

Essays on Regional Economics and Political Risk in Mexico

by

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Abstract.

This dissertation consists of three essays related to current Mexican economic policy problems. The first essay is a theoretical exploration of the factors that determine the regional agglomeration of industry in a long run perspective. A general equilibrium model that emphasizes the role of long—haul and urban transportation infrastructure is developed. We conclude that a process of initial agglomeration and later dispersion (a regional Kuznets curve) can be explained by technological improvements in the transportation sector. The second essay extends the model developed previously to analyze the possible regional effects of opening up an economy to international trade. In particular we analyze what happens when the regions that comprise a country have different proximities to the country's trading partners. Looking at evidence from Mexico, we provide a rationale for the recent relocation of industry in the border regions. The final essay is an analysis of the structure and evolution of the risk premia that Mexican peso denominated bonds pay. We look at the deviations from different interest rate parity conditions. The data supports the claim that peso problems suffice to explain deviations from uncovered interest parity. Deviations from covered interest parity (CIP) provide evidence of a well integrated internal financial market. CIP deviations between instruments issued in different national jurisdictions are large and significant but show a clear declining trend.

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Chapter 1.

Introduction

The motivating factors behind this thesis are two pressing issues currently facing the Mexican economy: regional inequality and financial fragility. Two problems that are by no means exclusive to Mexico, but prevalent in many developing nations. The theoretical approach taken to analyze these problems--specially in the first two chapters-- make the adequacy of its models and the validity of its results more generally applicable.

This thesis consists of two parts which show how varied the field of international economics can be. The first part--chapters two and three--on economic geography, deals with the real side of international economics and takes a long term theoretical approach to the problems posed. It proposes some of the first steps of a new way to look at regional and international economic interaction following a path opened by Paul Krugman.

The second part--chapter three--on country risk premia, deals with the financial side of international economics and takes a short term and empirical approach. Interest rate parity conditions have been abundantly and thoroughly studied. I derive the stylized facts for the Mexican economy and provide them as a new case study to the international literature. At the same time, the vast body of work done in this field helps to interpret Mexican current financial behavior, providing us with an intelligible explanation of its major trends.

Mexico's economic growth has not been equally shared by all its regions. As the country develops the gap between the North and the South of the country widen up generating a situation similar to that experienced by many other countries of which Italy is the archetypical case. Although there

exists a vast amount of literature addressing the problem of regional disparity, there is still a lot of debate on the underlying causes of dualism.

The aim of chapters two and three is to provide some analysis in the task of filling this gap. In chapter two we retake an old theme from the development literature, the "regional Kuznets curve" and provide a theoretical framework that can explain it. In the context of our model an inverted "u" shaped pattern of regional inequality can be caused by a continuous process of reduction in transportation costs. As transportation costs fall, it is profitable for firms to cluster together to save transportation costs but if transportation costs become irrelevant and industry finds it optimal to disperse in order to save in the costs that urban agglomerations create.

An important policy implication of the previous analysis is that categories such as urban infrastructure and long-haul transportation infrastructure which are usually bundled together in the heading of "social overhead capital" have radically different regional implications. Investing in one of them or the other generates opposite effects in terms of the concentration or dispersion of economic activity.

Chapter three focuses directly on the case of Mexico analyzing the possible regional implications that enhanced trade with the United States may bring about. We show how, as the economic linkages are mainly with foreign markets, and linkages with the domestic market lose importance, it becomes profitable for industry to relocate close to the foreign market. Analyzing empirical evidence from Mexico we can conjecture that this adjustment is taking place at a fast pace.

Chapter four shifts to another important problem Mexico faces; the evolution of interest rates. We analyze the structure and evolution of

deviations from different interest rate parity conditions in the last five years. Covered Interest Parity (CIP) between Mexican instruments holds for most of the period between 1987 and 1992 except for some months during the initial phases of the Mexican stabilization program that started in December of 1987. This provides evidence of financial domestic market integration.

However, CIP deviations between domestic and foreign instruments are large and significant. Showing that the Mexican financial system is still not well integrated into the world capital markets. The size of these deviations shows a declining trend. At the current rate of decline CIP deviations should disappear before the decade's end. This is in line with the current debate among financial rating institutions that are starting to give investment grades to Mexican bonds. Chapter four also analyzes the large deviations from uncovered interest parity between Mexican and U.S. Bonds. These deviations seem to result from a "peso problem", since they became insignificant in sample periods that include a "peso" event.

Regional inequality and financial fragility will continue hunting developing economies for a long time. A better understanding of these problems can help to devise adequate policy measures to confront them.

Chapter 2.

Increasing Returns and the Regional Kuznets Curve

An important issue in Development Economics is the high degree of regional inequality that exists within developing countries. Economic Dualism was a central tenet in a seminal paper by Arthur Lewis (1954) that became a fundamental piece in the research agenda of Development Economics. The tendency towards convergence or divergence of regional income per capita was debated among the leading development theorists (see Hirschman (1958) and Myrdal (1957)). 30 years later, the stylized fact remains that regional inequality is prevalent in developing economies. Manufacturing and service production are clustered in a few regions in these countries. However, the literature does not provide a satisfactory explanation for this phenomenon. The gap in the knowledge of this process is evident by looking at the contrast between these theories and a recent research trend in the macroeconomics literature (Blanchard and Katz (1992), Barro and Sala-i-Martin (1991)) that focuses on the convergence of regional income in developed economies. Both sets of literature emphasize different factors that lead to convergence or divergence, but the set of factors that explain one process does not explain the other. More puzzling still is the fact that in some cases, similar factors are used to explain both tendencies. To settle this issue an integrated approach to explain regional inequality is required.

An encompassing framework is the literature on the regional Kuznets curve (Williamson, 1965). If regional income dispersion follows an inverted "U" shaped curve, then both sets of factors can be told as part of the same story. In the early stages of industrialization, production activities tend to concentrate geographically yielding significant regional income disparities. However, lagging regions eventually catch up and the disparities disappear. A problem with these theories, is that we do not have a unified theoretical framework to explain this evolution. Not knowing what drives concentration or dispersion leaves us the disturbing thought that disparities could persist indefinitely.

The purpose of this chapter is to provide a unified theoretical framework for the analysis of the regional Kuznets curve from the perspective of recent developments in economic geography (see Krugman 1991). We argue that long term trends in the reduction of transportation technology are the single most important element driving first to regional concentration and later on to regional dispersion of economic activity.

Simply stated, the argument runs as follows. Consider an economy in which transport costs follow a secular declining trend. The production of manufactures is subject to increasing returns to scale. This is a crucial feature since in order to realize scale economies, production activities must take place in a single site. Initially, if transportation costs are prohibitively high, markets will be segmented. Production plants will mostly serve the local [regional] market causing the home market effect to dominate. In other words, by concentrating production activities at a single site, transportation

costs are minimized. An initial reduction in transport costs may trigger the concentration of industry in a single region. The interaction between scale economies and transport costs triggers a process that Myrdal (1958) has described as "cumulative causation" where firms want to be close to the larger market to save transport costs and workers also want to live close to the larger market because goods are cheaper there. As transport costs fall even more, their share in the final consumer's price becomes insignificant and a dispersing factor, say increasing land rents in a large city, will become the dominant factors in the determination of firm location. These forces will push industry away from the initial agglomerations and be the main decentralizing force in developed economies.

The model is useful in clarifying an old debate about the relative centrifugal and centripetal forces that arise in the process of economic development. It also has important policy implications. The balance between public investment in transportation infrastructure and urban infrastructure has an important effect on the geo-economic landscape of the country. Traditionally, these two types of investment are usually lumped together into the general heading of social overhead capital.

The chapter is organized in four sections. Section 2.1 discusses the evidence and some of the arguments on regional income convergence and divergence. In Section 2.2 we present a simple model where transportation costs interact with scale economies and urban commuting costs to determine the industry concentration within a country. Section 2.3 shows how the

model can generate a regional Kuznets curve. Finally, Section 2.4 presents the policy implications and conclusions.

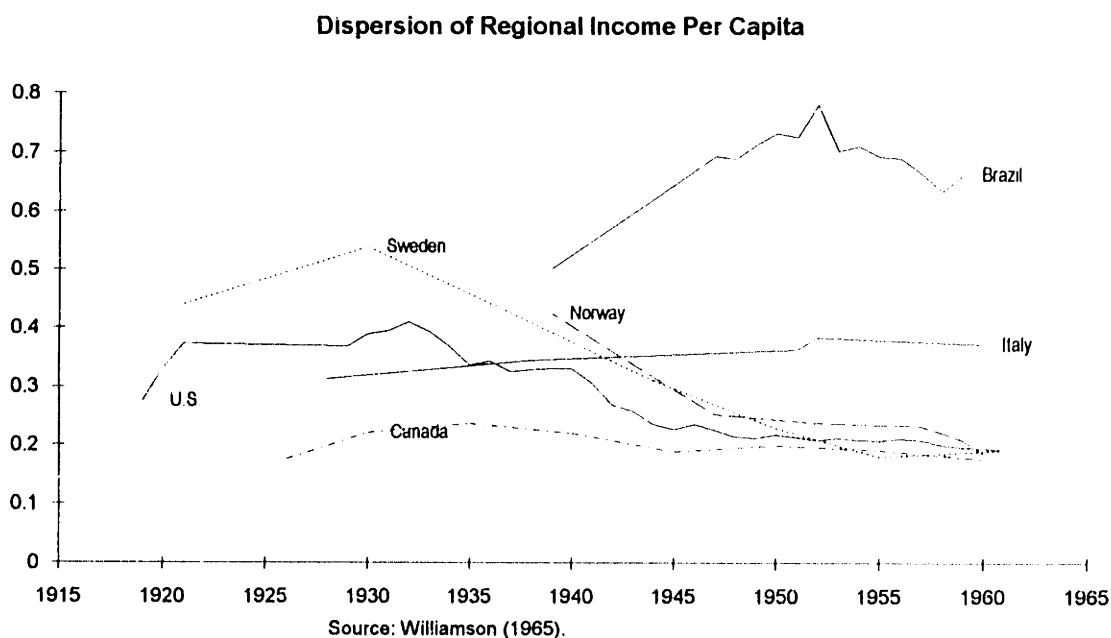
2.1. The Regional Kuznets Curve

A recent outburst in the macroeconomics literature has focused in describing regional income convergence as a stylized fact for developed economies. Blanchard and Katz (1991) find that there is a tendency for the convergence of regional income, although they find evidence of divergence in levels of employment. In their words, the time series of the level of employment for the United States can be characterized as a unit root process. This paper follows a research trend initiated by Barro and Sala-i-Martin (1990) who show that the process of convergence across states in the US and regions in the European Community can be described by a version of the Solow growth model. This result extends their evidence in support of convergence at the international level.

Regional convergence in developing economies has been a standard piece of evidence for development economists for a long time. Myrdal (1957) stressed the striking difference of convergence among developed economies and divergence among less developed ones. In his seminal paper on regional inequality, Williamson (1965) also shows evidence of regional income convergence among developed nations. His paper, following a long tradition of research on income inequality seeks to describe the patterns of regional income dispersion. Extending Kuznet's (1955) hypothesis that the distribution of income follows an inverted "U" shaped process as the economy

grows, he argues that there is an important regional component to this process. In Figure 2.1, we plot Williamson's original data. Evidence on the side of convergence is strong. Developed economies show a strong tendency of declining variance in regional income. The only country that shows an odd behavior in Williamson's data is Italy. Another point that is clear in the figure is the second of Myrdal's stylized findings that regional inequalities are much wider in the poorer countries than in the richer ones. Brazil's regional inequality shows evidence of an inverted "U" shaped pattern but with much higher levels of dispersion.

Figure 2.1



This brings us to the issue of divergence. In contrast with the new literature coming from the macroeconomics field, which makes no attempt to

give theoretical reasons for divergence, one of the central pieces of development economics is an emphasis on dualism, where a modern and a backward sector with large differences in wages coexist in the same economy.¹ Although these models do not imply divergence, the emphasis is on explaining why there is inequality rather than stressing the trend towards convergence. Lewis' (1954) model can be used to explain the Kuznets curve in the following sense: As peasants move from the backward sector to the modern one initially we will have income dispersion and later on convergence, as a majority of workers end up in the modern sector.

The issue of convergence was a central piece for an important debate among the leading development economists. In particular Hirshman (1958) and Myrdal (1957) were at odds on the process of regional evolution in a developing economy. Both of them believed that there were strong centripetal and centrifugal forces entering into play to determine the location of economic activities in a particular region. Myrdal calls the centripetal forces "spread" effects, and labels the centrifugal ones "backwash" effects. His main hypothesis is that there is no "tendency towards automatic self stabilization in the social system." [p.13] He had a pessimist view of a *laissez-faire* economy and thought that if it were left to itself, the process of circular and cumulative causation would drive the economy to ever increasing divergence of income levels across regions. He argued that government intervention was required to foster development in backward regions to prevent backwash effects from dominating.

¹ There are many definitions of dualism, for a survey see Ranis (1988).

Hirschman (1958) also identifies centripetal and centrifugal forces which he labels "trickle down" and "polarization" effects. In his Strategy of Economic Development he criticizes Myrdal's pessimism. He believes that unbalanced growth is necessary initially, but "[e]ventually, economic pressures to remedy such a situation are likely to assert themselves again. Industry will become congested in the Northern cities (the developed region) and its expansion will be hampered by the insufficient size of the home market resulting from the depressed income level in the South (the underdeveloped region)."[p.190]

Any possible agreement in the literature completely breaks down when the discussion focuses on what constitutes a centrifugal or a centripetal force in the concentration of industry within a country. For example, Myrdal (1957) considers selective migration as a "backwash effect". Hirschman (1958) in contrast says that it can also play as a trickle down effect if the advanced region absorbs the "disguised unemployment" of the backward region raising marginal productivity of labor there.

Furthermore, it is difficult to separate cause from effect in Myrdal's argument. Take for example his contention that the movement of capital and labor from South to North constitutes a "backwash effect". Myrdal believes in a process of circular and cumulative causation. Once factors start moving to a region this process may reinforce itself, but these changes must be triggered by something else.

The spread or trickle down effects are equally elusive. For Hirschman, the most important effect comes from the Northern purchases or investments in the South. For Myrdal it is the provision of raw materials. But it is unlikely that these forces will completely counteract the initial thrust towards concentration.

On a different token, they agree on the role of government to counteract these forces. In particular they mention the importance of income transfers from the rich regions to the poor ones (Myrdal is known for his advocacy of this argument at the international level).

After revising the literature on these issues we do not end up with a clear picture of the variables and effects involved. An important source of confusion comes from the fact that development economists were not strong advocates of the mathematization of economic theory. More recently, however, there has been a trend in modeling the old themes of development economics in a rigorous way. Murphy, Shleifer and Vishny (1988) model Rosenstein Rodan's (1943) "big-push" story. Krugman (1991) develops a model of economic geography that shows how a country can grow into an industrialized core and an agricultural periphery. Krugman's model yields a natural interpretation for Hirschman's forward and backward linkages. The model presented in this paper extends Krugman's framework by imposing an explicit urban system where manufacturing takes place. Workers that live in

a city have to pay rents that result from the cost of commuting to a central business district where production takes place.

Our hypothesis is that transportation technology plays a crucial role in determining if the spread or backwash effects will dominate. Infrastructure investment also has important regional effects. This has been known by regional economists for a long time. But the problem is that the framework of analysis is in partial equilibrium, from which is difficult to draw general conclusions. In general equilibrium an input output matrix does not stress the linkage effects. Others have analyzed regions like countries using the Heckscher Ohlin Samuelson framework, but this is not really well suited to deal with transportation issues. We turn now to a formal model where the precise interaction of all these factors can be analyzed systematically.

2.2. A Formal Model

Any model of economic geography involves a tension between factors that promote agglomeration of economic activity and the factors that tend to disperse it. In this paper, we want to focus on how the relevant forces that determine economic location shift over time. The long run trends in these centrifugal and centripetal forces can change the incentives for industry agglomeration and give rise to a Kuznets curve.

By adding some theoretical structure to the analysis of regional inequality, we can take a further step and provide a framework to analyze

why some countries show clear evidence to support the existence of the Kuznets curve while others do not.

It should be noted that non pecuniary externalities may be important determinants of industry concentration. For example pollution creates incentives to leave a city because of discomfort, or technological externalities are pervasive in regions like Massachusetts and Silicon Valley attracting high tech firms to settle in these areas. The stories in competitive advantage from Porter (1990) rely on clusters. However, non pecuniary externalities are difficult to measure empirically and we do not rely on them.

Instead we focus on pecuniary externalities. The main agglomeration force arises from the interaction of scale economies, market size and transport costs. The driving centripetal forces are the external economies that arise from increasing returns to scale. Firms, by clustering together, create a larger market and save transportation costs, workers can get their goods cheaper in the larger market. Also, profit maximizing firms will want to minimize transport costs and thereby try to locate themselves in the biggest market. This process of circular causation has been interpreted by Krugman (1991) in terms of Hirschman's notion of forward and backward linkages.²

We include two centrifugal forces. The demand pull of a dispersed rural market and the push of increasing land rents in a city. The rationale for including both of these sources of dispersion is that each one of them has a

² See Hirschman (1989).

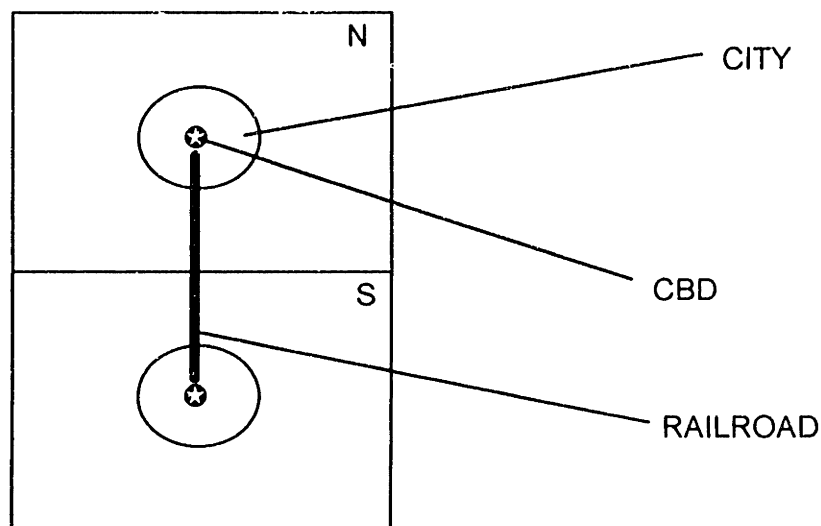
different importance at different stages of development. In societies that are predominantly rural, the effect of land rents will be minimal and the most important centrifugal force will be the pull of a dispersed rural market. In most urban societies, the rural labor market will not matter much but the location decisions of firms and individuals will be affected by the high costs of urban land close to the centers of economic activity.

The rest of this section is divided into four subsections: Subsection 2.3.1 provides the geographical layout. Subsection 2.3.2 describes production, preferences and technology. Subsection 2.3.3 describes the urban structure. Finally, Subsection 2.3.4 solves the model explicitly.

2.2.1 Geographical Layout

Our geographical setup consists of a country that has two regions, North and South. Each region comprises an urban center and a rural hinterland. For simplicity, imagine the regions are connected only by a railroad having unique transport cost, indexed by τ , and let us think of progress in this sector as a drop in τ . Figure 2.2 shows a stylized description of the general setup.

Figure 2.2.
GEOGRAPHICAL LAYOUT



2.2.2 Factors of Production, Preferences and Technology.

We assume there are two factors of production in this model, workers and farmers. Workers live in the cities and are the only factor used in the production of manufactures. Farmers live in the rural hinterland and produce agricultural goods³. In this paper our focus is to analyze the uneven evolution of manufacturing concentration. We do not want to know why peasants go to the cities but rather to explain why cities are there in the first

³ There is a sizeable literature that focuses on rural urban migration, following the seminal article by Lewis (1954) and the important contributions by Harris & Todaro (1970). For a survey of the issues see Williamson (1988).

place. To avoid unnecessary complications in the model we assume that the decision to migrate to the city is exogenous.

Increasing returns to scale present a modeling problem because we need to address the issue of imperfect competition. Dixit and Stiglitz'(1977) rendition of the Chamberlinian monopolistic competition model provides an elegant solution to the problem that has become a standard.

Consumers in this economy buy two types of goods, agricultural commodities and manufactures. All agents in the economy have the same preferences:

$$(2.1) \quad U = \left(\frac{C_A}{1-\mu} \right)^{1-\mu} \left(\frac{C_M}{\mu} \right)^{\mu}$$

where C_A is the consumption of agricultural goods and C_M is a consumption index of manufactures. This Cobb-Douglas upper level utility function yields constant shares of expenditure in each type of good. Manufactures are a composite commodity of which consumers buy several varieties that are weighted by the consumer in a CES subutility function.

$$(2.2) \quad C_M = \left[\sum_{i=1}^N C_{iM}^{(\sigma-1)/\sigma} \right]^{\sigma/(\sigma-1)}$$

The elasticity of substitution (σ) between manufacturing varieties is constant. This parameter will play an important role since it also represents the elasticity of demand for any particular variety of manufactures.

Agricultural goods will be produced using only farm labor under constant returns to scale. Production technology is fully characterized by the unit labor coefficient which we assume to be equal to one ($a_A = 1$). Therefore, farm wages will be equal to agricultural prices. Peasants are assumed to be affixed to the land and purchase all of their goods at the CBD of their region. For convenience, we choose agricultural goods as the numeraire making farm wages identically equal to one. We also assume that farm goods are transported costlessly in order to insure that their delivered price is identically one⁴.

Manufacturing goods will be produced exclusively using labor. The production of a particular variety of manufactures is subject to increasing returns to scale which takes the form of a fixed labor input cost of α plus a constant marginal cost β . $Q_{i,j}$ is the production of a particular variety i of a manufactured good in location j . $\lambda_{i,j}$ is the labor input required to produce it.

$$(2.3) \quad \lambda_{i,j} = \alpha + \beta Q_{i,j}$$

⁴ On the relevance of this assumption see Krugman (1991).

