These states are dynamic economies growing at a rate above the national average but have a level of industrial GSP in 1993 below the national average. They are less industrialized than winners (as it is explained by their low levels of industrial GSP), but have an industrial base that supports high rates of industrial growth. There are eleven winners on the move producing 18% of the industrial GSP in 2003. They include Tlaxcala (Tla), San Luis Potosí (SLP), Durango (Dgo), Zacatecas (Zac), Michoacán (Mich), Yucatán (Yuc), Tamaulipas (Tam), Baja California Sur (BCS), Baja California Norte (BC), Aguascalients (Ags), and Querétaro (Qro). With the exception of Yucatán which needs further study, "winners on the move" also have a favorable location in the road network connecting national and international markets (Figure 5.4 and Figure 5.5). The high industrial dynamics is evident in all states located on the road network connecting the northeastern Mexican border with the international port of Lázaro Cárdenas (Michoacán) in the southwest of Mexico. Lázaro Cárdenas is an important port for the Far East markets, mainly Tokyo (Japan), Busan (Korea), Hong Kong, and Singapore (Figure 5.6 and Figure 5.7).[3]

Stagnated states (Quadrant 3). Stagnated or backsliding states are the least favored economies and the most numerous group (12 states) producing only 8% of the national manufacturing output. They are in the opposite situation of the winners (Quadrant 1). This group tends to increase its distance from the most dynamic states because their level and grow rate are below the national average. It is possible to identify three possible subgroups inside this category: the subgroup with some opportunity of change (Son, Sin, Nay, Hgo, and QR); the subgroup of economically lagged states from the south and southeast dominated by agriculture and high proportion of indigenous population (Gro, Mor, Oax, and Chis); and the subgroup of oil producer states (Tab and Cam).

[3] Further details may be obtained from the website of the Kansas City-Lázaro Cárdenas Transportation Corridor at www.kcsmartport.com.

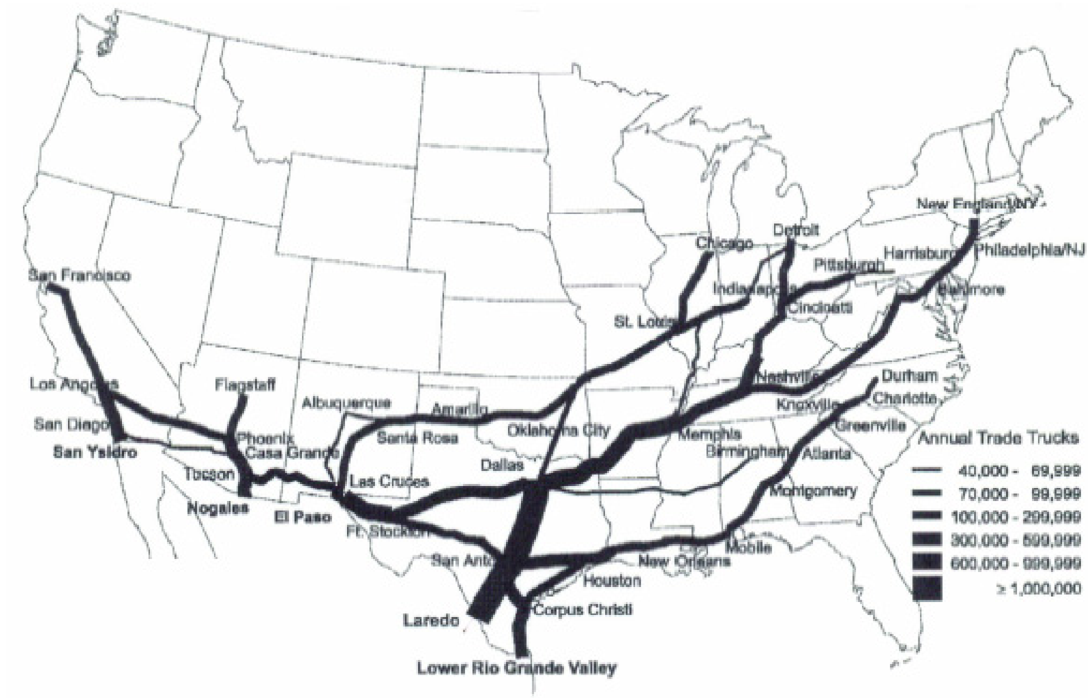


Figure 5.6 Dominant U.S.-Mexico Trade Corridors. Highway Segments with More than 40,000 Trade Trucks per Year, 1996.

Source: After McCray (1998).

Figure 5.7 Main Mexican Cities in the Lázaro Cárdenas-Kansas City Transportation Corridor

Source: Own elaboration based on brochures at www.kcsmartport.com.

Recessing states (Quadrant 4). These states are important industrial centers with the highest industrial GSP in 1993. They generate almost half of all Mexican industrial production (47%). Recessing states have levels of activity above the national average but grow at a rate below the national average. They include states in process of industrial reconversion (Jalisco and Veracruz), relative economic deconcentration from Mexico City (Mexico and Distrito Federal) and, to a lesser degree, direct dependency from the international industrial cycle and international division of labor (Chihuahua). Except for the "maquilador" state of Chihuahua located at the Mexico-US border, recessing economies are traditional economic poles that may recover their economic dynamism after temporal adjustments.

The main criticism to this taxonomy would be that big economies grow slower than the smaller ones. Such is the case of Mexico City (Mex and DF). But it is not the case of NL, the second industrial state, which grows at a higher rate than Jalisco (the third industrial area in Mexico). However, some people may insist, for example, that the movement of a state from tenth to sixth place implies a more remarkable achievement than that one moving from twenty-fifth to twenty-first. Although both cases advance four rank positions, the upward shift is more easily attained by the small state than by the large one. It is possible to overcome this problem focusing growth rate patterns in two different but complementary ways: first, using a regression line to see if small economies grow faster than bigger ones; and second, using a simple index of rank mobility.

Do small economies grow faster than bigger ones? As discussed in Chapter 4 (subsection 4.2.1), this study uses "Barro equations'" to identify if small economies grow faster than the bigger ones. Recall that the two basic variables in "Barro regressions'" are the growth rate (dependent variable) and the initial level of GSP (independent variable). If the coefficient for the independent variable is negative and statistically significant, small states grow faster than the bigger ones and, therefore, the regional system tends to converge. Results for the Mexican case study do not support the absolute convergence model (Equation 5.1). For period 1993-2003, the independent variable $ln(y_{93})$ is not significant and has the "wrong" sign.[4] The fact that the equation is not significant tells us that there is no direct relation between initial level of industrial GSP and its growth rate. The "wrong" sign indicates that, if the equation were significant, small economies do not necessarily grow faster nor large states grow slower. In terms of the neoclassical model, there is no absolute convergence and the model, neoclassical theorists would say, must be extended to include other regional "conditions" such as labor force skills, investment in infrastructure, and/or FDI.

(5.1) $$\frac{1}{T}\ln\left(\frac{y_{ij,t+T}}{y_{ij,t}}\right) = \underset{(.043)}{-0.007} + \underset{(0.003)}{0.003}\ln(y_{ij,t}) + u_{ij,t,t+T}$$

Where,

R^2=0.026; $\bar{R}^2$=-0.007; *SE of the Estimate* =0.022; F =0.380; n =32; Std. Error in brackets.

[4]This result for industrial GSP is consistent with recent studies for Mexico considering the whole economic activity (Chiquiar 2005; Rodríquez-Pose and Sánchez-Reaza 2005; García-Verdú 2005; Serra *et al.* 2006, Silva 2005).

So far, results in the equation (5.1) tell us that there is no direct correspondence between the level of industrial GSP and its growth rate. However, they say anything about the growth rate in specific states. It is possible to overcome this difficulty by the use of a simple index of rank mobility (M).

Rank mobility (M). The rank mobility index corrects the possible effect of small economies growing faster than bigger ones. Since the use of ranks does not need information on regional inflation rates to deflate the GSP that the "Barro regression" requires, this study extends the comparative period from 1970 to 2004 (Table 5.5). Results show that main economic poles—Mexico City, Monterrey, and Guadalajara, located in the states of Mexico and DF, Nuevo León, and Jalisco, respectively—were dominant through the whole period (1970-2004). Studies from the new spatial economics (NSE) perspective sustain that free trade liberalization policies operating since mid-eighties appear "to have contributed to a relocation of economic activity away from the closed-economy industry center in Mexico City and towards the border region with the USA" (Hanson 2000, 489). The weighted mean center (WMC) introduced in Chapter 3 (Methodology) confirms this finding: The WMC shows that the gravity center for manufacturing shifts from the Valley of Mexico to the north of the country from 1970 to 2003 (Figure 5.8).[5] On the other hand, state ranks and rank mobility show that main economic poles have maintained their position since 1970 and they continue growing at a positive rate (Figure 5.9). *If traditional poles maintained their position in the whole period, the only explanation for the shift from the center to*

[5] The neoclassical model would interpret this result as a "conditional" convergence explained by the regional characteristics of the northern states.

the northern periphery is that other states located in the north increased their growth rate. These states can be easily identified as those with a positive rank mobility in each period. In period 1993-2004, main responsible states of the industrial shift to the north are Guanajuato (Gto) and Querétaro (Qro). If period 1970-2004 is considered, main winners are Coahuila (Coa), Chihuahua (Chih), Guanajuato (Gto), San Luis Potosí (SLP), Querétaro (Qro), and Aguascalientes (Ags).

On the other hand, it may be noticed that the dynamism of northern states is not at the expense of the industrial growth in southern states. Main losers in the 1970-2004 period are not southern states (Table 5.5, and Figure 5.9): Puebla (Pue), Veracruz (Ver), Hidalgo (Hgo), Sinaloa (Sin), and Yucatán (Yuc). Except for Yucatán, which is located at the southeast, all southern states had a low industrial participation in the whole period. In short, the industrialization of the north does not imply a deindustrialization of the south or an absolute relocation of industries or a lost of the industrial primacy of main industrial cities.

So far, it is clear that rank mobility expresses the state growth rate and helps us to identify winner and loser states in a time period. A "Barro regression" line shows that there is no direct connection between the initial level of industrial GSP and its growth rate: larger industrial economies do not grow slower nor smaller ones faster. So, what does explain growth rate? Next chapter answers this question.

Figure 5.8 Shift of the Industrial Gravitational Center, 1970-2003.

Source: Elaboration based on Table A.8 and Table A.9. The Weighted Mean Centers are calculated using *Avenue* scripts for *ArcView 3.X* in Wong and Lee (2005). Dots represent state centroids generated by *GeoDa*™

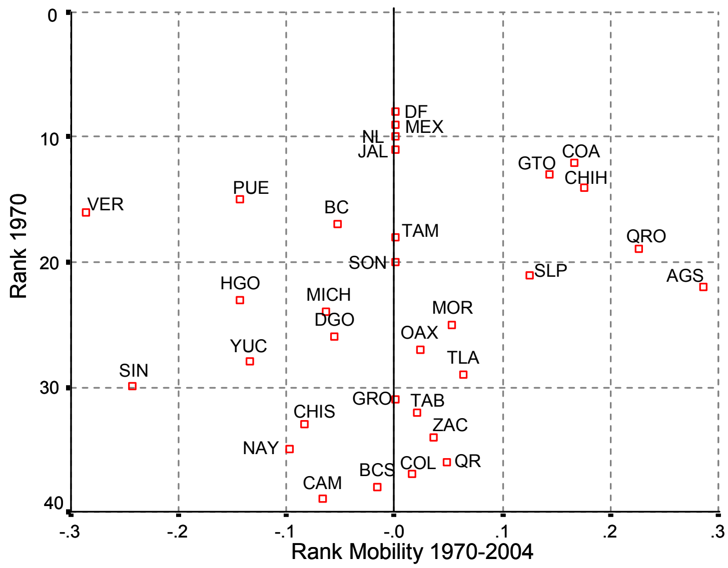


Figure 5.9 Rank 1970 and Mobility index 1970-2004

Source: Elaboration based on Table 5.5

5.3 Chapter remarks.

The two Mexican strategies of development until mid-eighties (the Import Substitution Industrialization until mid-seventies and the oil-export strategy that replaced it until early eighties) favored industrial concentration in only three main cities (Mexico City, Monterrey, and Guadalajara). The free trade reforms after 1985 (mainly the macroeconomic changes related to the GATT after 1985 and NAFTA after 1993) made the US market more accessible and broke down the highly concentrated spatial pattern of industries. This industrial deconcentration, however, selectively favors some northern states ("winners" and "winners on the move") located on the NAFTA transportation corridors in general, and those located on the Lázaro Cárdenas-Kansas City Transportation Corridor, in particular.

The chapter notes that the shift in the industrial gravity center to the North does not imply the deindustrialization of the South or a loss of the primacy of three main industrial growth poles Mexico City (Mexico and DF), Monterrey (Nuevo León) and Guadalajara (Jalisco). The analysis of the 1970-2004 period shows that all southern states had a low industrial participation through the whole period.

Finally, the analysis of spatial patterns of industrial growth shows that there is no direct connection between the initial level of industrial GSP and its growth rate: bigger economies do not grow slower nor smaller ones faster. So, what does explain growth rate? The next chapter answers this question in terms of dynamic externalities, institutional variables, and other regional conditions.

Table 5.5 Rank Mobility, 1970-2004

State	Ranks				Rank mobility				
	1970	1980	1993	2004	1970-1980	1980-1993	1993-2004	1970-2004	1980-2004
DF	1	1	1	1	0.000	0.000	0.000	0.000	0.000
MEX	2	2	2	2	0.000	0.000	0.000	0.000	0.000
NL	3	3	3	3	0.000	0.000	0.000	0.000	0.000
JAL	4	4	4	4	0.000	0.000	0.000	0.000	0.000
COA	7	7	5	5	0.000	0.167	0.000	0.167	0.167
GTO	8	8	9	6	0.000	-0.059	0.200	0.143	0.143
CHIH	10	10	7	7	0.000	0.176	0.000	0.176	0.176
PUE	6	6	8	8	0.000	-0.143	0.000	-0.143	-0.143
VER	5	5	6	9	0.000	-0.091	-0.200	-0.286	-0.286
BC	9	12	11	10	-0.143	0.043	0.048	-0.053	0.091
TAM	11	11	10	11	0.000	0.048	-0.048	0.000	0.000
QRO	19	13	15	12	0.188	-0.071	0.111	0.226	0.040
SON	13	16	12	13	-0.103	0.143	-0.040	0.000	0.103
SLP	18	14	14	14	0.125	0.000	0.000	0.125	0.000
AGS	27	27	18	15	0.000	0.200	0.091	0.286	0.286
HGO	12	9	13	16	0.143	-0.182	-0.103	-0.143	-0.280
MICH	15	15	17	17	0.000	-0.063	0.000	-0.063	-0.063
MOR	20	18	16	18	0.053	0.059	-0.059	0.053	0.000
DGO	17	21	19	19	-0.105	0.050	0.000	-0.056	0.050
OAX	21	20	20	20	0.024	0.000	0.000	0.024	0.000
YUC	16	22	21	21	-0.158	0.023	0.000	-0.135	0.023
TLA	25	25	23	22	0.000	0.042	0.022	0.064	0.064
SIN	14	19	22	23	-0.152	-0.073	-0.022	-0.243	-0.095
GRO	24	26	25	24	-0.040	0.020	0.020	0.000	0.040
TAB	26	24	26	25	0.040	-0.040	0.020	0.020	-0.020
CHIS	22	17	24	26	0.128	-0.171	-0.040	-0.083	-0.209
ZAC	29	30	29	27	-0.017	0.017	0.036	0.036	0.053
NAY	23	23	27	28	0.000	-0.080	-0.018	-0.098	-0.098
QR	32	32	28	29	0.000	0.067	-0.018	0.049	0.049
COL	31	29	30	30	0.033	-0.017	0.000	0.016	-0.017
BCS	30	31	32	31	-0.016	-0.016	0.016	-0.016	0.000
CAM	28	28	31	32	0.000	-0.051	-0.016	-0.067	-0.067

Source. Own calculations based on Table D.2. States arranged in descending order in 2004

CHAPTER 6

DETERMINANTS OF INDUSTRIAL GROWTH

What determines the industrial regional growth rate? Following the empirical strategy outlined in Chapter 4 (Methodology), this chapter organizes the answer into six parts: first part evaluates alternative dependent variables and concludes that the only viable dependent variable in this research is the growth rate in the logarithmic form. Second part examines variables having more than one indicator and establishes criteria to choose competing indicators. Then, it carries out an inter-correlation checking of all selected indicators to examine and prepare the database for statistical analysis in next sections. Third part uses a simple correlation analysis to provide information on the hypothesized relationships between variables. The fourth part, excluding all highly correlated indicators identified in the second part, uses factor analysis to reduce the number of variables for the multiple regression analysis. The fifth part conducts a regression analysis to identify which variables, if any, explain regional growth.

The last section presents the chapter remarks and extends the relevance of main findings for planning and public policy.

6.1 Sources of regional growth

This section focuses on the question what determines the industrial regional growth rate? The answer is organized in five parts: alternative dependent variables, alternative independent variables and inter-correlation checking, expected relationships (simple correlation analysis), variable reduction (factor analysis), and regression analysis. Next lines expand each one of these parts.

Alternative dependent variables. A region may grow above the national average for two reasons: it has a mix of fast growing industries and/or it has industries growing faster than their respective industry's national average. For this reason, empirical literature shows that total regional growth may be decomposed into components representing national forces, the region-specific industrial mix, and region-specific characteristics. This decomposition has, at least, four related benefits: First, the growth rate decomposition isolates the regional advantage component that *numerically expresses the concept of regional competitiveness and its relevance in regional growth*. Second, each component may be examined to identify clusters of states with regional advantages (hot spots) or cluster of falling behind states (cold spots). Third, it allows measuring the relevance of regional competitiveness in relation to the rest of components of regional growth. And fourth, it is important to separate or "break up" total regional growth because different dynamic externalities may differently affect each of these components (the mix or regional comparative advantage component) and the total growth of *all* existing industries. For example, industry specialization (MAR externalities) may attract fast growing industries, while industry diversity (Jacobs externalities) raises growth for *all* existing industries. Examining total growth only gives the aggregate effect neglecting the counterbalancing forces of MAR and Jacobs externalities on regional growth (Partridge and Rickman 1999, 320). Considering all these four benefits, planners and policy makers, based on the industrial performance, would suggest that a region should design incentives to have a special mix of fast growing industries. In other words, they would approach regional growth from the viewpoint of “what-regions-do.” On the other hand, those approaching regional growth from the characteristics of the place perspective would emphasize agglomeration economies, especially dynamic externalities and actions to support them. They would suggest actions to make the area attractive or desirable to set up activities such as better education, efficient investments in infrastructure, and *ad hoc* taxation (new spatial economics and intitutionalism). In other words, the approach on place refers to “how-regions-do-it” (Malpezzi, Seah, and Shilling 2004). In policy making, whereas “what-regions-do” (industrial structure effect) implies activity oriented actions, “how-regions-do-it” (regional effect) entails place oriented policies

Regional growth components. This research uses the shift-share analysis to identify what industries and components of industrial growth have greater impact on the current distribution of economic activities and it previous evolution. Unlike those studies using this technique to analyze the role of regional competitiveness in the context of the convergence/divergence debate (*inter alia*, Doyle and O’Leary 1999, Paci and Pigliaru 1997, and O’Leary 2003 and 2005), *this research applies the shift-share analysis to numerically express the concept of regional competitiveness (“how-regions-do-it” rather than “what-regions-do”) and its relevance in regional growth*. This preference for the regional competitiveness component comes from the assumptions that it represents all “common features within a region which affect the competitiveness of all firms located there" (Commission Européenne, 1999). This study assumes that these "common features" include dynamic externalities and other variables included in the model in this research. The methodological decision in this dissertation is in tune with a recent formulation of the shift-share analysis that is used "for identifying industries in the local economy that may be exhibiting dynamic agglomeration economies" (McDonald 1997, 359). As such, this dissertation reviews and uses three different versions of the shift-share for the identification of industries experiencing regional competitive advantages.[1] These advantages may be related to the endogenous structure (entrepreneurship, efficiency of public policies, dynamic externalities) or exogenous factors (national/international economic shocks, regional geographical or historical conditions to attract labor-intensive transnational companies) (Meunier and Mignolet 2005, 87).

In the Mexican case study, after reviewing results for several shift-share adaptations to decompose the local growth rate, this study selects and examines the traditional method of decomposition (TMD), as in Peh and Wong (1999); the constant market analysis (CMA) in Laursen (1999); and the Malpezzi's *et al.* (2004) version.

[1] Some authors prefer the two-factor shift-share approach instead of its conventional three-component expression. They suggest that while the three-component version is appropriate for examining economic change in a particular region, the two-factor approach seems more suitable when a region is compared to another (Meunier and Mignolet 2005). This research reviews versions for both the two and three-component formulations.

Limitations and benefits of the shift-share are very well known. In the Mexican case study, two points should be mentioned among the widely discussed points in the in the literature (Polèse and Shearmur 2006, 368 and 371): (a) results are sensible to different levels of spatial and industrial aggregation, (b) The interpretation of the regional effect or competitive component is not straightforward: above average industry "shifts" may be the result of a combination of different possible processes (new plants, plant expansion, plant closures, downsizing). In some cases, a positive competitive component may simply reflect that a declining industry has declined less rapidly in the state than elsewhere.

Calculation details for all these three versions are presented in Chapter 4 (Methodology, subsection 4.2.2.1). Applying these adaptations to the Mexican data, this section shows that the competitive effect is the dominant component explaining the aggregate industrial growth rate. However, detailed statistical tests show that it is not worthwile to conduct such decomposition analysis at the aggregate level. The same situation is true at the specific industry level: Food, Chemicals, Machinery, and Other industries. On the other hand, none of the regression models is statistically significant in industries where the competitive component is not dominant (Textiles, Paper, Wood, and Nonmetallic industry). Therefore, the competitive component is discarded as an alternative dependent variable. As such, the dependent variable in this research is the logarithmic growth rate, as originally stated in the model. Table 6.1 presents all details on the decomposition exercise for the whole industrial activity.

Coefficients for all four components in the CMA version are statistically significant. However, the dominance of the competitiveness term (MSE) is evident: it alone explains about 99% of the industrial growth rate variation. The four effects in the CMA version may not be independent. Some scholars suggest regressing the growth rate against its various components resulting from the shift-share analysis (excluding competitiveness) to identify the influence of structural and interaction components (Cheptea, Gaulier, and Zignago 2005, 28-29). In the Mexican case of study, this exercise is not necessary considering the high value of R^2 in the competitive component.

On the other hand, in the TMD version only the national and industrial mix coefficients are significant. Unfortunately, the national component is not relevant for this research and industrial mix only explains about 18% of the variation. Therefore, next lines will only center on the CMA and Malpezzi's versions.

Finally, in Malpezzi's version, the competitive component (COM) is the only one showing a significant coefficient and explaining about 50% of the growth rate variation. Both mix and interaction terms are not statistically significant and have a very low explanation power.

Table 6.1 Regression Parameters for Components of Industrial Growth from Three Shift-Share Versions.

	Constant Market Analysis (CMA)				Shift-Share (TMD version)				Shift-Share (Malpezzi's version)			
		$\hat{a}$	$\hat{b}$	R^2		$\hat{a}$	$\hat{b}$	R^2		$\hat{a}$	$\hat{b}$	R^2
—					NAT	1088834.2** (479439.9)	0.579*** (0.112)	0.470				
Model μ	MSE	6.752 (0.000)	1.161*** (0.021)	0.990	COM	2441481*** (534321)	0.195 (0.168)	0.043	COM	-0.041 (0.042)	0.596*** (0.109)	0.499
Model π	SME	-8.526 (0.001)	3.728*** (1.115)	0.271	MIX	2199451*** (506971)	3.390*** (1.339)	0.176	MIX	0.050 (0.054)	1.552 (1.031)	0.070
Model φ	ADAP+	-4.662 (0.001)	7.959*** (0.672)	0.824	INT	2363732*** (536775)	-0.652 (0.492)	0.055	INT	0.054 (0.059)	0.174 (0.221)	0.020
Model θ	ADAP-	7.820 (0.001)	-24.025*** (2.815)	0.708								

Standard Error in parenthesis. *** and ** significant at the 0.01 and 0.05 level, respectively.

Source: Calculations based on Table D.20 and Table D.21.
Note: Dependent variable: total growth rate as measured in each of the three models.

- MSE: Market Share Effect; SME: Structural Market Effect; ADAP+: Market Growth Adaptation Effect; and ADAP-: Market Stagnation Adaptation effect.
- NAT: National or overall effect; MIX: Industry Mix Effect; COM: Regional Effect; and INT: Interaction effect.
- As presented in section 4.2.2.1 in Chapter 4, Model μ is for the competitive effect (COM=MSE); Model π is for the Industrial Mix Effect (SME=MIX); Models φ and Model θ is for the adaptation effect (ADAP≈INT). The formal equations for all models correspond to the system of equations (4.8) presented in Chapter 4. The NAT (National) component in the TMD version is not in this system of equations. Data reported for NAT are the result of regressing the industrial growth rate on the National component.

Basic Metal Industry, as in Bannister and Stolp (1995), is not included due to its extreme concentration in a few regions.

Partially following Malpezzi, Seah and Shilling (2004) and basic statistics, this study suggests taking the component with the highest R^2 and check if remaining components add significant explanation to the variation. Discarding the TMD version, the competitive component ("market share effect" in the CMA, or "relative or competitive growth" in Malpezzi's shift-share) has the highest R^2. Table 6.1 shows that all components in the CMA are statistically significant on the basis of *separate t* tests. Now, to measure the "incremental" relevance of each component, this dissertation suggests using the competitive component (the one with the highest R^2) in a basic equation that sequentially introduces each one of the remaining components at the time. For the CMA version, main expressions are:

(6.1)
$$r_{ist} = a + b_1 MSE + b_2 SME + e$$
$$r_{ist} = a + b_1 MSE + b_2 (ADAP+) + e$$
$$r_{ist} = a + b_1 MSE + b_2 (ADAP-) + e$$

The conditional explained variance measures the statistical effect of each component sequentially introduced. It is given by $\Delta R^2 = \frac{(R^2_{new} - R^2_{old})}{R^2_{old}}$, where R^2_{old} is the R^2 in *separate t* tests for each component and R^2_{new} is R^2 for the *sequential* introduction of each component. Considering that MSE alone explains about 99% of the growth rate variation, it is not a surprise that increments are insignificant (Table 6.2).

Table 6.2 *F-value* Test for Additional Components in Three Different Versions of the Shift-Share Analysis.

CMA version. Net increment to explained variance to MSE (in percent)			Malpezzi's version. Net increment to explained variance to REL (in percent)	
MSE	ADAP+	ADAP-	MIX	INT
ΔR^2= 0.8% R^2= 0.998 $F_{1,29}$= Fc = 7.60			ΔR^2= 0.7% R^2= 0.569 $F_{1,29}$= 4.71 Fc = 7.60	
	ΔR^2= 0.1% R^2= 0.991 $F_{1,29}$= Fc = 7.60			ΔR^2= 47.2% R^2= 0.971 $F_{1,29}$= 472 Fc = 7.60
		ΔR^2= 0.0 R^2= 0.990 $F_{1,29}$= Fc = 7.60		

Source: Calculations based on information in Table D.20 and Table D.21.

In cases where the net increment to the explained variation is high, as in the interaction component in Malpezzi's version, it is useful to test if the additional component is statistically significant. The null hypothesis is H_0: $\rho^2_{new} - \rho^2_{old} = 0$ in the population. If H_0 is rejected, it is possible to conclude that the addition of the new growth component to the basic equation significantly increases the Explained Sum of Squares (ESS) and hence the R^2 value. Therefore, the new growth component should be added to the equation. Statistics textbooks suggest the following version of the F test (Guajarati 1995, 250-253, and Knoke and Bohrnstedt 1994, 414):

$$(6.2) \qquad F_{(k_2-k_1),(N-k_2-1)} = \frac{(R^2_{new} - R^2_{old})/(k_{new} - k_{old})}{(1-R^2_{new})/(N-k_{new}-1)}$$

Where:
k_{new} = The number of independent variables in the equation used to estimate R^2_{new}
k_{old} = The number of independent variables in the equation used to estimate R^2_{old}

In this equation, $k_{new} > k_{old}$, and since R^2_{new} is based on more variables than R^2_{old}, it is always true that R^2_{new} is greater than R^2_{old}. Replacing values for Malpezzi's version,

Industry Mix (MIX):

$$F_{1,29} = \frac{(0.569 - 0.499)/(2-1)}{(1-0.569)/(32-2-1)} = 4.71$$

Interaction (INT):

$$F_{1,29} = \frac{(0.971 - 0.499)/(2-1)}{(1-0.971)/(32-2-1)} = 472$$

The critical value of F for α=0.01 with 1 and 29 degrees of freedom is 7.598.[2] This value indicates that it is *not* possible to reject the null hypotheses for industry mix. Therefore, it is concluded that the industry mix component does not add a significant explanation power to be included in the equation.