Aggregating equation (2.3) we find that total labor input demand in a particular region will be given by:

$$(2.4) \quad \Lambda_j^d = \sum_{i=1}^{n_j} \lambda_{i,j}$$

We will assume that transportation costs do not affect the elasticity of demand of manufactures in different locations and hence the profit maximizing pricing decision is simply to charge a constant markup over marginal cost. This implies that *f.o.b.* prices of manufactures are given by:

$$(2.5) \quad P_j = \frac{\sigma}{\sigma - 1} \beta w_j$$

In short, prices are proportional to wages paid in the cities. By a useful choice of units we can set manufacturing prices equal to the wages paid in the city.

$$(2.5') \quad P_j = w_j$$

As profits are driven to zero by the assumption of free entry, all firms will end up producing the same amount of manufactures.

$$(2.6) \quad Q_{i,j} = Q = \frac{\alpha(\sigma - 1)}{\beta}$$

Constant output per firm means that the number of goods will be proportional to the net labor input. It is important to distinguish between net labor input (Λ_j) and total labor available (L_j) since some labor will be lost in urban commuting. The number of goods produced in location j is given by

$$(2.7) \quad n_j = \frac{\Lambda_j}{\alpha \sigma}$$

We can also simplify equation (2.7) by grouping the goods in bundles that will insure that the number of goods produced in a region is identical to the net available labor in a region.

$$(2.7') \quad n_j = \Lambda_j$$

A crucial feature of this type of geography models is the prevalence of home market effects. Larger locations will produce more varieties of goods. Thus the role of increasing returns to scale in the model is reflected in equation (2.7).

2.2.3 Urban Structure.

The next step is to superimpose an explicit urban structure to the model. The simplest way to do it is by assuming a Henderson type city. There is a central business district (CBD, see Figure 2.2) where manufactures are produced.⁵ The CBD is located at the center of a two way avenue that connects all urban land lots. Each worker needs a unit of land to live in, so that the city is a line of houses spread evenly around the manufacturing district.⁶

To go to work, workers incur in a commuting cost indexed by γ per unit of distance. A worker that lives at a distance l_i from the CBD loses a fraction $2\gamma l_i$ of his income in two way commuting trip. Therefore, the net labor that a worker living at a distance l_i from the center can provide for the production of manufactures is $1 - 2\gamma l_i$. We note that the maximum size for a city is $l_j = 1 / 2\gamma$. i.e. as the transportation cost falls the maximum size for a city increases. We assume the length of the avenue to be greater than the above so that land scarcity is not an issue, i.e. a competitive urban developing market will always urbanize enough land to make land rents in the border location equal to zero.

⁵ See Henderson (1988).

⁶ Nothing is changed if we assume that the city is circular instead of linear.

To avoid modeling the behavior of a land renting group, we will assume that all land rents will be redistributed in a lump sum fashion. An amount \bar{r} is given to each urban worker. The rent associated with living in location l_i is given by $r(l_i)$. Therefore, the total income that a worker living at a distance l_i from the central business district has is:

$$(8) \quad I(l_i) = \omega_i(1 - 2\gamma l_i) + \bar{r} - r(l_i)$$

The indirect utility function associated with equations (1) and (2) has a similar functional form.

$$(2.9) \quad V = \left(\frac{I}{\Pi_j} \right)^\mu \left(\frac{I}{1} \right)^{1-\mu} = \frac{I}{(\Pi_j)^\mu}$$

where Π_j is the real price index of manufactures at location j is a weighed average of the prices of manufactures inclusive of transportation costs and is given by:

$$(2.10) \quad \Pi_j = \left[\sum_{i=1}^n c_{i.f} P_i^{1-\sigma} \right]^{1/(1-\sigma)}$$

In equilibrium, rents have to be such that any individual is not willing to move to a different urban lot. This gives us the following expression for the rent gradient:

$$(2.11) \quad \frac{dV}{dl_i} = -2\gamma w - r'(l_i) = 0$$

Solving the difference equation, land rents at urban lot l_i are $r = \kappa - 2\gamma w l_i$ where κ is a constant of integration that can be determined using the fact competition in the urban housing market drives the border urban lot rent to zero, $r(\bar{l}) = 0$. The characterization is in order with the empirical observation that rents tend to fall as the distance to the center of the city increases. The final expression for land rents becomes then a function of the border location.

$$(2.12) \quad r = 2\gamma w(\bar{l} - l_i)$$

Since population is spread evenly on both sides of the central business district and each worker needs one unit of land to live in, the border location will be given by the population living in that city.

$$(2.13) \quad \bar{l} = L_j^M / 2$$

where L^M is the total labor supply. Since every worker has $(1 - 2\gamma l)$ units of net labor available to offer at the CBD, total net labor supply will be determined by the commuting cost and given by

$$(2.14) \quad \Lambda_j = 2 \int_0^{L_j^M/2} (1 - 2\gamma l) dl = L_j^M (1 - \gamma L_j^M / 2)$$

Note that this formulation is consistent with our earlier assertion about the maximum size of the urban center. Beyond $1/2\gamma$, commuting costs are so large that a worker does not have any remaining labor to produce at the CBD if he tries to commute.

Total income of manufacturing workers in location j is denoted by Y_j^M . In order to verify that it is equal to the wage payments to the available labor for production Λ_j , first notice that since the rent gradient is linear, average rental payments are equal to median rental payments. The value of the lump-sum rental payment is $\bar{r} = 2\gamma w(L_j^M/4) = \gamma w(L_j^M/2)$. Average income is given in equation (2.15).

$$(2.15) \quad \frac{Y_j^M}{L_j^M} = w_j \left(1 - 2\gamma \frac{L_j^M}{2} \right) + \bar{r} - r \left(\frac{L_j^M}{2} \right) = w \left(1 - \gamma \frac{L_j^M}{2} \right)$$

So effectively, aggregate income can be reduced to:

$$(2.16) \quad Y_j^M = w_j \Lambda_j$$

Workers are interested in their real wage which is given by their indirect utility

$$(2.17) \quad \omega_j = V_j = \frac{w_j(1 - \gamma L_j^M / 2)}{\Pi_j^\mu}$$

The result from the interaction of urban rents and commuting costs is intuitive. With the redistribution of rents, every worker at location earns the same income. That is, the workers located near the CBD who incur in low commuting costs have to pay a high rent for their urban lot while workers who live far from the CBD and loose much income in commuting pay a low rent.

As a technical matter in order to be able to discriminate between stable and unstable equilibria we will assume that labor moves in response to real wage differentials.

$$(2.18) \quad \frac{dL_N^M}{dt} = \rho(\omega_N - \omega_s)$$

The transportation technology is straight-forward. The central districts of the two cities on in our hypothetical country are connected by a railroad

serving two purposes in the model. On one hand, it will be used to transport manufacturing goods from one city to the other. To derive equation (2.5) we assumed that the elasticity of demand facing a particular firm was equal to σ . This will only be true if we assume that transportation costs are of the Samuelson's "iceberg form". Of every good shipped in one city, only $(1/\tau)$ arrives at the other end. The ratio of c.i.f. to f.o.b. prices in shipped goods is equal to $\tau > 1$.

The railroad is also used to transport workers from one urban center to the other. If a worker can obtain a higher real wage by moving to the other city he will board the train and settle in the other location. Only urban markets are integrated.

2.2.4. Solving the Model

To find a solution to the model we will make some extra definitions and assumptions. The total labor force of the country will be normalized to unity so that $L = L^M + L^A = 1$. We will set L^M , the number of workers to be equal to μ . Since workers can move freely between the two business districts some share of the manufacturing population will live in the North (ϕ) and the rest will live in the South ($1 - \phi$). Given these definitions, we can give exact expressions for total income in both regions.

$$(2.19) \quad Y_N = \frac{1-\mu}{2} + w_N \mu \phi (1 - \gamma \mu \phi)$$

$$(2.20) \quad Y_S = \frac{1-\mu}{2} + w_S \mu (1-\phi) (1 - \gamma \mu (1-\phi))$$

Using the first order conditions of the consumers maximization problem subject to (2.19) and (2.20) we can find expressions for $\theta_{i,j}$, the share of region i's expenditure in region j's goods.

$$(2.21) \quad \theta = \begin{bmatrix} \theta_{N,N} & \theta_{N,S} \\ \theta_{S,N} & \theta_{S,S} \end{bmatrix} = \mu \begin{bmatrix} \frac{\Lambda_N w_N^{1-\sigma}}{\Pi_N^{1-\sigma}} & \frac{\Lambda_S (w_S \tau)^{1-\sigma}}{\Pi_N^{1-\sigma}} \\ \frac{\Lambda_N (w_N \tau)^{1-\sigma}}{\Pi_S^{1-\sigma}} & \frac{\Lambda_S w_S^{1-\sigma}}{\Pi_S^{1-\sigma}} \end{bmatrix}$$

Since the number of goods is equal to the amount of labor available for manufacturing production, the price indices of manufactures given by equation (2.10) are:

$$(2.22) \quad \Pi_N = \left[\Lambda_N w_N^{1-\sigma} + \Lambda_S (w_S \tau)^{1-\sigma} \right]^{1/(1-\sigma)}$$

$$(2.23) \quad \Pi_S = \left[\Lambda_N (w_N \tau)^{1-\sigma} + \Lambda_S w_S^{1-\sigma} \right]^{1/(1-\sigma)}$$

The wages of workers in the two cities can be found by setting income equal to expenditure. The total payroll of Northern workers has to be equal to the sum of what workers and farmers in both regions spend in

manufactures produced in the North. The same reasoning applies to Southern manufactures and is represented in (2.24) and (2.25).

$$(2.24) \quad w_N \Lambda_N = \theta_{N,N} Y_N + \theta_{S,N} Y_S$$

$$(2.25) \quad w_S \Lambda_S = \theta_{N,S} Y_N + \theta_{S,S} Y_S$$

Finally, using the definitions of the manufacturing price index and plugging them into the expressions in equation (2.21) we can solve for the nominal wages from (2.24) and (2.25).

$$(2.26) \quad w_N = \left[\mu \left(Y_N \Pi_N^{\sigma-1} + Y_S (\Pi_S / \tau)^{\sigma-1} \right) \right]^{1/\sigma}$$

$$(2.27) \quad w_S = \left[\mu \left(Y_N (\Pi_N / \tau)^{\sigma-1} + Y_S \Pi_S^{\sigma-1} \right) \right]^{1/\sigma}$$

To solve the model we will define two sorts of equilibria. If we fix ϕ , equations (2.19), (2.20), (2.26) and (2.27) define a system of four equations and four unknowns that can be solved simultaneously. This will be called short run equilibrium. Then we can use (2.17) to define the real wages and analyze the dynamics implied in (18). Long run equilibrium will occur when $\omega_N = \omega_S$ or when all labor is in region i and $\omega_i > \omega_j$.

2.3 Comparative Statics

The model outlined in the previous sections can be used to shed light on the debate about convergence and divergence in developing economies. In subsection 2.3.1. we show that for a particular selection of parameter values, a Kuznets curve results from a transportation revolution. Subsection 2.3.2 shows that this process is reinforced if the transportation revolution happens at the same time as the rural population moves into the cities. Subsection 2.3.3 discusses the robustness of these results when the economy is open to foreign trade.

2.3.1 Transportation Revolution

In the development literature, transportation costs are not usually related with the geographic concentration of industries. Instead, they are generally discussed under the general heading of social overhead capital (see (Hirschman 1958 p.76), (Rosenstein-Rodan, in Crandall and Eckaus,1972 p.424). As such, it was thought to be essential in the development process but there was no specific discussion on its role in determining the geographic distribution of industry. Trade theorists tend to analyze regions as small open economies, but under the Hecksher Ohlin framework, transportation costs do not fit naturally and factor mobility is not considered. On the other hand, location theorists and economic geographers are the scholars that

devote more attention to the question of transport costs, but their analysis is usually framed in a partial equilibrium framework⁷ and therefore miss important interactions that arise in general equilibrium.

Transportation costs interact with the centrifugal forces of the model in opposite ways and therefore the effect of an improvement in transportation technology on the geo-economic landscape is ambiguous.

To understand the source of this ambiguity, imagine that transportation costs are high and industry is dispersed evenly in the two business districts. Each firm is mainly devoted to serving the local market and has no incentive to go to the other region because by moving, competition in the other market would be tougher and profits would fall while the opposite would happen in the region it is leaving from.

As transportation costs fall, the other market becomes a more important source of demand. This implies more shipments of goods from one regions to the other, with a significant "melting" in the process. If there is a sizable number of worker who can take the train and move to the other region, it will result profitable for all firms to locate in the same city and save in transportation costs. The two rural markets will end up served from the same city. This initial reduction in transport costs induces geographic concentration.

⁷ Weber's transportation problem is the central piece of analysis in location theory.

The above effect will persist as long as commuting costs do not rise so much that the movement of population to a single site causes too much labor to be wasted in commuting. We assume that commuting costs remain constant throughout this process, but this need not be so.

If transportation costs continue falling until they become a negligible portion of the delivered price, concentrating economic activity to avoid long haul shipments is no longer optimal and the relative importance of urban land rents presents an incentive to decentralize production. Therefore, when transportation costs are small, we end up again in a decentralized equilibrium.

The plausibility of these results depends on the selection of parameters. A concentrated outcome need not happen if urban disamenities are high or if the share of population that produces manufactures (and is allowed to move) is a small portion of total population.

We now turn a specific example where a regional Kuznets curve is generated. The transportation revolution is modeled as a reduction in the transportation cost parameter from a level of almost prohibitive long haul costs ($\tau = 3$) to a level where transport costs add a markup of 10 percent to f.o.b. prices ($\tau = 1.1$). For this particular simulation we set the elasticity of substitution (σ) equal to 4. Due to the tight structure of the Dixit Stiglitz framework, σ , can be interpreted as an inverse index of scale economies even

though it is a preference parameter. The above holds because in equilibrium $\sigma / (\sigma - 1)$ will be the scale elasticity (Average Cost/Marginal Cost). To interpret this parameter we can conceive manufacturing technology as a two stage process where in the first stage a competitive sector produces machines using only labor with a unit labor coefficient α , and in the second stage firms that decide to produce manufactures must buy a machine to make a particular variety, Equation (2.3) reflects the compound procedure. Now we can interpret $1 / (\sigma - 1)$ as the share of sales that is used to pay for the fixed cost. A parameter of $\sigma = 4$ would correspond to a situation where $1/4$ of the manufacturing income is used to pay for the machine and $3/4$ represent the firm's payroll.

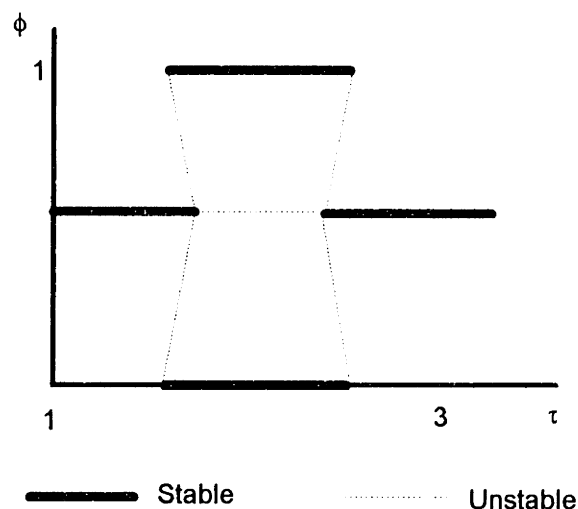
Urban commuting costs are represented by γ . They can be read as a measure of urban infrastructure. We set γ at a level where if all of the population lived in a single site, a worker on the border of the city would lose 10 percent of her time in commuting ($\gamma = 0.1$). Finally we have μ , the share of the workers in the population.

In the first simulation round, assume that the population consists of equal numbers of workers and farmers. To analyze equilibrium configurations our definitions of short and long run equilibria will come handy. If we fix the share of workers that live in the North, we can solve for all variables in the model. To analyze if the solution is a long run equilibrium configuration we look at real wages. If $\omega_N > \omega_S$ the labor will move towards the Northern region until wages are equalized or until all workers end up located in the North.

Figures A1 to A5 in the Appendix tell our story of the transportation revolution. In figure A1, transportation costs are high ($\tau = 3$). There is a unique stable equilibrium where workers are evenly distributed between the two cities. As transport costs fall, ($\tau = 2.3$) equal division of the manufacturing population is still an equilibrium but concentration in either city is also an equilibrium (see figure (A2)). In between these three stable equilibria lie two unstable ones. Further improvement in transportation technology ($\tau = 1.9$) is represented in figure A3 where the only stable equilibria result when all manufactures are produced in a single city. Equal division of workers between the two cities is also an equilibrium, but it is unstable.

An interesting result is that further reductions in τ reproduce the story in reverse. When $\tau = 1.16$ three stable equilibria are obtained again including uniform distribution as one of them (see figure A4). Finally, when the markup due to transport costs is only 10 percent (Figure A5) we are back to a similar situation to the one we had at the beginning. The only stable equilibria occurs when the same number of workers lives in each city. The complete process is summarized in figure 3.3.

FIGURE 3.3



This is a stylized description analogous to the regional Kuznets curve described by Williamson (1965). The secular downward trend in τ what drives the process of concentration and decentralization. It is important to notice that the results are driven by the particular selection of parameters. In this example, if we assume that commuting costs are much higher ($\gamma = 0.4$) then for the same range of τ there is no concentrated equilibrium.

The choice of equal division of the population between workers and farmers is questionable. The transportation revolution was accompanied by a massive flow of peasants to the cities. Does this fact affect the plausibility of our results since we assumed farmers to be immobile? The question will be addressed in section 2.3.2.

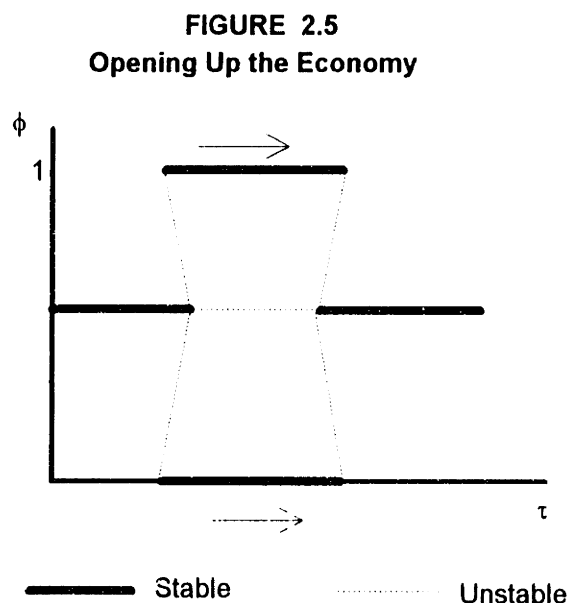
2.3.2 Urbanization.

If the transportation revolution happens at the same time as a change in the composition of labor (farmers becoming workers) our results are actually reinforced. Consider that fact that τ is falling at the same time μ is increasing. On one extreme, we have a situation where most population is rural and transportation costs are high. A high share of farmers in the labor force strengthens the segmentation effect thus raising the likelihood of a dispersed industry. On the other extreme we have very low transport costs and a population consisting mainly of urban workers. If most of the population lives in the cities, the commuting costs are higher so the dispersion effects resulting from a desire to pay less urban land rents are stronger. The intermediate case is similar to what was described in the previous section, with a concentrated equilibrium as likely as before.

To capture this process in we perform the following experiment. We begin in a situation where only 10 percent of the population consists of workers ($\mu = 0.1$). Then we consider a process of structural transformation where the rural population falls from 90 percent of the total to 10 percent. We tie the transportation costs to a simultaneous fall from a markup of 100 percent to a markup of 10 percent over f.o.b. prices.⁸ Figure A6-A10 show

⁸ There is a problem with moving μ in this model due to its dual role as a taste and a transportation parameter. Our purpose here is only to illustrate that the urbanization process does not contradict the previous results of the model. To be completely formal we should specify an upper level CES with an EOS >1 . This implies that the shares of expenditure in a good will fall as their price rises. As the population leaves the countryside, there will be more manufacturing goods produced. As the number of goods increases, the CES price index falls and consequently the share of expenditure in manufacturing increases.

Although we will not exhaust the effects of international trade on our model, we will explore the results based on the outcome of two related papers. Krugman & Livas (1992) consider the case of an open economy where the only centrifugal force is the push of urban land rents. In that case, reducing the level of protection increased the likelihood of a decentralized equilibrium. Livas (1992) considers the case when the only centrifugal force is the "pull" of a dispersed rural market. In that case, the results were the opposite. A greater degree of openness fostered concentration. The joint effect of these forces is plotted in figure 2.5.



As the economy opens up the range where concentration can occur shifts to the right. This result can explain why latecomers in the development process show less evidence of an increasing region of the Kuznets Curve. As argued in Krugman & Livas (1992), closing the economy by, for example, pursuing an import substitution strategy, will delay the period of decentralization that lower transport costs bring about.

2.4. Conclusions

In this paper we provide a unified framework to explain the existence of a regional Kuznets curve. Using the recent developments in Economic Geography we conjecture that the driving force in this process is the evolution of transportation technology.

In doing so, we revive a central debate of development economics and show that a rigorous formulation of the old issues in this field is not only possible but is useful to provide a unifying explanation.

The main conclusion that can be derived from this theoretical exercise is that transportation technology plays a crucial role in the regional evolution of a country. While the advantages of having better long-haul transportation infrastructure are always stressed, their asymmetrical regional impact is seldom mentioned.

Another implication is that investment categories like urban infrastructure or transportation facilities, which fall under the general heading of social overhead capital, may have very different regional effects. A city bias in infrastructure expenditure in mostly urban countries will tend to promote agglomeration. The size of third world megalopolis may be explained

by an inward looking strategy of development coupled with an urban bias in public investment in infrastructure.