On the other hand, the interaction component adds 47.2% to the variation explained in the growth rate. Since F= 472 is higher than the critical value of F for α=0.01, the null hypotheses is *not* accepted. It is concluded that the interaction

[2] Tables for critical values of F-statistics are available at:
http://www.itl.nist.gov/div898/handbook/eda/section3/eda3673.htm
http://faculty.vassar.edu/lowry/apx_d.html
http://www.statsoft.com/textbook/sttable.html#f10
The F-statistics may also be obtained by using the online calculator at:
http://www.biokin.com/tools/fcrit.html

significantly increases the ESS and hence the R^2 value. Therefore, unlike the industry mix component, the interaction term should be added to the model.

When the structural and/or adaptive effects are significant they should be explicitly included in the regressions that explain regional growth. As an example, Garcia-Mila (1993) presents a theoretical framework and identifies variables to specifically explain the regional mix component. However, in the Mexican case study the determinants of growth model will be conducted only using the competitive component in the CMA version for three reasons: It reports the highest R^2 (99%) and correlates high (rank correlation of 0.796) with the "relative growth" component in Malpezzi's version.

Considering previous results, there are two candidates to express the dependent variable: the total growth rate and its competitive component in the CMA version. Since the competitive component explain almost all variation in total growth rate in the CMA version (it is confirmed by a rank correlation coefficient of 0.982 between the competitive component and the total growth rate), the dependent variable is only expressed in logarithmic terms of total growth rate. Additionally, neither of the regression models having the competitive component as dependent variable is significant for the aggregate industry as a whole or for specific industries. Briefly, the only dependent variable in this research is the logarithmic growth rate.

6.2 Alternative independent variables and inter-correlation checking

Variables with more than one indicator. This section examines all three variables representing dynamic externalities, two institutional variables (social capital and income distribution) and one variable representing other regional conditions (market accessibility). The reason is that these variables have more than one indicator. In the interest of parsimony, one-indicator variables are not examined in this section.

Dynamic externalities. All three variables (MAR, Porter, and Jacobs economies) in this set have more than one indicator.

Specialization (MAR economies). In this research, MAR externalities stand for dynamic economies of specialization and are measured by the natural logarithm of industrial GSP and/or the Hoover-Balassa index of specialization presented in Chapter 4 (Methodology) (Table A.23). Its calculation is straightforward and does not require further comment.

High rank correlation coefficients between specialization and $lnGSP_i$ show that they may be used as interchangeable measure of MAR economies for Metallic, Machinery, and Other industries (Table 6.3). However, in remaining industries (Food, Textile, Paper, Wood, Chemicals, and Non-Metallic industries) the correlation is not high (less than 0.8). In this case some elaboration is necessary, as suggested in Chapter 3 (Methodology): $lnGSP_i$ and the specialization index are complementary measures of specialization. On the other hand, $lnGSP_i$ may also measure convergence or congestion diseconomies for the specific industry rather than economies of specialization. This ambiguity is partially cleared out in correlations of all variables in each set (*i.e.*, MAR, Porter, and Jacobs in the dynamic externalities set) in the next section. So far, it is concluded that specialization index and $lnGSP_i$ may be simultaneously used to capture MAR economies in Food, Textile, Paper, Wood, Chemicals, and Non-Metallic industries. In remaining industries, any of these two indicators may work, but not both values at the same time because they "tell the same story."

Table 6.3 Rank Correlation Between Industrial *lnGSPi* and the Specialization Index, 1993

Specialization Index	GSP 1993 (in logarithms)								
	LNFOOD	LNTEXTIL	LNPAPER	LNWOOD	LNCHEM	LNMET	LNNO_MET	LNMACH	LNOTHER
S_FOOD	-.436(*)	-.723(**)	-.566(**)	-.375(*)	-.669(**)	-.606(**)	-.735(**)	-.843(**)	-.644(**)
S_TEXTIL	.234	.769(**)	.238	.219	.239	.420(*)	.406(*)	.447(*)	.468(**)
S_PAPER	.035	-.254	.215	.087	-.034	-.108	-.169	-.197	-.112
S_WOOD	-.308	-.428(*)	-.308	.303	-.575(**)	-.308	-.472(**)	-.426(*)	-.177
S_CHEM	.361(*)	.299	.454(**)	.061	.795(**)	.213	.429(*)	.325	.103
S_MET	.655(**)	.665(**)	.624(**)	.565(**)	.497(**)	.878(**)	.743(**)	.643(**)	.561(**)
S_NO_MET	-.312	-.116	-.302	-.333	-.137	-.015	.123	-.131	-.187
S_MACH	.405(*)	.643(**)	.476(**)	.299	.385(*)	.494(**)	.553(**)	.840(**)	.662(**)
S_OTHER	.285	.469(**)	.360(*)	.403(*)	.126	.381(*)	.297	.489(**)	.833(**)

** Correlation is significant at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed).
The value for Metallic industry is based on 22 cases. Rest of coefficients is calculated for 32 cases.

Competition (Porter economies). This variable indicates the intensity of local competition and is measured in terms of the relative firm size (*SIZE*) or the relative number of small firms (*SMALL*) (Table A.23). This dissertation chooses *SIZE* for three reasons: first, it correlates high with *SMALL* (the rank correlation coefficient is 0.963); second, there are data constraints for *SMALL* at the industry level; and third, *SIZE* fits to the tradition of identifying spatial industrial competition. Glaseser *et al.* (1992) use it under the assumption that a large number of small firms are a good indicator of intense competition. Briefly, *SIZE* permits comparisons with classical studies and is available for each industry in all 32 states.

Variety (Jacobs economies). These are urbanization externalities external to the industry but internal to the state and last for a reasonable period to sustain regional growth. This dissertation calculates two alternative measures: The global specialization index and the Hirschman-Herfindahl Index (*HHI*). For the latter, this research evaluates the four different adaptations introduced in Chapter 3 (Methodology). Results show that all indices are highly correlated (Table 6.4). Since there is perfect correlation for all HHI versions and their correlation with the global coefficient of specialization (*COS*) is high (0.875), this study chooses *UNCTAD Hj*. To the benefit of future research, *UNCTAD Hj* is easily available (UNCTAD stands for United Nations Conference of Trade and Development). Therefore the diversification index is *JACOBS= 1-UNCTAD*.

Table 6.4 Rank Correlations for Alternative Indicators of Diversification

	HHI	VAR	SUNDRUM	HF	UNCTAD	COS
HHI	1.000	1.000(**)	1.000(**)	1.000(**)	1.000(**)	.876(**)
VAR		1.000	1.000(**)	1.000(**)	1.000(**)	.875(**)
SUNDRUM			1.000	1.000(**)	1.000(**)	.875(**)
HF				1.000	1.000(**)	.875(**)
UNCTAD					1.000	.875(**)
COS						1.000

** Correlation is significant at the 0.01 level (2-tailed).
Alternative indicators as defined in Chapter 4, subsection 4.2.2.2

Source: Calculations based on Table D.24.

Institutional variables**.** In this set there are two variables with more than one indicator: social capital and income distribution.

Social capital (Putnam and Olson type). Literature distinguished between Putnam type social capital that facilitates social interaction and economic progress and Olson type social capital that restricts regional growth.

▪ Indicators. In the case study, the research uses the Census of Services to get the necessary information. The study uses the number of units of commercial, professional, and labor force associations (Activity 9250) for rent-seeking organizations or Olson type social capital. On the other hand, the research uses the number of political, civil, and religious organizations (Activity 9220) for Putnam indicators. Both indicators are expressed per 10,000 persons. The rank correlation coefficient between Putnam and Olson type measures is not significant (0.179) meaning that both indicators should be considered in the analysis. The hypothesis from literature is that while Putnam type of social capital favors regional growth, Olson type social capital imposes an economic burden on regions.

Income distribution (INCOME). There is no agreement on income distribution and regional growth. While some authors argue that social polarization impede economic progress (Rupasingha, Goetz, and Freshwater 2002), others find a positive association between income inequality and economic growth (Bhatta 2001, Barro 1999).

▪ Indicators. This research evaluates Gini and Theil indices of income distribution for 1995. Since the rank correlation between these two indices is 0.994, the study takes the most popular measure, the Gini coefficient. There is no a conclusive hypothesis about its influence on regional growth.

<u>Other Conditions (*OC*)</u>**.** Only one variable, market accessibility, has more than one indicator in this third set.

Market accessibility. Alfred Weber's classical theory suggests that three factors determine the location of industry: transport costs, labor costs, and forces of agglomeration. Since Weber the world has changed. Regarding transportation cost, transportation technologies (*i.e*., transport of containers) and refrigeration permits firms location flexibility. Bulk-gaining products or time-urgent (perishable) goods do not necessarily need to locate at or close to the market place. This research tests if there is still a relation between market accessibility and industrial regional growth.

▪ Indicators: This research evaluates three indicators of accessibility: Centrality (*CENTRAL*), distance to Mexico City (*DISMX*), and distance to the US border (*DISUS*). The low correlation coefficient (-0.297) between *DISUSA* and *CENTRAL* confirm that they measure different things (Table 6.5). While *CENTRAL* measures accessibility to the domestic market, *DISTUSA* assesses distance to the US market. On the other hand, the high negative coefficient (-0.893) between *CENTRAL* and *DISMX* show that they inversely measure the same thing: the more central a state is, the closer it is to Mexico City. Therefore, this dissertation keeps *DISUSA* and *CENTRAL* as measures of accessibility to two different markets. The hypothesis is that both indicators contribute to regional growth, but for different reason. Note that Nuevo León (NL) and Coahuila (Coa) have high accessibility to the domestic and international market. Both states are close to the US border and have a relatively high centrality.

Table 6.5 Rank Correlation for Three Measures of Market Accessibility

	CENTRAL	DISUSA	DISMX
CENTRAL	1.000	-.297	-.893(**)
DISUSA		1.000	-.007
DISMX			1.000

** Correlation is significant at the 0.01 level (2-tailed).

Once established the criteria to choose competing indicators representing a single variable, next step carries out an inter-correlation checking of all selected indicators to filter out those "telling the same story."

Inter-correlation checking. All selected indicators in previous section are included in different matrices of correlation organized in the three main sets of variables: dynamic externalities, institutional variables and other regional conditions. While the set for dynamic externalities is checked for every single industry, those for institutions and other state conditions do not need this industry-level analysis for two reasons: first they are common to all regional industries, and second, they are condensed in a variable reduction process in next section.

The intention of the inter-correlation checking is to examine the pre-selected indictors and prepare the database for statistical analysis in next sections. The rule in this section is to exclude an indicator if its inter-correlation coefficient is equal to or higher than 0.8. No attempt to interpret the relationships suggested by these coefficients is tried. Following the empirical research strategy outlined in Chapter 4 (Methodology), this task is reserved for regression analysis in the next section.

Dynamic externalities. The inter-correlation checking for different industries shows that specialization highly correlates with other variables in Food, Chemicals, Metallic, Machinery, and Other (Table 6.6). Most of these correlations are with the alternative indicator of MAR economies (*lnGSPi*). Since *lnGSPi* does not highly correlate with other variables (except with Jacobs in textiles), this study keeps *lnGSPi* as the only indicator of MAR externalities. This decision is consistent with the theoretical assumption that MAR economies should be measured in absolute rather than relative terms. In this way, dynamic economies are represented by only one indicator: *lnGSPi* for MAR externalities, *SIZE* for Porter, and *1-UNCTAD Hj* for Jacobs.

Table 6.6 Rank Correlations for Indicators of Dynamic Externalities

FOOD

	PORTER	JACOBS	SPEC	LNFOOD
PORTER	1.000	.606(**)	-.884(**)	.321
JACOBS		1.000	-.738(**)	.598(**)
SPEC			1.000	-.436(*)
LNFOOD				1.000

TEXTILES

	PORTER	JACOBS	SPEC	LNTEXTIL
PORTER	1.000	-.569(**)	-.606(**)	-.580(**)
JACOBS		1.000	.615(**)	.818(**)
SPEC			1.000	.769(**)
LNTEXTIL				1.000

PAPER

	PORTER	JACOBS	SPEC	LNPAPER
PORTER	1.000	.368(*)	-.274	.234
JACOBS		1.000	-.097	.658(**)
SPEC			1.000	.215
LNPAPER				1.000

WOOD

	PORTER	JACOBS	SPEC	LNWOOD
PORTER	1.000	.390(*)	-.333	.275
JACOBS		1.000	-.398(*)	.490(**)
SPEC			1.000	.303
LNWOOD				1.000

CHEMICALS

	PORTER	JACOBS	SPEC	LNCHEM
PORTER	1.000	-.235	-.868(**)	-.546(**)
JACOBS		1.000	.436(*)	.695(**)
SPEC			1.000	.795(**)
LNCHEM				1.000

NON-METALLICS

	PORTER	JACOBS	SPEC	LNNO_MET
PORTER	1.000	.178	-.582(**)	.077
JACOBS		1.000	-.003	.752(**)
SPEC			1.000	.123
LNNO_MET				1.000

METALLIC

	PORTER	JACOBS	SPEC	LNMET
PORTER	1.000	-.279	-.873(**)	-.676(**)
JACOBS		1.000	.525(*)	.713(**)
SPEC			1.000	.848(**)
LNMET				1.000

MACHINERY

	PORTER	JACOBS	SPEC	LNMACH
PORTER	1.000	-.488(**)	-.827(**)	-.724(**)
JACOBS		1.000	.531(**)	.744(**)
SPEC			1.000	.840(**)
LNMACH				1.000

OTHER

	PORTER	JACOBS	SPEC	LNOTHER
PORTER	1.000	-.365(*)	-.373(*)	-.363(*)
JACOBS		1.000	.412(*)	.657(**)
SPEC			1.000	.833(**)
LNOTHER				1.000

* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).

The number of cases for all activities is N= 32 cases, except for Metallic industry (N=17 cases)

Institutional variables. None of the correlation coefficients in this set has a value higher than 0.8 (Table 6.7). Therefore, this study keeps all selected indicators for subsequent analysis.

Table 6.7 Rank Correlations for Institutional Variables

	PUTNAM	OLSON	INCOME	ATTEND	ETHNIC	IGP
PUTNAM	1.000	.179	-.314	.314	-.342	.232
OLSON		1.000	-.207	-.152	-.096	.515(**)
INCOME			1.000	-.417(*)	.510(**)	-.361(*)
ATTEND				1.000	-.595(**)	.113
ETHNIC					1.000	-.359(*)
IGP						1.000

** Correlation is significant at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed).

Other regional conditions. There are three correlation coefficients above the 0.8 limit (Table 6.8). Since the economically active population (*EAP*, *labor supply*) and state population (*POP, local market size*) are highly correlated (0.994), this study keeps the later because it is more common in literature. Two remaining coefficients correspond to the relationship between *URBAN* (*urban population*) and *SCHOOL* (*human capital*), and *URBAN* and *FDI* (*Foreign Direct Investment*). This research keeps *URBAN* because it is the most highly correlated variable. Therefore, *URBAN* represents three regional traits: urban population, human capital, and Foreign Direct Investment. In this way this study excludes *EAP*, *SCHOOL* and *FDI* from subsequent analysis. Notice that the two indicators of population this study keeps (*POP* and *URBAN*) are uncorrelated. Therefore, they represent different regional characteristics.

Table 6.8 Rank Correlations for Other Regional Characteristics

	POP	EAP	URBAN	ROADS	SCHOOL	SERVICE	FDI	DISUSA	CENTRAL
POP	1.000	.994(**)	.130	.074	.006	-.227	.199	-.144	.462(**)
EAP		1.000	.188	.056	.065	-.236	.253	-.179	.446(*)
URBAN			1.000	-.065	.830(**)	-.129	.862(**)	-.402(*)	.097
ROADS				1.000	-.087	-.205	.017	.212	.630(**)
SCHOOL					1.000	-.045	.703(**)	-.423(*)	.065
SERVICE						1.000	-.245	.657(**)	-.579(**)
FDI							1.000	-.517(**)	.197
DISUSA								1.000	-.297
CENTRAL									1.000

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

6.3 Expected relationships (simple correlation analysis)

The objective of this section is twofold. On one hand, it provides information on the hypothesized direction and strength between industrial growth and different regional characteristics introduced in Chapter 3 (Methodology). The expected association between variables does not imply the existence of a cause-effect relationship. On the other hand, the rank correlation analysis provides a first idea on the data structure used in the regression analysis in the last section of this chapter.

The strength of the relationship and the direction of the association are measured by the degree in which the observations are scattered around the least-square line. If all points locate on exactly on the line, the relationship is perfect and the value of the coefficient will be 1.0 if the slope is positive. The coefficient will be -1.0 if the slope is negative. The more scattered the observations, the closer the correlation coefficient will be to zero.

Considering the correlation between growth and regional characteristics, only six variables (*Porter, Jacobs, Olson, Roads, DisUSA, and Central*) and three activities (Textiles, Chemicals, and Other industries) have statistically significant correlation coefficients (Table 6.9). Only variables for Chemicals (*Porter* and *DisUSA*) have the expected sign. The fact that only two variables have the expected sign means that theoretical assumptions on determinants of industrial growth and results for other case studies reviewed in the variable selection process do not exactly match to the Mexican case of study. It also warns about generic policy designs uncritically based on outcomes from other experiences. On the other hand, the presence of significant correlation coefficients in so few activities requires further analysis about the possible influence of regional characteristics on industrial growth. This task is addressed in a regression analysis. However, since the number of observations is reduced (32 states) the number of variables needs to be condensed before the regression analysis. To this end, next section conducts a variable reduction procedure.

Table 6.9 Rank Correlation Coefficients Between Growth and Regional Characteristics

SET	VARIABLE	GROWTH RATE								
		FOOD	TEXTILE	PAPER	WOOD	CHEM	NO_MET	MET	MACH	OTHER
Dyn. Extern.	MAR	.201	-.324	.070	-.241	-.074	.033	-.151	-.021	-.199
	PORTER	.185	.165	.210	.265	.448(*) (+)	-.089	-.116	-.232	-.048
	JACOBS	.301	-.300	.202	.008	.178	.145	.167	-.059	-.404(*) (+)
Institutional Variables	PUTNAM	.161	-.164	-.027	.070	.003	-.235	-.245	-.027	.012
	OLSON	-.116	.249	.063	.045	.061	-.053	-.014	.155	.362(*) (-)
	GINI	-.080	.054	-.165	-.146	-.106	-.028	.124	.054	-.085
	ATTEN	.213	-.244	.113	.276	.132	.140	.108	.053	-.024
	ETHNIA	-.226	-.042	-.016	-.171	-.222	-.151	-.185	-.343	-.021
	IGP	-.033	.345	-.004	.319	.283	-.012	-.027	.169	.267
Other Conditions	ROADS	.245	-.415(*) (+)	.000	.058	-.228	.059	-.089	-.095	-.004
	SERVICE	-.292	.166	-.163	-.027	-.195	-.250	-.112	-.200	.288
	URBAN	.208	.086	.034	.060	.322	.114	-.054	.163	.072
	POP	.004	-.251	-.149	-.280	-.180	-.171	-.172	-.142	-.341
	DISUSA	-.060	-.148	-.272	-.109	-.366(*) (-)	-.049	-.192	-.193	.202
	CENTRAL	.262	-.471(**) (+)	.062	.011	.022	.016	.032	-.083	-.323

* Correlation is significant at the 0.05 level (2-tailed). ** Correlation is significant at the 0.01 level (2-tailed).
Correlations for Metallic industry are based on 22 cases. Rest of coefficients is calculated for 32 cases.
IGP calculated for 31 cases (DF omitted). For Metallic industry the number of cases for indicator IGP is 21.

6.4 Variable reduction (factor analysis)

This section uses factor analysis to reduce the number of variables for the multiple regression analysis (after discarding all highly correlated variables in previous steps there is a matrix of 11 independent variables for 32 cases). In general, factor analysis extracts factors based on the eigenvalue of each variable. Factors may be rotated by an orthogonal or oblique method. If they are rotated by an oblique transformation, the resulting factors become correlated. If an orthogonal rotation is used, factor analysis groups independent variables into uncorrelated factors. The choice between both methods of rotation depends on the researching needs. Since uncorrelated factors can be employed as groups of uncorrelated variables into multiple regression, this research uses the orthogonal rotation to transform subsets of independent into few uncorrelated factors. Main steps in factor analysis in this section are: (a) to set the prior communality estimate for each variable to 1 (default value in SPSS software); (b) to select principal components analysis (PCA) for extracting factors; (c) to select factors with eigenvalues greater than 1; (d) to select orthogonal varimax for rotation; (e) to examine percents of variance accounted for the factors; and (f) to interpret and assign a name to the estimated factors.

This study runs PCA for two subgroups of variables. The first subgroup only includes variables representing social capital in Rupasingha, Goetz, and Freshwater (2002): community-building groups (*PUTNAM*), rent-seeking groups (*OLSON*), income inequality (*INCOME*), and ethnicity (*LNETHNIA*). The second group comprise remaining variables, excluding dynamic externalities (MAR, Porter, and Jacobs), governmental performance (*GPI*), and neighbor effects (*WY*). This study excludes dynamic externalities because main research interest is to measure their specific effect on state industrial growth. This analysis would not be possible if they are grouped in factors. *GPI* is also excluded because it has a missing value (DF) and was calculated using factor analysis. Therefore, it may be included in partial tests in regression analysis. The neighbor effect is also excluded because the econometric test of spatial autocorrelation for the equation of regression will require its explicit inclusion. There is no need to include it twice.

Finally, this research estimates factor scores for each of these components and will use them in subsequent regression analysis as if they were uncorrelated raw variables representing regional institutions and other economic conditions.

Subgroup one. Factor analysis was conducted using "Data Reduction" in SPSS to determine what, if any, underlying structure exists for measures on the following four variables: *PUTNAM*, *OLSON*, *INCOME*, *LNETHNIA*.[3] All four variables were subject to a principal component analysis using ones as prior communality estimates. The Principal Components Analysis was used to extract the components and they were examined after an orthogonal (varimax) solution. Following "Kaiser's rule" the study only retains components whose eigenvalues are greater than 1. Two components displayed eigenvalues greater than 1. Based on examination of the percents of variance accounted for the factors, a two-factor solution, accounting for 70% of the variance, was selected (Table 6.10). Although one variable did not reach the communality criteria[4] of .7, the rotated factor loadings clearly identify two groups including variables with positive loadings. The first component accounted for 44% of the variance and included variables representing adverse social conditions (income inequality, *INCOME,* and ethnicity, *LNETHNIA*). For this reason, this component was labeled *social inequality*

[3] In his analysis of state industrial growth, Erickson (1989) conducts a similar Factor Analysis to create indices with three and four variables.

[4] The thumb rule is that the eigenvalue criteria are questionable when communalities are less than 0.7. This rule may be eliminated if other criteria such as the scree plot and variance criteria are met (Mertler and Vannatta 2001, 262). Since in the case study all components retained have eigenvalues greater than 1 and they account most of the variance, the examination of the scree plot is not reported.

(INEQ). The second component accounts for 27% and aggregates into a single group both rent-seeking (*OLSON*) and community-building organizations (*PUTNAM*). This second group was labeled *social capital* (SK). Against the assumption in the literature review that presents them as opposite forces, Putnam-Type and Olson-type groups positively work in the same direction.

Table 6.10 Factor Analysis for Institutional Variables

Communalities

	Initial	Extraction
PUTNAM	1.000	.626
OLSON	1.000	.719
INCOME	1.000	.723
LNETHNIA	1.000	.754

Extraction Method: Principal Component Analysis.

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	1.753	43.815	43.815	1.753	43.815	43.815
2	1.069	26.723	70.538	1.069	26.723	70.538
3	.666	16.639	87.177			
4	.513	12.823	100.000			

Extraction Method: Principal Component Analysis.

Rotated Component Matrix

	Component	
	1	2
PUTNAM	-.229	.757
OLSON	.018	.848
INCOME	.827	-.195
LNETHNIA	.868	-.015

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.

Subgroup two. Factor analysis was conducted as in subgroup one using six variables representing "other conditions." Attendance, an institutional variable, was also added to this second group because it did not fit to the Rupasingha, Goetz, and Freshwater (2002) group of variables in group one. All seven variables were subject to a principal component analysis using ones as prior communality estimates. The Principal Components Analysis was used to extract the components, and this was followed by a varimax (orthogonal) rotation. All communalities were > 0.70: the lowest communality was .756 (Table 6.11). Following "Kaiser's rule" this study only retains components whose eigenvalues are greater than 1. Four components meet this rule. After rotation, all four components accounted for 83% of the total variance. All four components only included variables with positive loadings representing different market characteristics: quality, size, accessibility, and disadvantages. The first component accounted for 35.5% and included percentage of state population in areas of 15, 000 or more (*LNURBAN*), and electoral turnout in the 1994 presidential election (*LNATTEN*). This component was labeled *quality* (*QLTY*) because its variables represent *urbanization economies* such as quality of labor force (*URBAN* correlates high with *Schooling*), supply of public services (in Mexico, as in many developing countries, services only are available in major urban centers), opportunity of global links (*URBAN* correlates high with *FDI*) and general social connectedness (*ATTEND*). The second component accounted for 21% and was labeled (*SIZE*) because it included variables denoting *domestic market potential*, such as domestic market size (state population in 1993, *LNPOP*), and proximity to national markets (centrality index, *CENTRAL*). The third component accounted for 15.6% and was labeled (*ACCESS*) because it included variables corresponding to *national market accessibility*, such as availability of infrastructure (ratio of paved roads to the total surface of state, *LNROADS*) and distance to the US border (Kilometers to the US border, *LNDISUSA*). Finally, the fourth component accounted 15% and was labeled *market disadvantages* (*DISADV*) because its main variable stands for sectoral structure unfavorable to manufactures (ratio of services to manufacturing, *LNSERVICE*).

Table 6.11 Factor Analysis for Other Regional Conditions

Communalities

	Initial	Extraction
ROADS	1.000	.801
SERVICE	1.000	.894
URBAN	1.000	.786
POP	1.000	.925
DISUSA	1.000	.775
CENTRAL	1.000	.872
ATTEN	1.000	.756

Extraction Method: Principal Component Analysis.

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.204	31.489	31.489	2.204	31.489	31.489
2	1.469	20.985	52.474	1.469	20.985	52.474
3	1.093	15.613	68.087	1.093	15.613	68.087
4	1.043	14.903	82.989	1.043	14.903	82.989
5	.491	7.013	90.003			
6	.433	6.182	96.185			
7	.267	3.815	100.000			

Extraction Method: Principal Component Analysis.

Table 6.11- continued

Rotated Component Matrix

		Component			
		1 (*QLTY*)	2 (*SIZE*)	3 (*ACCESS*)	4 (*DISADV*)
URBAN	Percentage of state population in areas of 15, 000 or more (Ln)	.858	.143	-.163	.059
ATTEN	Electoral turnout in the 1994 presidential election (Ln)	.747	-.037	.316	-.311
POP	State population in 1993 (Ln)	-.062	.917	-.057	-.278
CENTRAL	Centrality index	.408	.713	.376	.235
ROADS	Ratio of paved roads to the total surface of state (Ln)	.120	.090	.847	-.246
DISUSA	Kilometers to the US border (Ln)	-.473	.012	.625	.401
SERVICE	Ratio of services to manufacturing (Ln)	-.088	-.131	-.110	.926

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.

6.5 Regression analysis

Previous factor analysis collapses 11 independent variables into two groups of uncorrelated components. This section uses multiple regression analysis to answer the research question: which predictor variables (*MAR, PORTER, JACOBS, INEQ, SK, QLTY, SIZE, ACCESS*, *DISADV,* and four *DUMMY* variables) grouped in four subsets subsequently included into an equation matter for predicting regional growth? The empirical test in this section examines the influence of the predictors entering into a regression equation in specific order (Table 6.12). Economic variables enter first and variables for institutions and other state conditions later. Since main research interest is dynamic externalities, variables representing this subset (*MAR, Porter, Jacobs*) enter first (Model 1). Next step adds at once institutional variables (*INEQ, SK*) and variables representing other regional conditions (*QLTY, SIZE, ACCESS*, and *DISADV*) (Model 2).[5] The third step leaves dynamic externalities in the model but replaces institutional variables and other regional conditions with dummy variables (*BORDER*, *POLES*, *OIL*, and *REST*) representing different groups of states (Model 3). Finally, all variables enter into the model (Model 4). This order does not restrict the inclusion or exclusion of some variables to get the best results. These four sets of variables are evaluated in four alternative versions of the basic model introduced in Chapter 4 (Table 6.12).

All models use data from the national accounting system for the two-digit industrial classification (Table 6.13). Results for these models are evaluated with traditional and new econometric criteria such as R^2, $\overline{R}^2$, *F-value*, multicollinearity, normality of errors, heteroskedasticity, and spatial dependence (Table 6.14 and Table 6.15). Regressions for industries reported in next sections have a significant *F-value* at the 10% and meet all requirements in diagnosis tests in at least one of the four models.

[5] Preliminary tests in this research show that forward and stepwise regressions do not improve results. In regression analysis, forward and stepwise selections are very similar. In both cases the most significant independent variable is selected and remaining variables are successively added according to their predictive power. The difference between forward and stepwise is that the former orders and adds variables based on the researching plan (externalities in the case study) whereas the later is based solely on statistical analysis. This study used both procedures but results did not increase the regression parameters.