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Figure A1
Relative Wages $\omega_n - \omega_s$

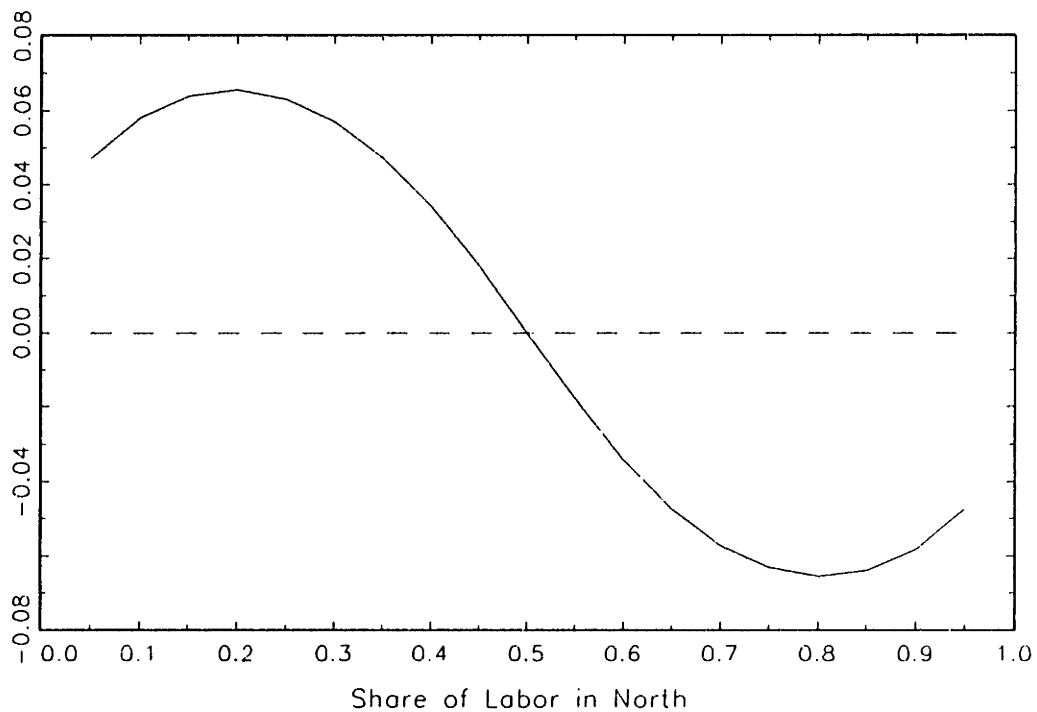


FIGURE A1

Parameter	Value
μ	0.5
τ	3.0
γ	0.2
σ	4.0

Figure A2
Relative Wages $\omega_n - \omega_s$

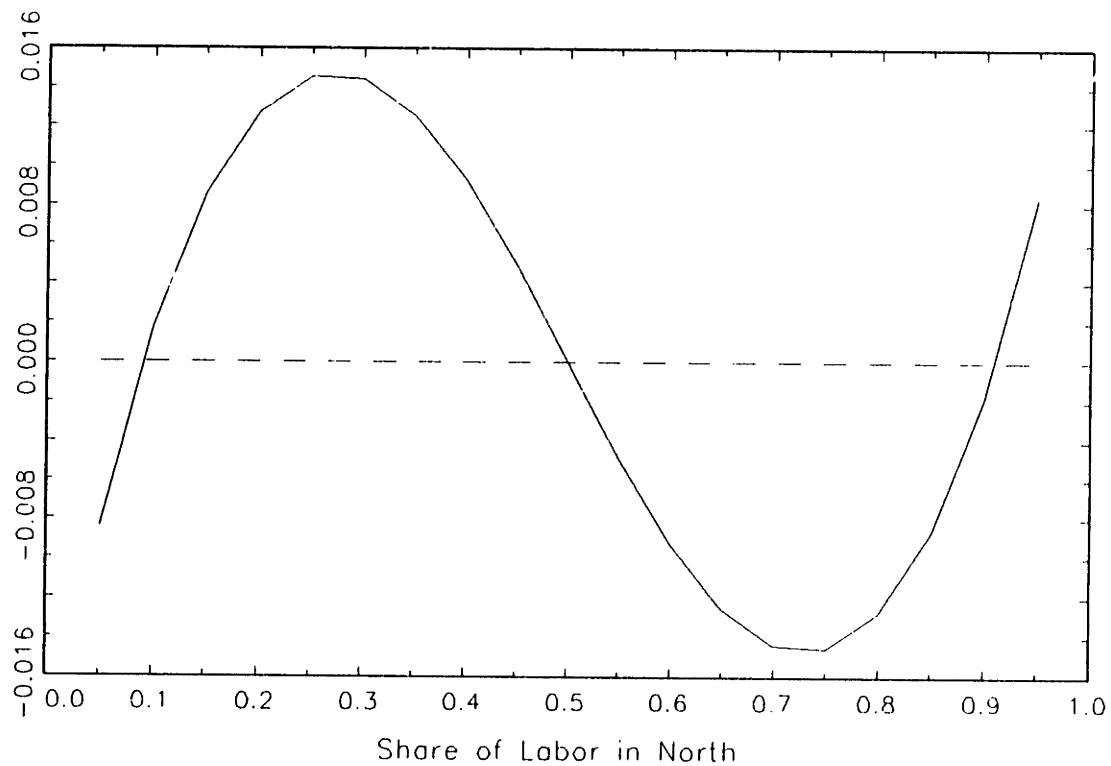


FIGURE A2

Parameter	Value
μ	0.5
τ	2.3
γ	0.2
σ	4.0

Figure A3
Relative Wages $\omega_n - \omega_s$

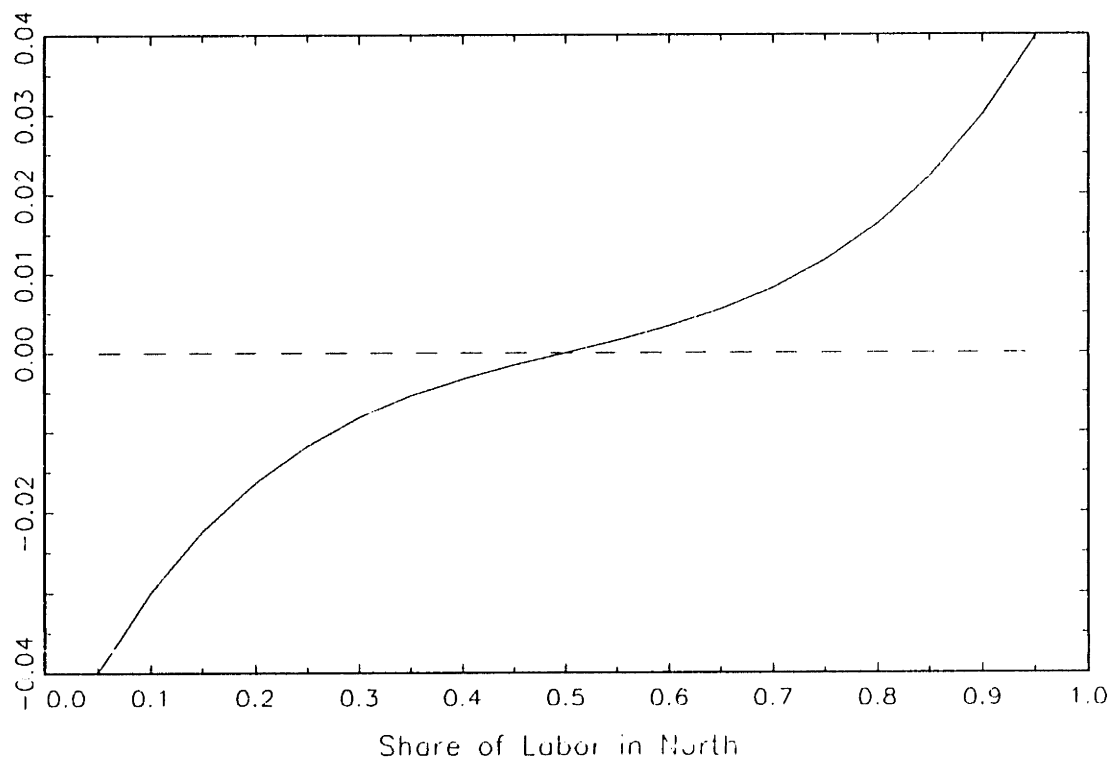


FIGURE A3

Parameter	Value
μ	0.5
τ	1.9
γ	0.2
σ	4.0

Figure A4
Relative Wages $\omega_n - \omega_s$

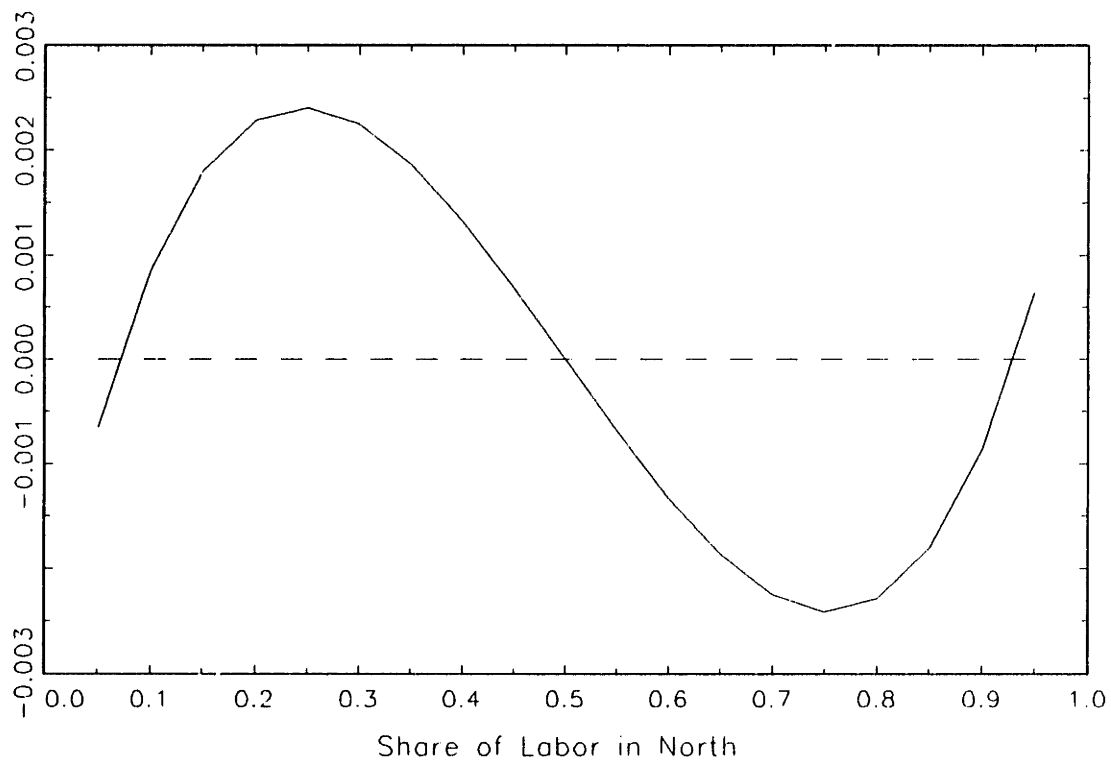


FIGURE A4

Parameter	Value
μ	0.5
τ	1.16
γ	0.2
σ	4.0

Figure A5
Relative Wages $\omega_n - \omega_s$

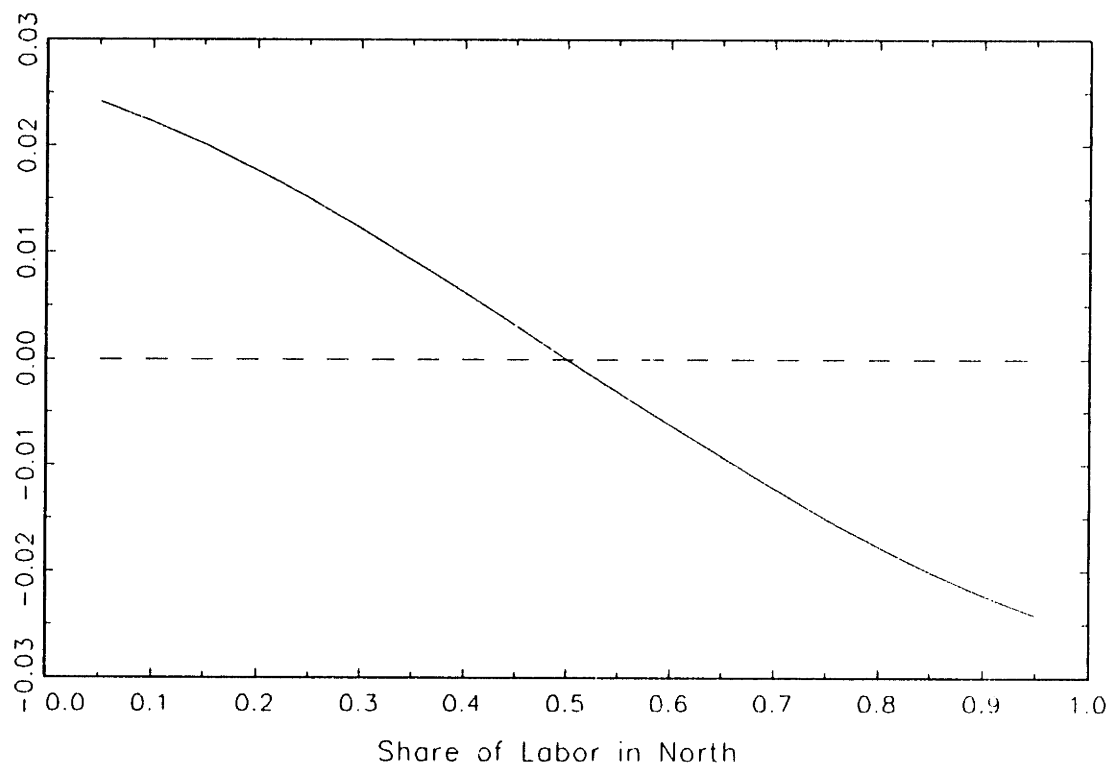


FIGURE A5

Parameter	Value
μ	0.5
τ	1.1
γ	0.2
σ	4.0

Figure A6
Relative Wages $\omega_n - \omega_s$

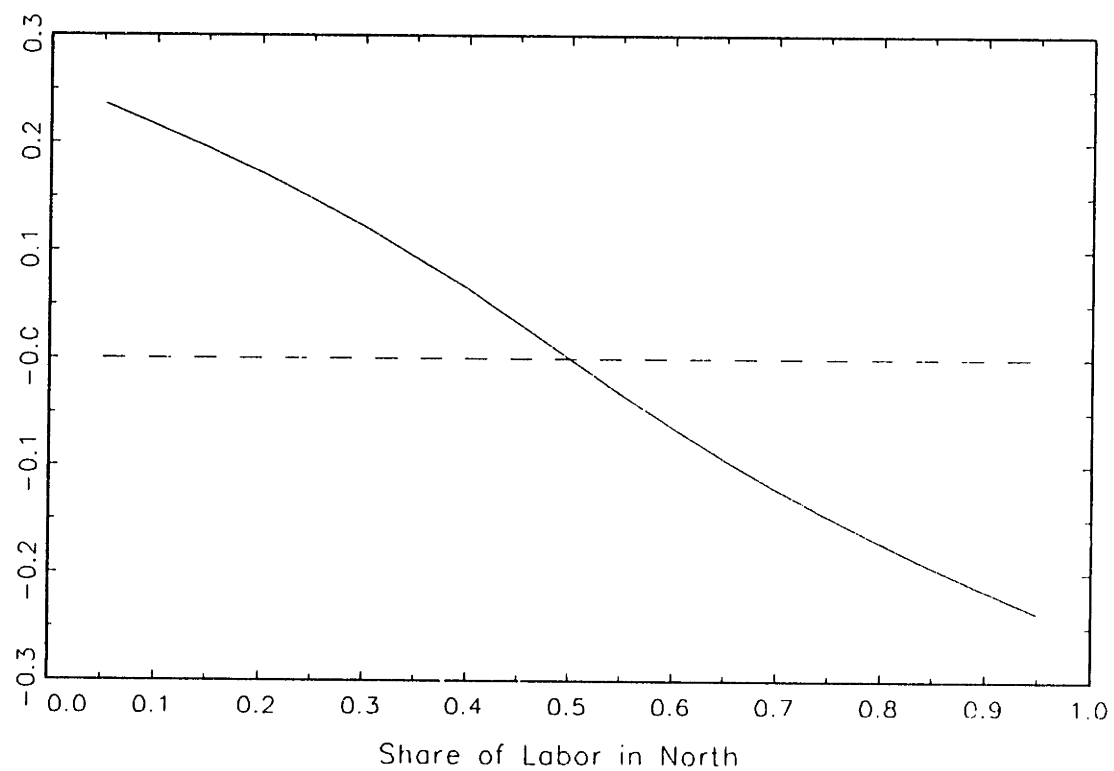


FIGURE A6

Parameter	Value
μ	0.1
$\tau = 2 - \mu$	1.9
γ	0.2
σ	4.0

Figure A7
Relative Wages $\omega_n - \omega_s$

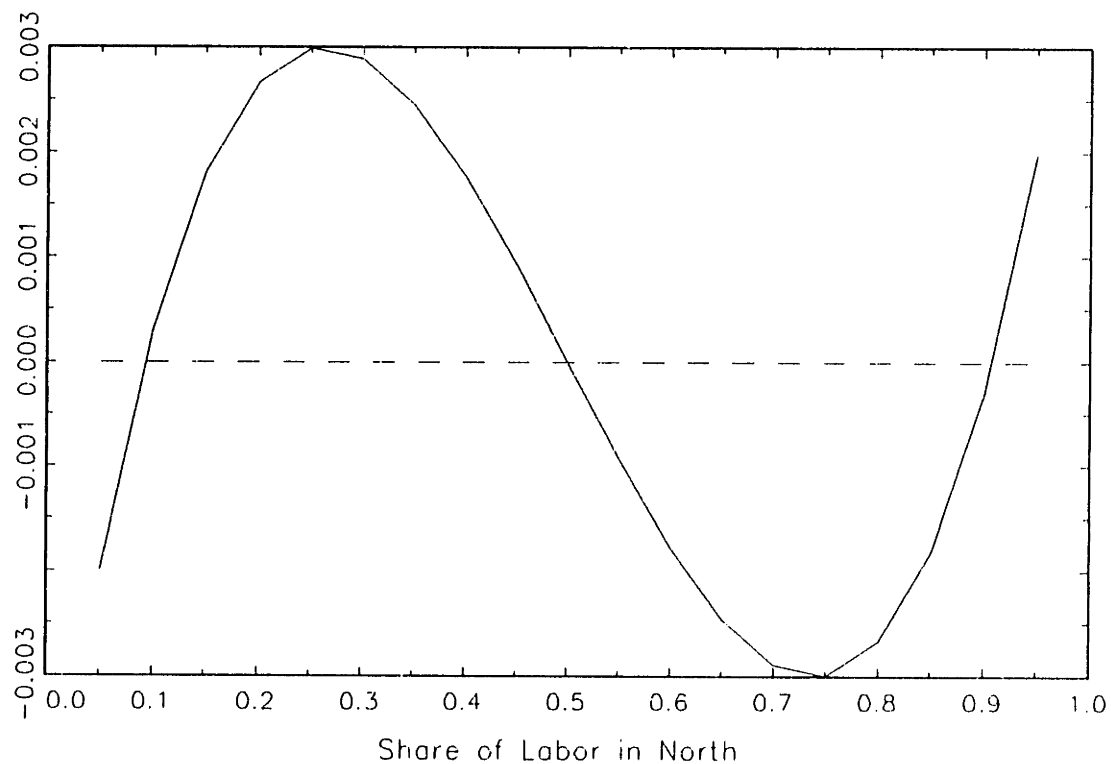


FIGURE A7

Parameter	Value
μ	0.38
$\tau = 2 - \mu$	1.62
γ	0.20
σ	4.00

Figure A8
Relative Wages $\omega_n - \omega_s$

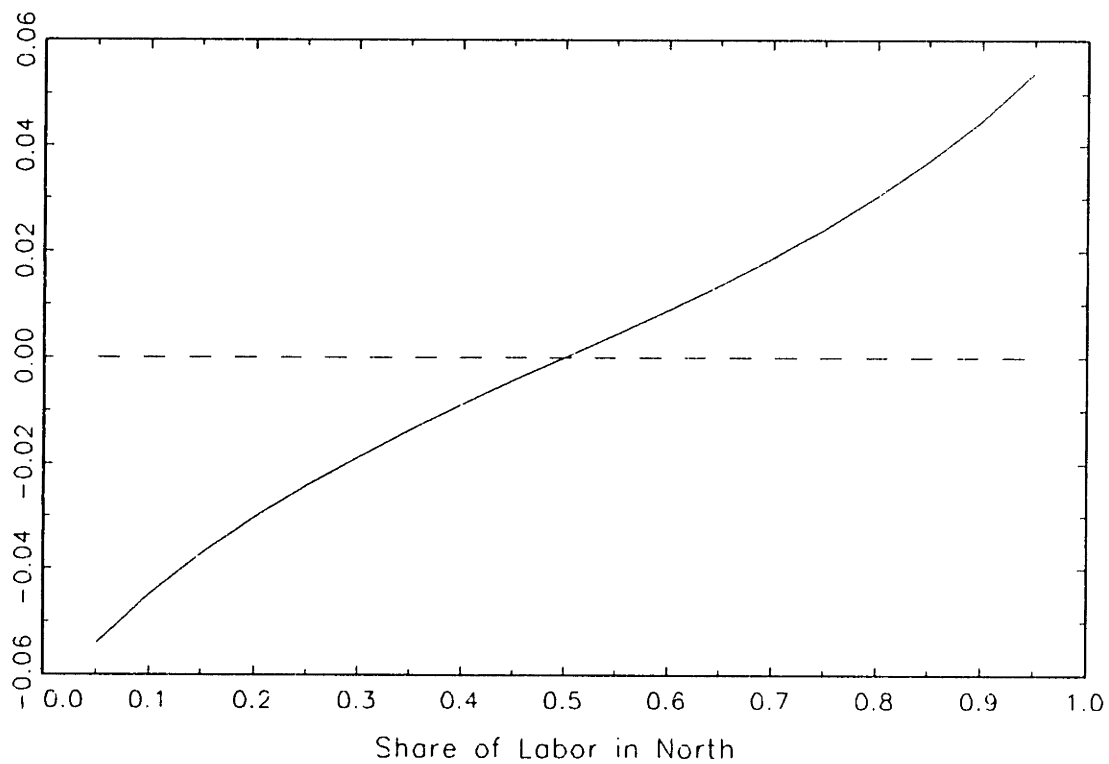


FIGURE A8

Parameter	Value
μ	0.5
$\tau = 2 - \mu$	1.5
γ	0.2
σ	4.0

Figure A9
Relative Wages $\omega_n - \omega_s$

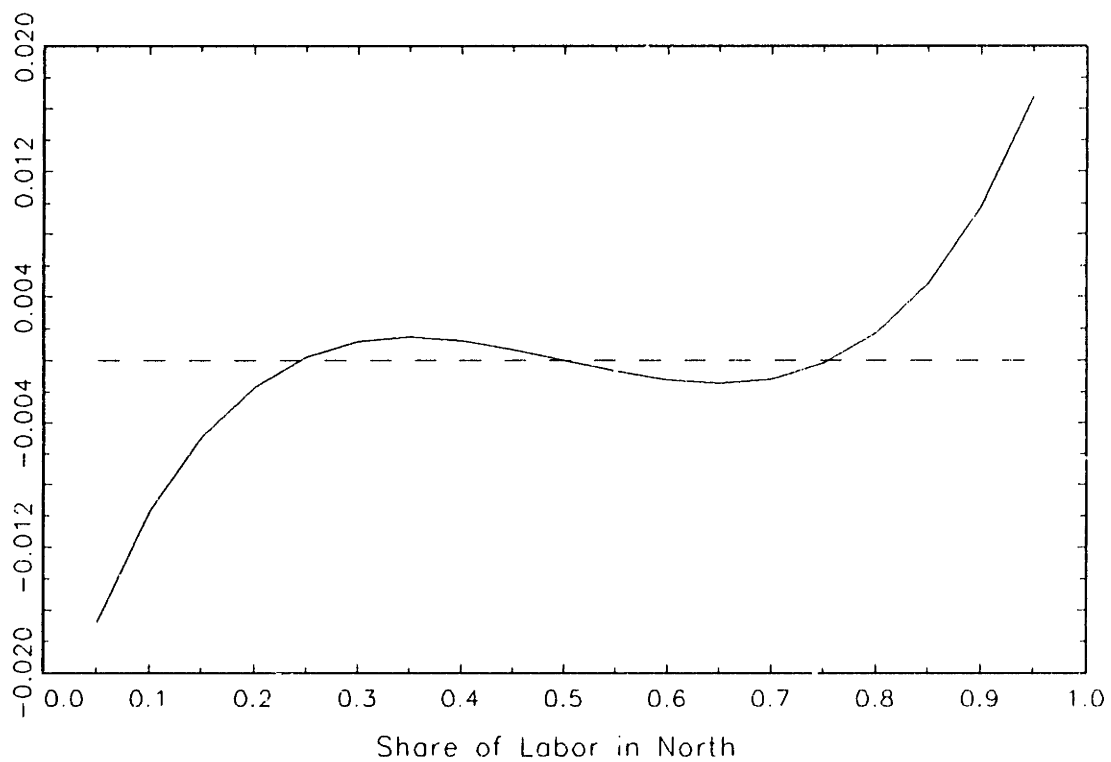


FIGURE A9

Parameter	Value
μ	0.83
$\tau = 2 - \mu$	1.17
γ	0.20
σ	4.00

Figure A10
Relative Wages $\omega_n - \omega_s$

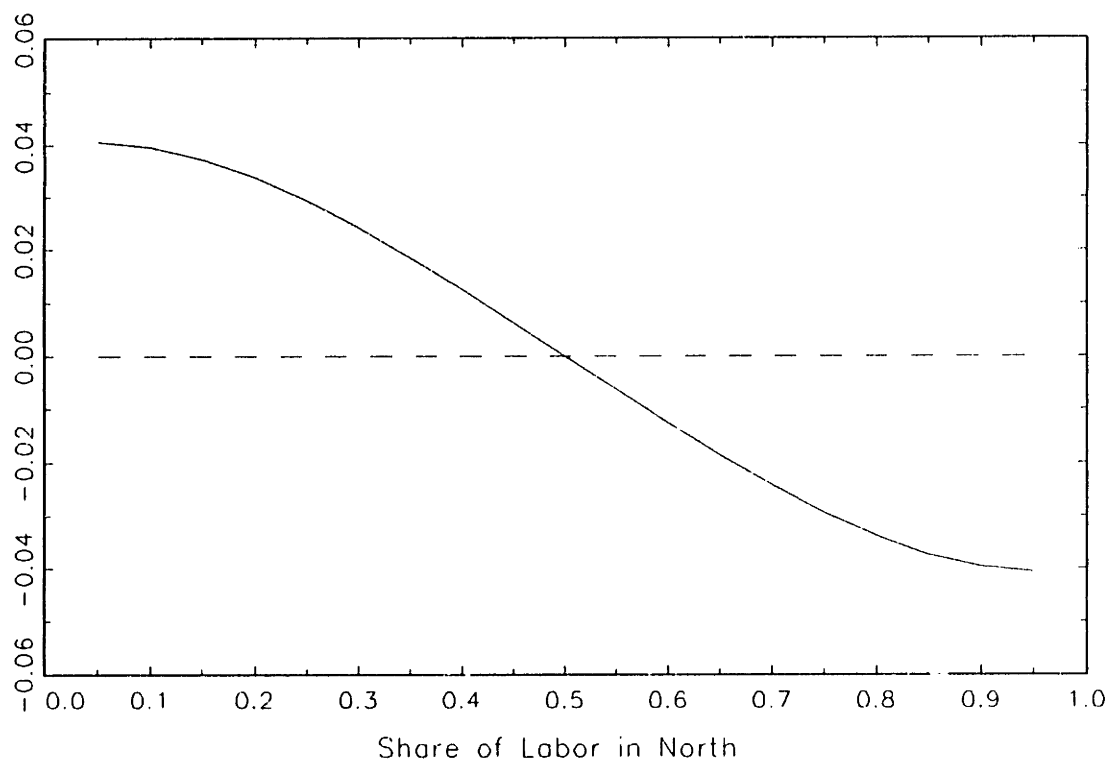


FIGURE A10

Parameter	Value
μ	0.9
$\tau = 2 - \mu$	1.1
γ	0.2
σ	4.0

Chapter 3.

Regional Implications of International Trade in Mexico

This chapter explores the relationship between regional location of industry and international trade regimes. Mexico represents an interesting case study because during the last decade it has experienced dramatic structural changes. Between 1982 and 1988, Mexico reversed its trade regime. From being one of the most closed economies in the world it has become one of the most open ones. During the same period, the pattern of regional location of manufacturing activity seemed to be changing.

There is an ongoing discussion about the effects of free trade in North America. This debate has focused on the national level impact of a reduction in trade barriers. However, the regional impact of the agreement has been neglected. In part, this results from the particular way in which we usually model countries. If we assume that producing entities are dimensionless points and that production is carried under constant returns to scale, the issue of geographic concentration disappears.

Traditional Heckscher-Ohlin-Samuelson (HOS) trade theory assumes that countries are homogeneous entities. Intracountry characteristics are not related to the trade pattern of a country. Courant and Deardorff (1992) explore how some of these characteristics may affect trade decisions. Their paper focuses on the implications of having an uneven or "lumpy" distribution of factors of production. They extend the traditional framework to a country with two regions. If factors are evenly distributed within the regions, then the two regions may trade with each other in a way in which

they reproduce the optimal output of an integrated economy. In a sense, this constitutes an extension of Samuelson's angel parable one step further. In this setup interregional trade results because regions have different factor endowments, if the endowment falls inside the factor price equalization region, then the regions can reproduce the integrated economy through trade.

A crucial aspect of the previous analysis is the validity of the assumption that factors of production are immobile. A key distinction between national borders and regional borders is that factors can cross freely through the latter but not through the former. The idea of nationality is closely related with identifying where people are allowed to work or invest.⁹

In this chapter we pose Courant and Deardorff's question from a different perspective. Instead of asking how an uneven distribution of factors of production can distort the pattern of trade we study how a particular trade regime sustained in the long run affects regional location decisions.

The issue of location decisions has been addressed by Krugman (1991). He develops a model of industry location based on the interplay of scale economies, transport costs and the share of population that is "footloose", i.e

⁹ A notable exception to this idea is Europe 1992, which has been the inspiration for much of the recent work in regional economics. However, the removal of legal barriers may not suffice to achieve labor mobility at a level similar to the one observed in the United States. Language and other cultural barriers are expected to significantly block the movement of people.

that is not attached to the land. Increasing returns to scale (IRS) and transportation costs are crucial features of location models, under constant returns to scale the issue of location disappears. Firms can build plants to serve each location and do not need to incur at all in transport costs. IRS interact with transportation costs to determine the optimal location for production. If transportation of goods is cheap, it will be better to have a single large plant and ship the goods to other regions rather than to have a plant in each region and save in transportation expenditures.

To address this issue we consider the determinants of location decisions under alternative trade regimes. Labor, the only factor of production in the model can move freely between the regions of the small country, but cannot cross the border. Trade has an asymmetric effect because one region is closer to the large economy than the other.

In the simple two region model two outcomes are possible. If transportation costs are high and scale economies unimportant, manufacturing production is spread in proportion to the distribution of the immobile factor. Alternatively, if transportation costs are low and scale economies significant, we could have multiple equilibria characterized by manufacturing concentration in any of the regions.

When another country enters the picture, the outcome depends on which of the two situations was prevalent in autarky. In general, the effect of