Table 6.12 Options to the Four Alternative Models

Dependent variable	Model specification
Basic Model	*RATEi= f(DE_0, $INST_0$, OC_0, DUM)*
Growth rate for every specific industry, 1993-2003	
▪ Model 1	*RATEi= f(DE_0)*
▪ Model 2	*RATEi= f(DE_0, $INST_0$, OC_0)*
▪ Model 3	*RATEi= f(DE_0, DUM)*
▪ Model 4	*RATEi= f(all previous variables)*
Growth rate for every specific industry, 1993-1998	
▪ Model 1	*RATEi= f(DE_0)*
▪ Model 2	*RATEi= f(DE_0, $INST_0$ and OC_0)*
▪ Model 3	*RATEi= f(DE_0, DUM)*
▪ Model 4	*RATEi= f(all previous variables)*

Where:

DE_0: Variables representing dynamic externalities: *MAR*, *PORTER* and *JACOBS* economies.

$INST_0$: Variables representing institutional variables, as compressed in factors analysis (*INEQ,* social inequality; and *SK*, social capital).

OC_0: Other regional conditions such as natural advantages and local market conditions, as compressed in factors analysis (*QLTY,* market quality; *SIZE,* domestic market potential; *ACCESS,* accessibility; and *DISADV,* market disadvantages).

DUM: Dummy variables for groups of states: *BORDER* states= states at the US border (TAM, COA, CHIH, SON, and BC). *POLES*= states containing the traditional industrial cities of Mexico City, Guadalajara, and Monterrey (MEX and DF, JAL, and NL, respectively). *OIL*= oil producer states (CAM and TAB). *REST*= all states not classified in any of the three previous groups.

Subscript *0* stands for the initial year of the period of study (1993 or close to it).

Table 6.13 Two-Digit Industrial Classification

Industry	Description
31	Food, Feed, and Tobacco (Food)
32	Textiles, Apparel, and Leather (Textiles)
33	Wood and Wooden Products (Wood)
34	Paper, Printing, and Publishing (Paper)
35	Chemicals, Petrochemicals, Rubber and Plastic (Chemicals)
36	Nonmetallic Minerals (Nonmetallic)
37	Metal Industries (Metal)
38	Metallic Products, Machinery and Equipment (Machinery)
39	Other industries.

Cases of multicollinearity and spatial dependence are present and need to be solved. The case of multicollinearity, if associated to two independent variables, is corrected by removing the variable with the least impact. If the problem is between an independent variable and the dependent variable, it is solved dropping the independent variable (there is no other choice). On the other hand, the case of spatial dependence may be corrected by the spatial lag model or the spatial error model. The case of spatial autocorrelation in the residuals (Textiles) is treated with a spatial lag specification solved with the maximum likelihood procedure. Results are examined in comparison to those from the OLS model (Table 6.15). On the other hand, preliminary regressions detected two outliers for period 1993-2003: Campeche (Cam) in Textiles and Guanajuato (Gto) in Machinery. The examination of models for Textiles excludes the outlier. Models for Machinery are not significant with or without the outlier.

Table 6.14 Criteria to Evaluate Regression Results and Diagnostic Tests

Parameter/Test	Results should:
Goodness of Fit	
R^2	Be the highest value among different models and statistically examined with the *F-test* in the case of competing models. It measures the amount of varia*tion* (not variance) in the dependent variable that is explained by the independent variables.
$\overline{R}^2$	Be the highest value among different models, but dependent on the *F-test* for R^2 in the case of competing models. It is the R^2 adjusted for the degrees of freedom.
SE of the Estimate	Be visually examined in case of competing models. It measures the scatter of the observed values around the line of regression.
F & (prob F)	Be significant at least for $p < 10\%$. It confirms that strong models have high R^2 and low *SE*. The *F* test is a measure of the overall significance of the estimated regression.
AIC (Akaike Information Criterion)	Be the smallest. It is analogous to the smallest residual sums of the squares of linear regression (the largest R^2). (Charemza and Deadman 1992, 293-294).
SC (Schwarz's Bayesian Information Criterion)	Be the smallest. It is analogous to the *AIC* and decreases with the goodness of fit.
Regression Diagnostics	
MCN (Multicollinearity Number)	Be 30 or less (or when *GeoDa*™ makes it explicit). Not a serious problem: "It does not bias coefficient estimates. It does not result in inefficient use of the data available, nor does it cause falsely confident conclusions" (Voss 2004, 760).
NORMALITY OF ERRORS	
Jarque-Bera	Be non-significant. The *t*, *F*, and χ^2 test require the assumption of normality in small or finite (or exact) samples.
HETEROSKEDASTICITY	
Breusch-Pagan test	Be non-significant. Otherwise, it needs to be solved with Generalized Least Squares if normalizing transformations such as the inverse or the logarithmic transformation do not work (Arbia 2006, 127-131).
Koenker-Bassett test	Be non-significant.
SPECIFICATION TEST	
White	Be non-significant. Although it "is consistent with respect to a wide range of parametric alternatives, it may not be very powerful in finite samples" (Arbia 2006, 129).
SPATIAL DEPENDENCE	
Moran's I (error)	Be non-significant. Otherwise it needs to be solved with the spatial lag or the spatial error model.

Regression analysis results of the four alternative models are ordered according to the dependent variable: Results for the growth rate for every specific industry in period 1993-2003 ($RATE_{i,1993\text{-}2003}$) come first. Then, considering the possibility that dynamic externalities may vanish in a ten year period for some industries, as stated in Lamorgese (1997), this dissertation presents results for the growth rate for every specific industry in period 1993-1998 ($RATE_{i,1993\text{-}1998}$). As in Bannister and Stolp (1995, 684), this study excludes Metal industry due to its extreme concentration in a few states.

Table 6.15 Criteria to Evaluate Results of a Spatial Lag Model Solved with the Maximum Likelihood Procedure

Parameters and tests	Spatial Lag Model (ML)
	Regarding results for OLS, it should:
LIK	Increase
AIC	Decrease
SC	Decrease
HETEROSKEDASTICITY	
Breusch-Pagan test	Be non-significant, as in OLS
SPATIAL DEPENDENCE	
Likelihood Ratio Test	Be non-significant

6.5.1 Dependent variable: growth rate for every specific industry in period 1993-2003 ($RATE_{i,1993\text{-}2003}$)

Industries with significant results in at least one of the four models are Food, Textiles, Paper, and Chemicals (Table 6.16, Table 6.17, Table 6.18, and Table 6.19). On the other hand, results for the industrial activity as a whole, adjusted to only express inter-industry externalities, also are statistically significant in one model (Table 6.20).

In these industries the study includes all significant and non significant models and variables to illustrate the evaluation process.

Food. Preliminary regressions show that MAR economies create problems of multicollinearity in all Models.[6] Therefore, it is dropped from the regression analysis of Food industry. Results for Model 2 and Model 3 are significant and do not present problems in diagnostic tests (Table 6.16). While the five variables in Model 3 have an explicative value of 15% ($\bar{R}^2$ = 0.1519), the eight variables included in Model 2 explain about 20% of variation of the dependent variable. An *F-value* test for these two models shows that the higher explicative value of Model 2 is not statistically different from that in Model 3 (Table 6.16. See the Annex B for details on the *F-value* test for competing models). Therefore, Model 3 with less variables and similar explicative power is the most efficient specification. Results for Model 3 show that *JACOBS* economies are significant in food industry.

The fact that Model 3 is more efficient than Model 2 does not imply that the latter should be discarded at all. It provides information not included in Model 3 such as the positive and statistically significant influence of social capital (*SK*) on industrial growth in the Food industry. This extra information may be relevant for planning or policy making strategies considering institutional variables in their approaches to regional growth.

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[6] If MAR economies stay in the equation and other dynamic economies are dropped the regression outcome shows that variables are not statistically significant, there are problems in the diagnosis tests, and/or generate less efficient results.

Table 6.16 Food. Dependent Variable: Growth Rate 1993-2003

	Model 1	Model 2	Model 3	Model 4
Constant	0.02605259	-0.04553517	-0.01387308	-0.03087644
	(0.05491992)	(0.02968537)	(0.01962096)	(0.03267185)
MAR	-0.003634062			
	(0.004605906)			
Porter	-0.008289728	-0.007451759	-0.006139359	-0.007063881
	(0.008884533)	(0.009222191)	(0.01079047)	(0.01200855)
Jacobs	0.08753715	0.117528***	0.07735119**	0.1008982
	(0.03478146)	(0.04310714)	(0.03181044)	(0.04571656)
INEQ		-0.00319524		-0.000564420
		(0.00595085)		(0.00664722)
SK		0.01466388**		0.01328371
		(0.006245607)		(0.006658483)
QLTY		-0.005777678		-0.001567394
		(0.006684192)		(0.007948327)
SIZE		-0.00232767		-0.001763246
		(0.005376772)		(0.006795383)
ACCESS		0.002932281		0.002405738
		(0.004222138)		(0.006694913)
DISADV		-0.003679646		-0.004931003
		(0.006801679)		(0.007062016)
D1_BORDER			-0.009064349	-0.007364614
			(0.01416407)	(0.02388629)
D2_POLES			-0.01897247	-0.00754166
			(0.0133997)	(0.02107049)
D3_OIL			-0.02459971	-0.02434179
			(0.01730367)	(0.01930627)
R^2	0.195284	0.408676	0.288661	0.463830
$\overline{R}^2$	0.109064	0.202999	0.151865	0.168937
SE of the Estimate	0.0232364	0.0219774	0.0226714	0.0224421
F & (prob F)	2.26496	1.98697	2.11015	1.57287
	(0.10279)	(0.0945496)	(0.0961996)	(0.182464)
MCN	39.69592	18.57159	13.30963	21.59263
NORMALITY OF ERRORS				
Jarque-Bera	0.9772143	0.4372157	0.1087855	2.09341
	(0.6134803)	(0.8036368)	(0.9470601)	(0.3510926)
HETEROSKEDASTICITY				
Breusch-Pagan test	2.697439	7.742741	6.122412	11.74627
	(0.4406627)	(0.4589950)	(0.2944893)	(0.3830148)
Koenker-Bassett test	3.383794	6.186963	5.735782	7.612832
	(0.3361493	(0.6262982)	(0.3327832)	(0.7475084)
SPECIFICATION TEST				
White	5.244225	N/A	N/A	N/A
	(0.8125200)			
SPATIAL DEPENDENCE				
Moran's I (error)	-0.176406	-0.090360	-0.207367	-0.116052
	(0.2702970)	(0.8908231)	(0.2266291)	(0.8884060)
n	32	32	32	32
F-value test for Model 2 and Model 3	$F_{3,23} = \frac{(0.4087-0.2887)/(8-5)}{(1-0.4087)/(32-8-1)} = 1.56 < F_{.99(3,23)} = 4.76$			

*. Significant at the 0.10 level; **. Significant at the 0.05; ***. Significant at the 0.01

Textiles. All models in this activity exclude Campeche (Cam) because it is an outlier. The *F-value* for Model 1, before and after excluding MAR economies to correct multicollinearity, is not significant. Results for Model 4 report problems in the normality of errors (Table 6.17). The thumb rule in econometrics says that the non-normality of the errors may not be too serious a problem (Tabachnick and Fidell 1989, 83). However, in small or finite (or exact) samples like the Mexican case of study the *t*, *F*, and χ^2 test require the assumption of normality (Guajarati 1995, 145; Anselin 2005, 195). Therefore, Model 4 is also discarded. On the other hand, the *F-value* for Model 2 and Model 3 is significant at the 10% level. While Model 2, with eight variables, explains 26% of the variation of growth rates, Model 3 explains 16% of the variation with five variables. Since the *F-test* for the two competing models suggests that there is not significant difference between them, Model 3 is the most efficient formulation. Unfortunately, Model 3 provides little information. It only shows that Textiles at the US border (*D1_BORDER*), holding everything else constant, are statistically different from those in the rest of the country (the base category[7] represented by the constant). The positive sign means that the intersect for Textiles at the US border is higher than that one for the rest of the country (see the Annex B for details on the dummy variable interpretation). Although Model 2 is less efficient than Model 3, it provides important information. Unlike the expected hypotheses, social capital, *SIZE* (*domestic market potential*, representing domestic market size and proximity to national markets), and *ACCESS* (*national market accessibility*, representing availability of infrastructure and

[7] Literature indistinctly uses “base,” “benchmark,” “control,” “comparison,” “reference,” or “omitted” category (Guajarati 1995, 504).

distance to the US border) do not foster growth in Textiles. On the contrary, states with an economic structure unfavorable to manufactures (represented by *market disadvantages, DISADV*) favors growth of Textiles. This is a surprising and promising finding. It is surprising because it does not fit to the expected hypotheses. It is promising because it means that Textiles may create employment out of the traditional industrial areas. As it may be noticed, the exclusion of Campeche (the outlier) does not permit the spatial dependency test because it modifies the matrix of contiguity. This test would be possible if the definition of "neighborness" is defined in different way, such as distance between state centroids.

Paper. Model 3 and Model 4 are significant for Paper industry (Table 6.18). Model 3, with five variables, has more explicative power ($\overline{R}^2$ = 32%) than Model 4 ($\overline{R}^2$ = 26%), with eleven variables. Therefore, Model 3 is the most efficient formulation. Model 4 may be discarded because it does not add extra information on regional growth. Significant variables are the same for both models: *D2_POLES* and *D3_OIL*. The negative sign for *D2_POLES* contradicts the hypothesis that traditional industrial centers have an economic structure that fosters industrial growth in general. The negative sign for *D2_POLES* shows its intersect is below the rest of states. Therefore, it seems that Paper industry grows faster outside the three traditional industrial cities (Mexico City, Guadalajara and Monterrey). On the other hand, the negative sign for *D3_OIL* is consistent with hypotheses that oil producer economies do not favors manufacturing in general and the Paper industry in particular. This is in line with previous results showing that Paper is a good candidate activity to encourage industrial growth outside the traditional industrial centers (Mexico City, Monterrey, and Gudalajara).

Table 6.17 Textiles. Dependent Variable: Growth Rate 1993-2003 (Campeche excluded)

	Model 1	Model 1 (Corrected for MC)	Model 2	Model 3	Model 4
Constant	0.0991902	0.05739036	0.03192828	0.0221536	0.06075722
	(0.07471036)	(0.05583122)	(0.08264994)	(0.05384552)	(0.0948608)
MAR	-0.006401453				
	(0.007553687)				
Porter	-0.001161257	0.0007877935	0.00073065	0.009055526	-0.001133288
	(0.01025544)	(0.00994381)	(0.009532897)	(0.01060605)	(0.01229415)
Jacobs	-0.0002703993	-0.05459484	-0.01775991	-0.02949128	-0.05411514
	(0.09265627)	(0.06656569)	(0.1058276)	(0.06468394)	(0.1131582)
INEQ			-0.00661522		-0.008495939
			(0.01277626)		(0.01212448)
SK			-0.03036637**		-0.03770659***
			(0.01227945)		(0.0126518)
QLTY			0.002440304		0.007812037
			(0.01418622)		(0.01688826)
SIZE			-0.01863808*		-0.008837523
			(0.01001749)		(0.01262922)
ACCESS			-0.02459845***		-0.01269022
			(0.007800811)		(0.01065928)
DISADV			0.02149762*		0.02642441**
			(0.01235906)		(0.01206438)
D1_BORDER				0.05934298***	0.0347499
				(0.0221607)	(0.03513861)
D2_POLES				-0.01902429	-0.05336493
				(0.02539581)	(0.03930266)
D3_OIL				-0.03264498	-0.002992555
				(0.05109622)	(0.0511039)
R^2	0.061666	0.036706	0.455650	0.299998	0.581451
$\overline{R}^2$	-0.042594	-0.032100	0.257705	0.159998	0.339133
SE of the Estimate	0.0479126	0.0476709	0.0404279	0.0430064	0.038146
F & (prob F)	0.591465	0.533473	2.3019	2.14284	2.39954
	(0.625941)	(0.592408)	(0.0581613)	(0.0932951)	(0.0452969)
MCN	25.26076	14.03494	25.5013	16.16841	32.84849
NORMALITY OF ERRORS					
Jarque-Bera	0.1605268	0.0670171	2.433987	2.188034	7.371165
	(0.9228733)	(0.9670466)	(0.2961191)	(0.3348686)	(0.0250826)
HETEROSKEDASTICITY					13.21185
Breusch-Pagan test	2.630028	2.892564	10.81978	7.724594	(0.2797051)
	(0.4522496)	(0.2354440)	(0.2121212)	(0.1720812)	
Koenker-Bassett test	3.165225	3.202776	9.094225	4.748981	8.070935
	(0.3668455)	(0.2016165)	(0.3344098)	(0.4472764)	(0.7069358)
SPECIFICATION TEST					
White	7.007949	5.872153	N/A	N/A	N/A
	(0.6362917)	(0.3188585)			
n	31	31	31	31	31

*. Significant at the 0.10 level; **. Significant at the 0.05; ***. Significant at the 0.01

Table 6.18 Paper. Dependent Variable: Growth Rate 1993-2003

	Model 1	Model 2	Model 3	Model 4
Constant	0.03121216	-0.02302796	-0.01127988	0.02177891
	(0.03831055)	(0.03982856)	(0.01972496)	(0.03489323)
MAR	-0.005529715			
	(0.004379177)			
Porter	0.009480875	0.004004217	0.005335301	-0.004493084
	(0.009413495)	(0.01338845)	(0.008028021)	(0.0122303)
Jacobs	0.06132105	0.05612692	0.04441214	0.01155195
	(0.0426985)	(0.05652755)	(0.03043881)	(0.0482206)
INEQ		0.003446805		0.006363441
		(0.007891217)		(0.006920485)
SK		0.008778542		0.004153545
		(0.009402996)		(0.008000409)
QLTY		0.0004806733		0.01030768
		(0.008630155)		(0.00847228)
SIZE		-0.003398004		0.004314651
		(0.007115074)		(0.007143192)
ACCESS		-0.002727631		0.008866502
		(0.00605007)		(0.008133223)
DISADV		-0.006587218		-0.007387065
		(0.009727885)		(0.008062193)
D1_BORDER			0.01230906	0.02286066
			(0.01154658)	(0.02226342)
D2_POLES			-0.04005783***	-0.04830284**
			(0.01348697)	(0.0219435)
D3_OIL			-0.03300856*	-0.04249453**
			(0.01728563)	(0.01989066)
R^2	0.132232	0.182751	0.430187	0.524695
$\bar{R}^2$	0.039256	-0.101509	0.320608	0.263278
SE of the Estimate	0.0270135	0.0289249	0.0227163	0.0236554
F & (prob F)	1.42222	0.642901	3.92581	2.00711
	0.257146	(0.734102)	(0.00874673)	(0.0847042)
MCN	25.97243	18.56905	12.81305	21.33575
	(Extreme MC)			
NORMALITY OF ERRORS				
Jarque-Bera	1.623644	1.660264	0.2682429	1.033577
	(0.4440482)	(0.4359917)	(0.8744839)	(0.5964330)
HETEROSKEDASTICITY				
Breusch-Pagan test	0.8206709	6.070866	4.992042	7.280452
	0.8445167	(0.6392940)	(0.4168522)	(0.7759384)
Koenker-Bassett test	0.756215	4.937402	6.099277	5.256443
	0.8599086	(0.7642453)	(0.2966784)	(0.9181137)
SPECIFICATION TEST				
White	5.332705	N/A	N/A	N/A
	(0.8043949)			
SPATIAL DEPENDENCE				
Moran's I (error)	0.011829	-0.090247	-0.032656	-0.114040
	(0.6522433)	(0.9157904)	(0.7952068)	(0.9052782)
n	32	32	32	32

*. Significant at the 0.10 level; **. Significant at the 0.05; ***. Significant at the 0.01

Chemicals. The *F-value* shows that only Model 1 and Model 3 are significant (Table 6.19). Both models have similar explanative power. While Model 1, with three variables, explains 17% of the variance, Model 3, with six variables, explains 20% of the variance. The *F-value* test confirms that the difference in explanative power of these two models is not significant: $F_{(calculated)} = 1.34 < F_{(critical)} = 4.68$ with 3 degrees of freedom (DF) in the numerator and 25 DF in the denominator, for $\alpha = 0.01$. Model 1 has the expected positive sign in *JACOBS* economies, the only significant variable. This means that diversity favors growth of Chemicals.

On the other hand, Model 3, although less efficient than Model 1, should not be discarded at all. It provides information not considered in Model 1: Border states (*D1_BORDER*) have a significant and positive sign, meaning that they not only favor the growth of Chemicals but also that this activity grow faster in these states than in the rest of the country.

Table 6.19 Chemicals. Dependent Variable: Growth Rate 1993-2003

	Model 1	Model 2	Model 3	Model 4
Constant	-0.0110	0.0013	-0.0068	-0.0126
	(0.0344)	(0.0698)	(0.0449)	(0.0778)
MAR	-0.0029	-0.0015	-0.0032	0.0012
	(0.0035)	(0.0059)	(0.0042)	(0.0067)
Porter	0.0054	0.0051	0.0052	0.0087
	(0.0034)	(0.0049)	(0.0039)	(0.0060)
Jacobs	0.0917**	0.0502	0.0865*	0.0144
	(0.0453)	(0.0567)	(0.0448)	(0.0621)
INEQ		0.0086		0.0112
		(0.0074)		(0.0079)
SK		-0.0054		-0.0132
		(0.0097)		(0.0116)
QLTY		0.0160*		0.0196*
		(0.0080)		(0.0094)
SIZE		-0.0059		-0.0053
		(0.0107)		(0.0110)
ACCESS		-0.0063		-1.4e-005
		(0.0052)		(0.0080)
DISADV		-0.0030		0.0001
		(0.0099)		(0.0107)
D1_BORDER			0.0250*	0.01732
			(0.0135)	(0.0233)
D2_POLES			-0.0023	-0.0238
			(0.0186)	(0.0277)
D3_OIL			-0.0043	-0.0145
			(0.0208)	(0.0228)
R^2	0.2528	0.4325	0.3566	0.4985
$\bar{R}^2$	0.1727	0.2004	0.2021	0.1818
SE of the Estimate	0.0267	0.0262	0.0262	0.0265
F & (prob F)	3.1579	1.8632	2.3092	1.5741
	(0.0402)	(0.1126)	(0.0653)	(0.1823)
MCN	21.2110	39.4842	28.1643	47.3918
NORMALITY OF ERRORS				
Jarque-Bera	0.4234	0.1197	2.8880	0.8432
	(0.8092)	(0.9419)	(0.2360)	(0.6560)
HETEROSKEDASTICITY				
Breusch-Pagan test	1.6316	3.5685	5.1283	7.6364
	(0.6522)	(0.9374)	(0.5275)	(0.8129)
Koenker-Bassett test	1.5469	3.2775	3.5939	5.5146
	(0.6715)	(0.9523)	(0.7314)	(0.9385)
SPECIFICATION TEST				
White	7.7592	N/A	N/A	N/A
	(0.5586)			
SPATIAL DEPENDENCE				
Moran's I (error)	-0.0482	-0.0439	0.0119	0.0022
	(0.9772)	0.5907	(0.4402)	(0.3315)
n	32	32	32	32

F-value test for Model 1 and Model 3

$$F_{3,25} = \frac{(0.3566-0.2528)/(6-3)}{(1-0.3566)/(32-6-1)} = 1.34 < F_{3,25}(critical) = 4.68,\ for\ \alpha = 0.01$$

*. Significant at the 0.10 level; **. Significant at the 0.05; ***. Significant at the 0.01

Aggregate industrial activity. Because of *MAR* and *PORTER* economies are *intra-industry* externalities, previous models cannot be applied straight forward to the industrial activity as a whole. Two major adaptations are necessary. First, the study replaces MAR economies measured by GSP in industry *i* (*lnGSPi*) with total industrial output in the state (*lnGSP*). If *lnGSP* is positive, it represents regional economies (external to the industry but internal to the region) creating the snowball or self-sustained effect in cumulative causation (Myrdal 1957, Krugman 1991) and path dependent theories (Arthur 1989). If negative, the initial level of GSP may partly be capturing congestion effects (*e.g*., decreased availability of favored land and required labor). In the second change the study replaces Porter intra-industry competence (*SIZE* in industry *i*) with inter-industry competence (relative *SIZE* of all regional industries. The study calls it competence, *COMP*). Briefly, the application of previous models to the aggregate industrial activity only considered inter-industrial economies.

Results for Model 2, the best formulation for the industrial activity as a whole, show that *JACOBS* economies is the only significant variable for industrial growth (Table 6.20). Model 1 is multicollinear and its corrected version has not variables with significant coefficients. Model 3 presents problems of spatial dependence. Model 2 and Model 4 do not present econometric problems. However, Model 2, with less variables and similar explicative power to Model 4, is the most efficient formulation. Model 4 may be discarded because it does not provide additional information to Model 2.

Table 6.20 Total Manufacturing. Dependent Variable: Growth Rate 1993-2003

	Model 1	Model 1 (Corrected for MC)	Model 2	Model 3	Model 4
Constant	0.1161212**	0.004713826	-0.03667394	0.005646064	-0.01618365
	(0.0565976)	(0.02312293)	(0.0299415)	(0.02406266)	(0.03199251)
GSP (instead of MAR)	-0.008791508**				
	(0.004120863)				
COM (instead of Porter)	-0.008175323*	-0.003589172	0.004952982	-0.004822804	0.00296893
	(0.004367678)	(0.004028123)	(0.00641465)	(0.004652787)	(0.006577038)
Jacobs	0.08557343***	0.04609538	0.08606823**	0.05348055*	0.06995099*
	(0.03161211)	(0.02715421)	(0.03786671)	(0.02759661)	(0.03951419)
INEQ			-0.002094355		-0.0003162147
			(0.005511443)		(0.00586234)
SK			0.004186104		0.001431676
			(0.006000853)		(0.006241042)
QLTY			0.005195343		0.01082091
			(0.006210273)		(0.006992434)
SIZE			-0.00696283		-0.003939738
			(0.005082619)		(0.005974073)
ACCESS			-0.004848634		-0.006671686
			(0.003687716)		(0.005305976)
DISADV			-0.003983242		-0.003952786
			(0.00659098)		(0.006656245)
D1_BORDER				-0.001150143	-0.01521904
				(0.01169132)	(0.01661135)
D2_POLES				-0.02303332*	-0.0222501
				(0.01233318)	(0.0177886)
D3_OIL				-0.01466305	-0.01654184
				(0.01510436)	(0.01603778)
R^2	0.315323	0.204028	0.441498	0.329180	0.518098
$\overline{R}^2$	0.241965	0.149133	0.247237	0.200176	0.253051
SE of the Estimate	0.0192802	0.0204267	0.0192131	0.0198046	0.0191387
F & (prob F)	4.2984	3.71671	2.2727	2.5517	1.95474
	(0.0129334)	(0.0365612)	(0.0590621)	(0.052443)	(0.0928829)
MCN	46.63426	13.751	19.55156	15.47116	21.8911
NORMALITY OF ERRORS					
Jarque-Bera	0.7592008	1.065331	1.645136	0.5103461	1.356162
	(0.6841347)	(0.5870380)	(0.4393022)	(0.7747824)	(0.5075901)
HETEROSKEDASTICITY		1.604508			
Breusch-Pagan test	2.325352	(0.4483173)	2.701649	4.16521	8.003821
	(0.5076816)		(0.9516643)	(0.5258834)	(0.7129615)
Koenker-Bassett test	3.734247	2.762112	5.427623	5.928339	15.81123
	(0.2916275)	(0.2513131)	(0.7110449)	(0.3132545)	(0.1482850)
SPECIFICATION TEST					
White	8.665956	3.730878	N/A	N/A	N/A
	(0.4686629)	(0.5887756)			
SPATIAL DEPENDENCE					
Moran's I (error)	0.027791	0.121552	-0.082887	0.127758	-0.121048
	(0.4546366)	(0.1281250)	(0.7813533)	(0.0908823)	(0.9144835)
n	32	32	32	32	32

*. Significant at the 0.10 level; **. Significant at the 0.05; ***. Significant at the 0.01

Notice that in previous results for Food, Textiles, Paper, and Chemicals *intra-industry* externalities (*MAR* and *PORTER* economies) are not significant in any activity at the state level. On the other hand, *inter-industry* externalities, represented by *JACOBS* economies, are only significant and with the expected sign for Chemicals and Food. Textiles are the "atypical" case with the significant negative sign in diversification. Results for the industrial activity as a whole, adjusted to only express inter-industry externalities, show that *JACOBS* economies is the only significant variable for industrial growth. This finding is not exclusive for the Mexican case study. Similar statistical testing problems at different levels of economic and spatial aggregation are common in literature (Gao 2004, Combes 2000, Henderson 1997). As an example, an author concludes for China:

> [O]ur results at best present a weak case for the importance of dynamic externalities in industrial growth. Regional industrial growth is found to be positively associated with location, suggesting a possible role of competition promoting growth. No significant positive correlation is found between industrial growth and either specialization or industrial diversity. (Gao 2004, 116).

Disagreement in findings and use of different statistical methods to test the influence of dynamic externalities on industrial growth is a continuous challenge in regional analysis calling for analytical imagination and additional research.

Based on Lamorgese's idea that in some industries dynamic externalities may vanish before reaching the average optimum in a 10 years period, the study repeats all previous regressions using as a dependent variable the growth rate for 1993-1998. The assumption that some dynamic externalities may vanish before a ten year period seems feasible in a phase dominated by three major changes in Mexico: the economic crisis of

1994, the new international scenario under NAFTA, and the substitution of the ruling party after seventy consecutive years in power (PRI).

6.5.2 The short-run hypothesis

Previous results show that *PORTER* and *MAR* externalities, as measured in current literature, do not matter for most of the Mexican industries. Only *JACOBS* economies in Food, Textiles, Paper, and Chemicals fit to theoretical predictions. For this reason, the study re-runs regressions to see if same results hold for a shorter period. In sharp contrast with assumptions in current literature, Lamorgese (1998), studying manufactures in US cities, concludes that dynamic externalities matter in the short- and medium-run rather than in the long run as Glaeser *et al.* (1992) and Henderson *et al*. (1995) suggest. These findings, of course, may differ at higher aggregation or finer desegregation of industries.

Results for five year growth rates (1993-1998) show that dynamic externalities are important in three industries: Textiles, Chemicals, and Nonmetallic industry.

Textiles. Model 2 and Model 4 are discarded because they report problems in the normality of errors (Table 6.21). On the other hand, Model 1 and Model 3 are significant, but with some econometric problems: While Model 1 presents problems of spatial autocorrelation among residuals, Model 3 is slightly above the limit of the multicollinearity condition number (MCN). Since the explicative power of Model 3 is similar to that in Model 1, the study takes Model 1 as the best formulation and solves its spatial dependence problem using the maximum likelihood estimation. The OLS method cannot be used in the case of spatial autocorrelation among errors because it leads to "biased estimation of the residual variance and inefficient estimates of the regression parameters. . . . as well as unrealizable standard regression diagnostics" (Ying 2003, 620).

So far, the Moran's I statistic in Model 1 suggests a problem of spatial autocorrelation but is does not help much on which spatial regression formulation to use. It is necessary to examine the Lagrange Multiplier tests in diagnostics for spatial dependence to choose the most appropriate specification. Applying the thumb rule for spatial autocorrelation presented in the Annex C, the Lagrange Multiplier (*lag*, significant at $p < 0.0242$) indicates that the Spatial Lag Model rather than the Spatial Error Model is the most appropriate specification to solve the spatial autocorrelation problem in residuals (Anselin 2005, 197-200).

Table 6.21 Textiles. Dependent Variable: Growth Rate 1993-1998

	Model 1	Model 2	Model 3	Model 4
Constant	0.3679***	0.1074	0.3580652	0.1682
	(0.0942)	(0.1065)	(0.1083469)	(0.1208)
MAR	-0.0128		-0.01506277	
	(0.0097)		(0.01223576	
Porter	-0.0394***	-0.0193	-0.03197213	-0.0301*
	(0.0133)	(0.0129)	(0.01398179)	(0.0159)
Jacobs	-0.1206	-0.0059	-0.09356211	-0.0603
	(0.1204)	(0.1361)	(0.1246851)	(0.1465)
INEQ		-0.0333**		-0.0400**
		(0.0150)		(0.0164)
SK		0.0166		0.0094
		(0.0164)		(0.0179)
QLTY		-0.0224		-0.0127
		(0.0169)		(0.0213)
SIZE		-0.0179		-0.0024
		(0.0135)		(0.0185)
ACCESS		-0.0252**		-0.0261
		(0.0105)		(0.0157)
DISADV		0.0147		0.0163
		(0.0166)		(0.0174)
D1_BORDER			0.06202787	-0.0168
			(0.03206615)	(0.0506)
D2_POLES			-0.009744359	-0.0664
			(0.04255449)	(0.0569)
D3_OIL			-0.02709057	0.0518
			(0.05592912)	(0.0529)
R^2	0.2877	0.5441	0.402181	0.5849
$\bar{R}^2$	0.2114	0.3855	0.258704	0.3566
SE of the Estimate	0.0624	0.0550	0.0604617	0.0563
F & (prob F)	3.76977	3.4306	2.80311	2.5621
	(0.0217)	(0.0096)	(0.0316983)	0.0326
MCN	25.1720	24.3012	34.0654	28.5969
NORMALITY OF ERRORS				
Jarque-Bera	1.2277	6.9112	4.194399	11.1934
	(0.5413)	(0.0316)	(0.1227998)	(0.0037)
HETEROSKEDASTICITY				
Breusch-Pagan test	1.6321	11.8672	9.381603	13.7018
	(0.6521)	(0.1572)	(0.1532269)	(0.2499)
Koenker-Bassett test	1.6655	6.1953	6.284072	6.2232
	(0.6446)	(0.6254)	(0.3921321)	(0.8581)
SPECIFICATION TEST				
White	10.0351	N/A	N/A	N/A
	(0.3476)			
SPATIAL DEPENDENCE				
Moran's I (error)	0.2311	-0.1568	0.060994	-0.1901
	(0.0242)	(0.6001)	(0.3117246)	(0.3798)
Lagrange Multiplier (lag)	(0.0256)			
Robust LM (lag)	(0.0900)			
Lagrange Multiplier (error)	(0.0788)			
Robust LM (error)	(0.3216)			
Lagrange Multiplier (SARMA)	(0.0507)			
n	32	32	32	32

*. Significant at the 0.10 level; **. Significant at the 0.05; ***. Significant at the 0.01

Spatial Lag Model (Textiles). New developments in econometrics suggest that the OLS estimation with spatial correlation among residuals yields unbiased coefficients but generates inconsistent standard errors. Therefore, inferences based on *t* and *F* statistics are misleading and measures of fit such as the coefficient of determination (R^2) are incorrect (Greenbaum 2002, 72). The spatial lag specification for Model 1 is as follows:

(6.3) $RATE_{(Textiles)} = \alpha + \beta_1 PORTER + \beta_2 JACOBS + \rho WRATE + \varepsilon$

Where: *RATE*, *PORTER* and *JACOBS* defined as before; *W* is the spatial weights matrix based on simple contiguity[8] (Table D.27); ρ captures the impact of regional growth in textiles in the surrounding states. While *PORTER* and *JACOBS* capture intraregional dynamic economies, $\rho WRATE$ represents the inter-regional (neighboring) effect. Finally, ε is a normally distributed and uncorrelated error term. The use of OLS to solve this model specification is inconsistent. It would create problems of simultaneity because the spatial lag term includes the dependent variable. For this reason, current literature suggests solving the spatial lag equation via maximum likelihood (Rey and Monturi 1999, 151).[9]

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[8] This study uses a "queen case" contiguity to create the matrix. It means that state borders only need touch to be considered contiguous.

[9] Literature refers that errors must be uncorrelated displaying a spherical distribution (a). Regression parameters will be biased if their distribution is not "spherical" as in (b) and (c).

(a) Spherical distribution of errors (b) Positively correlated errors (c) Negatively correlated errors

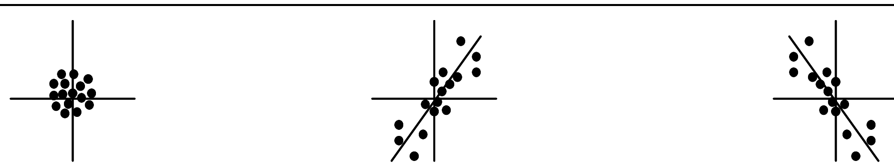
Table. 6.22 Textiles Dependent variable: Growth rate (*RATE*), 1993-1998.

Parameters and tests	Ordinary Least Squares Model (OLS)			Spatial Lag Model (ML)		
	Coefficient	t-value	p-value	Coefficient	z-value	p-value
WRATE				0.3873	2.1124	0.0346
CONSTANT	0.3679***	3.9067	0.0005	0.3312	4.0515	0.0000
MAR	-0.0128	-1.3218	0.1969	-0.0165	-1.9797	0.0477
PORTER	-0.0394***	-2.9511	0.0063	-0.0345	-3.0096	0.0026
JACOBS	-0.1206	-1.0014	0.3252	-0.0556	-0.5366	0.5915
LIK	45.5242			47.628		
AIC	-83.0484			-85.256		
SC	-77.1855			-77.9273		
HETEROSKEDASTICITY						
Breusch-Pagan test	1.6321		0.6521	1.6009		0.6592
SPATIAL DEPENDENCE						
Likelihood Ratio Test				4.2076		0.0402

*. Significant at the 0.10 level; **. Significant at the 0.05; ***. Significant at the 0.01

Note: LIK= value of the maximum likelihood function. AIC= Akaike information criterion. LM= Lagrange multiplier test. SC= Schwartz criterion.

In the maximum likelihood estimation (ML) of the spatial lag model the traditional R^2 parameter of fit is no longer applicable. Instead the goodness of fit is based on values of the likelihood function: Maximized Log Likelihood (LIK), Akaike Information Criterion (AIC), and Schwartz Criterion (SC). These three values are comparable with those in the OLS model. The best model is the one with the highest LIK or the lowest AIC or SC (Anselin 2005, 207). Results show a slight increase in the Log-Likelihood (LIK) from 45.5242 (for OLS) to 47.628 (for ML) (Table 6.22). On the other side, the Akaike Information Criterion (AIC) increases from -83.0484 to -85.256



and the Schwartz value (SC) does not compensate the improved fit for the added variable (*WRATE*, the spatially lagged variable), increasing from -77.1855 to -77.9273. The Likelihood Ratio Test confirms the significance of the spatial lag coefficient (4.2076), significant for $p < 0.0402$, suggesting the presence of spatial autocorrelation. The increasing values in AIC and SC (they should decrease) suggest the model must be improved including new explanatory variables and/or trying different spatial weights. To correct these problems, the study rans both the OLS and the spatial lag specification including variables in Model 3 (Table 6.23). Results show that LIK increases from 48.3276 to 49.5694. On the other hand, AIC increases from -82.6551 to -83.1388 but SC, compensating the improved fit for *WRATE*, decreases from -72.395 to -71.4129. Except for AIC, all values suggest the spatial lag formulation improves.

There are minor differences in the significance of the regression coefficients between the OLS and the ML model. However, the significant coefficient of the spatially lagged dependent variable (*WRATE*) is significant at the 10%, meaning that there are inter-state or neighboring externalities. On the other hand, it may be noticed that *PORTER* slightly increases its significance from $p < 0.0310$ to $p < 0.0110$ (Table 6.23). In general, intra-industrial competence (Porter economies) favors the industrial growth of Textiles in the short run. This finding gives the reason to the *JACOBS* argument that competition encourages growth, at least in this specific industry. Porter economies maintain their statistical significance when additional variables are included into the model. Results also suggest that in the short-run the growth of Textiles is faster in the border states (*D1_BORDER*) than in the rest of the country. *D1_BORDER* is significant and increases the explicative power of the spatial lag model (LIK and SC values).

Diagnostics tests do no show problems: the Breusch-Pagan test indicates that there is no problem of heteroskedasticity in the error terms. Finally, the value of the Likelihood Ratio Test (2.4837, non-significant with a $p < 0.1150$) confirms that the spatial lag model is different from the OLS formulation.

Table 6.23 Textiles Dependent Variable: Growth Rate (RATE), 1993-1998 (Model 3).

Parameters and tests	Ordinary Least Squares Model (OLS)			Spatial Lag Model (ML)		
	Coefficient	t-value	p-value	Coefficient	z-value	p-value
WRATE				0.3001	1.6599	0.0969
CONSTANT	0.3581	3.3048	0.0029	0.3223	3.4739	0.0005
MAR	-0.0151	-1.2310	0.2298	-0.0163	-1.5853	0.1129
PORTER	-0.0320	-2.2867	0.0309	-0.0298	-2.5410	0.0110
JACOBS	-0.0936	-0.7504	0.4600	-0.0539	-0.5103	0.6098
D1_BORDER	0.0620	1.9344	0.0645	0.0478	1.7244	0.0846
D2_POLES	-0.0097	-0.2290	0.8207	-0.0146	-0.4092	0.6824
D3_OIL	-0.0271	-0.4844	0.6323	-0.0171	-0.3824	0.7022
LIK	48.3276			49.5694		
AIC	-82.6551			-83.1388		
SC	-72.395			-71.4129		
HETEROSKEDASTICITY						
Breusch-Pagan test	9.3816		0.1532	8.8714		0.1809
SPATIAL DEPENDENCE						
Likelihood Ratio Test				2.4837		0.1150

*. Significant at the 0.10 level; **. Significant at the 0.05; ***. Significant at the 0.01

Note: LIK= value of the maximum likelihood function. AIC= Akaike information criterion. LM= Lagrange multiplier test.
SC= Schwartz.

Briefly, the short run analysis shows that intra-industry externalities (*PORTER* economies) and inter-regional effects matter for the growth of Textiles. However, these effects fade away in long run model where institutional factors (social capital) and other market conditions (urbanization economies, availability of public services, and opportunity of social connectedness) better explain the regional growth of textiles.

Chemicals. The *F-value* shows that Models 2 and Model 4 are not statistically significant (Table 6.24). On the other hand, the *F-value* test shows that Model 1 with fewer variables than Model 3 is the most efficient formulation. Model 1 has similar explicative power to Model 3, explaining 12% of the variance. In Model 1, *JACOBS* economies are the only statistically significant variable favoring growth of chemicals.

Model 3, a less efficient formulation than Model 1, confirms the relevance of *JACOBS* economies and suggests that chemicals grow faster in border states (*D1_BORDER*) than in the rest of states (represented by the constant). Diagnostics tests for normality of errors, multicollinaerity, heteroskdasticity, and spatial dependence report no econometric problems for any of the two significant models.

Table 6.24 Chemical Industry. Dependent variable: Growth Rate 1993-1998

	Model 1	Model 2	Model 3	Model 4
Constant	0.0323	0.0813	0.0469	0.0603
	(0.0562)	(0.1113)	(0.0728)	(0.1240)
MAR	-0.0095	-0.0089	-0.0103	-0.0041
	(0.0056)	(0.0094)	(0.0067)	(0.0108)
Porter	-0.0008	-0.0020	-0.0017	0.0032
	(0.0056)	(0.0078)	(0.0063)	(0.0095)
Jacobs	0.1973***	0.1200	0.1865**	0.0617
	(0.0740)	(0.0905)	(0.0726)	(0.0990)
INEQ		0.0079		0.01168
		(0.0118)		(0.0126)
SK		-0.0099		-0.0224
		(0.0155)		(0.0185)
QLTY		0.0236*		0.0332**
		(0.0127)		(0.0150)
SIZE		-0.0060		-0.0037
		(0.0171)		(0.0175)
ACCESS		-0.0131		-0.0081
		(0.0083)		(0.0128)
DISADV		-0.0078		-0.0032
		(0.0157)		(0.0170)
D1_BORDER			0.0412*	0.0057
			(0.0220)	(0.0372)
D2_POLES			-0.0038	-0.0503
			(0.0301)	(0.0442)
D3_OIL			-0.0181	-0.0263
			(0.0337)	(0.0363)
R^2	0.2087	0.428167	0.3298	0.4943
$\overline{R}^2$	0.1239	0.194235	0.1690	0.1749
SE of the Estimate	0.0436	0.0418493	0.0425	0.0423
F & (prob F)	2.46106	1.8303	2.0505	1.5476
	0.0833	0.119135	0.0961	0.191109
MCN	21.2110	39.4842	28.1643	47.3918
NORMALITY OF ERRORS				
Jarque-Bera	0.0999	0.3754	1.7442	2.9252
	(0.9513)	(0.8288)	(0.4181)	(0.2316)
HETEROSKEDASTICITY				
Breusch-Pagan test	1.1906	5.9302	4.3443	10.0254
	(0.7552)	(0.7469)	(0.6302)	(0.6137)
Koenker-Bassett test				
	1.1209	4.8164	2.9611	5.9411
	(0.7720)	(0.8500)	(0.8137)	(0.9190)
SPECIFICATION TEST				
White	8.7686	N/A	N/A	N/A
	(0.4589)			
SPATIAL DEPENDENCE				
Moran's I (error)	0.0084	0.0271	-0.0117	0.0358
	(0.6055)	(0.2148)	(0.5739)	(0.1932)
n	32	32	32	
F-value test for Model 1 and Model 3	$F_{3,25} = \frac{(0.3298-0.2087)/(6-3)}{(1-.03298)/(32-6-1)} = 1.52 < F_{3,25}\ (critical) = 4.68$			

*. Significant at the 0.10 level; **. Significant at the 0.05; ***. Significant at the 0.01

Nonmetallic industry. Model 1 with and without MAR externalities presents problems of multicollinearity (Table 6.25). Model 2, Model 3, and Model 4 do not have econometric problems. *F-value* tests show that there is not significant difference in the explicative power of these three models (Table 6.26). Therefore, Model 3 with fewer variables than the other two models is the most efficient formulation. Model 3, explaining 22% of the variance, shows that *JACOBS* economies favors growth of nonmetallic industry in the short run. On the other side, the significant negative sign of *D2_POLES* suggests that nonmetallic industry grows out of the traditional industrial cities (industrial growth is higher in *D2_POLES* than in the rest of the states represented by the constant).

Model 4, less efficient than Model 3, explains 30% of the variance and provides relevant information for policy making. It confirms the positive influence of *JACOBS* economies on industrial growth in the metallic industry. The statistically significant negative sign of *SIZE* suggests that the growth of this industry is not favored by the domestic market size and the proximity to national markets. On the other side, as expected, the negative sign of *D3_OIL* shows that the nonmetallic industry in oil producer states grows below the rate in the rest of the sates (the benchmark group represented by the constant).

Table 6.25 Nonmetallic Industry. Dependent Variable: Growth Rate 1993-1998.

	Model 1	Model 1 (excluding MAR)	Model 2	Model 3	Model 4
Constant	0.1294	-0.0775	-0.1727**	-0.0754	-0.1116
	(0.0901)	(0.0457)	(0.0707)	(0.0471)	(0.0719)
MAR	-0.0269***				
	(0.0104)				
Porter	0.0104	0.0152	0.0128	-0.0090	-0.0032
	(0.0169)	(0.0184)	(0.0234)	(0.0223)	(0.0239)
Jacobs	0.3107***	0.1216*	0.2638**	0.1665**	0.2026*
	(0.0938)	(0.0645)	(0.1038)	(0.0664)	(0.1015)
INEQ			0.0115		0.0178
			(0.0148)		(0.0149)
SK			0.0044		0.0005
			(0.0164)		(0.0157)
QLTY			0.0049		0.0146
			(0.0158)		(0.0176)
SIZE			-0.0340***		-0.0299*
			(0.0129)		(0.0152)
ACCESS			-0.0019		0.0077
			(0.0114)		(0.0139)
DISADV			0.0062		0.0037
			(0.0162)		(0.0155)
D1_BORDER				0.0177	0.0338
				(0.0325)	(0.0436)
D2_POLES				-0.0777**	-0.0348
				(0.0311)	(0.0461)
D3_OIL				-0.0566	-0.0850*
				(0.0408)	(0.0418)
R^2	0.3102	0.1446	0.4172	0.350280	0.5483
$\overline{R}^2$	0.2363	0.0857	0.2145	0.225334	0.2999
SE of the Estimate	0.0517	0.0566	0.0525	0.05212	0.0495
F & (prob F)	4.19673	2.4522	2.0580	2.8034	2.2073
	(0.0143)	(0.1038)	(0.0841)	(0.0373)	(0.0597)
MCN	34.0564 (Extreme Multicol	10.4928 (Extreme Multicol	18.4016	12.7145	21.3254
NORMALITY OF ERRORS					
Jarque-Bera	0.9202	0.1309	1.3655	0.8355	2.0367
	(0.6312)	(0.9366)	(0.5052)	(0.6585)	(0.3612)
HETEROSKEDASTICITY					
Breusch-Pagan test	0.9848	0.7757	3.3495	1.8364	6.2853
	(0.8049)	(0.6785)	0.9105	(0.8713)	(0.8537)
Koenker-Bassett test					
	1.6017	0.7910	4.0887	2.7643	12.8452
	(0.6590)	(0.6733)	0.8490	(0.7363)	(0.3036
SPECIFICATION TEST					
White	3.4186	2.3597	N/A	N/A	N/A
	(0.9454)	(0.7974)			
SPATIAL DEPENDENCE					
Moran's I (error)	0.0443	-0.0167	-0.1201	-0.0143	-0.0677
	(0.4042)	(0.7385)	(0.8551)	(0.6620)	(0.7659)
n	32	32	32	32	

*. Significant at the 0.10 level; **. Significant at the 0.05; ***. Significant at the 0.01

Table 6.26 Evaluation of Competing Models for Growth of Nonmetallic Industry, 1993-1998.

Competing models	H_0: There is no difference between the two competing models
Model 2 *vs* Model 3	H_0 not rejected
$F_{3,23} = \frac{(0.4172-0.3503)/(8-5)}{(1-0.4172)/(32-8-1)} = 0.88 < F_{3,28}\ (critical) = 4.76,\ for\ \alpha = 0.01$	
Model 2 *vs* Model 4	H_0 not rejected
$F_{3,20} = \frac{(0.5483-0.4172)/(11-8)}{(1-0.5483)/(32-11-1)} = 1.93 < F_{3,20}\ (critical) = 4.94,\ for\ \alpha = 0.01$	
Model 3 *vs* Model 4	H_0 not rejected
$F_{7,20} = \frac{(0.5483-0.3503)/(11-5)}{(1-0.5483)/(32-11-1)} = 1.25 < F_{7,20}\ (critical) = 3.70,\ for\ \alpha = 0.01$	

Aggregate industrial activity. In the 1993-1998 period, intra-industry externalities in models for the aggregate industrial activity, as for the equivalent models in period 1993-2003, are adjusted to only express inter-industrial externalities. The study uses regional *GSP* instead of industry specific *MAR* economies and regional competence (*COM*) instead industry specific *PORTER* economies.

Model 1 presents problems of multicollinearity and spatial autocorrelation (Table 6.27). When Model 1 is corrected for multicollinearity, spatial autocorrelation persist. Since Model 3 also presents problems of spatial autocorrelation, Model 2 and Model 4 are the only two specifications with no econometric problem. The *F-test* for competing models shows that Model 2 is the most efficient formulation. The explicative power of Model 4, with more variables, is not significantly different from that of Model 2.

The significant positive sign of *JACOBS* economies in Model 2 shows that diversification fosters industrial growth for the industrial activity as a whole. On the other hand, the negative sign in *ACCESS* (representing road infrastructure and distance to the US border) indicates that low road density and distant areas from the US border are not favorable for the aggregate industrial growth.

On the other hand, Model 4, although less efficient than Model 2, provide additional information. Model 4 notes that, besides *JACOBS* and *ACCESS*, the statistically significant variables in the short-run for the aggregate industrial activity clearly express the deconcentration of manufacturing towards northern states: the negative sign in *D2_POLES* shows that manufacturing in the three traditional cities grows slower than in the rest of the regions. Additionally, the negative sign in *D3_OIL* suggests that oil-producer states have an unfavorable economic structure for total industrial growth.

Briefly. The hypothesis that dynamic economies are important in some industries in the short- and medium-run and fade away in the long-run only holds for Nonmetallic industries in Mexico. Dynamic economies are relevant in the short- and long-run for Textiles, Chemicals, and the aggregate industrial activity. While the short-run analysis adds nothing to the long-run analysis of Chemicals and the industry as a whole, it suggests that intra-firm externalities (*PORTER* economies) in Textiles fade away before a ten year period.

Table 6.27 Total Manufacturing. Dependent Variable: Growth Rate 1993-1998.

	Model 1	Model 1 (Corrected for MC)	Model 2	Model 3	Model 4
Constant	0.1551655**	0.01641164	-0.04571777	0.01638445	-0.005601028
	(0.07376734)	(0.02995402)	(0.03679999)	(0.02665353)	(0.03414717)
GSP (instead of MAR)	-0.0109495**				
	(0.00537099)				
COM (instead of Porter)	-0.0164123***	-0.01070042**	0.001908415	-0.01088864**	-0.001072068
	(0.00569268)	(0.005218131)	(0.007884008)	(0.005153761)	(0.007019995)
Jacobs	0.1214674***	0.07229896**	0.132816***	0.08203542***	0.09653579**
	(0.04120212)	(0.03517624)	(0.04654056)	(0.03056798)	(0.04217543)
INEQ			-0.007578148		-0.003572356
			(0.006773909)		(0.006257167)
SK			0.007195739		0.00156572
			(0.007375426)		(0.00666137)
QLTY			0.0008970576		0.01149292
			(0.007632816)		(0.007463368)
SIZE			-0.007315283		-0.00190685
			(0.006246859)		(0.006376421)
ACCESS			-0.01035611**		-0.01110469*
			(0.004532435)		(0.005663328)
DISADV			-0.0067967		-0.006638902
			(0.008100728)		(0.007104536)
D1_BORDER				0.005869269	-0.01846163
				(0.01295014)	(0.01773011)
D2_POLES				-0.03787605***	-0.04091193**
				(0.01366111)	(0.01898665)
D3_OIL				-0.04035**	-0.03787555**
				(0.01673067)	(0.01711791)
R^2	0.464660	0.385199	0.611685	0.621174	0.747312
$\overline{R}^2$	0.407302	0.342799	0.476618	0.548322	0.608334
SE of the Estimate	0.0251292	0.0264613	0.0236141	0.0219369	0.0204277
F & (prob F)	8.10106	9.08487	4.52878	8.5266	5.37719
	(0.000486527)	(0.000864272)	(0.0020552)	(6.99009e-005)	(0.000581571)
MCN	46.63426	13.751	19.55156	15.47116	21.8911
NORMALITY OF ERRORS					
Jarque-Bera	0.4485969	0.8319285	0.3794179	0.1216639	0.1590806
	(0.7990766)	(0.6597039)	(0.8271998)	(0.9409814)	(0.9235408)
HETEROSKEDASTICITY					
Breusch-Pagan test	1.417229	1.158749	3.898853	8.114337	12.36781
	(0.7015012)	(0.5602487)	(0.8661320)	(0.1500459)	(0.3366408)
Koenker-Bassett test	1.920031	1.892053	4.850518	7.133659	14.34272
	(0.5891693)	(0.3882807)	(0.7734270)	(0.2108882)	(0.2146063)
SPECIFICATION TEST					
White	9.602635	5.396139	N/A	N/A	N/A
	(0.3836008)	(0.369469)			
SPATIAL DEPENDENCE					
Moran's I (error)	0.156804	0.243102	-0.053066	0.186519	-0.189568
	(0.0655440)	(0.0108455)	(0.5608186)	(0.0288465)	(0.4169230)
n	32	32	32	32	32

F-value test for Model 2 and Model 4

$$F_{3,20} = \frac{(0.7473-0.6117)/(11-8)}{(1-0.7473)/(32-11-1)} = 3.57 < F_{3,20}\,(critical) = 4.94,\ for\ \alpha = 0.01$$

*. Significant at the 0.10 level; **. Significant at the 0.05; ***. Significant at the 0.01

6.6 Chapter remarks

In contrast with predictions in the neoclassical model, Chapter 5 shows that there is no direct connection between the initial level of industrial GSP and its growth rate: bigger economies do not grow slower nor smaller ones faster. So, what does explain growth rate? This issue is the main focus of this chapter. The research hypothesis assumes that regional characteristics (dynamic externalities, institutional variables, and other regional conditions) explain industrial regional growth. Results show that inter-industry (*JACOBS*) economies rather than intra-industry (*MAR* and *PORTER*) externalities dominate in models explaining industrial regional growth in Mexico. On the other hand, the effect of social capital (*SK*) and other regional variables explaining industrial growth is selective (it is only significant for some industries) and contradictory (they may be positive or negative, depending on the industry of reference). Similarly, different groups of states (border states, oil-producer states, traditional industrial centers, and rest of the country) matter for industrial growth in a different way.

Briefly, results partially provide support to the primary hypothesis and suggest that a one-size-fits-all policy is unlikely to be either desirable or viable for all industries and all places. The contradictory influence of variables and the differential importance of regions call for a selective spatial policy of industrial growth.

CHAPTER 7

FINDINGS AND POLICY IMPLICATIONS

This chapter reviews and integrates results from all previous chapters into an industrial regional policy that combines the spatial effects of the current macroeconomic policy, endogenous growth factors and resources from oil exports. To this end, the chapter has three sections. The first section examines results of the regression analysis to find support to the primary hypothesis. The second section combines results in the regression analysis with findings in Chapter 6 to suggest some policy guidelines. Finally, the last section presents in a nutshell the main argument elaborated in this chapter.

7.1 Test of the primary hypothesis and discussion

In contrast with the exogenous growth model, the primary hypothesis states: "regional characteristics matter for industrial regional growth creating a local environment that evolves in a self-organizing and self-reinforcing way, as predicted by new spatial economics (endogenous growth models and NEG)." Dynamic externalities, local institutions and other economic conditions represent the "regional characteristics" in this hypothesis. Regarding dynamic externalities, results of the regression analysis suggest that inter-industry rather than intra-industry externalities dominate in models explaining industrial regional growth in Mexico. This finding is consistent with the classical study by Glaeser *et al*. (1992) who conclude that *only JACOBS* economies matter for the economic activity: “the research on growth should change its focus from looking inside industries to looking at the spread of ideas across sectors” (Glaeser *et al*. 1992, 1151).

In the ten year period, *JACOBS* economies have the expected positive influence on growth in Food, Chemicals and the industrial activity as a whole (Table 7.1).

Regarding institutional factors, social capital (SK) fosters growth in Food but discourages it in Textiles. It is evident that this bipolar effect does not allow standard or generic social or institutional strategies of industrial growth. Institutions matter and are endogenous to industrial regional growth, but their effect is selective (only affects some industries) and contradictory (it may be either positive or negative, depending of the industry).