reducing trade barriers will be to attract industry to the border, but the mechanics will be quite different depending on the initial situation. If industry was initially dispersed, reducing trade barriers will slowly attract a larger share of manufacturing to the border. If multiple equilibria were prevalent initially the result depends on what was the former layout of industry. If industry was concentrated near the border, the layout remains as an equilibrium, but if industry was concentrated far away from the border, the reduction in trade barriers may trigger a dramatic shift in manufacturing activity. These results carry on to the case of a small country with more than two regions. In this situation, multiple equilibria are possible, but in general the reduction in trade barriers leads to equilibria where the mass of manufacturing employment is located closer to the border.

This chapter consists of three sections. In Section 3.1, we explore the regional evolution of Mexico to give perspective on the relative magnitude of the recent changes. In section 3.2, we consider several models of a big single region country and a small multiple region one. In section 3.3. we show empirical evidence on the relationship of scale economies and regional concentration.

3.1. The Regional Structure of Mexican Manufacturing

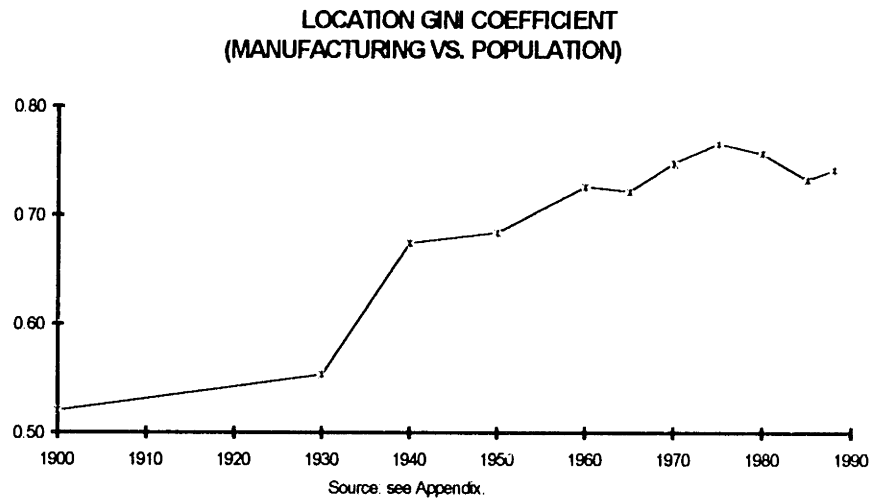
In the last century the landscape of the country has changed dramatically. For anyone looking at the actual size of Mexico City—one of the biggest in the world with its 17 million inhabitants—and particularly when comparing it with the rest of Mexico, it may seem natural to think that Mexico City's share in the country's economic activity has always been overwhelming, and that industry has always been concentrated there. However, this is not true.

At the beginning of this century, manufacturing activity was much more dispersed than it is today. Mexico City's population was 5 percent of the country's total and 10 per cent of total manufacturing jobs were located there. Export oriented mining and agriculture were then the leading sectors of the economy. Manufacturing was undertaken to provide the domestic markets but without the protectionist framework that would later arise. Manufacturing activity consisted mainly of artisanal shops, industries related to agricultural or mining production and other low technology sectors such as beer and textiles.

As has been documented by Cardenas (1987), during the Great Depression Mexico started a de-facto import substitution strategy of industrialization. Concentration of economic activity in Mexico City soared. In

Figure 3.1, where we plot the evolution of the location GINI coefficient (LGC) for manufacturing over the century.¹⁰ Between 1930 and 1940 the LGC rose from 0.55 to 0.67 accounting for most of the observed concentration increase in the century.

Figure 3.1



Between 1940 and 1970 the country followed an explicit import substitution policy. Simultaneously, the structural transformation was dramatic. In 1940, 65.4 per cent of population was employed in agriculture and 15.5 per cent in manufactures. By 1970 those numbers were 37.5 and

¹⁰ The location GINI coefficients are defined as the cumulative difference between the shares of manufacturing in a particular industry with respect to the cumulative share of total manufacturing activity. States were taken as the unit region of analysis. If industry's dispersion is similar to the dispersion of a reference variable (in this case population) the index will be close to 0. If industry is completely concentrated in a single location, the index will be 1 (See Wheeler (1981) on the use of this and other measures of dispersion in Economic Geography).

23.1 per cent respectively. The service sector absorbed a great proportion of the population that left agriculture.

This process involved significant regional changes. Peasants not only abandoned agriculture, they also departed from their home states searching for jobs in Mexico City. A closer look at the components of the LGC reveals a better picture of the regional evolution. Figures 3.2 and 3.3 help us to tell a stylized description of the regional concentration process. Between 1930 and 1960 industry agglomerated around two poles., a large one —the Mexico City Metropolitan Area (MCMA)— and a smaller one in the city of Monterrey (in the border state of Nuevo Leon). In Figure 3.2 we can observe that between 1930 and 1960 Nuevo Leon's share in National Manufacturing employment rose from 2.78 to 7.33 per cent while its share in population only moved from 2.5 to 3.5 percent. In the same period Mexico City captured 17.5 percent of national manufacturing employment. By 1960, Mexico City, Nuevo Leon and the State of Mexico accounted for 52.6 percent of manufacturing jobs with only 22.5 percent of the population.

Figure 3.2
EARLY INDUSTRIAL BORDER STATES
1900-1990

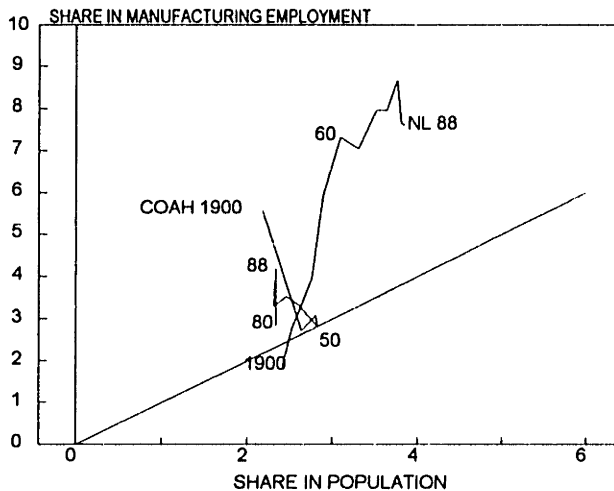
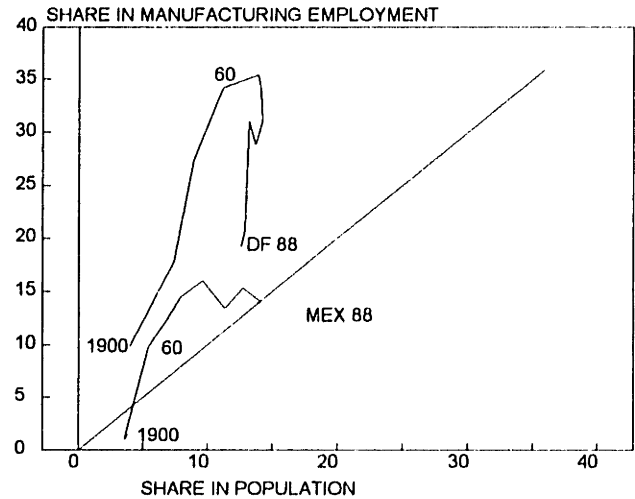


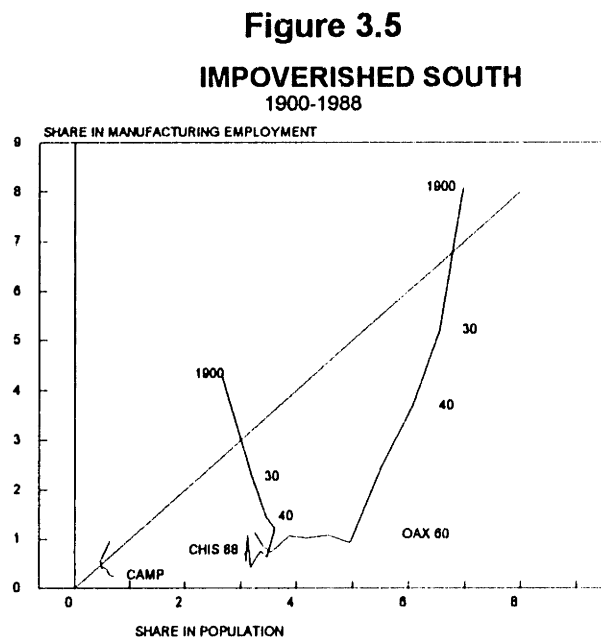
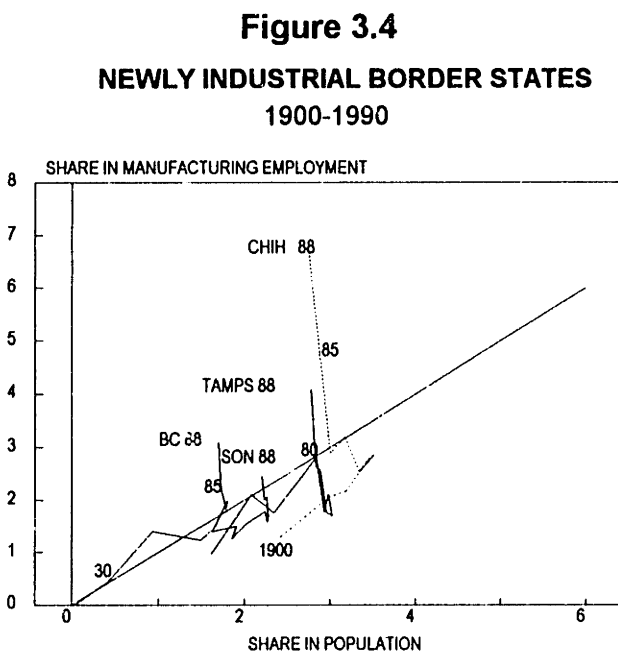
Figure 3.3
MEXICO CITY METROPOLITAN AREA
1900-1990



This process took place at the expense of several states, the most dramatic case of which are the states of Oaxaca and Chiapas (See Figure 3.4). Between 1900 and 1960, these two states lost more than 10 percent of the manufacturing employment. The state of Oaxaca has been a large supplier of labor for the rest of the country. Its share in population has steadily decreased during the whole century.

From the 1960's on, the problem of agglomeration began to be addressed [see Bassols (1967) and Solis (1975)]. The Federal government and several state governments undertook active industrial location policy which actually slowed the flow of economic activity to the MCMA. Queretaro, for example was able to attract almost 2% of the manufacturing employment from 1960 to 1988. Another successful case of industrial location policy is the

one of Aguascalientes which pulled 1% of the manufacturing population from 1975 to 1988 (The Appendix shows the evolution of individual states).



The widening of commercial ties with the United States has been the single policy element that has caused greater regional disparities in the recent years. Industrial census data shows that between 1985 and 1988 there was no creation of jobs in the formal manufacturing sector. However, the border region managed to create 200 thousand new positions (see Table 3.1).

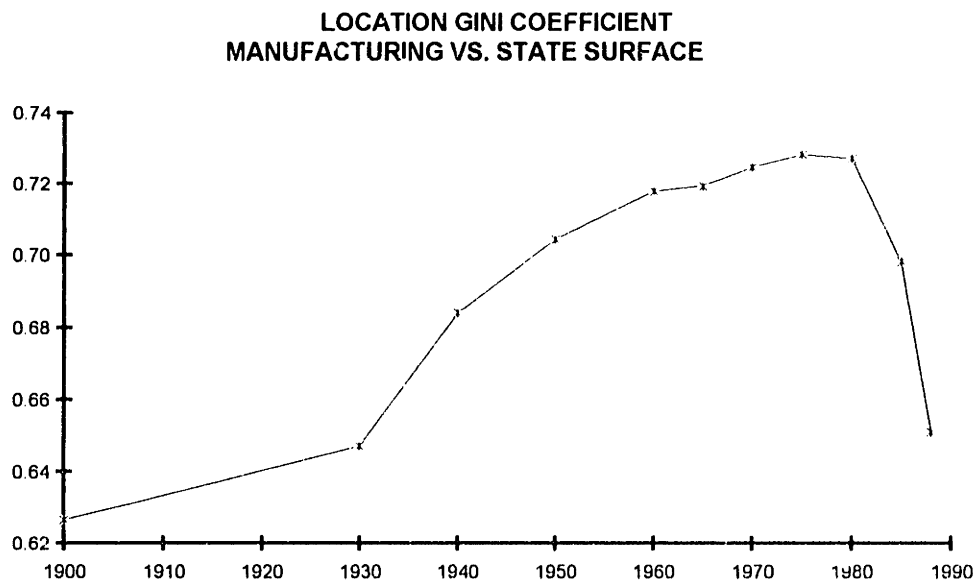
Table 3.1
Workers Employed In Manufacturing Activities

	1985	1988	Δ %
National	2,576,775	2,506,945	-0.03%
Border States	585,384	705,530	20.52%

SOURCE: Censo Industrial 1985, Censo Industrial 1988 (Resultados Preliminares). INEGI.