On the other hand, *SIZE (domestic market potential)*, *ACCESS (national market accessibility)*, and *DISADV (unfavorable economic structure)*, all of them representing variables from the set of natural advantage and local market conditions, only are significant for Textiles. All these variables have the “wrong” sign. It is important to highlight for policymaking that unfavorable regional economic structures for manufacturing, in general, fosters growth of Textiles in particular. This specific case may be linked to the sources of raw materials and/or low labor cost availability. However, more research needs to be done to confirm or reject this speculation.

Regarding dummy variables, Chemicals and Textiles grow faster in the border states than in the rest of regions. On the other hand, Paper industry grows significantly slower in the traditional industrial cities than in the rest of the country. This finding shows that Paper is a good candidate to encourage industrial growth in the periphery.

Table 7.1 Regression Results for Short- and Long-Run Effects of Regional Characteristics on Industrial Growth

	Dependent variable: $RATE_{i,\ 1993\text{-}2003}$					*Dependent variable: $RATE_{i,\ 1993\text{-}1998}$*		
	TOTAL	FOOD	TEXTILES	PAPER	CHEM	TEXTILES	CHEM	NONMETALLIC
WRATE						+ (+)		
MAR								
PORTER						+ (+)		
JACOBS	+ (+)	+ (+)			+ (+)		+ (+)	+ (+)
INEQ								
SK		+ (+)	− (+)					
QLTY								
SIZE			− (+)					− (+)
ACCESS			− (+)					
DISADV			+ (−)					
D1_BORDER			+ (+)		+ (+)	+ (+)	+ (+)	
D2_POLES				− (+/−)				− (+/−)
D3_OIL				− (−)				− (−)

Source: Tables in Chapter 6.
Note: Expected signs in brackets. Textiles 1993-2003 include signs from their two significant models (Model 2 and Model 3). The aggregate industrial activity in 1993-1998 also includes signs for the two significant models (Model 2 and Model 4).

Previous results from the viewpoint of industries may be summarized as follows: In the long run—the ten year period—Food, Paper, Chemicals, and the industry as a whole have the expected sign in all statistically significant variables. Textiles, the atypical case, have the opposite sign to the one expected in their four significant variables: SK, *SIZE*, *ACCESS*, and *DISADV*. Briefly, variables explaining regional growth have not a unidirectional influence on all different industries. Therefore, a one-size-fits-all policy is unlikely to be either desirable or viable for all industries.

Short-run effects. In his 1997 classical article, Henderson states that dynamic economies require more than five years establishing information and social communications network. Referring dynamic externalities, he concludes that "conditions from four or more years ago typically have a greater direct impact than conditions last year, suggesting the presence of an aging and transmission mechanism" (Henderson 1997, 469). Contrasting this conclusion, Lamorgese (1998) suggests that in some industries dynamic economies may only be significant in the short- and medium-run and fade away in the long-run. There are no cut-off results for the case study. Nonmetallic industry fits to the short-run hypothesis. In Nonmetallic industry, *JACOBS* economies are statistically significant in the short run but no dynamic externality is significant in the long run. In the five year period, Nonmetallic industry has the expected positive sign in *JACOBS* economies and negative sign in oil producer states (*D3_OIL*). Results show that nonmetallic industry grows faster in states other than the traditional industrial centers (negative sign in *D2_POLES*) and orients towards the international market (negative sign in *SIZE*, domestic market size and proximity to national markets). However, no variable is significant or no model is satisfactory for the nonmetallic industry in the long-run.

On the other hand, in Textiles, *PORTER* economies are important in the short-run but they are replaced by the negative influence of variables representing regional conditions (SK, *SIZE*, *ACCESS*, and *DISADV*) in the long run. Note that that intra-firm externalities (*PORTER* economies) and inter-regional effects (*WRATE*) are only significant for Textiles. The outlier (Campeche, an oil-producer state) shows that Textiles are compatible with non-manufacturing states rather than being confined to the border states.

The four statistically significant variables in the short-run for the aggregate industrial activity clearly express the deconcentration of manufacturing towards diversified northern states: diversity (*JACOBS* economies) fosters industrial growth. The negative sign in *ACCESS* shows that low road density and distant regions from the US border do not favor growth. The negative sign in *D2_POLES* shows that manufacturing in the three traditional cities grows slower than in the rest of the regions. Additionally, the negative sign in *D3_OIL* suggests that oil-producer states have an unfavorable economic structure for total industrial growth. For the industry as a whole, except for JACOBS economies that are significant in the short- and long-run, all short-run variables are not significant in the long-run.

Finally, Chemicals have no variations: *JACOBS* economies and border states (*D1_BORDER*) are the only two significant variables for this industry in both periods.

Briefly, the short run hypothesis only holds for Nonmetallic industries in Mexico. Dynamic economies are relevant in the short- and long-run for Textiles, Chemicals, and the industrial activity as a whole.

7.2 Spatial effects of the current macroeconomic policy and the urban system

New spatial trends in industrial growth in Mexico show that free trade liberalization (a macroeconomic policy) has been more effective in deconcentrating Mexico City than previous theoretical/technical proposals and institutional efforts in regional planning, for whatever reason (*i.e.*, path-dependent forces such as agglomeration economies, dominant interest, uncoordinated actions, or all of them mixed together). The fact that previous regional planning could not counterbalance stronger agglomerative forces in the capital city does not mean that all previous thought and experience on regional planning should be discarded. On the contrary, some previous ideas on the spatial distribution of industries may now be feasible under the current spatial inertia of industrial regional growth.

All spatial policy aimed to deconcentrate the economic activity when market forces and institutional support moves in the opposite direction is an impossible policy. Unlike ISI (Import Substitution Industrialization) macroeconomic forces that favored industrial concentration in only three main cities (Mexico City, Monterrey, and Guadalajara), the current free trade macroeconomic context favors deconcentration to some northern states ("winners" and "winners on the move"). A regional policy consistent and complementary with this trend becomes a logic issue.

The fact that current industrial growth is favorable to northern states out of the traditional industrial areas shows that manufacturing finds new location advantages. For the first time in the last century, there is a unique opportunity to integrate previous proposals of regional industrialization into a national strategy of development guided by macroeconomic and sectoral policies favorable to industrial deconcentration.

Industry is an urban activity. Therefore, any industrial regional policy must be linked to the study of the national urban system in two levels. In the first level, proposals to relocate industries require targeting activities in selected cities or “points” of development regarding their role in the national urban hierarchy. In the second level, each selected city, in turn, is the center of secondary cities with different economic structure and regional roles. This is the old idea of “deconcentration concentrated” of industries inspirited by the growth pole theory. Evaluation of cases from developed and developing countries warn about failed experiences of growth poles disarticulated from the urban national system, poles based on industrial complexes that became technologically obsolete, poles with industries that did not created regional multipliers, and so forth (Richardson and Townroe 1986). What this dissertation proposes is to retake the idea of “deconcentration concentrated” considering the lessons from these failed experiences and place them into the current spatial trend of industrial growth in Mexico. The idea of targeting systems of cities considering their specialization and competitive advantage already was suggested for Mexico when market forces and macroeconomic policies did not favor this proposal (Garza 1980). This industrial “deconcentrated concentration” would help to spatially distribute or reorganize industries considering the national urban hierarchy of the “winners” and “winners on the move” states.[1] This strategy would articulate the current industrial spatial trend to the national urban hierarchy rather than reacting “on the spot” to pragmatic needs of industrial relocation. If no proposal is suggested, industries will relocate anyway, but there is no guarantee they will do so in the most convenient way in social and economic terms. This last observation is particularly important in the context of free trade and globalization. There is a “retreat of the state” in the current international scenario, and Mexico is no exception. At the international scale, there is a hollowing-out of national regulatory prescriptions in favor of regional groups of interest that shape the territory replacing the State as rule making, policy-formulating and implementing, agent (Swyngedouw 2000, 553). This remark clearly fits in with the Mexican case study. In his review of the institutional planning in Mexico, Garza (1999) notes that the national government abdicated its role of formulating national urban policies in favor of local interests, as illustrated with the case of the general urban development plan for Mexico City and the general master plan of Monterrey.[2]

The equity/efficiency dilemma. The fact that this study approaches industry does not imply that the equity does not matter. On the contrary, as it is stated in Chapter

[1] Particular attention should be given to the city systems of San Luis Potosí and Guanajuato, strategic nodes in the Lázaro Cárdenas-Kansas City Transportation Corridor (Figure 5.7 in Chapter 5).

[2] None of these plans has been updated since the mid-eighties, for different local reasons. The case of Mexico City is complex because it includes governments from different states headed by opposing political parties (PRD and PRI), both opposing the national ruling party (PAN) that governs the country from the capital city. To this political complexity should be added the magnitude of social problems and the intensity of contradictory economic interests in a city of 30 million habitants. On the other hand, in the case of Monterrey, the government of the state has not a stable institutional structure to manage urban development. In recent years, the government of the state has abdicated its regulatory function in favor of local interests expressed in municipal plans unarticulated from the metropolitan context.

2 (Industrial regional policy and public policy), no regional policy would be complete until the equity/efficiency issue comes into the discussion. Five observations on this particular issue must be considered:

First, there is no clear evidence that industrial policies steering private and public activity to places left behind have been successful or beneficial either for the people in the places they are designed to help or for the national economic activity as a whole.

Second, Mexico is an oil producer country. Resources obtained from oil exports allocated in socially depressed areas (where most oil-dwells are located) cannot be considered transfers of benefits generated in richer areas.

Third, as Chapter 5 (Industrial location and growth) shows, the recent industrialization of the North is not at the expense of the South. It is opportune to notice that the industrial regional policy issue is set up in terms of industrial rates of growth rather than social welfare. Equity concerns with the well-being of the population. A potential conflict with equity would arise if incentives for people and firms relocating in low-growth areas reduce the growth rates in the whole country. Since the growth of northern states is not at the expense of the southern states, there is no reason for this debate.

Fourth, endogenous growth creates context conditions of a non-zero-sum game. Growth in one region does not imply deviating resources from the rest of the regions. Jacobs economies is an important driving force for endogenous regional growth and development. The aggregate industrial activity and some specific industries (*i.e.*, Food and Textiles) experience dynamic economies and institutional advantages (*i.e*., social capital in Food) that may lead to higher growth rates as a result of a cumulative and self-sustained process.

Finally, locating an industry in a socially depressed area not only would be economically inefficient but also socially adverse because that industry soon or later will close operations or continuously suck subsidies from the rest of the economy. In the first case, closing operations is a socially undesirable situation because it would imply a loss of jobs. In the second case, a policy of uninterrupted subsidies implies a continuous social cost/benefit evaluation difficult to measure and a deviation of resources from other social alternatives. In more realistic terms,

> What must be guarded against is the desire to increase equity by assisting distressed areas in ways that reduce overall economic efficiency and perhaps inhibit natural correctives by encouraging people to remain in places at costs well in excess of benefits—even taking a very broad view of benefits. The efficiency argument for public intervention must be made in terms of increasing national income, rather than moving it around. (Pack 2002, 177)

In this line of thought, equity issues must focus on social mechanisms of distribution rather than on promoting industries in socially depressed areas. As an example, in developed countries such as France, USA or Japan, industries are concentrated in few areas or, even more, in other countries. What matters in developed countries is how benefits of industrial activity are taxed and socially and economically distributed. The same argument applies to Mexico: let industries locate in the most economically efficient states and support them to be competitive. Social mechanisms of distribution may operate regardless where industry locate.

7.3 Chapter remarks

Considering results from Chapter 5 (Industrial location and growth) and Chapter 6 (Determinants of industrial growth), this chapter suggests an industrial regional policy combining the spatial effects of the current macroeconomic policy, endogenous growth factors and resources from oil exports. Since industry is an urban activity, the study proposes articulating the current spatially convergent industrial trend to the hierarchy of the national urban system in general and the urban subsystems in nodal points of the NAFTA superhighway in particular. This articulation is consistent with and complementary to the macroeconomic policy. If no proposal is presented, industries will relocate anyway, but there is no guarantee they will do so in the most convenient way in social and economic terms. Finally, resources from oil exports and factors of self-sustained growth such as Jacobs economies, suggest that it is possible to have a process of regional industrialization in Mexico with no critical decisions in terms of the equity/efficiency dilemma.

CHAPTER 8

CONCLUSIONS

The convergence model and the divergence model, the two dominant regional growth approaches, do not present cut-off results on the spatial evolution of economic activities, leave the topic open to debate, and call for empirical studies. This research tackles the convergence/divergence question in terms of determinants of industrial regional growth. Planners and policy makers require understanding the effect of these determinants to promote economic development at all different levels of government and provide analytical tools and frameworks that can lead to coherent actions.

Although the empirical analysis in this research shows a very complex problem in terms of regional policy, Chapter 7 (Findings and policy implications) suggests that some recommendations for a targeted regional industrialization of Mexico can, however, be derived from results in this study. The core argument in these suggestions is that endogenous growth variables such as Jacobs economies and macroeconomic spatial effects (reported in Chapter 6 and Chapter 7, respectively) may be combined to design a policy of regional industrialization in Mexico. Additionally, the allocation of resources from oil exports under economic and non-economic criteria facilitates this process with no critical decisions in terms of the equity/efficiency dilemma. The main elements supporting this argument are summarized in the next four sections. The first section reviews the definition of and reasons for an industrial policy. The second and third sections summarize empirical findings and policy implications, respectively. Finally, the last section highlights the limitations of the study and future research needs.

8.1 Industrial policy and public policy

Industrial regional policy is a sectoral public policy ultimately justified by economic as well as non-economic reasons. The three main economic reasons are efficiency, equity, and macroeconomic stabilization. While efficiency relates to the question of what to produce and how to produce, equity is concerned with how to distribute the outcome. The third economic reason, the macroeconomic policy, focuses on controlling the outcome of the market forces such as inflation and employment.

Finally, the non-economic reasons justifying regional public intervention include actions based on political or social grounds. These actions include allocation of resources resulting from labor union pressures, national security, or political lobbing.

Any element of public policy in general and industrial regional policy, in particular, may ultimately be addressed to any of these reasons for governmental intervention (efficiency, equity, macroeconomic stability, and non economic factors).

8.2 Findings

Results for the Mexican case study show that traditional poles have maintained their dominant position since 1970 but the industrial dynamics of additional states from the northern periphery create a shift in the industrial gravity center to the north. The industrialization of the North does not imply the deindustrialization of the South or a loss of the industrial primacy of Mexico City. The analysis of the 1970-2004 period shows that all southern states had a low industrial participation through the whole period.

On the other hand, the analysis of spatial patterns of industrial growth shows that there is no direct connection between the initial level of industrial GSP and its growth rate: bigger economies do not grow slower nor smaller ones faster. So, what does explain growth rate? The answer is presented in terms of dynamic externalities, institutional variables, and other regional conditions.

Three types of externalities have been found to exist in literature, but the empirical test of the primary hypothesis for Mexico shows they only explain growth in a few industries. Specifically, inter-industry (*JACOBS*) economies rather than intra-industry (*MAR* and *PORTER*) externalities dominate in models explaining industrial regional growth in Mexico. This lack of robust econometric results for dynamic externalities is not exclusive for the Mexican case study. For example, Glaeser *et al.* (1992) and Ó'hUallachain and Satterthwaite (1992) for USA, Combes (2000) for France, Gustavsson (2003) for Sweden, and Gao (2004) for China find weak importance of dynamic externalities in industrial growth. In Mexico, *JACOBS* economies (diversification) is the only dynamic externality that matters for the growth of the aggregate industrial activity and for two out of eight industries analyzed (Food and Chemicals).[1] On the other hand, two industries in Mexico show that dynamic

[1] Current literature on dynamic externalities suggests that while Jacobs economies are important for attracting new industries, specialization (MAR economies) is important for retaining existing industry Henderson, Kuncoro, and Turner 1995, 1084). Here arises another policy issue: specialization of cities/regions in narrow product groups may increase demand risk for individual cities/regions. This is usually discussed as a problem because makes them vulnerable to "asymmetric shocks." Therefore,

externalities may be subject to temporary changes, as Lamorgese (1998) suggests. In the short run (1993-1998), while *JACOBS* economies are relevant for the aggregate industrial activity, Chemicals and Nonmetallic industry, Porter economies matter for Textiles. However, dynamic externalities in Textiles and Nonmetallic industry become statistically irrelevant in the long run (1993-2003). It is important to note that the statistically significant variables in the short-run for the aggregate industrial activity clearly express the deconcentration of manufacturing towards northern states: the negative sign in *D2_POLES* shows that the aggregate industrial activity in the traditional cities grows slower than in the rest of the regions; and the negative sign in *ACCESS* (representing road infrastructure and distance to the US border) indicates that low road density and distant areas from the US border are not favorable for the aggregate industrial growth. Additionally, the negative sign in *D3_OIL* suggests that oil-producer states have an unfavorable economic structure for total industrial growth. Finally, the positive sign in *JACOBS* economies shows that diversity fosters growth of the aggregate industrial activity.

In general, since *JACOBS* economies is the only variable with consistent effects for the short and long run, there is statistical support to conclude that policies promoting diversity are more likely to enhance industrial regional growth. Unfortunately, policymakers cannot directly control *JACOBS* economies and, in some cases, their effect may take seven or more years.

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studies on the contribution of industry structure and its change are called for to provide more detailed assessments.

Institutional variables matter for industrial growth, but they matter in different ways for different sectors. Social capital (*SK*), as suggested by new institutionalism, is statistically significant for Food and Textiles, but in opposite direction. While *SK* favors growth in Food, it has an adverse effect on growth in Textiles. In general, the effect of social capital (*SK*) and other regional variables explaining industrial growth is selective (it is only significant for some industries) and contradictory (they may be positive or negative, depending on the industry of reference). Similarly, different states matter for industrial growth in a different way. While border states favor growth of Chemicals and Textiles, traditional economic poles and oil-producer states discourage growth of Paper.

In conclusion, there is no variable with a systematically strong effect for all industries which policymakers and planners might directly control. These results may express two influences for the period of study: the crisis in years 1994-95 and the recovery from 1996-2003; and the free trade policy in its first decade breaking down (replacing?) a long-run trend that concentrated the industry in only three main cities in Mexico. The hypothesized influence of factors explaining industrial growth rate (dynamic externalities, institutional variables, and other regional conditions) seem to be formulated for more stable regional environments. The spatial effect may be asymmetric on industrial growth or dynamic externalities may have less influence during some periods of growth, recovery, and/or trade liberalization as the one in this study. In any case, results show that the assumptions for dynamic externalities do not exactly match industrial growth in the Mexican case study and warn us about generic policy designs uncritically based on outcomes from other experiences (mainly developed countries).

8.3 Policy implications

Although these results show a complex problem in terms of regional policy, some recommendations for industrial spatial distribution may, however, be derived from this research. For instance, during this period and on average, industries work in favor of geographical convergence of manufacturing. In other words, unlike recent findings for the whole economic activity (Silva-Lira 2005, Serra *et al.* 2006, Chiquiar 2005, Rodríguez-Pose and Sánchez-Reaza 2005, Aguayo 2006), industry became more dispersed for the period 1993-2003. Current industrial deconcentration to some northern states favored by the free trade macroeconomic context is a unique opportunity to design an industrial regional policy matching both economic and social criteria. To this end, since industry is an urban activity, regional planners should examine and select cities from the national urban hierarchy and suggest an urban strategy of industrialization consistent with the spatial effects of the current macroeconomic policy, rather than oppose it. Better to facilitate the industrial deconcentration process already in place than retard the national development dispersing resources into diverse areas and activities. The contradictory influence of variables and the differential importance of regions call for a selective spatial policy of industrial growth. Jacobs externalities (a variable statistically significant for the aggregate industrial activity) create conditions for a cumulative and self-sustained process. If an industrial policy combines them with current spatial trends, industrial growth may be encouraged in a previously selected urban system. The combination of endogenous growth variables and spatial effects of the macroeconomic policy may accelerate the current industrial deconcentration process. Otherwise, considering that the time externalities take to reach their maximum effect, the industrial policy would be effective after seven or more years. This period may be reasonable for most regional scholars but it is not practical from the viewpoint of the six year Mexican political cycle.

It is necessary to keep in mind that there is not spatial policy technically perfect. In reality there are firms with strong lobbying power and regions “singled out” for political reasons such as defense and national security. In this sense, as Downs (1994, 124) states “formulating alternatives for any set of elements is an art, not a science.” Regional planners and public officers must be technically clear and politically astute to present any regional policy. As an example, they must be technically clear to explain that the selection suggested of industries for a region may not create a significant number of direct jobs but creates linkages and other externalities that potentially generate indirect employment. On the other hand, they may be politically smart to involve and coordinate groups of different interests to ensure the best policy results.

8.4 Limitations and future research

Results in this study may be improved if they are contrasted with those obtained for a more stable period, using data at a more disaggregated industrial and geographic level (*i.e.*, four digits industries in cities). Results may also be enhanced including alternative variables (*i.e.*, capital and labor) and methodologies such as panel data analysis.

While many research hypotheses may be derived from findings in this study, the most important proposition for future analysis is that no other subsystems of Mexican cities will grow faster than those articulated to NAFTA corridors and, among them, those linked to the Lázaro Cárdenas-Kansas City Transportation Corridor. Data on the industrial growth of Mexican states located on this road network and the high activity at the Laredo port support this assumption. Finally, the role of variables suggested by the New Spatial Economics (endogenous models and New Economic Geography), such as dynamic externalities and institutional variables, may also be tested in this context.

APPENDIX A

EXAMPLE TO INTERPRET COEFFICIENTS OF DUMMY VARIABLES

This example uses results for Model 4 in Textiles for period 1993-2003. It is organized in two steps. First step runs a regression through the origin (or without a constant), including *all* dummy variables (without a benchmark group) (Table D.1).

Table A.1 Coefficients for Textiles Using All Dummies (Model 4) for a Regression-Through-Origin Estimation

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
P_TEXT	-.022	.013	-.572	-1.614	.122
JACOBS	-.242	.123	-2.525	-1.961	.064
INEQ	.008	.014	.118	.583	.566
SK	-.050	.015	-.735	-3.341	.003
QLTY	.038	.018	.556	2.122	.047
SIZE	-.003	.016	-.049	-.216	.831
ACCESS	-.016	.013	-.229	-1.189	.248
DISADV	.017	.015	.255	1.194	.246
D1_BORDER	.235	.099	1.377	2.382	.027
D2_POLES	.146	.092	.768	1.583	.129
D3_OIL	.349	.118	1.295	2.960	.008
D4_REST	.226	.102	2.721	2.224	.038

Note: Dependent Variable: RATE in a Linear Regression through the Origin. For regression through the origin (the no-intercept model), R Square measures the proportion of the variability in the dependent variable about the origin explained by regression. This CANNOT be compared to R Square for models which include an intercept. I only use these results to illustrate the measuring of dummy variable coefficients.

Second step uses the same data input and runs a regression *including* the constant and using *D4_REST* as the benchmark group for dummies (the omitted variable) (Table A.2). It may be noticed that the value of *D4_REST* in step one (the dropped dummy variable in step two) is equal to the constant in step two. I have included in the second column the difference between each coefficient for each dummy variable and the constant in the second equation (or the dummy variable *D4_REST* in the first equation). For this reason, when a constant is included, one dummy has to be dropped to avoid perfect collinearity (Guajarati 1995, 526-527). Since the value of the constant in the second regression equals the value of the dropped dummy in the regression-through-origin estimation, the dropped dummy is seen as the benchmark group. Negative coefficients in dummy variables mean they are lower than the intercept (which is equal to the benchmark group, *D4_REST* in my example). Positive values mean the opposite situation. In this example, the statistically significant coefficient for oil producer states (*D3_OIL*) means that the intercept for Textiles in this region is above the constant (represented by the rest of regions *D4_REST*).

Table A.2 Coefficients for Textiles Using Dummies (Model 4) for a Regression Including the Constant Term. (Dependent Variable: Growth Rate 1993-2003)

		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
(Constant)	=D4_REST=	.226	.102		2.224	.038
PORTER	-.022 =	-.022	.013	-.363	-1.614	.122
JACOBS	-.242 =	-.242	.123	-.622	-1.961	.064
INEQ	.008 =	.008	.014	.130	.583	.566
SK	-.050 =	-.050	.015	-.808	-3.341	.003
QLTY	.038 =	.038	.018	.612	2.122	.047
SIZE	-.003 =	-.003	.016	-.054	-.216	.831
ACCESS	-.016 =	-.016	.013	-.252	-1.189	.248
DISADV	.017 =	.017	.015	.281	1.194	.246
D1_BORDER	.235 - (.226)=	.008	.043	.050	.199	.844
D2_POLES	.146 - (.226)=	-.080	.048	-.432	-1.670	.111
D3_OIL	.349 - (.226)=	.123	.045	.485	2.754	.012
D4_REST	(Dropped)					

APPENDIX B

F-VALUE TEST TO DECIDE BETWEEN COMPETING MODELS

The conditional explained variance measures the statistical effect of each component sequentially introduced. It is given by $\Delta R^2 = \frac{(R^2_{new} - R^2_{old})}{R^2_{old}}$, where R^2_{old} is the R^2 in *separate t* tests for each component and R^2_{new} is R^2 for the *sequential* introduction of additional variables.

In cases where the net increment to the explained variance is high it is useful to test if the additional variable is statistically significant. The null hypothesis is H_0: $\rho^2_{new} - \rho^2_{old} = 0$ in the population. If H_0 is rejected, it is possible to conclude that the addition of the new variable to the basic equation significantly increases the Explained Sum of Squares (ESS) and hence the R^2 value. Therefore, the new variable should be added to the equation.

Statistics textbooks suggest the following version of the *F* test (Guajarati 1995, 250-253, and Knoke and Bohrnstedt 1994, 414):

(A.1) $$F_{(k_2-k_1),(N-k_2-1)} = \frac{(R^2_{new} - R^2_{old})/(k_{new} - k_{old})}{(1-R^2_{new})/(N-k_{new}-1)}$$

Where:

k_{new} = The number of independent variables in the equation used to estimate R^2_{new}

k_{old} = The number of independent variables in the equation used to estimate R^2_{old}

In this equation, $k_{new} > k_{old}$, and since R^2_{new} is based on more variables than R^2_{old}, it is always true that R^2_{new} is greater than R^2_{old}. If the *F*-value obtained is lower than the critical value of *F*, it is *not* possible to reject the null hypotheses for the new variables industry mix. Therefore, it is concluded that the new variable does not add a significant explanation power to be included in the equation.

On the other hand, if the *F*-value calculated is higher than the critical value of *F* for $\alpha=0.01$, the null hypotheses is *not* accepted. Then, it is concluded that the new variable significantly increases the ESS and hence the R^2 value. Therefore, the new variable should be added to the model.

APPENDIX C

DECISION PROCESS TO CHOOSE A SPATIAL LAG OR SPATIAL ERROR MODEL

The rule in spatial econometrics is to test for spatial autocorrelation using the Moran statistic. If Moran's *I* statistic is significant, it is necessary to decide which model specification to use. There are four (two standard and two robust) Lagrange Multiplier (LM) test statistics to assist on this decision. The first two, LM-Lag and Robust LM-Lag), pertain to the spatial lag model as the alternative. The next two, LM-Error and Robust LM-Error, refer to the spatial error model as the alternative. If the standard versions of these tests are not significant, forget the robust versions. There is no a spatial dependent specification. If one of the standard versions is significant, it will indicate which model to test. If both standard versions are significant, the robust test will tell you which specification to run. If both standard and robust tests are significant, choose the model matching the highest values. In the rare case that both models are highly significant, some causing is needed. It may be necessary to review the basic model specification or the spatial weight matrix (Anselin 2005, 196-200). Since this description may be confusing for those unfamiliar with the spatial autocorrelation diagnosis, Figure C.1 illustrates main steps in the Spatial Regression Model Selection Decision Rule. The computation of the Moran *I* -statistic and other asymptotically valid tests (the LM error statistic or the Wald test) require matrix multiplications involving large spatial weight matrices that may be performed using commercial (*ArcView* or *ArcGIS*) and/or free software (*GeoDa*^{TM}).