This flow of jobs to the North of the country has been significant. In Figure 3.6 we show the results of calculation the LGC with state surface as the reference variable. This movement of manufacturing to areas with low population density, together with the reduced importance of the MCMA as a manufacturing area, has made the LGC fall dramatically in the last decade.

Figure 3.6



One of the main reasons for this behavior is the change in orientation of the development strategy. After the 1982 crisis, policymakers shifted their attention to external markets as a source of demand for Mexican products.

They changed the trade regime dramatically. In 1985, Mexico joined the GATT and trade barriers were reduced at fast pace (see table 3.2).

Table 3.2
Mexican Trade Policy

	June 1985	June 1988
Coverage of Import Permits	92.2	23.2
Maximum Tariff	100.0	20.0
Weighted Tariff	23.5	11.0

SOURCE: SECOFI.

A link between these trade policy reforms and the pattern of industry location clearly exists. Most of the new creation of jobs in the border states is a result of the Maquiladora program which promoted the creation of in-bound industry. The Maquiladora program started officially in 1965, however its importance was minimal until the 1980s. The sharp increase in the share of manufacturing employment that several border states have experimented can be seen in Figure 3.4.

Between 1985-1988 the movement of economic activity was not limited to the manufacturing sector. 30 per cent of new service sector jobs are created in the border area. The growth rate of service jobs during the same period (85-88) was 26.7% while the national average was 16.6 per cent. A present concern of Mexican policy makers is the regional impact of NAFTA. If the border continues pulling economic activity, this may further de-industrialize the already impoverished south. The model developed in section

3.2 is used to analyze the plausibility of this assertion from the perspective of recent developments in the theory of economic geography.

3.2. A Basic Two Country Three Region Model.

In this section, we follow the insights from the previous section to build a minimal model of location and trade. We assume that regions in the country we are studying are identical in all respects except for their proximity to the country's trading partner.

We consider a version of the Dixit-Stiglitz monopolistic competition model as used in Krugman (1991). There are two countries, Home and Foreign. Foreign is a single region country with population L^* . Home has two regions, North(N) and South(S). Its population is αL^* , i.e. α is a measure of the relative size of the two region country.

3.2.1. Preferences

There are two types of goods, manufactures and a numeraire good (A). All agents in the two economies share a common utility function

$$(3.1) \quad U = C_M^\mu C_A^{1-\mu}$$

where μ is the share of manufactured goods in expenditure. C_M , the manufacturing aggregate is defined as

$$(3.2) \quad C_M = \left[\sum_{i=1}^n C_i^{\frac{\sigma-1}{\sigma}} \right]^{\frac{\sigma}{\sigma-1}}$$

This specification implies that there will be a constant share of expenditure in manufactures. The share spent in a particular variety will be a function of relative prices. We assume that σ , the elasticity of demand for an individual variety, is greater than 1.

3.2.2 Production, pricing and shipping.

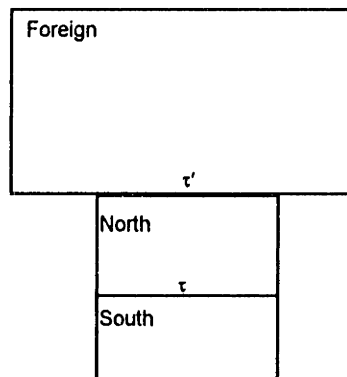
The numeraire good is produced under constant returns to scale with labor as the only input. We assume that the labor that is used in numeraire production is sector specific. Manufactures are produced under increasing returns to scale. Unit labor requirements are given by

$$(3.3) \quad L_{x_i} = \delta + \beta x_i$$

To keep matters simple, we assume that the numeraire good is freely tradeable (in equilibrium it will not be traded) and costlessly transportable.

Manufactured goods in contrast are costly to transport from one region to the other. Intracountry transport costs are denoted by τ and tariff and transport costs between countries are given by τ' . The geographical layout of the two countries is given by Figure 3.6.

Figure 3.7
GEOGRAPHICAL LAYOUT OF COUNTRIES



Foreign (F) is a single region country. Home has two regions, North (N) and South (S). The crucial characteristic is that North borders with Foreign. Therefore, trade between North and Foreign is cheaper than trade between South and Foreign. The difference between this model and a simple three region model is that Home workers can move freely between the northern and the southern regions but cannot cross the border. We assume that their location decisions are based on the level of real wages. Whenever a region has higher wages it will attract workers from the other regions. This implies that there will be two types of equilibria. The first type will have wages equalized across the two regions and some proportion of the manufacturing population

living in the two regions. In the other type of equilibria, all of the mobile population will live in the region with higher wages.

Transport costs are incurred in the goods themselves. Only τ of a unit shipped from the Southern region arrives at the Northern region and only $\tau\tau'$ arrives to the foreign country. This structure gives rise to the following transportation cost matrix.

(3.4)

$$\mathbf{T} = \begin{bmatrix} 1 & \tau' & \tau\tau' \\ \tau' & 1 & \tau \\ \tau\tau' & \tau & 1 \end{bmatrix}$$

where $\mathbf{T}_{i,j}$ represents the cost of shipping from location i to location j . This structure of transportation costs keeps unaltered the elasticity of demand for a firm's product. A firm's pricing decision will be to charge a constant markup over marginal cost, hence f.o.b. prices will be

(3.5)

$$P_i^{f.o.b} = \left(\frac{\sigma}{\sigma - 1} \right) \beta w_i$$

The zero profit condition and the constant markup rule imply that output per firm is constant across regions, $x_i = \delta(\sigma - 1) / \beta$. Hence, the number of goods produced in a region is proportional to the manufacturing labor that lives in that region.

We assume that the share of manufacturing workers is equal to μ percent of the total labor force of the country. Workers can move costlessly within a country, but cannot cross the border. Hence, once we fix the parameters of the model, our remaining question is to determine the optimal location decisions of Home manufacturing workers.

3.2.3 Determining Equilibrium Locations for Workers

The existence of the foreign country has an asymmetric effect on Home's two regions. Since c.i.f. prices of manufacturing goods depend on where a worker lives, we can say *a priori* that reducing trade barriers will distort the location decisions within the country. As τ' increases (transport costs decreases) the pressure to locate near the border will be higher in order to minimize transportation costs. But, how strong is this effect?

To address this question we must specify the equilibrium of the model. Define $\theta_{i,j}$ as the share of region i 's expenditure on region j 's goods. Then

(3.6)

$$\theta_{i,j} = \frac{\mu n_j (P_{i,j})^{1-\sigma}}{\sum_j n_j (P_{i,j})^{1-\sigma}}$$

where $P_{i,j}$ is the c.i.f. price of region j 's goods sold in region i . Constant markup rules and iceberg transportation costs yield

$$(3.7) \quad P_{i,j} = \frac{\kappa w^j}{\mathbf{T}_{i,j}}$$

where $\mathbf{T}_{i,j}$ is the (i, j) entry of the transportation cost matrix and κ is a constant.

We denote by ϕ the share of manufacturing population that lives in the northern region of the Home country and normalize $L^*=1$. Since total income has to be equal to total expenditure, we have

$$(3.8) \quad w^F \mu = \theta_{F,F} Y_F + \theta_{N,F} Y_F + \theta_{S,F} Y_F$$

$$(3.9) \quad w^N \alpha \mu \phi = \theta_{F,N} Y_F + \theta_{N,N} Y_F + \theta_{S,N} Y_F$$

$$(3.10) \quad w^S \alpha \mu (1 - \phi) = \theta_{F,S} Y_F + \theta_{N,S} Y_F + \theta_{S,S} Y_F$$

Where Y_i denotes income in region i . Since the only factor of production is labor, income in each region has to be equal to total wage earnings.

$$(3.11) \quad Y_F = (1 - \mu) w_A^F + w^F \mu$$

$$(3.12) \quad Y_N = \frac{(1-\mu)\alpha}{2} w_A^N + \phi \mu \alpha w^N$$

$$(3.13) \quad Y_S = \frac{(1-\mu)\alpha}{2} w_A^S + (1-\phi)\mu\alpha w^S$$

In the previous equations, w_A^i denotes wages earned by non manufacturing workers. The assumptions about numeraire production and transport costs insure that $w_A^F = w_A^N = w_A^S = 1$.

Total world population is $1+\alpha$, and $1-\mu$ percent of it consists of non manufacturing workers. Non manufacturing population is evenly distributed among home's two regions. If we fix ϕ arbitrarily at any level, we can determine real wages in North and real wages in South. If $(\omega^N / \omega^S) > 1$ workers will move to the northern region until wages are equalized or until all manufacturing workers live in North $\phi = 1$. With these dynamics in mind we can turn to the analysis of a reduction in trade barriers.

3.2.4 The Effect of Reducing Trade Barriers

Trade barriers are captured (together with transport costs) in τ' . Lower transport costs will change the share that workers in a region are willing to spend in a particular product. They do so by affecting the c.i.f. prices consumers perceive and hence they also affect real wages. Real wages in this model have to be calculated by using the real price index.

$$(3.14) \quad P_i = \left[\frac{1}{1+\alpha} (P_{i,F})^{1-\sigma} + \frac{\alpha\phi}{1+\alpha} (P_{i,N})^{1-\sigma} + \frac{\alpha(1-\phi)}{1+\alpha} (P_{i,S})^{1-\sigma} \right]^{\frac{1}{1-\sigma}}$$

With this definition, real wages of workers in region i are given by

$$(3.15) \quad \omega_i = w^i P_i^{-\mu}$$

Just as in the case of autarky, this model setup can yield multiple equilibria as outcome. In particular, we can take as reference point the situation where $\tau' = 0$ (autarky). With no trade, two outcomes are possible. If internal trade barriers are small, then industry concentration is the outcome: long run equilibrium will have all manufacturing production located in a single region. If internal trade barriers are high, then industry splits evenly between the two regions (given the assumption that non manufacturing population is divided evenly). Subsequently, we develop these two cases.

Industry concentration.

To study the effects of reducing trade barriers we focus initially in the case where transportation costs are prohibitively high. As barriers are reduced, trade with the foreign country gains importance in Home's consumption basket. Nevertheless, for small reductions in τ' the initial

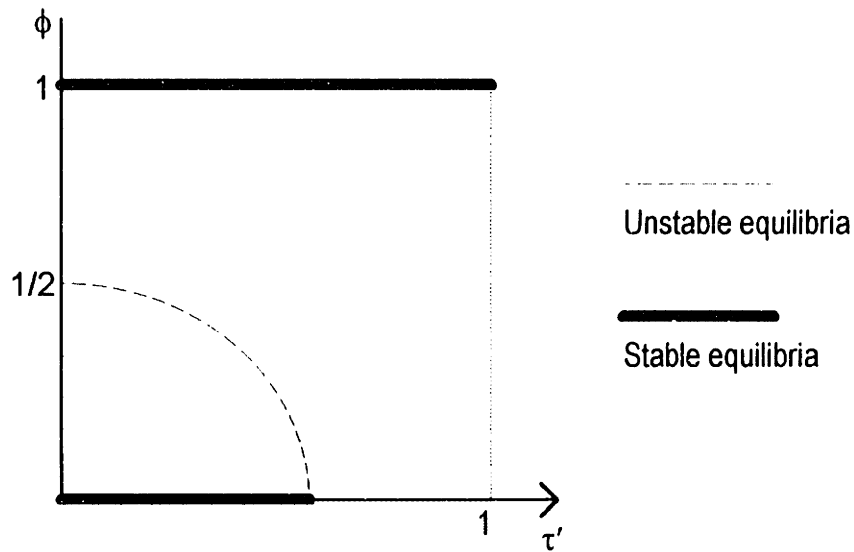
location of firms remains unaffected. Industry remains located where it was before the change in the trade regime.

However, if trade barriers decrease significantly, location in South may cease to be an equilibrium location. Consumption of manufactures from Foreign will tend to dominate in the consumption basket and will make South real manufacturing wages low relative to their North counterparts.

We solved the model for particular numeric values to prove that a shift in the trade regime can significantly alter the location decisions of firms within a country.¹¹ A stylized version of these simulations appears in figure 3.8. Reducing trade barriers causes relative wages in the northern region to increase. For low levels of τ' (high trade barriers) the two equilibria that were prevalent in autarky remain viable. However, there is a threshold level of τ' beyond which concentration in the south is no longer an equilibrium.

¹¹ For an analytical approach to a related problem we solve the conditions under which industry will be concentrated in the bordering regions of two symmetric two region countries. These results appear in Appendix 1. The simulations used to build Figure 10 consider the following selection of parameters: $\alpha = .3$, $\sigma = 4$, $\mu = .3$ and $\tau = .9$.

Figure 3.8
EQUILIBRIUM POINTS



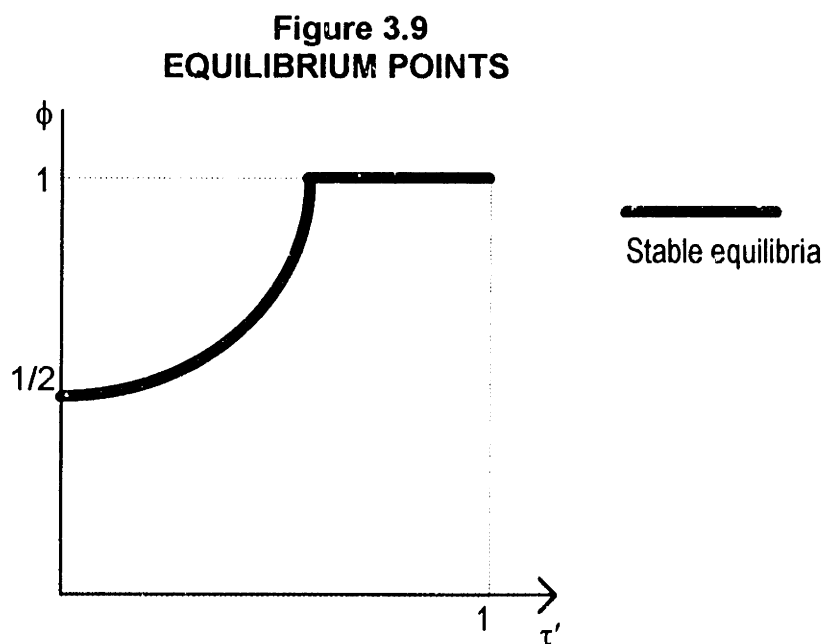
As we can see change in the trade regime can have dramatic regional effects in the long run. In autarky, industry may end up concentrated in South for accidental historical reasons. The multiplicity of equilibria disappears when trade is liberalized. In this case, the unique equilibrium is that industry will concentrate in the region that borders the country's trading partner (N).

Industry dispersed uniformly.

If industry was not concentrated initially because internal transportation costs were high, reducing trade barriers will also affect the

location decision of workers, but the possibility that small changes in the trade regime will produce dramatic changes in industry location is ruled out.

The results of the model for a selection of parameter values that yield industry dispersion in autarky are plotted in Figure 3.9, where we plot the equilibrium relative wages that result under alternative levels of trade barriers τ' and distributions of the manufacturing population ϕ .¹²



¹² There is another effect that has to be taken into account for very low values of τ . On the one hand, less trade barriers imply a gain in transportation costs that tends to make real wages (ω) higher. On the other hand, less trade barriers, imply tougher competition. When τ is low the South is relatively isolated. In this case, when τ' increases the equilibrium, nominal wage in the northern region may fall by more than the corresponding fall in wages in South, canceling the gains in lower transportation. It may result optimal to locate a *higher* share of manufacturing production in South.

Reducing trade barriers will increase the likelihood of more manufacturing concentration in the northern region, however the process by which this will take place is quite different depending on the initial situation. If industry was initially concentrated, change will be sudden. If industry was dispersed, the equilibrium share of manufacturing will be tilted towards North in proportion with the reduction in trade barriers.

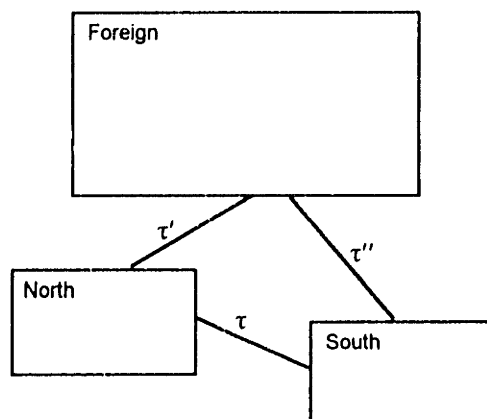
3.2.5 Extensions: Triangular Trade and Multiple Regions

The previous version of the model has some rather dramatic conclusions which should be assessed more carefully. To see the general validity of these results we perturb the basic model by adding more regions and altering the structure of transport costs.

Case 1: Triangular trade.

Previously we assumed that any shipment from the Southern region of the country had to cross through the North before reaching the foreign country. This need not be the case, we can assume that the structure of trade is described by Figure 3.10 where we assume that $\tau\tau' < \tau'' \leq \tau'$.

Figure 3.10
GEOGRAPHICAL LAYOUT OF COUNTRIES



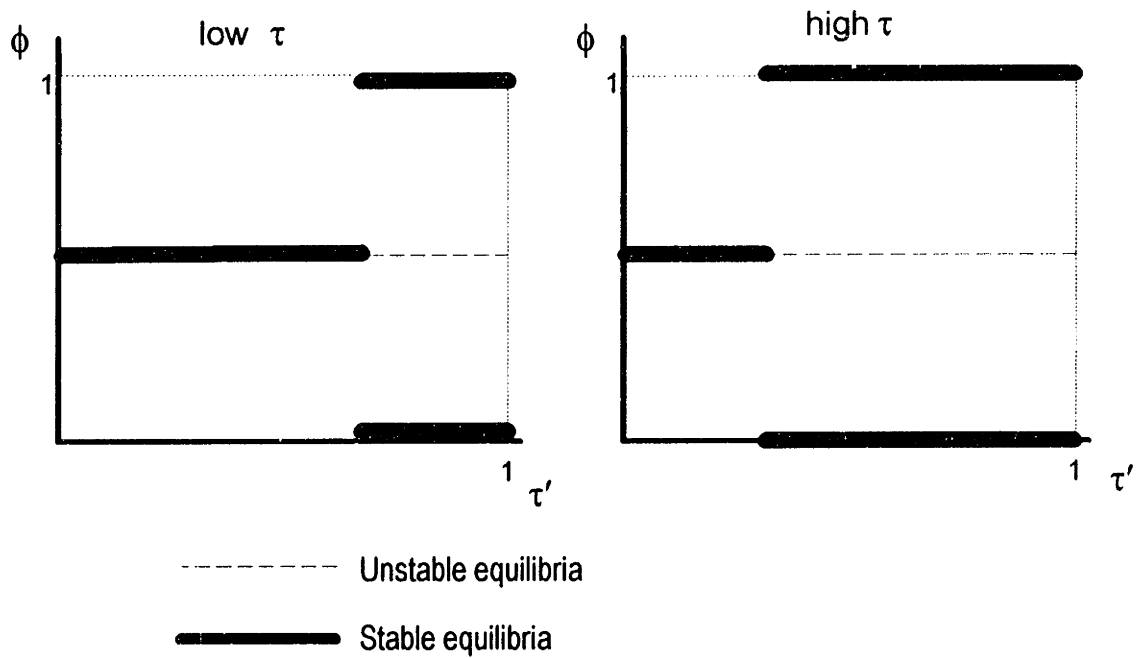
This is, the South is more "distant" from the foreign country than the North. We start from the reference case where both regions are equidistant from the foreign market $\tau' = \tau''$ in this case the new transportation matrix is

$$(3.16) \quad \mathbf{T} = \begin{bmatrix} 1 & \tau' & \tau'' \\ \tau' & 1 & \tau \\ \tau'' & \tau & 1 \end{bmatrix}$$

To find the equilibrium of the model we start by noticing that when we divide the manufacturing population evenly among the two regions equilibrium wages will have to be the same.

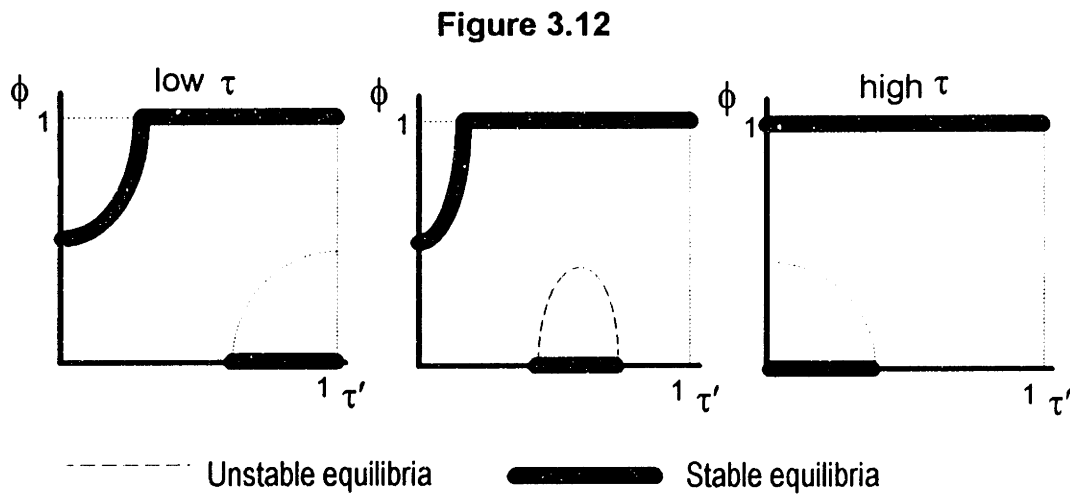
As before, in autarky we can have two types of equilibrium patterns. Industry may be uniformly dispersed or concentrated in any of the two regions.

Figure 3.11



As trade barriers are reduced each consumer spends a larger share of her income in foreign goods. The importance of the other local market falls. Hence the equilibrium may no longer be sustainable. The set of equilibria is plotted in Figure 3.11.

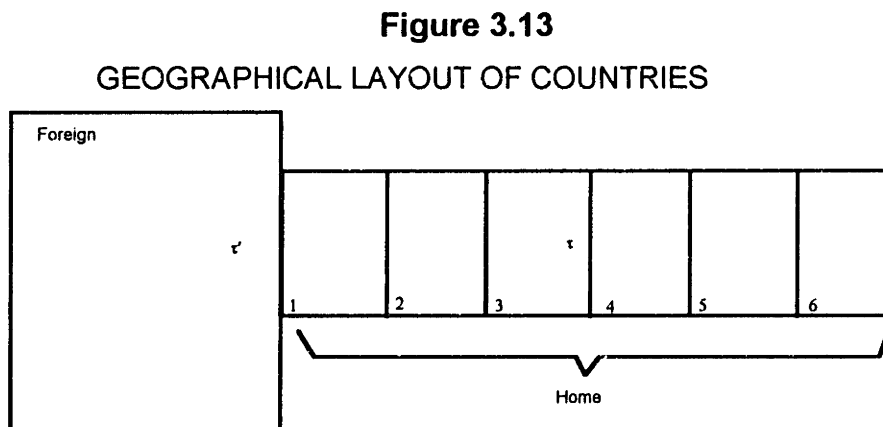
After considering this reference case we can check the transition from $\tau'' = \tau'$ to $\tau'' = \pi'$. As one region becomes more distant from the country's trading partner, wages in the northern region will rise *ceteris paribus* (when shares of manufacturing population are divided evenly). Equilibrium configurations are drawn in Figure 3.12.



We can see that changing the trade regime has an ambiguous effect on location. The intermediate section of Figure 3.11 shows that lifting trade barriers (higher τ') can make viable a core periphery pattern that was not sustainable at higher levels of protection. However for a given autarky configuration we can say what the effects will be. The results of the previous section still carry on. Trade barrier reduction creates a significant bias in favor of the location that is better suited for trade.

Case 2. Multiple Regions

The conclusion from the previous analysis that needs to be qualified is the result that for all cases industry ended up more or at least as concentrated as in autarky. If we extend the model to include several regions this result no longer holds. To do this we assume that Home now has six equidistant regions located on a line as shown in Figure 3.13.



We will assume that the cost of shipping a good from one region to the next is constant. Hence transportation costs fall exponentially. $\tau_{i,j}$, the cost of transporting one good from region i to region j is $e^{-\gamma \text{dist}(i,j)}$. We control trade barriers by adjusting the distance between Foreign and Home's closest region. We denote this distance by b , $b > 1$.

The new transportation cost matrix is $\mathbf{T} = e^{-\gamma A}$ where

$$(3.17) \quad A = \begin{bmatrix} 0 & b & b+1 & \dots & b+5 \\ b & 0 & 1 & \dots & 5 \\ b+1 & 1 & \ddots & & \vdots \\ \vdots & \vdots & & \ddots & \vdots \\ b+5 & 5 & \dots & \dots & 0 \end{bmatrix}$$

We assume that $1/6$ of the non manufacturing population lives in each region and now normalize the size of Home to be 1. Foreign's population is given by $L^* = \alpha L = \alpha$, $\alpha > 1$.

Prices and shares of expenditure are calculated as before. We denote by ϕ_i the share of manufacturing labor that lives in each region. Hence, the new equations for income are

$$(3.18) \quad Y_F = (1 - \mu)\alpha + \mu w^F$$

$$(3.19) \quad Y_i = \frac{(1 - \mu)}{6} + \phi_i \mu w^i$$

The expressions for wages are:

$$(3.20) \quad w^F \mu \alpha = \theta_{FF} Y_F + \sum_i \theta_{iF} Y_i$$

$$(3.21) \quad w^i \mu \phi_i = \theta_{Fi} Y_F + \sum_j \theta_{ji} Y_j$$

The real price index is

$$(3.22) \quad P_i = \left[\frac{\alpha}{1+\alpha} (P_{i,F})^{1-\sigma} + \sum_j \frac{\phi_j}{1+\alpha} (P_{i,j})^{1-\sigma} \right]^{\frac{1}{1-\sigma}}$$

Real wages are defined by equation 3.14. For an initial distribution of manufacturing population in Home we can compute equilibrium real wages. This determines short run equilibrium. To find stable long run equilibria we consider as in Krugman (1992) that labor moves to locations with higher relative wages according to the following law of motion:

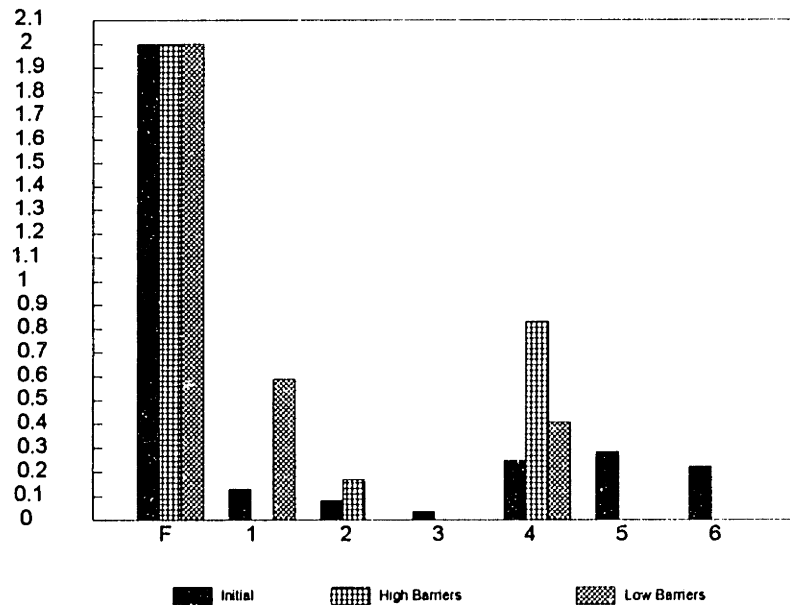
$$(3.23) \quad \frac{d\phi_j}{dt} = \rho \phi_j (\omega_j - \bar{\omega})$$

where $\bar{\omega} = \sum_j \phi_j \omega_j$. Long run equilibrium will require ω_j equal across all locations that end with some positive share of the manufacturing population ($\phi_j > 0$).

To analyze possible equilibrium locations we performed the following experiment repeatedly. Starting with a random draw from a uniform distribution, we computed equilibrium wages and set the new initial distribution of labor by applying equation 22. After convergence the procedure was restarted by setting $b = 1$ and using the final distribution from the previous round as initial vector.

Figure 3.14

A SAMPLE RUN



A sample run is shown in Figure 16.¹³ A crucial feature of the model is that historical accidents matter. This particular example was chosen because

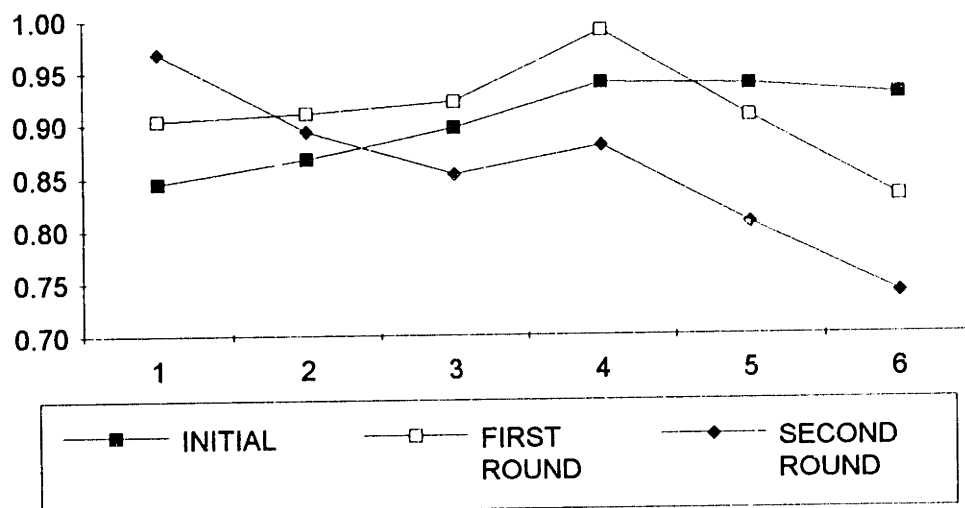
¹³ For this run we set $\alpha = 2, \gamma = 0.35, \sigma = 4, \mu = 0.25$ and $b = 4$ in the second round b was reduced to 1.

it resembles the story we told in Part 2 but for the same selection of parameters, several equilibrium configurations were possible. (e.g. $\phi_1 = 0.09, \phi_4 = 0.91$). The final distribution depended on which regions had a head start. Not necessarily the regions with larger initial share ended up with some manufacturing population. (as can be seen in Figure 13). Moreover for 40% of the cases (20 runs) in this run, the final equilibrium ended being $(\phi_1 = 0.59, \phi_4 = 0.41)$, and the remaining 60% had $(\phi_1 = 0.67$ and $\phi_5 = 0.33)$. Reducing internal barriers had similar effects as in the 2 region model. In a set of runs with $\gamma = 0.25$ 90% of the cases ended with ϕ_3 or $\phi_4 = 1$ and 10% with $(\phi_2 = 0.63$ and $\phi_5 = 0.37)$. The final equilibrium in all cases was $\phi_1 = 1$.

Increasing the size of the foreign country had similar effects. For $\alpha = 3$, initial equilibria were $(\phi_1 = 0.44$ and $\phi_4 = 0.56)$ 90% of the runs and $(\phi_1 = 0.6$ and $\phi_5 = 0.4)$ the remaining 10%. Final equilibria was $\phi_1 = 0.93$ and $\phi_6 = 0.07$ in all cases.

As a general principle, reducing trade barriers will attract labor to the border region. Nevertheless the structure of cities will be different than the structure proposed in Rauch (1990). Under Rauch's assumptions city size is a decreasing function of distance to the "coastal" region. In this case, cities do not decrease monotonically, but rather unevenly as we get far away from the region best suited for trade.

Figure 3.15
Non Manufacturing Wages

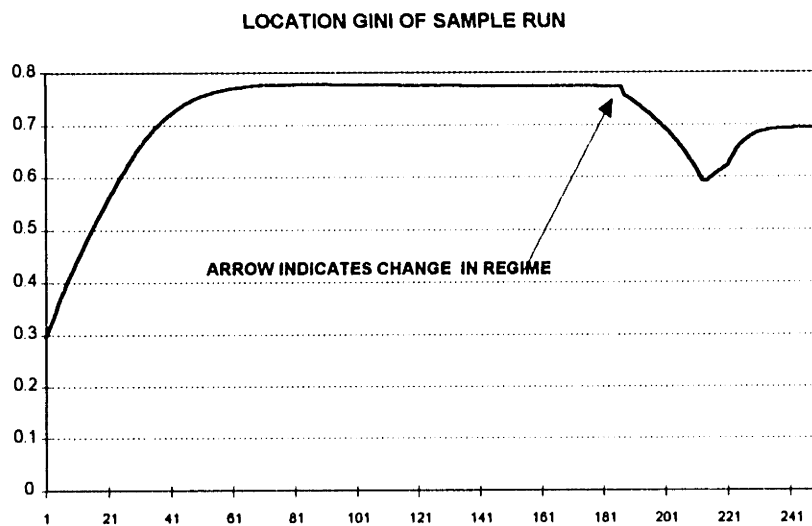


Our sample run can also be used to illustrate how changes in the trade regime can have significant effects on regional wage disparities. In Figure 3.15 we plot the value of real wages for non manufacturing labor ($\omega_i^A = P_i^{-\mu}$). The initial concentration of manufactures in region 4 causes wages to be highest in that region. After the change in the trade regime, real wages in the border region become the highest ones and real wages of the most distant region decrease even further.

Finally, this sample is also illustrative of the fact that a change in trade regime has an ambiguous effect on regional concentration. In Figure 3.16 we plot the Location Gini Coefficient of the sample run. Industry started relatively dispersed and over time stabilized at the level of 0.78. The reduction

of trade barriers induces a new location pattern for manufacturing activity. The new long run equilibrium has a LGC below the one that prevailed just before the change in regime. During the transition phase, industry disperses even more.

Figure 3.16



3.3. Empirical Evidence

The simplifying assumptions of this model do not allow a direct test. However, we can analyze the effects of transportation costs and scale economies in the location decisions of manufacturing activities. As a first step, we computed a set of location Gini coefficients (LGC) for the Mexican manufacturing sector. They were computed by number of workers, sales and

number of units for the years 1985 and 1988. These coefficients were computed at the state level and the results appear in the Appendix.

The model suggests that fixed costs and transportation costs matter for locational decisions. The idea of high fixed costs as they appear in the model has its closest analog in the data that measures capital intensity. We used the value of machines per employee from the manufacturing census as an indicator of fixed costs. Transportation costs are a bit more slippery. The census provides information about total costs spent in shipping and handling, however this data has two main problems. First, there is an adverse selection problem because goods that are too costly to transport will not be transported altogether. Second, the characteristic that makes transport costly is not value of the good but rather its bulkiness. However, the census questionnaire does not include any information about weight or volume of the goods produced. Wrapping materials needed for distant transportation are also an important component of transportation costs, but there is no information available on this matter.

With these caveats in mind, we regressed the Gini Coefficients on these indicators of fixed costs and transport costs for all definitions of the location GINI coefficients. Regression results appear in Table 3.3.

Table 3.3
Location Regressions

	Number of Firms	Number of Workers	Sales
1985 Data	**0.188	**0.1136	0.054
Fixed Cost	(0.071)	(0.059)	(0.056)
Transport Costs	-0.071 (0.092)	-0.021 (0.077)	-0.025 (0.070)
R2	0.15	0.09	0.05
1985 Data			
Fixed Cost	**0.184 (0.070)	**0.12 (0.050)	0.067 (0.050)
Transport Costs	-0.052 (0.091)	-0.05 (0.700)	-0.004 (0.060)
R2	0.15	0.09	0.04

Note: Standard errors in parenthesis,

** significant at the 5% level, N=42.

All coefficients have the expected signs. The general fit of the regression is low, in particular for the cases where Sales-LGC were taken as dependent variable. The coefficients on transport costs are not statistically significant. These results do not contradict the setup of the model developed in this paper. Further empirical research is needed to measure the importance of scale economies, trade barriers and shipping costs as determinants of industry location. One possible explanation of the low fit of the regression is the aggregation of data. It would be preferable to run a panel regression with disaggregated data, but confidentiality restrictions make it impossible to count with enough observations.

Confidentiality restrictions are an important limitation for empirical analysis at the regional level. In the Appendix we can observe that LGCs could not be computed for most of the machinery sectors because there was not enough data available. Confidentiality hits hardest precisely in the sectors which we are interested in because a low number of firms and imperfect competition are correlated.

A more casual approach to the data gives further validity to our assumptions. At the sector level we find a positive relationship between value added per worker and firm size. This gives plausibility to the hypothesis that, at the regional level, IRS is not an implausible assumption. For this to hold we do not need to postulate global increasing returns to scale. Due to imperfect competition, firms may be located in the decreasing region of their average cost curves.

Furthermore, between 1985 and 1988 firm size increased. In 1985 the typical manufacturing firm had 17 employees. By 1988 the number of employees rose to 18. This increase in size was most noticeable in sectors with a dynamic export performance.

Table 3.4

Sectors with highest significant contribution to increase in average firm size (80-88)		
		D% in workers per firm
3220	Leather	41%
3212	Textiles	34%
3214	Knitwear	93%
3841	Automobiles	27%
3530	Oil Refining	68%
3822	Machinery	32%
3130	Beverages (includes Bee	20%
3511	Basic Petrochemicals	58%
3320	Furniture	26%
3560	Plastic Products	13%
3832	Electronic Equipment	9%
3240	Shoes	10%
3821	Assorted Machinery	23%
3122	Animal Food	33%

Source: Censos Industriales. INEGI.

The microeconomic effects of greater economic openness are an open topic of research, however this preliminary data does not contradict the hypothesis that trade is increasing the scale of operation of exporting industries and that this shift in scale is likely to generate asymmetric regional effects since it reduces the number of firms operating in Mexico.

3.4. Conclusions.

A country that modifies its trade regime may experience important changes in its regional composition. The interaction between transport costs and scale economies, makes some regions more suitable for trade than others. In general we found a tendency for industries to move towards regions closer to the trading partner. However, this does not necessarily mean that industry will end up more concentrated after the change in regime. If we start from a very concentrated layout, the equilibrium that results after trade barriers are reduced may well be more dispersed than the original one.

Mexican data from the manufacturing census provides some support to the idea that scale economies matter for location decisions. However, more empirical research is needed to assess the location decisions of firms.

The regional effects of a change in the trade regime may be quite significant. A reduction in internal transport costs (more and better highways and communications) coupled with a reduction in trade barriers, can set in motion a shift of manufacturing activity towards the northern regions of Mexico. This poses problems for regional governments of all the country. The flow of workers to the northern regions may exacerbate urban problems in northern cities. There are strong incentives for firms to move away from the south of the country—the most impoverished region—. The change in the trade regime can have significant and asymmetric effects in the country's

regions. Decreased manufacturing activity in the South may worsen Mexico's already concentrated distribution of income.

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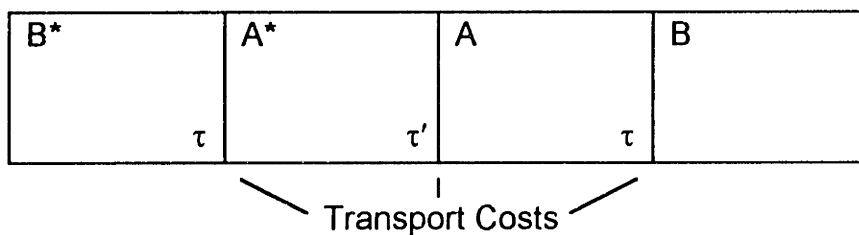
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Appendix B. Deriving the effects of reducing trade barriers in the symmetric case.

To obtain an analytical expression of the effects of trade we paste two countries together in the following way:



To check if manufacturing concentration is a sustainable equilibrium we consider the case of a firm located at B that decides to locate at A. The "defecting" firm will have to pay a higher wage to attract workers.

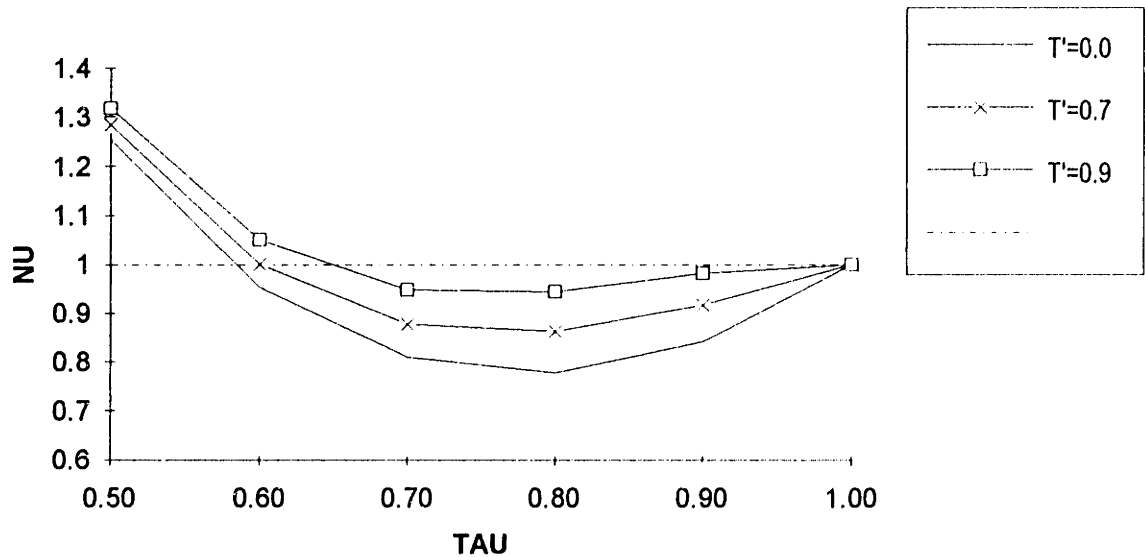
(3.24)

$$\frac{w_A}{w_B} = \left[\frac{1}{\tau^\mu} \left(\frac{1 + (\tau\tau')^{\sigma-1}}{1 + (\tau^2\tau')^{\sigma-1}} \right)^{\frac{\mu}{1-\sigma}} \right]$$

Computing the relative value of the firm's sales with respect to the typical firm in region A and adjusting for the higher fixed cost that has to be paid gives us an expression for v .

$$(3.25) \quad v = \frac{\tau^{\mu\sigma}}{2} \left(\frac{1 + (\tau^2\tau')^{\sigma-1}}{1 + (\tau\tau')^{\sigma-1}} \right)^{\frac{\sigma\mu}{1-\sigma}} \left[(1 + \mu) \frac{\tau^{\sigma-1}(1 + \tau')^{\sigma-1}}{1 + (\tau^2\tau')^{\sigma-1}} + (1 - \mu)\tau^{1-\sigma} \right]$$

We can check that as $\tau' = 0$ we are back in the autarky case (see Krugman 1991). Furthermore, $\partial v/\partial\tau' > 0$ i.e as transport costs diminish the threshold value increases, making it less likely that the concentrated equilibrium can be sustained. This makes intuitive sense, trade with the foreign country makes home firms willing to locate at A to save transport costs. The following picture allows us to compare the autarky case with different levels of trade barriers.



Appendix C. Location GINI Coefficients.