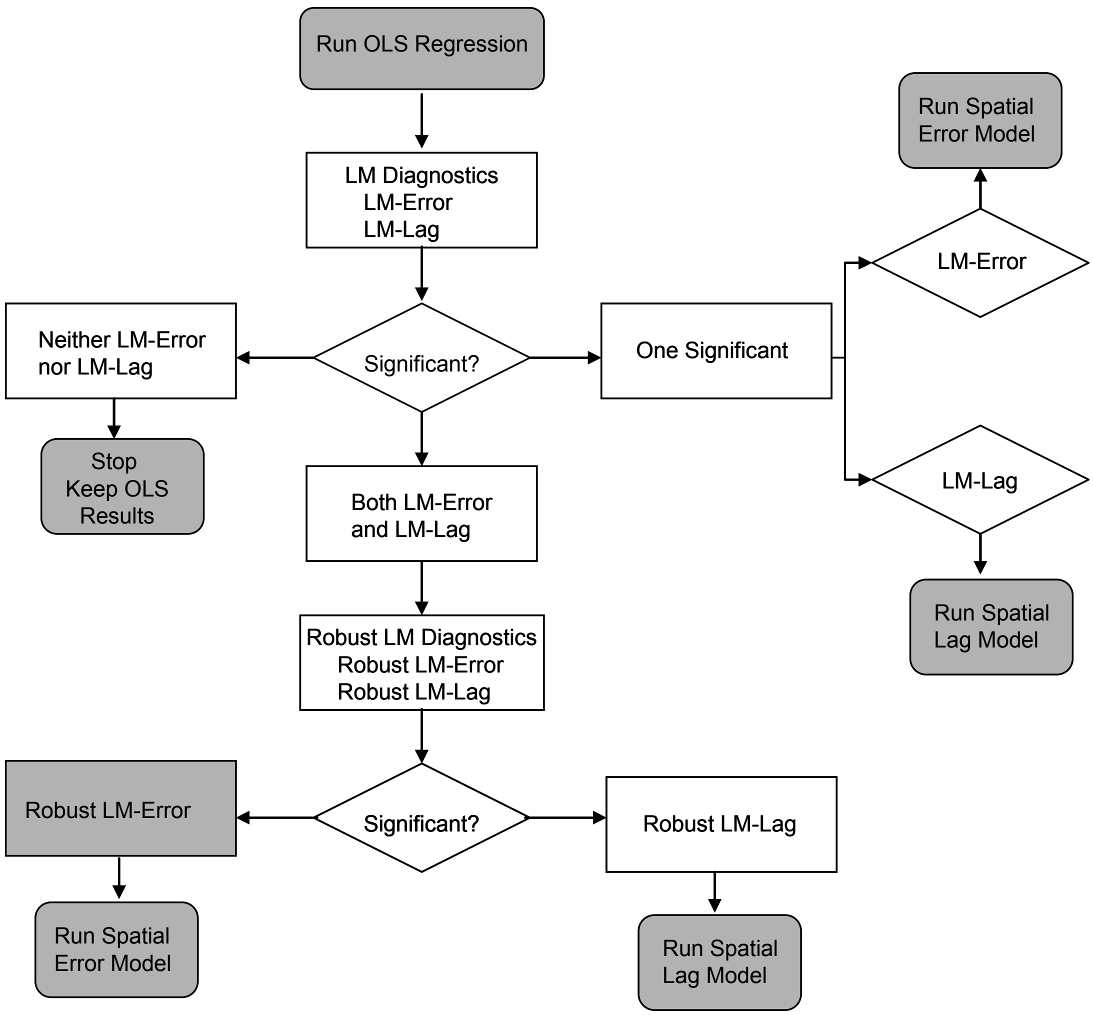

Figure C.1 Spatial Regression Decision Process

Source: After Anselin (2005, 199)

APPENDIX D

DATABASE AND OTHER TABLES

Table D.1 Industrial GSP, 1970-2004 (Nominal Values)

	1970	1975	1980	1985	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
TOTAL	105203	256701	985013.1	11068634	219934044	245012475	350155556	494520325	615478413	749292699	884331331	1013597561	1031217592	1068602799	1123213026	1257053641
AGS	296.7	947.7	3972.8	89340	2760868	3449043	5486427	7845240	9939677	11834869	14096559	18847196	19263867	19956679	21548398	24354475
BC	2154.7	4873.9	17236.9	191485	5815041	6942502	9851807	14427769	19924661	27117673	33558808	40491591	39555497	37572078	40266798	45339497
BCS	184	386.7	1341.1	14406	187699	204392	284811	431747	566794	740168	980424	1212542	1384195	1459831	1545403	1661815
CAM	298.1	555.1	2118.5	21778	229184	241081	358945	457232	486073	579024	719871	849517	1038627	1257203	1362841	1323134
COA	3074.5	7870.3	30631	377670	10438601	11626509	20071647	31245947	38529050	47944448	53412254	55459641	56266265	63461699	73095231	85216923
COL	181.4	587.3	1556.7	15592	299179	332151	467258	676894	814879	988468	1277543	1476672	1662616	1743657	1912075	2188851
CHIS	783.8	1696.2	12275.6	72073	1065520	1356254	1898376	2814723	2739018	2861863	3232962	3721750	3824095	3930389	4031011	4069471
CHIH	1846	5070.5	18192.2	254794	8911522	10247707	14933825	21701021	27948093	35694322	42558621	51586246	50204920	51356303	53190754	56260799
DF	33880.4	76541.8	290140	2735533	45856242	49910633	67451039	89238517	109286755	131749179	154474354	175141308	175130760	183638450	179433191	186225267
DGO	1097.4	2375.9	9262.5	161755	2625711	3111382	4257420	6278036	8136223	10071800	11121804	11912982	12347917	13215986	13814065	16396463
GTO	2947.7	5759.5	23439.6	333652	7174970	8518442	12789127	21746723	27211665	33318880	37977718	44867210	45229966	50224796	56699993	65944735
GRO	517	1287.6	3960.5	41719	982515	1071854	1510395	1961504	2461116	3312605	4331129	5175179	5826751	6204231	6805183	7130629
HGO	1574.4	3833	21541.7	227576	4777253	4775517	5356064	7583256	9930612	13281625	15162414	17531865	17270248	17893273	18997866	22059871
JAL	7248.7	18251.6	65603	846597	16324903	18497618	24879644	34934753	42952970	52689768	63619534	69978839	73657653	75519738	76693829	86446866
MEX	18425.4	44578.6	178024.7	2115228	38251807	40781115	55334583	80365742	99594546	118450420	138137565	156404924	160410851	161099608	165045765	185653509
MICH	1104.4	3225.8	12673	137267	3065992	3685314	6110972	8034828	9542382	11041674	13814621	15232309	14867160	14285351	16394877	21242178
MOR	857.1	2694.2	10366.1	148074	3626674	3644784	4648834	6393562	8158380	10561796	12357334	13960615	14916675	15279449	16983916	17654317
NAY	606.6	1254	6189.5	64444	756721	820292	934205	1276815	1541106	1928327	2284773	2468269	2756327	2667558	2828448	2874434
NL	10022.6	24223.8	89709.5	1051065	19027380	21409826	30728634	43261115	53960113	65582874	74115002	89146616	88773768	94833699	98207593	116268885
OAX	807.3	2080.9	9352.8	93781	2414501	2646336	3819312	5070869	6182988	7432283	9647288	11050870	12478859	13252463	14710181	15829993
PUE	3308.2	9521.3	37235.4	400129	8286879	9549498	14060327	20783285	26684246	34635177	45156373	48949978	49315368	50133800	55324923	55591773
QRO	964.4	3347.1	13898.6	234387	4600527	5413147	9048572	12940134	16999347	21674657	25486050	28661925	28683667	30146050	31619497	36190818
QR	64.9	151	549	13743	491112	488644	516529	756627	963936	1250761	1558917	1770213	2077757	2196331	2420322	2539649
SLP	1032.9	2822.7	13519.7	221231	4747668	5592165	8447939	11527848	14243570	16474580	18947227	22358839	21695750	22732012	24582895	30475136
SIN	1307.1	3241.5	10180.2	105777	1801211	2117731	2783701	4089706	4736398	5628113	6796637	7552126	8060924	8463017	9565510	10640746
SON	1362	3634	12614.5	163363	5139117	6031905	9748882	12167669	15901622	18475768	21068429	25089991	25970887	25177436	26465522	30424033
TAB	373.5	1626.3	5355.5	57190	873250	939342	1272326	1643619	2000088	2236054	2860393	3653126	3931134	3840624	4176796	4518779
TAM	1810	4558.8	17770.2	178765	5991052	6755506	9947328	13452481	16485210	20521542	26671496	32952632	34430238	35505982	39293549	44900157
TLA	404.2	1504.8	4696.2	94152	1551680	1690958	2452588	3544442	4453122	5370360	6551474	7663797	8379941	8418614	8995395	10832147
VER	5334.7	13825	51919	500410	9578959	10541639	17223682	22794567	26605141	27810300	31955723	36064494	38079978	38914776	42027616	50150273
YUC	1101.4	3871.3	8280.7	86389	1832143	2111584	2792482	4089256	5263498	6453441	8369343	10051029	11272698	11759108	12380104	13609929
ZAC	231.5	502.8	1406.4	19271	448164	507604	687874	984398	1235135	1579883	2028691	2313272	2452236	2462607	2793478	3038090

Source: INEGI's economic database (BIE). Sistema de Cuentas Nacionales. Available at: http://dgcnesyp.inegi.gob.mx/cgi-win/bdieintsi.exe/

Table D.2 Industrial GSP, 1970-2004 (Percentages)

	1970	1975	1980	1985	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
COUNTRY	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
AGS	0.28	0.37	0.40	0.81	1.26	1.41	1.57	1.59	1.61	1.58	1.59	1.86	1.87	1.87	1.92	1.94
BC	2.05	1.90	1.75	1.73	2.64	2.83	2.81	2.92	3.24	3.62	3.79	3.99	3.84	3.52	3.58	3.61
BCS	0.17	0.15	0.14	0.13	0.09	0.08	0.08	0.09	0.09	0.10	0.11	0.12	0.13	0.14	0.14	0.13
CAM	0.28	0.22	0.22	0.20	0.10	0.10	0.10	0.09	0.08	0.08	0.08	0.08	0.10	0.12	0.12	0.11
COA	2.92	3.07	3.11	3.41	4.75	4.75	5.73	6.32	6.26	6.40	6.04	5.47	5.46	5.94	6.51	6.78
COL	0.17	0.23	0.16	0.14	0.14	0.14	0.13	0.14	0.13	0.13	0.14	0.15	0.16	0.16	0.17	0.17
CHIS	0.75	0.66	1.25	0.65	0.48	0.55	0.54	0.57	0.45	0.38	0.37	0.37	0.37	0.37	0.36	0.32
CHIH	1.75	1.98	1.85	2.30	4.05	4.18	4.26	4.39	4.54	4.76	4.81	5.09	4.87	4.81	4.74	4.48
DF	32.20	29.82	29.46	24.71	20.85	20.37	19.26	18.05	17.76	17.58	17.47	17.28	16.98	17.18	15.97	14.81
DGO	1.04	0.93	0.94	1.46	1.19	1.27	1.22	1.27	1.32	1.34	1.26	1.18	1.20	1.24	1.23	1.30
GTO	2.80	2.24	2.38	3.01	3.26	3.48	3.65	4.40	4.42	4.45	4.29	4.43	4.39	4.70	5.05	5.25
GRO	0.49	0.50	0.40	0.38	0.45	0.44	0.43	0.40	0.40	0.44	0.49	0.51	0.57	0.58	0.61	0.57
HGO	1.50	1.49	2.19	2.06	2.17	1.95	1.53	1.53	1.61	1.77	1.71	1.73	1.67	1.67	1.69	1.75
JAL	6.89	7.11	6.66	7.65	7.42	7.55	7.11	7.06	6.98	7.03	7.19	6.90	7.14	7.07	6.83	6.88
MEX	17.51	17.37	18.07	19.11	17.39	16.64	15.80	16.25	16.18	15.81	15.62	15.43	15.56	15.08	14.69	14.77
MICH	1.05	1.26	1.29	1.24	1.39	1.50	1.75	1.62	1.55	1.47	1.56	1.50	1.44	1.34	1.46	1.69
MOR	0.81	1.05	1.05	1.34	1.65	1.49	1.33	1.29	1.33	1.41	1.40	1.38	1.45	1.43	1.51	1.40
NAY	0.58	0.49	0.63	0.58	0.34	0.33	0.27	0.26	0.25	0.26	0.26	0.24	0.27	0.25	0.25	0.23
NL	9.53	9.44	9.11	9.50	8.65	8.74	8.78	8.75	8.77	8.75	8.38	8.80	8.61	8.87	8.74	9.25
OAX	0.77	0.81	0.95	0.85	1.10	1.08	1.09	1.03	1.00	0.99	1.09	1.09	1.21	1.24	1.31	1.26
PUE	3.14	3.71	3.78	3.61	3.77	3.90	4.02	4.20	4.34	4.62	5.11	4.83	4.78	4.69	4.93	4.42
QRO	0.92	1.30	1.41	2.12	2.09	2.21	2.58	2.62	2.76	2.89	2.88	2.83	2.78	2.82	2.82	2.88
QR	0.06	0.06	0.06	0.12	0.22	0.20	0.15	0.15	0.16	0.17	0.18	0.17	0.20	0.21	0.22	0.20
SLP	0.98	1.10	1.37	2.00	2.16	2.28	2.41	2.33	2.31	2.20	2.14	2.21	2.10	2.13	2.19	2.42
SIN	1.24	1.26	1.03	0.96	0.82	0.86	0.79	0.83	0.77	0.75	0.77	0.75	0.78	0.79	0.85	0.85
SON	1.29	1.42	1.28	1.48	2.34	2.46	2.78	2.46	2.58	2.47	2.38	2.48	2.52	2.36	2.36	2.42
TAB	0.36	0.63	0.54	0.52	0.40	0.38	0.36	0.33	0.32	0.30	0.32	0.36	0.38	0.36	0.37	0.36
TAM	1.72	1.78	1.80	1.62	2.72	2.76	2.84	2.72	2.68	2.74	3.02	3.25	3.34	3.32	3.50	3.57
TLA	0.38	0.59	0.48	0.85	0.71	0.69	0.70	0.72	0.72	0.72	0.74	0.76	0.81	0.79	0.80	0.86
VER	5.07	5.39	5.27	4.52	4.36	4.30	4.92	4.61	4.32	3.71	3.61	3.56	3.69	3.64	3.74	3.99
YUC	1.05	1.51	0.84	0.78	0.83	0.86	0.80	0.83	0.86	0.86	0.95	0.99	1.09	1.10	1.10	1.08
ZAC	0.22	0.20	0.14	0.17	0.20	0.21	0.20	0.20	0.20	0.21	0.23	0.23	0.24	0.23	0.25	0.24

Source: Calculations based on Table D.1.

Table D.3 Industrial GSP, 1993 (Pesos of 1993)

STATE	TOTAL	FOOD	TEX	PAPEL	WOOD	CHEM	MET	NO-MET	MACH	OTHER
AGS	2760869	836625	497896	45660	46594	56256	3430	74912	868231	331265
BC	5815041	1205672	190362	175738	409553	278039	43553	446982	2522150	542992
BCS	187699	124561	13361	11021	6272	602	0	17599	13884	399
CAM	229184	159276	4639	13032	18916	1450	0	18240	12688	943
COH	10438601	1556264	347464	136518	97735	622347	1828708	1661529	4115255	72781
COL	299179	161331	11568	10948	18439	41946	0	39683	14933	331
CHIS	1065520	676946	37008	39596	92631	146458	0	44865	21190	6826
CHIH	8911523	1173911	1105121	329194	907716	179959	160635	458304	4183698	412985
DF	45856242	10885887	4535191	4695659	1247317	10353692	1057180	1801094	8950079	2330143
DGO	2625710	832817	182750	98174	781062	109363	10134	121773	473971	15666
GTO	7174969	1935106	1856197	179947	79061	1688863	72996	512050	813566	37183
GRO	982515	536464	77975	38152	109160	3108	182	96809	14964	105701
HGO	4777253	607248	530787	42754	65009	638913	49547	1297278	1514400	31317
JAL	16324904	7194917	1681184	369068	550739	2082090	288516	1086715	2417834	653841
MEX	38251806	8376479	3687258	2031412	712378	7001065	1312519	2830387	11534300	766008
MICH	3065992	1011415	106606	176569	403734	411804	600857	169883	143405	41719
MOR	3626675	653324	206552	52865	18518	856873	0	345449	1449932	43162
NAY	756720	644216	9568	8735	57204	6891	0	18640	10341	1125
NL	19027379	4404424	1174927	1007425	312898	2304207	1474926	3213230	4755089	380253
OAX	2414503	1034642	22747	124337	155520	800591	0	227762	32076	16828
PUE	8286879	1980999	1268265	156657	346207	636518	496263	522183	2808913	70874
QRO	4600528	1292202	267937	403803	48961	853116	10250	257824	1361665	104770
QR	491112	334099	8831	30876	50077	1517	0	51727	9772	4213
SLP	4747669	1557630	228699	169431	127458	219860	1032718	450632	802947	158294
SIN	1801211	1307545	26347	122527	63483	49173	0	116970	106307	8859
SON	5139117	1829366	282447	137110	161948	108331	366760	387663	1700944	164548
TAB	873249	463509	3818	45408	14354	185402	0	138126	21779	853
TAM	5991052	1163628	150317	196208	68092	1436415	21385	164916	2624856	165235
TLAX	1551680	359124	287792	36325	10463	387794	28548	184450	220128	37056
VER	9578958	3811124	189348	368138	68173	3539616	792620	470885	336851	2203
YUC	1832143	910499	252608	65326	66137	72229	52703	270498	101632	40511
ZAC	448163	275821	11246	11182	29164	684	2659	58075	42965	16367
TOTAL	219934043	59297071	19256816	11329797	7144970	35075177	9707089	17557131	54000744	6565248

Source: INEGI's economic database (BIE).

Table D.4 Industrial GSP, 2003 (Pesos of 1993)

STATE	TOTAL	FOOD	TEX	PAPEL	WOOD	CHEM	MET	NO-MET	MACH	OTHER
AGS	5331830	1341793	514539	46442	139026	71190	2724	103623	2529470	583023
BC	9114026	1422762	408750	315611	373881	556008	77026	503148	4380967	1075873
BCS	341246	231641	12476	13041	14236	1116	0	51195	16662	879
CAM	262586	147467	60455	14347	9776	1876	0	10181	16745	1739
COH	19366155	2331292	794813	197559	40530	1227949	3005085	2370608	9308260	90059
COL	383018	192585	15567	12526	17290	55624	0	62739	26130	557
CHIS	969497	704172	28578	43560	35526	78276	0	38076	34477	6832
CHIH	12037078	1272811	1430374	351180	906388	313683	105229	727117	6296372	633924
DF	51993946	12397785	4330240	5352393	1027116	13665413	951083	1804355	10102462	2363099
DGO	3641547	1802977	289227	160991	725752	92855	28056	61389	462550	17750
GTO	15076862	3104748	2336342	254397	30988	2380521	76343	803675	6023575	66273
GRO	1285487	697168	128294	33625	130409	4541	286	79454	16866	194844
HGO	4940867	597798	706778	95941	84544	975135	26829	1489237	941165	23440
JAL	19689737	9674723	1178475	253554	751134	2223929	364892	534691	4002126	706213
MEX	47231916	12203207	3478733	2236776	750093	8389020	2319947	3488676	13285461	1080003
MICH	4511085	1363908	162424	258723	375660	533675	1377636	244192	156868	37999
MOR	4130636	1379518	94743	98424	9902	1017373	0	364834	1008984	156858
NAY	641913	520700	10809	9745	58420	8524	0	11955	19636	2124
NL	29187035	5394510	1097878	834988	518434	3312934	2497151	4236909	10844283	449948
OAX	2992962	1405194	25148	154292	88698	863391	0	383219	37051	35969
PUE	14076549	3098110	1851971	149776	312282	868251	628937	512303	6589145	65774
QRO	8821975	2807777	163497	621155	79908	1646689	27457	305084	3104809	65599
QR	606265	369365	18011	33165	82632	2759	0	71279	22308	6746
SLP	6510635	1513898	179130	194314	59268	480800	1761314	448069	1732980	140862
SIN	2331240	1818268	44471	151241	31712	54164	0	70065	147323	13996
SON	6113928	2293607	568997	219368	288706	119399	349457	386590	1555265	332539
TAB	867828	489752	4172	29649	21304	176413	0	102276	42937	1325
TAM	10048964	1578993	350304	333827	72303	2197638	61121	216354	4849707	388717
TLAX	2219560	540907	282380	55845	14822	456504	80446	460578	239323	88755
VER	10878001	5415865	105726	434645	107305	2804857	1126692	595147	283453	4311
YUC	2912276	1492904	395878	83175	48284	86218	35532	500211	176471	93603
ZAC	610835	280200	44868	11709	35280	907	4597	82266	126900	24108
TOTAL	299127488	79886405	21114048	13055986	7241608	44667632	14907842	21119494	88380732	8753741

Source: INEGI's economic database (BIE).

Table D.5 Growth Rate for Manufacturing, 1993-2003

STATE	TOTAL	FOOD	TEX	PAPEL	WOOD	CHEM	MET	NO-MET	MACH	OTHER
AGS	0.066	0.047	0.003	0.002	0.109	0.024	-0.023	0.032	0.107	0.057
BC	0.045	0.017	0.076	0.059	-0.009	0.069	0.057	0.012	0.055	0.068
BCS	0.060	0.062	-0.007	0.017	0.082	0.062	0.000	0.107	0.018	0.079
CAM	0.014	-0.008	0.257	0.010	-0.066	0.026	0.000	-0.058	0.028	0.061
COH	0.062	0.040	0.083	0.037	-0.088	0.068	0.050	0.036	0.082	0.021
COL	0.025	0.018	0.030	0.013	-0.006	0.028	0.000	0.046	0.056	0.052
CHIS	-0.009	0.004	-0.026	0.010	-0.096	-0.063	0.000	-0.016	0.049	0.000
CHIH	0.030	0.008	0.026	0.006	0.000	0.056	-0.042	0.046	0.041	0.043
DF	0.013	0.013	-0.005	0.013	-0.019	0.028	-0.011	0.000	0.012	0.001
DGO	0.033	0.077	0.046	0.049	-0.007	-0.016	0.102	-0.068	-0.002	0.012
GTO	0.074	0.047	0.023	0.035	-0.094	0.034	0.004	0.045	0.200	0.058
GRO	0.027	0.026	0.050	-0.013	0.018	0.038	0.045	-0.020	0.012	0.061
HGO	0.003	-0.002	0.029	0.081	0.026	0.042	-0.061	0.014	-0.048	-0.029
JAL	0.019	0.030	-0.036	-0.038	0.031	0.007	0.023	-0.071	0.050	0.008
MEX	0.021	0.038	-0.006	0.010	0.005	0.018	0.057	0.021	0.014	0.034
MICH	0.039	0.030	0.042	0.038	-0.007	0.026	0.083	0.036	0.009	-0.009
MOR	0.013	0.075	-0.078	0.062	-0.063	0.017	0.000	0.005	-0.036	0.129
NAY	-0.016	-0.021	0.012	0.011	0.002	0.021	0.000	-0.044	0.064	0.064
NL	0.043	0.020	-0.007	-0.019	0.050	0.036	0.053	0.028	0.082	0.017
OAX	0.021	0.031	0.010	0.022	-0.056	0.008	0.000	0.052	0.014	0.076
PUE	0.053	0.045	0.038	-0.004	-0.010	0.031	0.024	-0.002	0.085	-0.007
QRO	0.065	0.078	-0.049	0.043	0.049	0.066	0.099	0.017	0.082	-0.047
QR	0.021	0.010	0.071	0.007	0.050	0.060	0.000	0.032	0.083	0.047
SLP	0.032	-0.003	-0.024	0.014	-0.077	0.078	0.053	-0.001	0.077	-0.012
SIN	0.026	0.033	0.052	0.021	-0.069	0.010	0.000	-0.051	0.033	0.046
SON	0.017	0.023	0.070	0.047	0.058	0.010	-0.005	0.000	-0.009	0.070
TAB	-0.001	0.006	0.009	-0.043	0.039	-0.005	0.000	-0.030	0.068	0.044
TAM	0.052	0.031	0.085	0.053	0.006	0.043	0.105	0.027	0.061	0.086
TLAX	0.036	0.041	-0.002	0.043	0.035	0.016	0.104	0.092	0.008	0.087
VER	0.013	0.035	-0.058	0.017	0.045	-0.023	0.035	0.023	-0.017	0.067
YUC	0.046	0.049	0.045	0.024	-0.031	0.018	-0.039	0.061	0.055	0.084
ZAC	0.031	0.002	0.138	0.005	0.019	0.028	0.055	0.035	0.108	0.039

Source: Calculations based on Table D.3 and Table D.4.

Table D.6 US-Mexico Transbroder Freight Data. Total for All Surface Modes of Transportation (Nominal Values)

Port	1994	1995	1996	1997	1998	1999	2000	2001	2002
Brownsville-Cameron, TX	7,331,659,702	7,048,439,486	8,003,884,043	9,144,072,184	8,986,572,431	10,517,939,072	12,108,261,835	10,911,207,350	10,269,646,709
Progreso, TX	218,954,073	169,528,678	207,705,948	134,770,334	165,998,539	179,349,984	144,294,831	134,404,101	143,831,913
Hildago, TX	4,763,175,741	5,557,193,332	6,267,739,312	7,500,639,517	8,593,126,165	9,629,478,926	12,593,610,225	12,422,910,723	12,666,364,330
Rio Grande City, TX	155,855,195	139,439,941	143,383,038	137,897,910	158,637,271	211,128,677	234,900,049	228,345,009	181,870,354
Roma, TX	91,217,169	95,247,827	133,290,314	124,437,388	141,162,998	193,613,166	108,364,604	124,538,524	151,649,262
Laredo, TX	29,380,178,279	29,778,572,196	38,820,659,981	49,980,069,531	55,214,600,066	64,695,450,132	83,673,998,699	79,607,196,120	79,279,487,999
Eagle Pass, TX	3,297,015,461	4,817,227,439	6,114,894,674	7,138,074,073	7,450,128,989	7,112,785,347	7,285,126,442	6,738,768,772	6,062,824,117
Del Rio, TX	1,401,620,712	1,603,235,716	1,844,783,916	2,300,925,857	2,359,103,973	2,489,260,811	2,387,017,315	2,375,379,876	2,670,619,789
Presidio, TX	100,861,680	115,401,529	96,123,388	138,265,891	192,386,669	236,304,189	265,029,491	188,844,587	196,525,719
Fabens, TX	182,443	23,666	1,550,829	52,735	8,136,239	93,416	882,311	142,799	97,701
El Paso, TX	17,955,961,435	20,387,921,955	22,305,862,630	23,768,292,270	28,201,972,756	31,893,500,484	39,375,732,106	37,930,862,256	38,450,258,920
Santa Teresa, NM	0	0	0	492,915,966	453,847,766	665,648,580	929,955,528	741,485,230	799,542,266
Columbus, NM	23,217,365	30,534,653	22,298,496	30,645,889	32,409,411	36,525,200	43,539,248	40,874,124	46,804,796
Douglas, AZ	665,052,296	943,718,440	820,124,825	920,608,352	960,622,741	824,087,533	935,225,719	781,218,230	564,737,031
Naco, AZ	67,531,065	112,536,577	98,632,938	149,597,398	198,220,929	280,202,848	278,760,796	209,271,228	70,545,100
Nogales, AZ	7,004,940,917	7,301,461,642	7,353,144,363	8,830,939,184	10,237,296,021	10,532,407,243	13,630,809,409	12,508,628,243	10,794,216,340
Sasabe, AZ	578,219	101,658	446,634	342,785	435,565	2,767,561	95,103	59,389	77,527
Lukeville, AZ	8,778,708	8,604,691	4,319,413	6,704,066	2,898,867	7,192,927	5,549,161	24,685,635	6,195,567
San Luis, AZ	495,801,975	565,639,419	665,974,747	766,263,430	972,884,867	1,170,387,010	1,225,710,845	1,007,321,181	959,772,459
Andrade, CA	3,210,404	930,771	1,316,529	1,328,224	9,187,399	8,211,675	2,069,195	1,133,076	1,315,547
Calexico-East, CA	0	26,678	109,184	4,601,855,339	6,166,706,997	7,750,516,446	8,319,548,683	7,347,676,887	8,408,850,640
Calexico, CA	3,022,953,897	3,386,094,601	4,426,084,618	997,240,577	0	46,052	2,500	112,136	2,570,025
Tecate, CA	530,716,932	508,403,144	640,355,344	807,367,006	886,519,962	985,742,834	921,116,351	850,277,412	950,201,598
Otay Mesa Station, CA	0	0	0	12,304,303,073	14,708,884,597	15,626,920,037	18,773,450,933	19,400,955,493	20,385,963,695
San Ysidro, CA	7,868,473,354	8,754,053,167	10,492,882,680	846,103,394	43,398,623	61,628,528	65,980,901	71,551,437	65,541,805
TOTAL	84,387,937,022	91,324,337,206	108,465,567,844	131,123,712,373	146,145,139,841	165,111,188,678	203,309,032,280	193,647,849,818	193,129,511,209

Source: US Department of Transportation, Bureau of Transportation Statistics, Transborder Surface Freight Data, at http://www.bts.gov/programs/international/transborder/reports/annual02/port/port2002_tx.html Note that data between 1993-1996 include transshipment activity (*i.e.*, shipments which entered or exited the United States by way of a US Customs port on the northern or southern borders but whose origin or final destination was other than Canada or Mexico). Data beginning with January 1997 **do not** include transshipment activity. Users should note these differences before comparing figures for 1993-1996 with 1997 and subsequent year data.

Table D.7 US-Mexico Transbroder Freight Data. Total for All Surface Modes of Transportation (Percentages)

Port	1994	1995	1996	1997	1998	1999	2000	2001	2002
Brownsville-Cameron, TX	8.69	7.72	7.38	6.97	6.15	6.37	5.96	5.63	5.32
Progreso, TX	0.26	0.19	0.19	0.10	0.11	0.11	0.07	0.07	0.07
Hildago, TX	5.64	6.09	5.78	5.72	5.88	5.83	6.19	6.42	6.56
Rio Grande City, TX	0.18	0.15	0.13	0.11	0.11	0.13	0.12	0.12	0.09
Roma, TX	0.11	0.10	0.12	0.09	0.10	0.12	0.05	0.06	0.08
Laredo, TX	34.82	32.61	35.79	38.12	37.78	39.18	41.16	41.11	41.05
Eagle Pass, TX	3.91	5.27	5.64	5.44	5.10	4.31	3.58	3.48	3.14
Del Rio, TX	1.66	1.76	1.70	1.75	1.61	1.51	1.17	1.23	1.38
Presidio, TX	0.12	0.13	0.09	0.11	0.13	0.14	0.13	0.10	0.10
Fabens, TX	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00
El Paso, TX	21.28	22.32	20.56	18.13	19.30	19.32	19.37	19.59	19.91
Santa Teresa, NM	0.00	0.00	0.00	0.38	0.31	0.40	0.46	0.38	0.41
Columbus, NM	0.03	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Douglas, AZ	0.79	1.03	0.76	0.70	0.66	0.50	0.46	0.40	0.29
Naco, AZ	0.08	0.12	0.09	0.11	0.14	0.17	0.14	0.11	0.04
Nogales, AZ	8.30	8.00	6.78	6.73	7.00	6.38	6.70	6.46	5.59
Sasabe, AZ	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lukeville, AZ	0.01	0.01	0.00	0.01	0.00	0.00	0.00	0.01	0.00
San Luis, AZ	0.59	0.62	0.61	0.58	0.67	0.71	0.60	0.52	0.50
Andrade, CA	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00
Calexico-East, CA	0.00	0.00	0.00	3.51	4.22	4.69	4.09	3.79	4.35
Calexico, CA	3.58	3.71	4.08	0.76	0.00	0.00	0.00	0.00	0.00
Tecate, CA	0.63	0.56	0.59	0.62	0.61	0.60	0.45	0.44	0.49
Otay Mesa Station, CA	0.00	0.00	0.00	9.38	10.06	9.46	9.23	10.02	10.56
San Ysidro, CA	9.32	9.59	9.67	0.65	0.03	0.04	0.03	0.04	0.03
TOTAL	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Source: Table D.6.

Table D.8 Mains Steps for Calculating the Weighted Mean Center (WMC) Based on Coordinates for State Centroids, Example for 1970

STATE	X	Y	GSP_{1970}	$X*GSP_{1970}$	$Y*GSP_{1970}$
BC	-114.79000	29.97500	2155	-247372.450	64596.125
BCS	-112.14000	25.84000	184	-20633.760	4754.560
NAY	-105.24000	21.76500	607	-63880.680	13211.355
JAL	-103.50000	20.87800	7249	-750271.500	151344.622
AGS	-102.30000	22.06800	297	-30383.100	6554.196
GTO	-101.01000	20.79200	2948	-297777.480	61294.816
QRO	-99.76900	20.93100	964	-96177.316	20177.484
HGO	-98.69700	20.52800	1574	-155349.078	32311.072
MICH	-101.93000	19.32000	1104	-112530.720	21329.280
MEX	-99.47000	19.39900	18425	-1832734.750	357426.575
DF	-99.11000	19.27700	33880	-3357846.800	653104.760
COL	-104.00000	19.12100	181	-18824.000	3460.901
MOR	-98.99900	18.75900	857	-84842.143	16076.463
YUC	-89.07800	21.11800	1101	-98074.878	23250.918
CAM	-91.38800	18.87900	298	-27233.624	5625.942
PUE	-97.81900	19.18800	3308	-323585.252	63473.904
QR	-87.63500	19.72400	65	-5696.275	1282.060
TLAX	-98.10200	19.45600	404	-39633.208	7860.224
GRO	-100.03000	17.87600	517	-51715.510	9241.892
OAX	-96.11600	17.03200	807	-77565.612	13744.824
TAB	-92.70000	17.94200	374	-34669.800	6710.308
CHIS	-92.09300	16.65800	784	-72200.912	13059.872
SON	-111.29000	29.13700	1362	-151576.980	39684.594
CHIH	-106.34000	28.50600	1846	-196303.640	52622.076
COH	-101.46000	27.23800	3075	-311989.500	83756.850
SIN	-107.76000	24.88700	1307	-140842.320	32527.309
DGO	-104.82000	24.76000	1097	-114987.540	27161.720
ZAC	-102.79000	22.78000	232	-23847.280	5284.960
SLP	-100.08000	22.40900	1033	-103382.640	23148.497
NL	-99.97700	25.52700	10023	-1002069.471	255857.121
TAM	-98.80400	24.97000	1810	-178835.240	45195.700
VER	-96.91100	19.88900	5335	-517020.185	106107.815
TOTAL			105203	-10539853.644	2221238.795
WMC				**-100.18587**	**21.11384**

Table D.9 Data Required for Calculating the Weighted Mean Center (WMC) Based on Coordinates for State Centroids

State	Coordinates		Industrial Gross State Product			
	X	Y	1970	1980	1993	2003
BC	-114.79000	29.97500	2155	17237	5815041	40367222
BCS	-112.14000	25.84000	184	1341	187699	1549991
NAY	-105.24000	21.76500	607	6190	756721	2834265
JAL	-103.50000	20.87800	7249	65603	16324903	77397455
AGS	-102.30000	22.06800	297	3973	2760868	20883854
GTO	-101.01000	20.79200	2948	23440	7174970	53217025
QRO	-99.76900	20.93100	964	13899	4600527	32454281
HGO	-98.69700	20.52800	1574	21542	4777253	19202995
MICH	-101.93000	19.32000	1104	12673	3065992	16432326
MEX	-99.47000	19.39900	18425	178025	38251807	165970471
DF	-99.11000	19.27700	33880	290140	45856242	181602838
COL	-104.00000	19.12100	181	1557	299179	1920104
MOR	-98.99900	18.75900	857	10366	3626674	16723241
YUC	-89.07800	21.11800	1101	8281	1832143	12430514
CAM	-91.38800	18.87900	298	2119	229184	1368162
PUE	-97.81900	19.18800	3308	37235	8286879	53590507
QR	-87.63500	19.72400	65	549	491112	2426934
TLAX	-98.10200	19.45600	404	4696	1551680	9050110
GRO	-100.03000	17.87600	517	3961	982515	6809893
OAX	-96.11600	17.03200	807	9353	2414501	14721163
TAB	-92.70000	17.94200	374	5356	873250	4189988
CHIS	-92.09300	16.65800	784	12276	1065520	4041172
SON	-111.29000	29.13700	1362	12615	5139117	25749691
CHIH	-106.34000	28.50600	1846	18192	8911522	52871386
COH	-101.46000	27.23800	3075	30631	10438601	72008137
SIN	-107.76000	24.88700	1307	10180	1801211	9596888
DGO	-104.82000	24.76000	1097	9263	2625711	13897343
ZAC	-102.79000	22.78000	232	1406	448164	2819482
SLP	-100.08000	22.40900	1033	13520	4747668	24963862
NL	-99.97700	25.52700	10023	89710	19027380	100408027
TAM	-98.80400	24.97000	1810	17770	5991052	39610053
VER	-96.91100	19.88900	5335	51919	9578959	42103624

Source: Coordinates for state centroids generated by *GeoDa*^{TM}. Industrial GSP from INEGI's website.

Table D.10 Components of Industrial Growth (Malpezzi's Version). Ex.: Zacatecas (Zac)

	Zac_{1993}	Zac_{2003}	$Country_{1993}$	$Country_{2003}$	μ	η	W	Y	$W\mu$	$Y\eta$	$(Y-W)\mu$	TOTAL
TOTAL	448163	610835	219934045	296528442								
FOOD	275821	280200	59297071	79886405	-0.331	-0.001	0.270	0.615	-0.089	-0.001	-0.115	-0.205
TEXTILES	11246	44868	19256816	21114048	2.893	-0.252	0.088	0.025	0.253	-0.006	-0.181	0.066
PAPER	11182	11709	11329797	13055986	-0.105	-0.196	0.052	0.025	-0.005	-0.005	0.003	-0.008
WOOD	29164	35280	7144970	7241608	0.196	-0.335	0.032	0.065	0.006	-0.022	0.006	-0.009
CHEM	684	907	35075177	44667632	0.053	-0.075	0.159	0.002	0.008	0.000	-0.008	0.000
MET	2659	4597	9707089	14907842	0.193	0.188	0.044	0.006	0.009	0.001	-0.007	0.002
NO-MET	58075	82266	17557131	21119494	0.214	-0.145	0.080	0.130	0.017	-0.019	0.011	0.009
MACH	42965	126900	54000744	88380732	1.317	0.288	0.246	0.096	0.323	0.028	-0.197	0.154
OTHER	16367	24108	6565248	8753741	0.140	-0.015	0.030	0.037	0.004	-0.001	0.001	0.005
Total									**0.526**	**-0.024**	**-0.487**	**0.015**

Table D.11 Components of Industrial Growth (TMD Version). Example: DF

	DF_{1993}	DF_{2003}	$Country_{1993}$	$Country_{1999}$	Natl comp	Ind Mix	Reg Share	Interacction	TOTAL
TOTAL	45856242	51993946	219934045	296528442					
FOOD	10885887	12397785	59297071	79886405	3791127	-11292	-2575766	307829	1511898
TEXTILES	4535191	4330240	19256816	21114048	1579429	-1142031	-568678	-73672	-204951
PAPER	4695659	5352393	11329797	13055986	1635314	-919891	-29525	-29164	656734
WOOD	1247317	1027116	7144970	7241608	434392	-417521	-283145	46073	-220201
CHEM	10353692	13665413	35075177	44667632	3605785	-774229	339157	141008	3311721
MET	1057180	951083	9707089	14907842	368174	198229	-1287475	614974	-106097
NO-MET	1801094	1804355	17557131	21119494	627250	-261806	-736125	373942	3261
MACH	8950079	10102462	54000744	88380732	3116961	2581175	-5718535	1172781	1152383
OTHER	2330143	2363099	6565248	8753741	811497	-34756	-436941	-306845	32956
Total					**15969930**	**-782121**	**-11297032**	**2246927**	**6137704**

Table D.12 Components of industrial growth (CMA Version). Example: Zacatecas (Zac)

	Zac_{1993}	Zac_{2003}	$País_{1993}$	$País_{2003}$	$X_{ij,1993}$	$X_{ij,2003}$	$Y_{ij,1993}$	$Y_{ij,2003}$	MSE	SME	ADAP+	ADAP-	TOTAL
TOTAL	448163	610835	219934043	299127488									
FOOD	275821	280200	59297071	79886405	0.004652	0.003507	0.269613	0.267065	-0.000308	-0.000012	0.000000	0.000003	-0.000317
TEXTILES	11246	44868	19256816	21114048	0.000584	0.002125	0.087557	0.070585	0.000135	-0.000010	0.000000	-0.000026	0.000099
PAPER	11182	11709	11329797	13055986	0.000987	0.000897	0.051515	0.043647	-0.000005	-0.000008	0.000000	0.000001	-0.000012
WOOD	29164	35280	7144970	7241608	0.004082	0.004872	0.032487	0.024209	0.000026	-0.000034	0.000000	-0.000007	-0.000015
CHEM	684	907	35075177	44667632	0.000020	0.000020	0.159480	0.149326	0.000000	0.000000	0.000000	0.000000	0.000000
MET	2659	4597	9707089	14907842	0.000274	0.000308	0.044136	0.049838	0.000002	0.000002	0.000000	0.000000	0.000003
NO-MET	58075	82266	17557131	21119494	0.003308	0.003895	0.079829	0.070604	0.000047	-0.000031	0.000000	-0.000005	0.000011
MACH	42965	126900	54000744	88380732	0.000796	0.001436	0.245532	0.295462	0.000157	0.000040	0.000032	0.000000	0.000229
OTHER	16367	24108	6565248	8753741	0.002493	0.002754	0.029851	0.029264	0.000008	-0.000001	0.000000	0.000000	0.000006
Total									**0.000061**	**-0.000054**	**0.000032**	**-0.000035**	**0.000004**

Table D.13 Food. Shift-Share. Competitive Component and Total Change as Measured in The Constant Market Share (CMS), Malpezzi's Version, and Traditional Version (TMD), 1993-2003

STATE	Constant Market Share		Shift-Share (Malpezzi's version)		Shift-Share (TMD version)	
	MSE	TOTAL	COM	TOTAL	COM	TOTAL
AGS	0.000725	0.000682	0.0692	0.0774	190999	505168
BC	-0.000680	-0.000726	-0.0451	-0.0349	-262085	217090
BCS	0.000215	0.000208	0.1382	0.3394	25932	107080
CAM	-0.000227	-0.000231	-0.1136	-0.2936	-26037	-11809
COH	0.000792	0.000718	0.0407	0	424358	775028
COL	-0.000084	-0.000090	-0.0414	-0.0833	-12381	31254
CHIS	-0.000701	-0.000724	-0.0828	-0.1957	-88196	27226
CHIH	-0.001042	-0.001082	-0.0709	-0.0348	-631840	98900
DF	-0.007654	-0.008050	-0.0562	-0.0497	-2575766	1511898
DGO	0.002298	0.002241	0.2205	0.259	578864	970160
GTO	0.001680	0.001581	0.0693	0.0691	497563	1169642
GRO	-0.000086	-0.000109	-0.0129	-0.0266	-12626	160704
HGO	-0.000744	-0.000763	-0.0978	-0.0462	-467271	-9450
JAL	-0.000062	-0.000371	-0.0007	-0.0016	-11279	2479806
MEX	0.003099	0.002710	0.0296	0.0238	1130517	3826728
MICH	0.000004	-0.000039	0.0003	0.0001	1067	352493
MOR	0.001685	0.001641	0.2061	0.1375	747345	726194
NAY	-0.001172	-0.001188	-0.1453	-0.4597	-109958	-123516
NL	-0.001820	-0.001992	-0.033	-0.0286	-628069	990086
OAX	0.000038	-0.000007	0.0029	0.0042	7110	370552
PUE	0.001449	0.001350	0.0584	0.0516	484139	1117111
QRO	0.003601	0.003511	0.2226	0.2316	1024091	1515575
QR	-0.000272	-0.000284	-0.0652	-0.1651	-31999	35266
SLP	-0.001973	-0.002021	-0.1012	-0.1235	-480396	-43732
SIN	0.000191	0.000133	0.0117	0.0307	21063	510723
SON	-0.000577	-0.000650	-0.0252	-0.0336	-129484	464241
TAB	-0.000455	-0.000470	-0.0784	0	-68420	26243
TAM	0.000038	-0.000012	0.0026	0.0017	15722	415365
TLAX	0.000193	0.000175	0.0429	0.0366	66502	181783
VER	0.000950	0.000777	0.0199	0.029	190711	1604741
YUC	0.000899	0.000851	0.0788	0.1448	144452	582405
ZAC	-0.000308	-0.000317	-0.0893	-0.2046	-40037	4379

Source: Calculations based on information in Table D.3 and Table D.4.

Table D.14 Textiles. Shift-Share. Competitive Component and Total Change as Measured in The Constant Market Share (CMS), Malpezzi's Version, and Traditional Version (TMD), 1993-2003

STATE	Constant Market Share		Shift-Share (Malpezzi's version)		Shift-Share (TMD version)	
	MSE	TOTAL	COM	TOTAL	COM	TOTAL
AGS	-0.000130	-0.000544	-0.0055	-0.0568	-15234	16643
BC	0.000829	0.000501	0.092	0.0262	535003	218388
BCS	-0.000009	-0.000019	-0.0142	-0.0295	-2674	-885
CAM	0.000230	0.000181	1.045	0.2365	239505	55816
COH	0.001716	0.001077	0.1043	0.0313	1088565	447349
COL	0.000012	-0.000001	0.0218	-0.0001	6529	3999
CHIS	-0.000050	-0.000073	-0.0284	-0.02	-30249	-8430
CHIH	0.000907	-0.000243	0.0173	-0.0067	154391	325253
DF	-0.002664	-0.006144	-0.0124	-0.0389	-568678	-204951
DGO	0.000368	0.000136	0.0426	0.0163	111776	106477
GTO	0.001249	-0.000629	0.0142	-0.0232	101914	480145
GRO	0.000177	0.000074	0.0481	0.0236	47218	50319
HGO	0.000518	-0.000051	0.0206	-0.0019	98347	175991
JAL	-0.002757	-0.003704	-0.0346	-0.0667	-565265	-502709
MEX	-0.002339	-0.005136	-0.0134	-0.039	-512425	-208525
MICH	0.000189	0.000058	0.0374	0.0061	114667	55818
MOR	-0.000546	-0.000622	-0.0558	-0.0507	-202514	-111809
NAY	0.000001	-0.000007	0.0029	-0.0028	2204	1241
NL	-0.000789	-0.001672	-0.0142	-0.0256	-269928	-77049
OAX	0.000001	-0.000019	0.0008	-0.0023	1925	2401
PUE	0.001913	0.000425	0.0319	0.0171	263961	583706
QRO	-0.000540	-0.000672	-0.0426	-0.043	-195862	-104440
QR	0.000035	0.000020	0.0826	0.0124	40553	9180
SLP	-0.000297	-0.000441	-0.0274	-0.0272	-130190	-49569
SIN	0.000065	0.000029	0.0518	0.005	93277	18124
SON	0.001075	0.000618	0.0804	0.0366	413106	286550
TAB	0.000000	-0.000003	-0.0003	0	-285	354
TAM	0.000769	0.000488	0.108	0.0246	647301	199987
TLAX	-0.000138	-0.000365	-0.0101	-0.0681	-15658	-5412
VER	-0.000422	-0.000507	-0.0471	-0.0156	-451289	-83622
YUC	0.000493	0.000175	0.0412	0.0302	75511	143270
ZAC	0.000135	0.000099	0.2533	0.0663	113530	33622

Source: Calculations based on information in Table D.3 and Table D.4.

Table D.15 Paper. Shift-Share. Competitive Component and Total Change as Measured in The Constant Market Share (CMS), Malpezzi's Version, and Traditional Version (TMD), 1993-2003

STATE	Constant Market Share		Shift-Share (Malpezzi's version)		Shift-Share (TMD version)	
	MSE	TOTAL	COM	TOTAL	COM	TOTAL
AGS	-0.000024	-0.000052	-0.007	-0.0055	-19233	782
BC	0.000446	0.000256	0.0332	0.0135	192784	139873
BCS	0.000001	-0.000007	0.0016	-0.0097	299	2020
CAM	-0.000003	-0.000011	-0.0027	-0.0141	-607	1315
COH	0.000159	0.000040	0.0152	0.0013	158509	61041
COL	0.000000	-0.000008	-0.0004	-0.0075	-127	1578
CHIS	-0.000008	-0.000034	-0.0027	-0.0092	-2868	3964
CHIH	-0.000111	-0.000323	-0.0044	-0.0104	-39283	21986
DF	-0.000232	-0.003457	-0.0006	-0.0213	-29525	656734
DGO	0.000189	0.000092	0.0251	0.0109	65940	62817
GTO	0.000186	0.000032	0.0135	0.0016	96608	74450
GRO	-0.000041	-0.000061	-0.014	-0.0181	-13717	-4527
HGO	0.000184	0.000126	0.0562	0.008	268657	53187
JAL	-0.000678	-0.000830	-0.024	-0.0149	-391342	-115514
MEX	-0.000411	-0.001759	-0.0026	-0.0131	-101017	205364
MICH	0.000218	0.000062	0.0161	0.0067	49424	82154
MOR	0.000148	0.000089	0.0365	0.0075	132542	45559
NAY	-0.000001	-0.000007	-0.0019	-0.0027	-1432	1010
NL	-0.001286	-0.001789	-0.0167	-0.0275	-317114	-172437
OAX	0.000043	-0.000050	0.0046	-0.0055	11015	29955
PUE	-0.000121	-0.000212	-0.0101	-0.0074	-83792	-6881
QRO	0.000615	0.000241	0.0199	0.0167	91457	217352
QR	-0.000010	-0.000030	-0.004	-0.0172	-1979	2289
SLP	-0.000004	-0.000121	-0.0003	-0.0072	-1344	24883
SIN	0.000040	-0.000052	0.0042	-0.0077	7608	28714
SON	0.000242	0.000110	0.0231	0.0067	118493	82258
TAB	-0.000089	-0.000107	-0.0257	-0.0362	-22466	-15759
TAM	0.000425	0.000224	0.0283	0.0116	169447	137619
TLAX	0.000055	0.000022	0.0198	0.0044	30776	19520
VER	0.000041	-0.000221	0.0015	-0.0064	13965	66507
YUC	0.000031	-0.000019	0.0062	-0.0027	11408	17849
ZAC	-0.000005	-0.000012	-0.0054	-0.0075	-2429	527

Source: Calculations based on information in Table D.3 and Table D.4.

Table D.16 Wood. Shift-Share. Competitive Component and Total Change as Measured in The Constant Market Share (CMS), Malpezzi's Version, and Traditional Version (TMD), 1993-2003

STATE	Constant Market Share		Shift-Share (Malpezzi's version)		Shift-Share (TMD version)	
	MSE	TOTAL	COM	TOTAL	COM	TOTAL
AGS	0.000412	0.000253	0.064	0.0276	176716	92432
BC	-0.000185	-0.000612	-0.0033	-0.0307	-19009	-35672
BCS	0.000035	0.000019	0.0408	0.0308	7660	7964
CAM	-0.000042	-0.000053	-0.0161	-0.0686	-3698	-9140
COH	-0.000263	-0.000309	-0.0195	-0.0087	-203075	-57205
COL	-0.000006	-0.000026	-0.0025	-0.0253	-737	-1149
CHIS	-0.000262	-0.000302	-0.0205	-0.0839	-21808	-57105
CHIH	-0.000061	-0.001097	-0.0005	-0.0356	-4339	-1328
DF	-0.001064	-0.002238	-0.0062	-0.0143	-283145	-220201
DGO	-0.000296	-0.001125	-0.0027	-0.1247	-7194	-55310
GTO	-0.000220	-0.000256	-0.0202	-0.0105	-144884	-48073
GRO	0.000089	-0.000060	0.0059	-0.0171	5782	21249
HGO	0.000084	-0.000013	0.0093	-0.0006	44537	19535
JAL	0.000866	0.000007	0.0114	0.0005	185801	200395
MEX	0.000126	-0.000731	0.0013	-0.0055	48983	37715
MICH	-0.000150	-0.000580	-0.0027	-0.055	-8273	-28074
MOR	-0.000040	-0.000051	-0.0156	-0.0042	-56412	-8616
NAY	0.000002	-0.000065	0.0003	-0.0247	190	1216
NL	0.000903	0.000310	0.0209	0.0051	397682	205536
OAX	-0.000309	-0.000411	-0.0144	-0.0501	-34764	-66822
PUE	-0.000173	-0.000530	-0.0036	-0.0186	-30022	-33925
QRO	0.000136	0.000045	0.0201	0.003	92446	30947
QR	0.000143	0.000049	0.0207	0.0308	10156	32555
SLP	-0.000314	-0.000381	-0.0178	-0.0237	-84603	-68190
SIN	-0.000146	-0.000183	-0.0167	-0.0299	-30076	-31771
SON	0.000559	0.000229	0.025	0.0137	128418	126758
TAB	0.000030	0.000006	0.0153	0.0022	13352	6950
TAM	0.000015	-0.000068	0.0016	-0.0033	9404	4211
TLAX	0.000019	0.000002	0.0131	0.0005	20319	4359
VER	0.000171	0.000049	0.0182	0.0016	174418	39132
YUC	-0.000084	-0.000139	-0.0092	-0.0223	-16872	-17853
ZAC	0.000026	-0.000015	0.0064	-0.009	2856	6116

Source: Calculations based on information in Table D.3 and Table D.4.

Table D.17 Chemicals. Shift-Share. Competitive Component and Total Change as Measured in The Constant Market Share (CMS), Malpezzi's Version, and Traditional Version (TMD), 1993-2003

STATE	Constant Market Share (CMS)		Shift-Share (Malpezzi's version)		Shift-Share (TMD version)	
	MSE	TOTAL	COM	TOTAL	COM	TOTAL
AGS	-0.000002	-0.000018	-0.0013	-0.0017	-3530	14934
BC	0.000721	0.000595	0.1158	0.0312	673528	277969
BCS	0.000001	0.000001	0.0926	0.0016	17372	514
CAM	0.000000	0.000000	0.0032	-0.0003	742	426
COH	0.001555	0.001275	0.1116	0.0373	1164679	605602
COL	0.000008	-0.000005	0.0084	-0.0031	2510	13678
CHIS	-0.000386	-0.000404	-0.1179	-0.1119	-125582	-68182
CHIH	0.000302	0.000230	0.0749	0.008	667399	133724
DF	0.001714	-0.001392	0.0074	-0.0064	339157	3311721
DGO	-0.000166	-0.000187	-0.0677	-0.0208	-177730	-16508
GTO	0.000820	0.000279	0.0217	0.0144	155687	691658
GRO	0.000002	0.000001	0.0299	0.0004	29393	1433
HGO	0.000577	0.000355	0.0403	0.0238	192571	336222
JAL	-0.001527	-0.002032	-0.0328	-0.0357	-534654	141839
MEX	-0.001881	-0.003788	-0.012	-0.0275	-458956	1387955
MICH	0.000033	-0.000088	0.0036	-0.007	10983	121871
MOR	-0.000264	-0.000495	-0.0137	-0.038	-49841	160500
NAY	-0.000001	-0.000003	-0.0058	-0.001	-4406	1633
NL	0.001352	0.000599	0.0262	0.0108	498548	1008727
OAX	-0.000558	-0.000754	-0.0311	-0.0895	-75104	62800
PUE	0.000206	0.000008	0.0144	0.0012	119711	231733
QRO	0.002000	0.001626	0.1047	0.1079	481834	793573
QR	0.000003	0.000002	0.087	0.0015	42705	1242
SLP	0.000717	0.000608	0.1457	0.0388	691563	260940
SIN	-0.000030	-0.000043	-0.0274	-0.0067	-49404	4991
SON	-0.000066	-0.000093	-0.0273	-0.0052	-140407	11068
TAB	-0.000213	-0.000253	-0.0513	-0.0842	-44839	-8989
TAM	0.001315	0.000816	0.0409	0.0436	245040	761223
TLAX	-0.000133	-0.000237	-0.0154	-0.0428	-23831	68710
VER	-0.006080	-0.006717	-0.0767	-0.2054	-734901	-734759
YUC	-0.000021	-0.000040	-0.0127	-0.0061	-23319	13989
ZAC	0.000000	0.000000	0.0084	0	3755	223

Source: Calculations based on information in Table D.3 and Table D.4.

Table D.18 Non-Metallic. Shift-Share. Competitive Component and Total Change as Measured in The Constant Market Share (CMS), Malpezzi's Version, and Traditional Version (TMD), 1993-2003

STATE	Constant Market Share (CMS)		Shift-Share (Malpezzi's version)		Shift-Share (TMD version)	
	MSE	TOTAL	COM	TOTAL	COM	TOTAL
AGS	0.000051	0.000006	0.0144	0.0009	39751	28711
BC	-0.000131	-0.000350	-0.0062	-0.0171	-35858	56166
BCS	0.000113	0.000091	0.1362	0.1463	25563	33596
CAM	-0.000044	-0.000049	-0.0515	-0.0629	-11796	-8059
COH	0.001406	0.000370	0.0179	0.0125	186545	709079
COL	0.000057	0.000029	0.0302	0.0309	9030	23056
CHIS	-0.000060	-0.000077	-0.0283	-0.021	-30130	-6789
CHIH	0.000665	0.000347	0.0306	0.0123	272919	268813
DF	-0.001369	-0.002157	-0.0161	-0.0136	-736125	3261
DGO	-0.000322	-0.000348	-0.0558	-0.0391	-146469	-60384
GTO	0.000710	0.000359	0.0293	0.0158	209991	291625
GRO	-0.000140	-0.000175	-0.0305	-0.052	-29975	-17355
HGO	-0.000269	-0.000920	-0.0044	-0.0544	-20949	191959
JAL	-0.002920	-0.003154	-0.0567	-0.057	-926415	-552024
MEX	0.000318	-0.001206	0.0024	-0.0086	90625	658289
MICH	0.000151	0.000044	0.0187	0.0049	57398	74309
MOR	-0.000192	-0.000351	-0.0117	-0.0278	-42497	19385
NAY	-0.000040	-0.000045	-0.0448	-0.0174	-33922	-6685
NL	0.001405	-0.000446	0.0092	-0.005	175713	1023679
OAX	0.000413	0.000246	0.0383	0.0315	92449	155457
PUE	-0.000438	-0.000662	-0.0177	-0.0231	-146743	-9880
QRO	-0.000019	-0.000152	-0.0016	-0.0092	-7197	47260
QR	0.000034	0.000003	0.014	0.0031	6864	19552
SLP	-0.000355	-0.000551	-0.0167	-0.0336	-79056	-2563
SIN	-0.000267	-0.000298	-0.0482	-0.0487	-86834	-46905
SON	-0.000301	-0.000470	-0.0164	-0.0265	-84376	-1073
TAB	-0.000241	-0.000286	-0.0369	-0.0961	-32237	-35850
TAM	0.000068	-0.000027	0.0087	-0.001	52132	51438
TLAX	0.000902	0.000701	0.1033	0.1366	160303	276128
VER	0.000109	-0.000151	0.0049	-0.0041	46637	124262
YUC	0.000661	0.000442	0.0516	0.074	94530	229713
ZAC	0.000047	0.000011	0.0171	0.0088	7644	24191

Source: Calculations based on information in Table D.3 and Table D.4.