LOCATION GINI COEFFICIENTS									
SECTOR		UNITS		WORKERS		PAYROLL		REVENUES	
		85	88	85	88	85	88	85	88
1	3111	0.312	0.271	0.278	0.287	0.309	0.393	0.349	0.448
2	3112	0.153	0.165	0.225	0.265	0.326	0.387	0.320	0.383
3	3113	0.552	0.551	0.662	0.636	0.635	0.672	0.664	0.671
4	3121	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5	3114	0.188	0.168	0.270	0.260	0.269	0.270	0.255	0.279
6	3115	0.185	0.174	0.231	0.279	0.352	0.383	0.337	0.339
7	3116	0.171	0.163	0.317	0.352	0.342	0.359	0.373	0.310
8	3117	0.575	0.615	0.592	0.633	0.614	0.668	0.664	0.690
9	3118	0.715	0.776	0.846	0.879	0.856	0.878	0.821	0.844
10	3119	0.404	0.440	0.577	0.574	0.609	0.636	0.598	0.597
11	3122	0.516	0.505	0.462	0.451	0.496	0.475	0.427	0.411
12	3130	0.387	0.369	0.316	0.335	0.324	0.360	0.284	0.289
13	3140	0.801	0.856	0.843	0.831	0.823	0.797	0.750	0.734
14	3211	0.799	0.674	0.723	0.845	0.798	0.874	0.797	0.813
15	3212	0.483	0.463	0.435	0.462	0.375	0.406	0.427	0.387
16	3213	0.414	0.504	0.492	0.532	0.490	0.581	0.547	0.544
17	3214	0.518	0.450	0.369	0.384	0.406	0.405	0.441	0.426
18	3220	0.219	0.228	0.333	0.323	0.365	0.373	0.478	0.468
19	3230	0.506	0.539	0.483	0.583	0.448	0.546	0.588	0.682
20	3240	0.565	0.564	0.708	0.732	0.744	0.764	0.750	0.777
21	3311	0.356	0.326	0.703	0.658	0.752	0.736	0.805	0.761
22	3312	0.392	0.510	0.559	0.512	0.585	0.533	0.642	0.572
23	3320	0.150	0.249	0.271	0.298	0.407	0.401	0.378	0.425
24	3410	0.409	0.469	0.320	0.371	0.292	0.372	0.353	0.400
25	3420	0.309	0.332	0.423	0.382	0.490	0.479	0.510	0.497
26	3511	0.953	0.942	0.950	0.956	0.947	0.944	0.947	0.929
27	3512	0.370	0.412	0.653	0.461	0.425	0.509	0.443	0.534
28	3513	0.901	0.882	0.898	0.878	0.859	0.840	0.843	0.872
29	3521	0.617	0.627	0.596	0.623	0.571	0.594	0.640	0.663
30	3522	0.357	0.388	0.475	0.490	0.458	0.514	0.467	0.485
31	3530	0.903	0.883	0.914	0.901	0.908	0.898	0.916	0.888
32	3540	0.507	0.578	0.721	0.735	0.751	0.742	0.701	0.751
33	3550	0.339	0.364	0.384	0.373	0.425	0.455	0.460	0.471
34	3560	0.450	0.457	0.384	0.392	0.374	0.436	0.466	0.584
35	3611	0.644	0.647	0.529	0.599	0.593	0.633	0.592	0.603
36	3612	0.480	0.486	0.511	0.456	0.615	0.607	0.615	0.613
37	3620	0.404	0.491	0.614	0.578	0.611	0.587	0.583	0.577
38	3691	0.327	0.337	0.277	0.339	0.360	0.402	0.388	0.473
39	3710	0.458	0.465	0.603	0.640	0.630	0.683	0.610	0.622
40	3720	0.525	0.568	0.522	0.619	0.483	0.604	0.579	0.704
41	3811	0.364	0.421	0.439	0.500	0.458	0.558	0.500	0.609
42	3850	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
43	3842	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
44	3832	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
45	3831	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
46	3823	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
47	3822	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
48	3821	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
49	3814	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
50	3813	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
51	3812	0.135	0.141	0.283	0.294	0.265	0.316	0.218	0.300
52	3833	0.435	0.502	0.457	0.475	0.443	0.444	0.528	0.479
53	3841	0.307	0.367	0.433	0.417	0.426	0.426	0.483	0.554
54	3900	0.392	0.428	0.464	0.393	0.454	0.458	0.472	0.578

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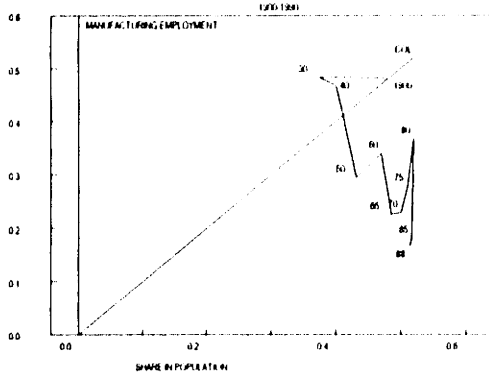
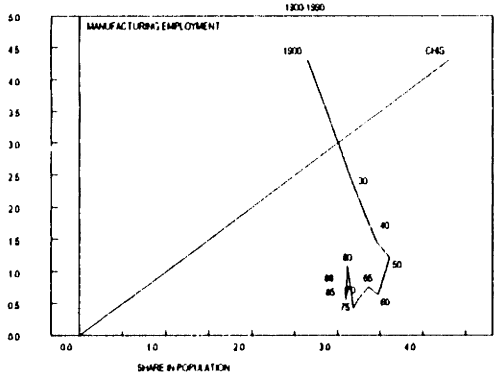
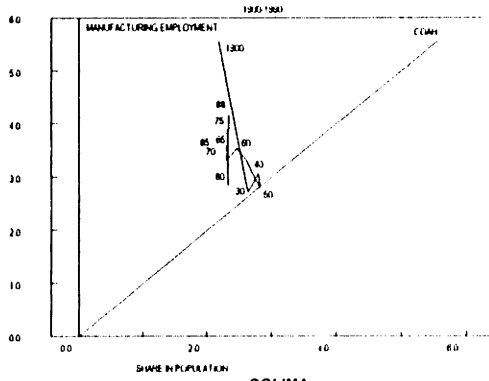
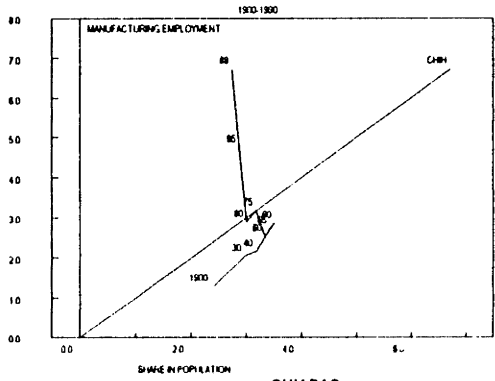
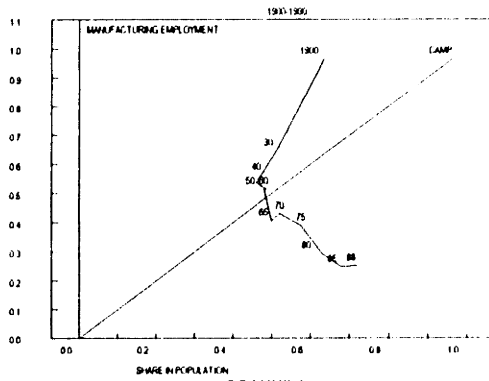
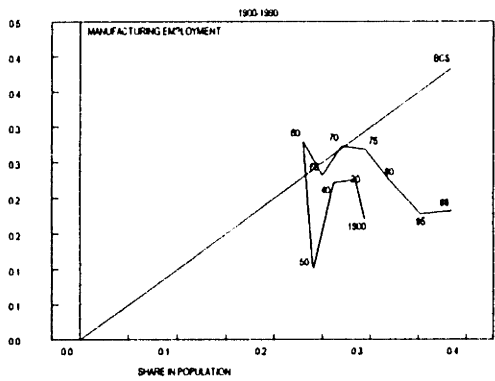
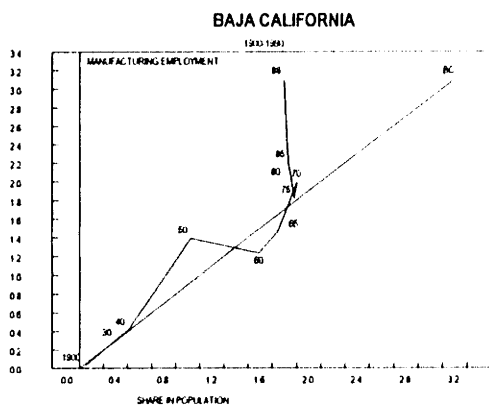
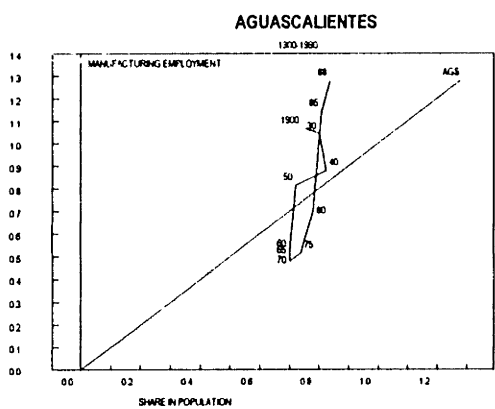
Group 31	Food, beverage and tobacco products
3111	Meat Industry
3112	Dairy products
3113	Preserves. It excludes meat and dairy it includes bullion.
3114	Grinding and milling of cereals.
3115	Bakery products
3116	Corn mills (Nixtamal) for the production of tortillas and tortilla shops.
3117	Oil and Fat food products
3118	Sugar industry
3119	Cocoa, chocolate and sweets.
3121	Other food products for human consumption
3122	Manufactured food products for animals
3130	Beverages industry
3140	Tobacco industry
Group 32	Textile mill products, apparel and leather industry.
3211	Textile industry of hard fibers and cordmaking.
3212	Spinning, weaving and finishing of soft fibers. It excludes knitting.
3213	Manufacturing with textile materials. It includes tapestry and carpets of soft fibers
3214	Knitwear
3220	Apparel and related products. It includes knits when the manufacturing is done in a different establishment.
3230	Leather and fur products. It excludes shows and apparel.
3240	Shoe industry. It excludes rubber and plastic shoes.
Group 33	Lumber and wood products. It includes furniture.
3311	Lumber, sawmill and carpentry products. It excludes furniture.
3312	Manufacturing of packing and other products of wood and cork.
3320	Furniture and fixtures. It includes mattresses.
Group 34	Paper and allied products
3410	Manufacturing of cellulose, paper and its products
3420	Printing and publishing

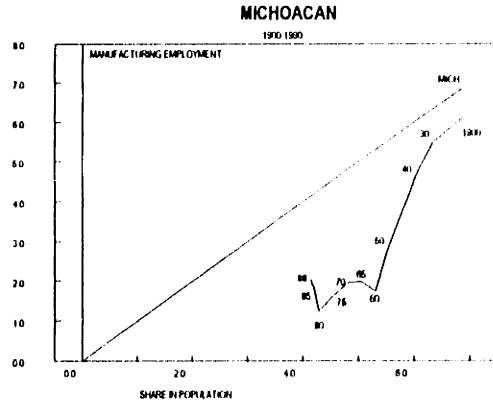
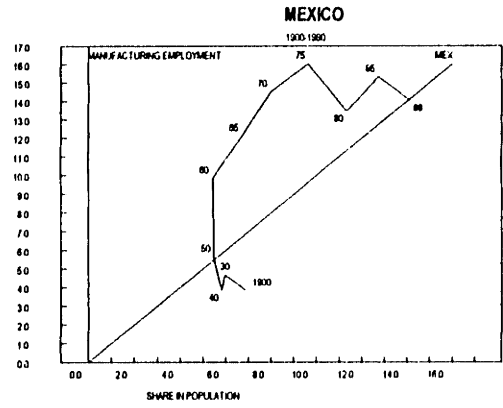
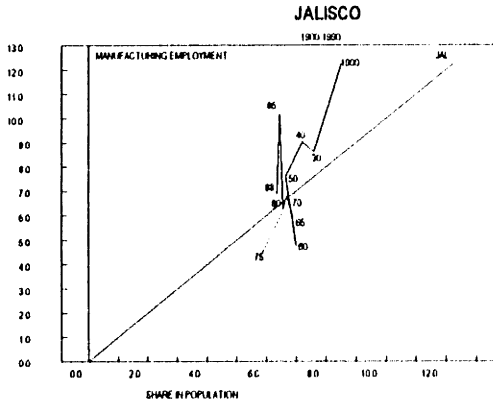
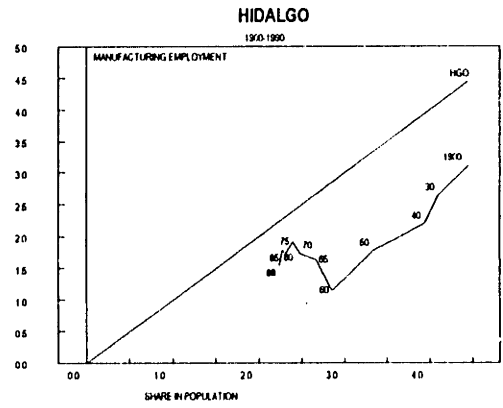
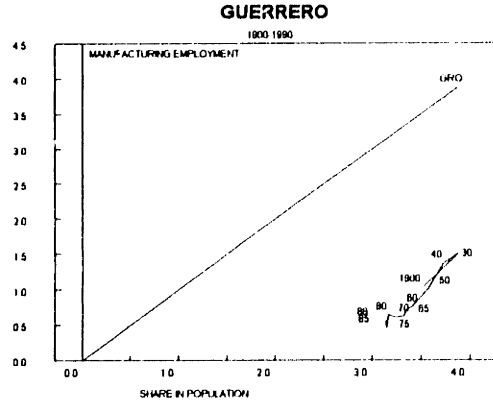
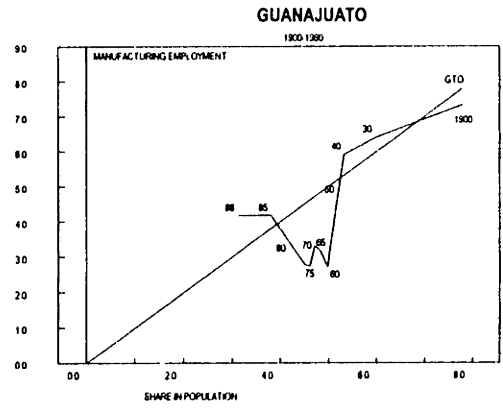
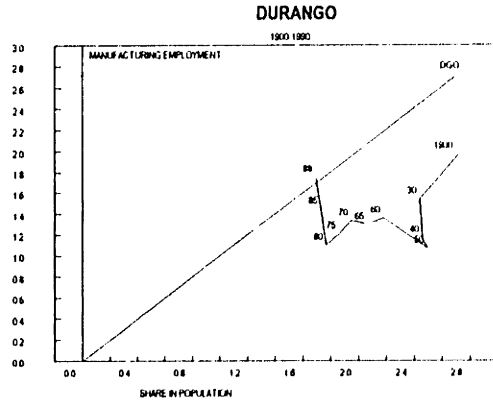
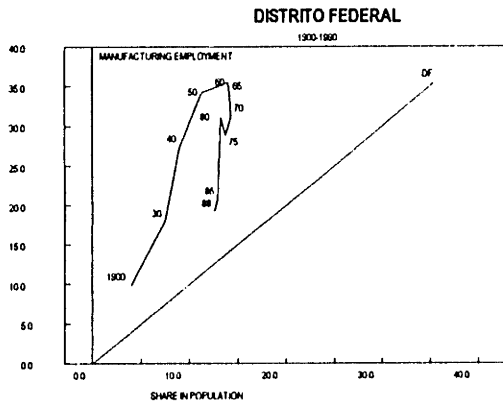
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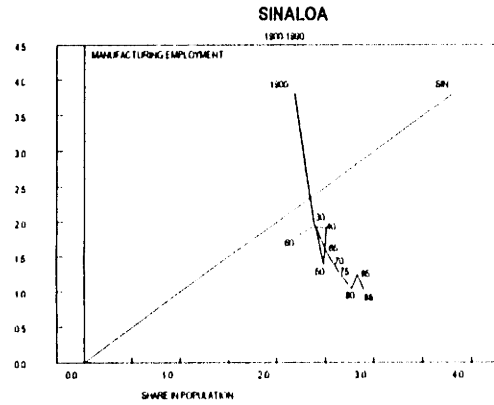
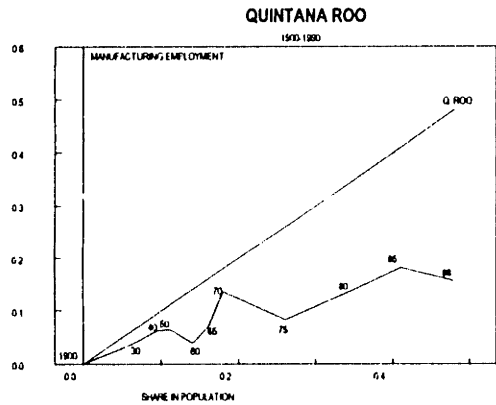
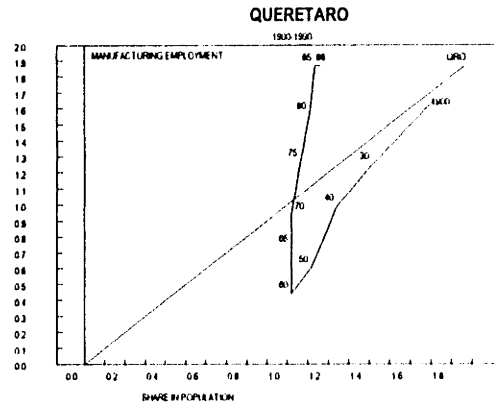
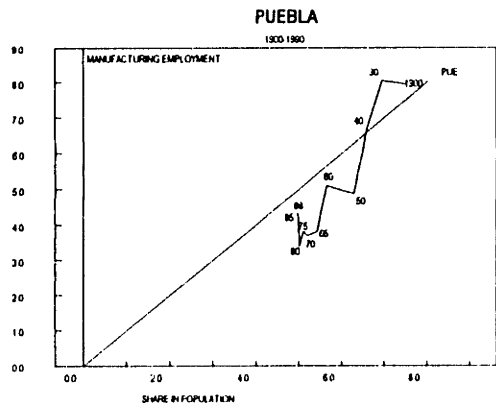
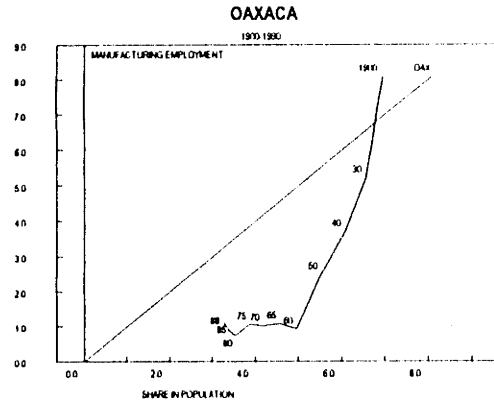
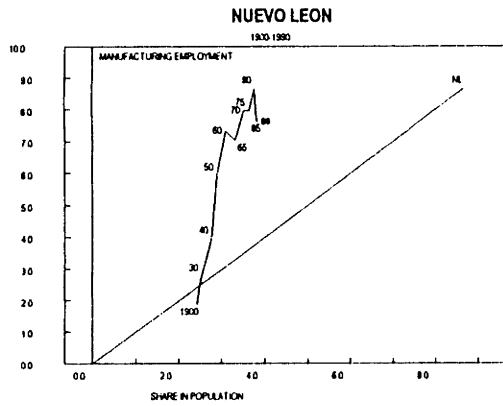
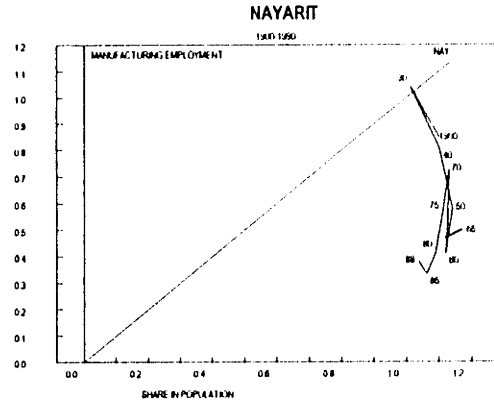
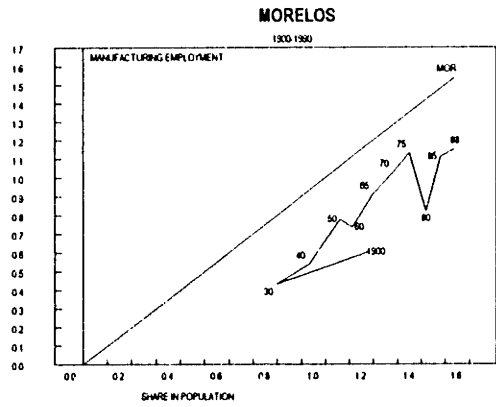
Group 35	Chemicals. It includes petroleum, coal, rubber and plastic products.
3511	Primary Petrochemicals. (Products elaborated by PEMEX)
3512	Manufacturing of basic chemicals. It excludes basic petrochemicals.
3513	Industry of artificial and synthetic fibers.
3521	Pharmaceuticals
3522	Other chemicals.
3530	Petroleum refining
3540	Coke industry. It includes other coal and petroleum products.
3550	Rubber industry.
3560	Plastic industry.
Group 36	Stone, clay and glass.
3611	Pottery and ceramics. It excludes construction materials.
3612	Clay products for the construction.
3620	Glass and glass products
3691	Cement, concrete, plaster and other products made of nonferrous minerals.
Group 37	Primary metals
3710	Iron and steel basic industry.
1720	Primary nonferrous metal industries. It includes the treatment of nuclear fuels.
Group 38	Fabricated metal and machinery. It includes surgical and other precision equipment
3811	Smelting and casting of metallic pieces, ferrous and nonferrous.
3812	Manufacturing of metallic structures, industrial boilers and tanks. It includes ironworks.
3813	Manufacture and repair of metal furniture.
3814	Other metallic products. It excludes machinery.
3821	Manufacturing, repairing and/or assembling of machinery for specific purposes, with or without an electrical engine. It includes farm machinery.
3822	Manufacturing, repairing and/or assembling of machinery for general purposes, with or without electrical engine. It includes arms.
3823	Manufacturing and/or assembling of computers and office equipment.
3831	Manufacturing and/or assembling of electrical equipment. It includes machinery for the production of electrical energy.
3832	Manufacturing and/or assembling of electronic equipment: radio, television, communications and medical equipment.

Data Sources: To compute the location GINI coefficients we used data from the population census from 1900 to 1950 and from the population and industrial censuses from 1960 to 1988. Sectoral analysis was done using data from the 1985 and 1988 industrial censuses.