Table D.19 Machinery. Shift-Share. Competitive Component and Total Change as Measured in The Constant Market Share (CMS), Malpezzi's Version, and Traditional Version (TMD), 1993-2003

STATE	Constant Market Share (CMS)		Shift-Share (Malpezzi's version)		Shift-Share (TMD version)	
	MSE	TOTAL	COM	TOTAL	COM	TOTAL
AGS	0.003079	0.004508	0.3135	0.4922	865452	1661239
BC	0.000703	0.003178	0.0246	0.1686	143262	1858817
BCS	-0.000017	-0.000007	-0.1072	-0.011	-20120	2778
CAM	-0.000011	-0.000002	-0.0778	-0.0016	-17833	4057
COH	0.007148	0.012407	0.1535	0.3602	1602478	5193005
COL	0.000005	0.000019	0.0278	0.02	8312	11197
CHIS	-0.000001	0.000019	-0.0024	0.0055	-2516	13287
CHIH	-0.001530	0.002027	-0.0323	0.0736	-288124	2112674
DF	-0.012629	-0.006921	-0.1247	-0.0428	-5718535	1152383
DGO	-0.000870	-0.000609	-0.1622	-0.0672	-425985	-11421
GTO	0.013035	0.016438	1.416	0.6866	10160072	5210009
GRO	-0.000021	-0.000012	-0.1251	-0.0034	-122924	1902
HGO	-0.004271	-0.003739	-0.2493	-0.2304	-1190773	-573235
JAL	0.000125	0.002386	0.0046	0.0455	74534	1584292
MEX	-0.015536	-0.008030	-0.119	-0.0592	-4553588	1751161
MICH	-0.000216	-0.000128	-0.1333	-0.0119	-408601	13463
MOR	-0.003790	-0.003219	-0.231	-0.2608	-837725	-440948
NAY	0.000008	0.000019	0.0644	0.0075	48715	9295
NL	0.008506	0.014633	0.1581	0.233	3008214	6089194
OAX	-0.000043	-0.000022	-0.1182	-0.0026	-285485	4975
PUE	0.005534	0.009256	0.1741	0.3381	1442883	3780232
QRO	0.002434	0.004188	0.158	0.2758	726880	1743144
QR	0.000018	0.000030	0.1587	0.0186	77920	12536
SLP	0.001164	0.002143	0.1281	0.137	608050	930033
SIN	-0.000074	0.000009	-0.0616	0.0022	-110931	41016
SON	-0.003413	-0.002535	-0.1773	-0.1436	-911414	-145679
TAB	0.000020	0.000045	0.0822	0.0155	71791	21158
TAM	0.001538	0.004278	0.0518	0.2188	310307	2224851
TLAX	-0.000336	-0.000201	-0.1349	-0.037	-209336	19195
VER	-0.000744	-0.000584	-0.1952	-0.0178	-1870210	-53398
YUC	0.000028	0.000128	0.0245	0.0215	44857	74839
ZAC	0.000157	0.000229	0.3233	0.1539	144910	83935

Source: Calculations based on information in Table D.3 and Table D.4.

Table D.20 Other. Shift-Share. Competitive Component and Total Change as Measured in The Constant Market Share (CMS), Malpezzi's Version, and Traditional Version (TMD), 1993-2003

STATE	Constant Market Share (CMS)		Shift-Share (Malpezzi's version)		Shift-Share (TMD version)	
	MSE	TOTAL	COM	TOTAL	COM	TOTAL
AGS	0.000482	0.000443	0.0127	0.0494	35162	251758
BC	0.001200	0.001128	0.0193	0.0591	112489	532881
BCS	0.000001	0.000001	0.026	0.0018	4873	480
CAM	0.000002	0.000002	0.0152	0.002	3494	796
COH	-0.000024	-0.000030	-0.0029	-0.0008	-29898	17278
COL	0.000000	0.000000	0.0104	0.0004	3121	226
CHIS	-0.000008	-0.000008	-0.0099	-0.0022	-10575	6
CHIH	0.000284	0.000241	0.006	0.0087	53639	220939
DF	-0.002536	-0.002695	-0.0095	-0.017	-436941	32956
DGO	-0.000011	-0.000012	-0.006	-0.0013	-15701	2084
GTO	0.000057	0.000052	0.0134	0.0023	96167	29090
GRO	0.000184	0.000171	0.0152	0.0533	14958	89143
HGO	-0.000062	-0.000064	-0.0175	-0.0039	-83406	-7877
JAL	-0.000565	-0.000612	-0.0076	-0.0107	-123410	52372
MEX	0.000200	0.000128	0.0023	0.0012	87427	313995
MICH	-0.000060	-0.000063	-0.0126	-0.006	-38670	-3720
MOR	0.000339	0.000328	0.0687	0.0272	249087	113696
NAY	0.000002	0.000002	0.0166	0.0008	12529	999
NL	-0.000195	-0.000225	-0.0045	-0.0033	-85232	69695
OAX	0.000046	0.000044	0.024	0.0055	57956	19141
PUE	-0.000098	-0.000102	-0.0121	-0.0036	-100261	-5100
QRO	-0.000253	-0.000257	-0.0211	-0.0164	-97123	-39171
QR	0.000004	0.000003	0.008	0.0022	3927	2533
SLP	-0.000239	-0.000249	-0.0132	-0.0153	-62850	-17432
SIN	0.000007	0.000007	0.0074	0	13255	5137
SON	0.000386	0.000364	0.0205	0.0215	105480	167991
TAB	0.000001	0.000001	0.0066	0.0002	5735	472
TAM	0.000574	0.000548	0.0304	0.0277	182266	223482
TLAX	0.000134	0.000128	0.0317	0.025	49182	51699
VER	0.000005	0.000004	0.0186	0.0001	178294	2108
YUC	0.000135	0.000129	0.0292	0.0213	53445	53092
ZAC	0.000008	0.000006	0.0042	0.0046	1868	7741

Source: Calculations based on information in Table D.3 and Table D.4.

Table D.21 Total Manufacturing. Shift-Share. Competitive Component and Total Change as Measured in Malpezzi's Version, and the Traditional Version (TMD), 1993-2003

STATE	Shift-Share (TMD version)					Malpezzi's Version			
	NAT	MIX	COM	INT	TOTAL	COM	MIX	INT	TOTAL
AGS	961502	80214	1179715	349529	2570961	0.4273	0.0291	0.1266	0.583
BC	2025151	420977	1399860	-547003	3298985	0.2407	0.0724	-0.0941	0.2191
BCS	65368	-6357	58906	35630	153547	0.3138	-0.0339	0.1898	0.4698
CAM	79816	-9333	183771	-220852	33402	0.8018	-0.0407	-0.9636	-0.2025
COH	3635355	1092011	4441697	-241509	8927554	0.4255	0.1046	-0.0231	0.507
COL	104192	-16001	16257	-20610	83839	0.0543	-0.0535	-0.0689	-0.068
CHIS	371079	-60249	-311923	-94930	-96023	-0.2927	-0.0565	-0.0891	-0.4384
CHIH	3103534	502611	-161633	-318957	3125555	-0.0181	0.0564	-0.0358	0.0025
DF	15969930	-782121	-11297032	2246927	6137704	-0.2464	-0.0171	0.049	-0.2144
DGO	914432	-215085	126361	190129	1015837	0.0481	-0.0819	0.0724	0.0386
GTO	2498760	-484101	11017972	-5130737	7901893	1.5356	-0.0675	-0.7151	0.7531
GRO	342171	-75737	-80344	116882	302972	-0.0818	-0.0771	0.119	-0.0399
HGO	1663730	44797	-1367931	-176981	163614	-0.2863	0.0094	-0.037	-0.314
JAL	5685323	-259481	-2487327	426318	3364833	-0.1524	-0.0159	0.0261	-0.1421
MEX	13321603	1052575	-3877115	-1516954	8980110	-0.1014	0.0275	-0.0397	-0.1135
MICH	1067765	-99716	-119564	596608	1445093	-0.039	-0.0325	0.1946	0.1231
MOR	1263029	233977	-60015	-933029	503961	-0.0165	0.0645	-0.2573	-0.2093
NAY	263536	-24196	-86080	-268067	-114807	-0.1138	-0.032	-0.3542	-0.5
NL	6626489	400335	2911914	220917	10159656	0.153	0.021	0.0116	0.1857
OAX	840877	-167192	-224896	129670	578459	-0.0931	-0.0692	0.0537	-0.1087
PUE	2885995	310575	1851700	741400	5789670	0.2234	0.0375	0.0895	0.3504
QRO	1602183	127482	2348605	143177	4221447	0.5105	0.0277	0.0311	0.5693
QR	171035	-30259	148147	-173770	115153	0.3017	-0.0616	-0.3538	-0.1138
SLP	1653427	205842	496743	-593047	1762966	0.1046	0.0434	-0.1249	0.0231
SIN	627291	-43398	-142043	88178	530029	-0.0789	-0.0241	0.049	-0.054
SON	1789753	338320	-632410	-520852	974811	-0.1231	0.0658	-0.1014	-0.1586
TAB	304118	-42816	-77370	-189353	-5421	-0.0886	-0.049	-0.2168	-0.3545
TAM	2086448	526872	1981281	-536689	4057912	0.3307	0.0879	-0.0896	0.3291
TLAX	540389	-70987	166066	32412	667880	0.107	-0.0457	0.0209	0.0822
VER	3335975	-233970	-2500696	697733	1299043	-0.2611	-0.0244	0.0728	-0.2126
YUC	638064	-105623	314341	233351	1080133	0.1716	-0.0577	0.1274	0.2413
ZAC	156078	-10918	235916	-218404	162672	0.5264	-0.0244	-0.4873	0.0147

Source: Calculations based on information in Table D.3 and Table D.4.

Table D.22 Total Manufacturing. Shift-Share. Competitive Component and Total Change as Measured in the Constant Market Share (CMS), 1993-2003

STATE	MSE	SME	ADAP+	ADAP-	ADAP	TOTAL
AGS	0.004585	0.000159	0.000625	-0.000098	0.000527	0.005271
BC	0.002934	0.001178	0.000147	-0.000230	-0.000083	0.004029
BCS	0.000342	-0.000029	-0.000003	-0.000023	-0.000026	0.000287
CAM	-0.000096	-0.000040	-0.000002	-0.000026	-0.000028	-0.000164
COH	0.013071	0.003238	0.001529	-0.000558	0.000971	0.017280
COL	-0.000009	-0.000065	0.000001	-0.000007	-0.000006	-0.000080
CHIS	-0.001476	-0.000244	0.000000	0.000116	0.000116	-0.001604
CHIH	-0.001006	0.001328	-0.000365	-0.000235	-0.000600	-0.000278
DF	-0.028424	-0.004426	-0.002825	0.000994	-0.001831	-0.034681
DGO	0.001229	-0.000823	-0.000172	0.000001	-0.000171	0.000235
GTO	0.017410	-0.001902	0.002637	-0.000365	0.002272	0.017780
GRO	0.000164	-0.000292	-0.000004	-0.000038	-0.000042	-0.000170
HGO	-0.004130	-0.000039	-0.000887	-0.000147	-0.001034	-0.005204
JAL	-0.007749	-0.001512	-0.000005	0.000864	0.000859	-0.008402
MEX	-0.015524	0.002008	-0.003043	0.000534	-0.002509	-0.016025
MICH	0.001515	-0.000454	0.000130	-0.000050	0.000080	0.001140
MOR	-0.002659	0.000639	-0.000771	0.000110	-0.000661	-0.002681
NAY	-0.001201	-0.000111	0.000002	0.000015	0.000017	-0.001295
NL	0.008763	0.000587	0.001818	-0.000108	0.001710	0.011060
OAX	-0.000368	-0.000654	-0.000009	0.000058	0.000049	-0.000973
PUE	0.007877	0.000711	0.001074	-0.000282	0.000792	0.009380
QRO	0.008009	0.000244	0.000500	-0.000178	0.000322	0.008575
QR	-0.000046	-0.000121	0.000004	-0.000043	-0.000039	-0.000206
SLP	-0.000782	0.000501	0.000304	0.000157	0.000461	0.000179
SIN	-0.000215	-0.000216	-0.000015	0.000050	0.000035	-0.000396
SON	-0.002729	0.000928	-0.000776	-0.000351	-0.001127	-0.002927
TAB	-0.000948	-0.000178	0.000004	0.000052	0.000056	-0.001069
TAM	0.004827	0.001525	0.000324	-0.000321	0.000003	0.006354
TLAX	0.000805	-0.000299	-0.000054	-0.000087	-0.000141	0.000365
VER	-0.006239	-0.001161	-0.000186	0.000397	0.000211	-0.007188
YUC	0.002008	-0.000425	-0.000012	-0.000165	-0.000177	0.001405
ZAC	0.000061	-0.000054	0.000032	-0.000035	-0.000003	0.000004

Source: Calculations based on information in Table D.3 and Table D.4.

Table D.23 Coefficients of Localization, 1993

	FOOD	TEX	PAPEL	WOOD	CHEM	MET	NO-MET	MACH	OTHER
AGS	1.124	2.060	0.321	0.519	0.128	0.028	0.340	1.281	4.019
BC	0.769	0.374	0.587	2.168	0.300	0.170	0.963	1.766	3.128
BCS	2.461	0.813	1.140	1.029	0.020	0.000	1.175	0.301	0.071
CAM	2.578	0.231	1.104	2.541	0.040	0.000	0.997	0.225	0.138
COH	0.553	0.380	0.254	0.288	0.374	3.969	1.994	1.606	0.234
COL	2.000	0.442	0.710	1.897	0.879	0.000	1.662	0.203	0.037
CHIS	2.356	0.397	0.721	2.676	0.862	0.000	0.527	0.081	0.215
CHIH	0.489	1.416	0.717	3.135	0.127	0.408	0.644	1.912	1.552
DF	0.880	1.130	1.988	0.837	1.416	0.522	0.492	0.795	1.702
DGO	1.176	0.795	0.726	9.157	0.261	0.087	0.581	0.735	0.200
GTO	1.000	2.955	0.487	0.339	1.476	0.231	0.894	0.462	0.174
GRO	2.025	0.906	0.754	3.420	0.020	0.004	1.234	0.062	3.604
HGO	0.471	1.269	0.174	0.419	0.839	0.235	3.402	1.291	0.220
JAL	1.635	1.176	0.439	1.038	0.800	0.400	0.834	0.603	1.342
MEX	0.812	1.101	1.031	0.573	1.148	0.777	0.927	1.228	0.671
MICH	1.224	0.397	1.118	4.053	0.842	4.440	0.694	0.190	0.456
MOR	0.668	0.650	0.283	0.157	1.481	0.000	1.193	1.628	0.399
NAY	3.158	0.144	0.224	2.327	0.057	0.000	0.309	0.056	0.050
NL	0.859	0.705	1.028	0.506	0.759	1.756	2.115	1.018	0.669
OAX	1.589	0.108	1.000	1.983	2.079	0.000	1.182	0.054	0.233
PUE	0.887	1.748	0.367	1.286	0.482	1.357	0.789	1.381	0.287
QRO	1.042	0.665	1.704	0.328	1.163	0.050	0.702	1.205	0.763
QR	2.523	0.205	1.220	3.139	0.019	0.000	1.319	0.081	0.287
SLP	1.217	0.550	0.693	0.826	0.290	4.928	1.189	0.689	1.117
SIN	2.692	0.167	1.320	1.085	0.171	0.000	0.813	0.240	0.165
SON	1.320	0.628	0.518	0.970	0.132	1.617	0.945	1.348	1.073
TAB	1.969	0.050	1.009	0.506	1.331	0.000	1.981	0.102	0.033
TAM	0.720	0.287	0.636	0.350	1.503	0.081	0.345	1.784	0.924
TLAX	0.858	2.118	0.454	0.208	1.567	0.417	1.489	0.578	0.800
VER	1.476	0.226	0.746	0.219	2.317	1.875	0.616	0.143	0.008
YUC	1.843	1.575	0.692	1.111	0.247	0.652	1.849	0.226	0.741
ZAC	2.283	0.287	0.484	2.003	0.010	0.134	1.623	0.390	1.223

Source: Calculations based on information in Table D.3.

Table D.24. Competition (Porter Economies), 1993

STATE	SMALL (relative)	SIZE (relative)
AGS	0.99	0.85
BC	0.94	0.35
BCS	1.01	1.67
CAM	1.02	3.20
COH	0.99	0.56
COL	1.02	2.99
CHIS	1.02	3.67
CHIH	0.97	0.39
DF	n.a	0.69
DGO	0.99	0.89
GTO	1.00	1.08
GRO	1.02	3.89
HGO	1.00	1.08
JAL	1.00	0.99
MEX	0.98	0.64
MICH	1.02	2.69
MOR	1.01	1.30
NAY	1.01	2.14
NL	0.97	0.48
OAX	1.02	3.52
PUE	1.01	1.85
QRO	0.98	0.62
QR	1.02	2.67
SLP	1.00	1.02
SIN	1.01	1.50
SON	0.99	0.76
TAB	1.01	1.92
TAM	0.99	0.54
TLAX	0.99	1.12
VER	1.01	1.65
YUC	1.02	2.95
ZAC	1.02	2.72
COUNTRY	1.00	1.00

Source: Calculations based on the Census of Manufactures, 1993.

Table D.25 Alternative Indicators for Jacobs Economies, 1993

State	HHI	(1/HHI_local)/ (1/HHI_nal)	Sundrum	Caniels (HF)	UNCTAD	Divers=1-UNCTAD
AGS	0.239	0.748	0.380	0.349	0.234	0.766
BC	0.255	0.702	0.402	0.378	0.257	0.743
BCS	0.464	0.386	0.630	0.651	0.522	0.478
CAM	0.503	0.356	0.664	0.687	0.564	0.436
COH	0.239	0.750	0.379	0.348	0.233	0.767
COL	0.337	0.531	0.504	0.505	0.371	0.629
CHIS	0.435	0.412	0.604	0.621	0.489	0.511
CHIH	0.270	0.662	0.423	0.405	0.280	0.720
DF	0.171	1.046	0.260	0.196	0.120	0.880
DGO	0.232	0.772	0.369	0.335	0.222	0.778
GTO	0.214	0.837	0.340	0.298	0.194	0.806
GRO	0.340	0.527	0.507	0.509	0.374	0.626
HGO	0.221	0.810	0.352	0.313	0.205	0.795
JAL	0.251	0.713	0.397	0.371	0.252	0.748
MEX	0.192	0.933	0.301	0.249	0.157	0.843
MICH	0.193	0.929	0.303	0.250	0.158	0.842
MOR	0.261	0.686	0.410	0.388	0.266	0.734
NAY	0.732	0.245	0.836	0.858	0.783	0.217
NL	0.173	1.038	0.263	0.200	0.123	0.877
OAX	0.310	0.578	0.473	0.466	0.335	0.665
PUE	0.211	0.848	0.335	0.292	0.189	0.811
QRO	0.216	0.830	0.343	0.302	0.197	0.803
QR	0.489	0.366	0.652	0.674	0.549	0.451
SLP	0.200	0.894	0.316	0.268	0.171	0.829
SIN	0.542	0.331	0.696	0.721	0.604	0.396
SON	0.253	0.707	0.400	0.375	0.255	0.745
TAB	0.355	0.504	0.524	0.529	0.394	0.606
TAM	0.291	0.616	0.449	0.437	0.309	0.691
TLAX	0.186	0.961	0.291	0.235	0.147	0.853
VER	0.307	0.583	0.470	0.463	0.331	0.669
YUC	0.296	0.604	0.456	0.446	0.316	0.684
ZAC	0.412	0.435	0.581	0.596	0.462	0.538
COUNTRY	0.179	1.000	0.276	0.217	0.135	0.865

Source: Calculations based on Census of Manufactures, 1993.

Table D.26 Distances Between Capital Cities Used in the Centrality Index

	AGS	BC	BCS	CAM	COAH	COL	CHIS	CHIH	DF	DGO	GTO	GRO	HGO	JAL	MEX	MICH	MOR	NAY	NL	OAX	PUE	QRO	QR	SLP	SIN	SON	TAB	TAM	TLX	VER	YUC	ZAC
AGS	0	2414	4112	2170	499	447	1493	988	519	430	185	794	548	245	503	328	608	464	581	970	642	308	1877	171	978	1692	1296	517	637	831	1855	130
BC	2414	0	1698	3880	2158	2378	3696	1416	2722	1984	2466	2997	2782	2176	2654	2468	2811	1957	2240	3173	2845	2542	4080	2483	1436	722	3499	2532	2840	3034	4058	2274
BCS	4112	1698	0	5578	3856	4063	5394	3114	4420	3682	4151	4695	4467	3861	4341	4153	4509	3655	3938	4871	4543	4227	5778	4181	3134	2420	5197	4230	4525	4732	5756	3972
CAM	2170	3880	5578	0	1955	1906	627	2638	1158	2084	1526	1396	1222	1704	1224	1460	1210	1923	1873	991	1035	1369	425	1581	2444	3158	381	1581	1068	971	178	1780
COAH	499	2158	3856	1955	0	1068	1771	742	861	520	672	1136	890	692	845	842	950	911	82	1312	984	654	2155	449	1068	1436	1574	374	979	1103	2133	369
COL	447	2378	4063	1906	1068	0	1665	1383	748	825	467	793	808	202	808	446	837	421	976	1199	871	568	2106	552	942	1656	1525	898	866	1060	2084	525
CHIS	1493	3696	5394	627	1771	1665	0	2454	974	1900	1342	1098	1038	1520	1038	1276	1026	1739	1689	550	851	1185	744	1397	2260	2974	284	1397	884	787	805	1596
CHIH	988	1416	3114	2638	742	1383	2454	0	1480	667	1173	1755	1513	1181	1513	1316	1569	1290	824	1931	1603	1273	2838	1057	1215	694	2257	1116	1598	1792	2816	858
DF	519	2722	4420	1158	861	748	974	1480	0	926	368	275	97	546	66	302	89	765	929	451	123	211	1358	423	1286	2000	777	729	118	312	1336	622
DGO	430	1984	3682	2084	520	825	1900	667	926	0	615	1201	955	623	910	758	1015	623	602	1377	1049	715	2284	499	548	1262	1703	845	1044	1238	2262	300
GTO	185	2466	4151	1526	672	467	1342	1173	368	615	0	643	397	290	397	177	457	509	740	819	491	157	1726	223	1030	1744	1145	569	486	680	1704	315
GRO	794	2997	4695	1396	1136	793	1098	1755	275	1201	643	0	372	821	282	577	186	1040	1204	642	361	486	1596	698	1561	2275	1015	1004	394	654	1574	897
HGO	548	2782	4467	1222	890	808	1038	1513	97	955	397	372	0	606	163	399	186	825	958	515	187	240	1422	452	1346	2060	841	632	154	348	1400	655
JAL	245	2176	3861	1704	692	202	1520	1181	546	623	290	821	606	0	480	292	635	219	774	997	669	366	1904	350	740	1454	1323	696	664	858	1882	323
MEX	503	2654	4341	1224	845	808	1038	1513	66	910	397	282	163	480	0	236	155	699	913	517	189	195	1424	407	1220	1934	843	753	184	378	1402	606
MICH	328	2468	4153	1460	842	446	1276	1316	302	758	177	577	399	292	236	0	391	511	914	753	425	192	1660	400	1032	1746	1079	746	420	614	1638	458
MOR	608	2811	4509	1210	950	837	1026	1569	89	1015	457	186	186	635	155	391	0	854	1018	503	175	300	1410	512	1375	2089	829	818	208	369	1388	711
NAY	464	1957	3655	1923	911	421	1739	1290	765	623	509	1040	825	219	699	511	854	0	993	1216	888	585	2123	569	521	1235	1542	915	883	1077	2101	542
NL	581	2240	3938	1873	82	976	1689	824	929	602	740	1204	958	774	913	914	1018	993	0	1380	1052	722	2073	517	1150	1518	1492	292	1047	1021	2051	451
OAX	970	3173	4871	991	1312	1199	550	1931	451	1377	819	642	515	997	517	753	503	1216	1380	0	328	662	1191	874	1737	2451	610	1085	361	439	1169	1077
PUE	642	2845	4543	1035	984	871	851	1603	123	1049	491	361	187	669	189	425	175	888	1052	328	0	334	1235	546	1409	2123	654	757	33	194	1213	745
QRO	308	2542	4227	1369	654	568	1185	1273	211	715	157	486	240	366	195	192	300	585	722	662	334	0	1569	216	1106	1820	988	562	329	523	1547	415
QR	1877	4080	5778	425	2155	2106	744	2838	1358	2284	1726	1596	1422	1904	1424	1660	1410	2123	2073	1191	1235	1569	0	1781	2644	3358	581	1781	1268	1171	409	1980
SLP	171	2483	4181	1581	449	552	1397	1057	423	499	223	698	452	350	407	400	512	569	517	874	546	216	1781	0	1047	1761	1200	346	541	735	1759	199
SIN	978	1436	3134	2444	1068	942	2260	1215	1286	548	1030	1561	1346	740	1220	1032	1375	521	1150	1737	1409	1106	2644	1047	0	714	2063	1393	1404	1598	2622	848
SON	1692	722	2420	3158	1436	1656	2974	694	2000	1262	1744	2275	2060	1454	1934	1746	2089	1235	1518	2451	2123	1820	3358	1761	714	0	2777	1810	2118	2312	3336	1562
TAB	1296	3499	5197	381	1574	1525	284	2257	777	1703	1145	1015	841	1323	843	1079	829	1542	1492	610	654	988	581	1200	2063	2777	0	1200	687	590	559	1399
TAM	517	2532	4230	1581	374	898	1397	1116	729	845	569	1004	632	696	753	746	818	915	292	1085	757	562	1781	346	1393	1810	1200	0	724	729	1759	545
TLX	637	2840	4525	1068	979	866	884	1598	118	1044	486	394	154	664	184	420	208	883	1047	361	33	329	1268	541	1404	2118	687	724	0	194	1246	740
VER	831	3034	4732	971	1103	1060	787	1792	312	1238	680	654	348	858	378	614	369	1077	1021	439	194	523	1171	735	1598	2312	590	729	194	0	1149	934
YUC	1855	4058	5756	178	2133	2084	805	2816	1336	2262	1704	1574	1400	1882	1402	1638	1388	2101	2051	1169	1213	1547	409	1759	2622	3336	559	1759	1246	1149	0	1958
ZAC	130	2274	3972	1780	369	525	1596	858	622	300	315	897	655	323	606	458	711	542	451	1077	745	415	1980	199	848	1562	1399	545	740	934	1958	0

Source: Mercamétrica.

Table D. 27 Matrix of Contiguity (Queen's Case)

State	BCN	BCS	NAY	JAL	AGS	GTO	QRO	HGO	MICH	MEX	DF	COL	MOR	YUC	CAM	PUE	QR	TLA	GRO	OAX	TAB	CHIS	SON	CHIH	COA	SIN	DGO	ZAC	SLP	NL	TAM	VER	Total
BCN	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	2.0000
BCS	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000
NAY	0.0000	0.0000	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	4.0000
JAL	0.0000	0.0000	1.0000	0.0000	1.0000	1.0000	0.0000	0.0000	1.0000	0.0000	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	0.0000	0.0000	0.0000	7.0000
AGS	0.0000	0.0000	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	2.0000
GTO	0.0000	0.0000	0.0000	1.0000	0.0000	0.0000	1.0000	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	0.0000	0.0000	0.0000	5.0000
QRO	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000	0.0000	0.0000	5.0000
HGO	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000	0.0000	1.0000	6.0000
MICH	0.0000	0.0000	0.0000	1.0000	0.0000	1.0000	1.0000	0.0000	0.0000	1.0000	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	6.0000
MEX	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	1.0000	0.0000	1.0000	0.0000	0.0000	1.0000	0.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	8.0000
DF	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	2.0000
COL	0.0000	0.0000	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	2.0000
MOR	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	4.0000
YUC	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	2.0000
CAM	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000	0.0000	1.0000	0.0000	0.0000	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	3.0000
PUE	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000	1.0000	0.0000	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	7.0000
QR	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	2.0000
TLA	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	3.0000
GRO	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	0.0000	0.0000	1.0000	0.0000	0.0000	1.0000	0.0000	0.0000	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	5.0000
OAX	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000	0.0000	1.0000	0.0000	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	4.0000
TAB	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	3.0000
CHIS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	3.0000
SON	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	3.0000
CHIH	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	4.0000
COA	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000	0.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	5.0000
SIN	0.0000	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	0.0000	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	4.0000
DGO	0.0000	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	5.0000
ZAC	0.0000	0.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000	1.0000	0.0000	1.0000	1.0000	0.0000	0.0000	8.0000
SLP	0.0000	0.0000	0.0000	1.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000	0.0000	1.0000	0.0000	1.0000	1.0000	1.0000	9.0000
NL	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000	0.0000	1.0000	1.0000	0.0000	1.0000	0.0000	4.0000
TAM	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	0.0000	1.0000	3.0000
VER	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000	1.0000	0.0000	7.0000

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