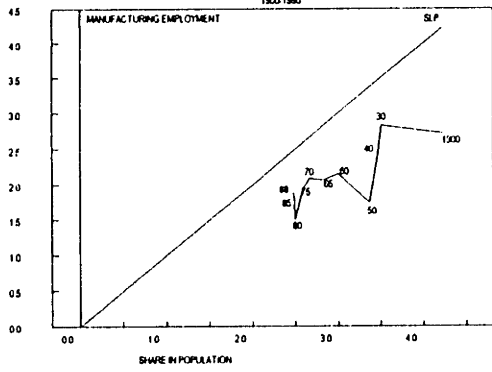
Appendix D. Shares of Population and Manufacturing Employment by State



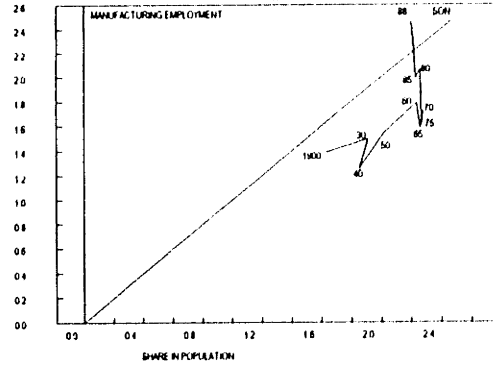




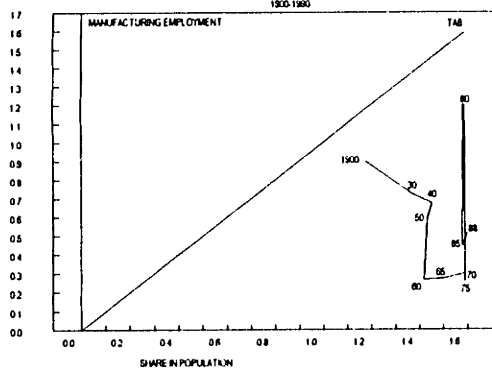
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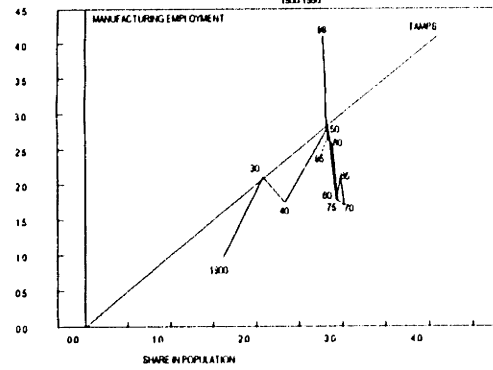
SONORA



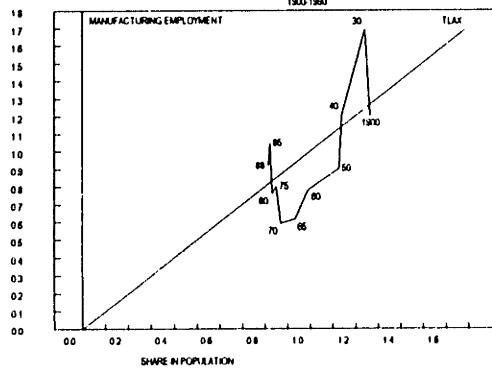
TABASCO



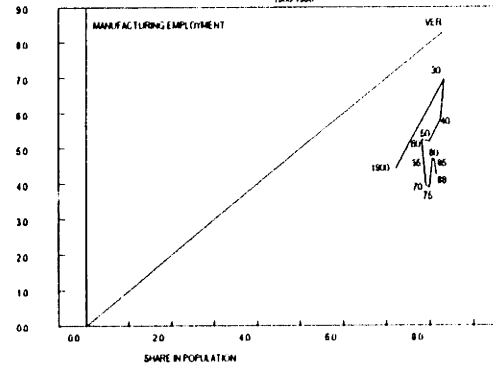
TAMAULIPAS



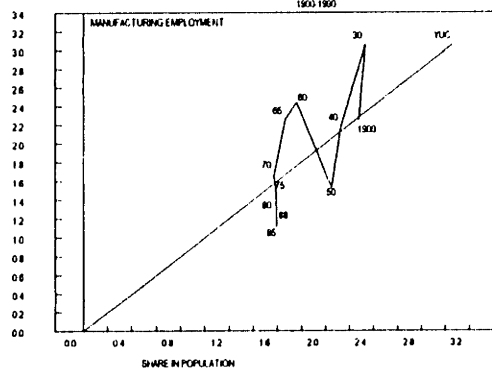
TLAXCALA



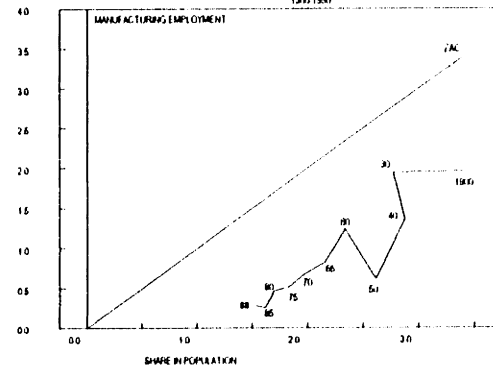
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Chapter 4.

Interest Rates and Political Risk Premia in Mexico

In the past few years, it has been very profitable to hold Mexican government bonds. Those who have held them have earned more than twice the yields they would have earned holding dollar denominated bonds in the US and Europe. For Mexican investors and for the Mexican government it has been more expensive to finance themselves domestically than through the international capital markets. Even though capital mobility should put pressure to close the gap between the domestic and foreign yields, the gap has remained significant. Why has this been so? To what extent do these yields represent a payment for the risk of holding bonds in Mexico? How much does it cost to be Mexico?

After the 1982 debt crisis and before capital started flowing back to the less developed countries, the analysis of country risk gained center stage in the economic research agenda. The economic outlook of these nations had become much grimmer overnight. Banks responded by being more cautious and by significantly reducing the flow of resources to LDC's. Unable to borrow and with significant amounts of short term debt, these countries became net exporters of capital during the 1980's. This in turn generated a drastic reduction in their capacity to grow. The inability to borrow abroad also forced many countries to rely on seigniorage to finance government deficits. In these cases, the debt crisis represented not only declining growth rates in production, but also the beginning of a period of price instability, which brought about the collapse of the exchange rate and in some cases it generated the dark clouds of a possible downfall of the political regime.

Assessing political risk has proven to be an assiduous task for financial institutions. The problem of correctly defining political risk is not trivial. For economists, political risk is closely related to the notion of capital mobility—a central building block of most exchange rate determination models—. The assumption of capital mobility, alters significantly the understanding of the transmission mechanisms of monetary and fiscal policies in the open economy. If capital can move across borders without restrictions and assets are perfect substitutes, then interest rates would tend to equalize. However, as any investor knows, bonds issued in different jurisdictions are subject to different sources of risk. Because the institutional setup is not carved on solid rock and may change significantly on short notice, one can not assume that capital mobility and perfect substitutability are permanent.

In this paper, we analyze the nature of yield differentials. We divide the risk of Mexican bonds into two components: currency and political risk. Currency risk comes from the randomness of the spot exchange rate; a devaluation of the peso can dramatically reduce the dollar yields of a peso denominated asset. Political risk is usually defined residually as the component of total risk that is not attributed to the volatility of the exchange rate.¹⁴ It can be interpreted as a payment for the probability that capital controls or extraordinary taxes, including default, would be imposed on the

¹⁴ For definitions see Aliber (1973). Given that political risk is measured residually, when its magnitude is small it is difficult to disentangle it from transaction costs.

holder of bonds. Therefore, in periods of high uncertainty, both the exchange rate and the political premiums will register greater magnitudes.

We show that in the case of Mexico, political or country risk has been a sizable component of excess yields.¹⁵ When in 1987 the government implemented the stabilization program, known as the "Pact of Economic Solidarity" (PSE), this particular risk premium reached its peak. Since then, as a result of a significant opening of the capital account, the political premium has presented a significant downward trend.

The paper is organized as follows. Section 4.1 describes the Mexican foreign exchange market and the general evolution of the economy. In section 4.2, we review the literature on political risk and the efficient market hypothesis. In section 4.3 we provide a theoretical framework to decompose the risk premia based on the deviations from covered and uncovered interest parity. Section 4.4 shows the results of empirical tests of the efficient market hypothesis in Mexico. Finally, in section 4.5, we provide some general conclusions derived from this study.

¹⁵ Throughout this paper we refer to political and country risk with the same meaning.

4.1 Two Mexican Episodes.

During the 1980's, Mexico experienced two currency crises: 1982 and 1987. Analyzing them in detail helps us clarify the economic disturbances that determine political risk premia.

4.1.1 The 1982 Episode.

The first episode that we analyze is the set of devaluations that came with the debt crisis in 1982. A combination of macroeconomic mismanagement and adverse external shocks forced the country to default its external debt and to devalue the currency.

To analyze how the 1982 crisis affected the linkages between the Mexican economy and the international financial system we can look at the evolution of cross border transaction costs. A useful indicator for this type of analysis is the bid-ask spread in the Mexican peso futures market.¹⁶ The financial story of the crisis is evident in figure 1. The first signs of "bad" news were reported in mid 1981 when high interest rates were coupled with a fall in oil prices. Oil exports represented 70 percent of the country's exports at the time. In the second quarter of 1981, record level of capital flight came together with rumors of devaluation. The bid-ask spread in the futures market rose above 10 percent as a result of these new developments.

¹⁶ The Mexican peso Futures Market was established in New York in 1977. This market operated continuously until 1985 when the government banned the operation of foreign banks through the nationalized commercial banking system.

When the public perceived a devaluation as an imminent possibility, it shifted into dollar denominated assets. By 1982, the so called Mex-dollar accounts, which were dollar denominated deposits in Mexico, represented more than 40 percent of all deposits (See Ramírez-Rojas, 1985). Simultaneously, massive amounts of capital fled the country. Table 1 shows that the deficit in the errors and omissions account increased dramatically during 1981.

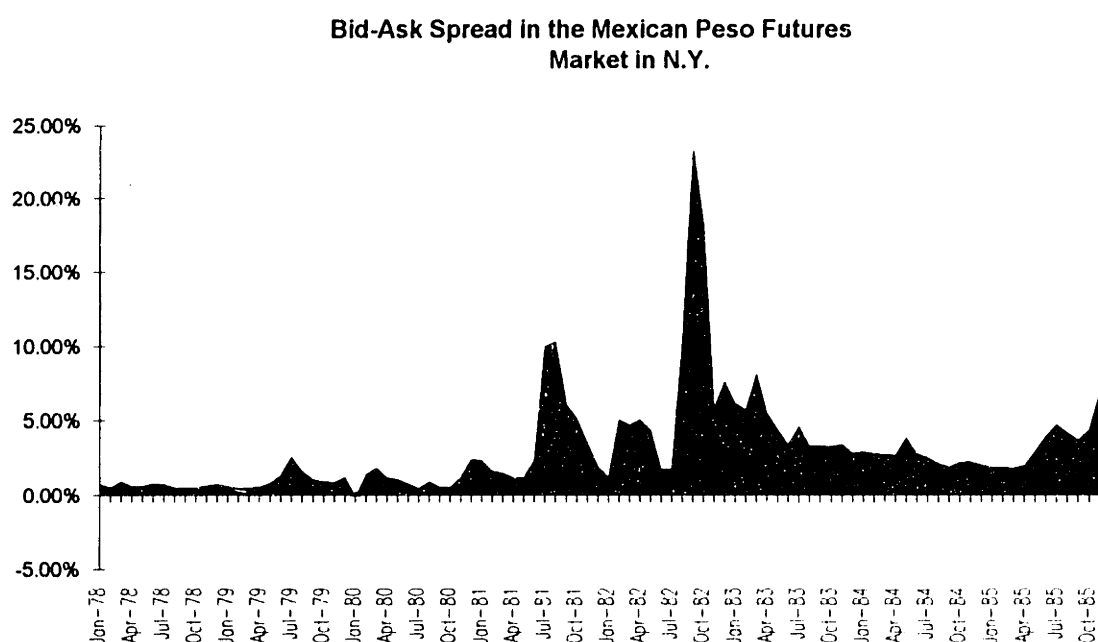
Table 4.1
Capital Flight
BoP Errors and Omissions
(millions of dollars)

1980	90.0
1981	-10,118.7
1982	-5,270.8
1983	-1,021.9
1984	-924.2
1985	-1,688.3

In order to defend the peso, the government used large amounts of short term borrowing. However, success was short lived and in February 1982 the government devalued the peso. In September 1982, the government nationalized the banking system and set strict restrictions on the movement of capital. Given the proximity of Mexico to the United States, these restrictions were insufficient to stop the flow of capital out of the country (see Table 1). Extraordinary taxes were set on dollar deposits in the Mexican banking system when the government decided to redeem the Mex-dollar

deposits below the market rate. In addition, the Mexican authorities established a dual exchange rate regime that had the purpose of isolating the real economy from the volatility that currency speculation could bring to the free rate. The system had a controlled rate used for current account transactions and a free rate for capital account transactions.

Figure 4.1



Financial markets clearly reflected this increased instability. For example, consider the evolution of the peso futures market. In August, when the government was forced to declare a moratorium on the external debt, the market practically disappeared (the bid-ask spread reached almost 25 percent). After this period of high uncertainty, the bid-ask spread started to

fall, even though severe capital controls were being imposed. Nevertheless, capital controls had a considerable impact in maintaining a high spread since it never returned to the levels that it had before 1982. The differences in bid ask spreads between periods were large and significant. As table 4.2 shows, while between 1978 and 1981 the average spread was 1.7 percent, during the unstable year of 1982, it was 7.4 percent. After the financial markets settled, the spread remained more than double of what it was before the crisis (3.54 percent). Running a regression with dummy variables to compare the average between those two periods we see that the difference between the pre and post crisis years is statistically significant. The null hypothesis of equality of both coefficient is rejected with a Wald test at the 99 percent confidence level.

Table 4.2
Bid ask spread

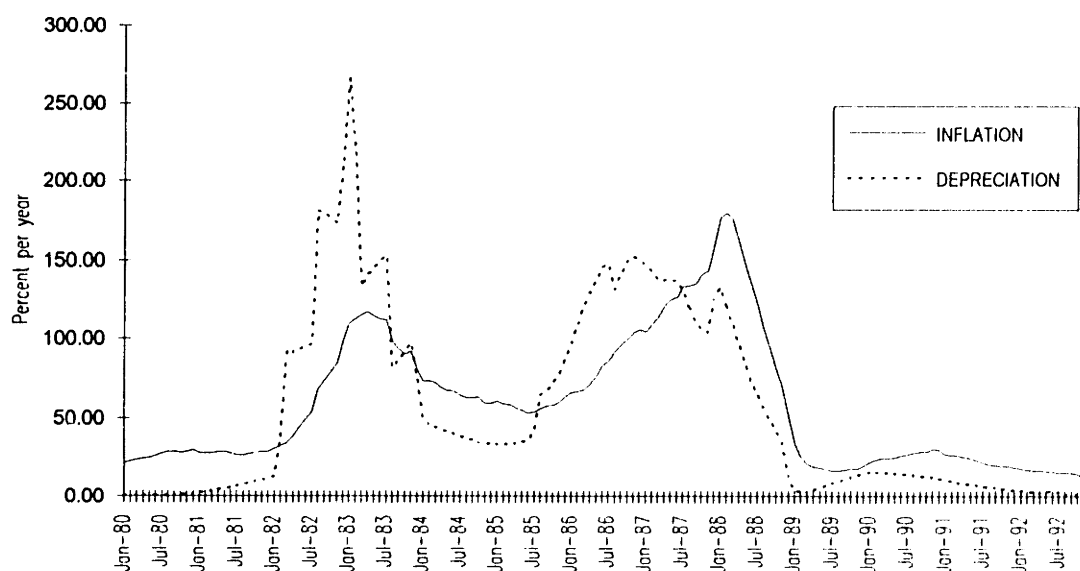
Spread= 1.701 D1 + 7.472 D2 + 3.548 D3		
(4.0)	(8.7)	(7.12)
R ² = .29		
Wald Test $H_0: \beta_1 = \beta_3$		
$\chi^2 = 7.95$		
t statistics in parenthesis		
Dummy Variables		
D1 Jan. 78 - Dec. 81		
D2 Jan. 82 - Dec. 82		
D3 Jan. 83 - Nov. 85		

The story of Mexico's financial instability during the 1980's can also be summarized by showing the evolution of the rates of inflation and depreciation (Figure 4.2). After three sharp devaluations in 1982, the rate of

depreciation of the Mexican peso slowed down and the rate of inflation jumped to over 100 percent per year in 1982.

Figure 4.2

Mexico: Prices and the Exchange Rate



Starting in 1983, Mexico embarked in a series of stabilization and structural change measures which encompassed tight fiscal and monetary policies as well as trade liberalization, deregulation and privatization. As a result of the fiscal reforms, the primary balance of the public sector went from a deficit of 7.3 percent of GDP in 1982 to a surplus from 1983 on. The adjustment effort, combined with a deceleration in the rate of depreciation of the exchange rate, led to a momentary slowdown in inflation that reached a rate of 59.2 percent in 1984. This effort, however, was not successful in achieving a sustained reduction in inflation because the economy faced a major reversal in its terms of trade in 1986 when oil prices fell more than 50

percent. In a short period of time, Mexico lost approximately 6 percent of GDP in fiscal and export earnings. In response, the government accelerated peso depreciation rate promoting a rapid increase in non-oil exports. The shock made inflation reach levels above those of 1982.

4.1.2 The 1987 Episode.

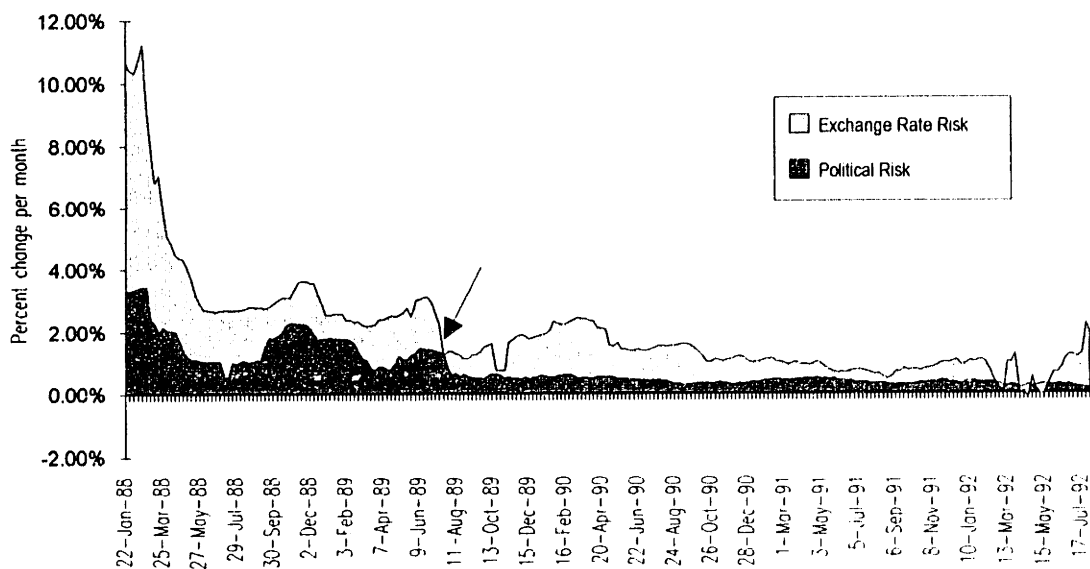
The second Mexican episode is the devaluation of November of 1987 which had a very different nature than the ones observed in 1982. In October 1987 the collapse of the stock markets in Mexico and around the world raised uncertainty with respect to the future evolution of the economy and increased speculation in the foreign exchange market. To prevent a loss of reserves, the government decided not to intervene in the foreign exchange free market in November. This resulted in a substantial depreciation of the free rate of almost forty percent. Most economists were surprised by the magnitude of such a jump since it could not be justified in terms of the economic fundamentals. The primary surplus had risen to 6.9 percent of GDP through the year , the current account of the balance of payments recorded a surplus of 4 billion dollars in the year and the RER was by no means overvalued. However, major price setters validated the devaluation over the weekend by marking up their products and the government was forced to adjust the controlled rate. These events put the economy on the brink of hyperinflation, and forced the government to abandon the policy of gradual adjustment to reduce inflation.

On December 1987 a comprehensive stabilization program, the "Pact of Economic Solidarity" (PES) was launched. It was a concerted program based on coordinated and decreasing price adjustments initiated on a tripartite agreement between government, workers and employers. The PES included tight fiscal policy measures, a credit squeeze, a greater opening of the economy, and wage and price controls. The government fixed the exchange rate and the prices and tariffs of the public sector goods.

The PSE was successful in abating inflationary inertia and reducing inflation rates to pre-crisis years. In 1988 the inflation rate was 51.7 per cent and was further reduced to 19.7 percent in 1989. However, since the exchange rate was used as a nominal anchor, significant RER appreciation followed. With the exchange rate remaining fixed, the gap between TBILL rates and Mexican interest rates expressed in dollars increased substantially. The deviation of interest rates away from uncovered interest parity (UIP) soon became one of the main worries of Mexican policy makers. (Figure 4.3 shows the deviation from uncovered interest parity). UIP did not register a substantial reduction until a debt negotiation agreement was reached in June 1989 (the arrow in the figure indicates the date of the agreement).

Figure 4.3

Decomposition of UIP Deviations



1989 was also a year in which the Mexican authorities adopted several measures encouraging banks to compete more effectively among themselves and with other intermediaries. Controls on interest rates and maturities for all traditional bank industries were eliminated and the reserve requirements were relaxed. The deregulation of the financial system was followed by an interest rate increase for a brief period (See Figure 4.3).

4.2. The Literature on Political Risk and Efficient Markets.

4.2.1 Political Risk.

Aliber (1973) in his seminal analysis distinguished between exchange rate risk and political risk as determinants of deviations from interest rate parity. For Aliber (1973, p.1453), political risk is defined as the "probability that the state will be imposed between investors in one country and investment opportunities in other countries".

Feldstein and Horioka (1980) challenged the conventional view that capital was highly mobile by analyzing the implications of capital mobility on macroeconomic aggregates. If capital is perfectly mobile a fall in savings or an increase in the government deficit should not lead to a crowding out of investment; instead, investment should be given by international interest rates and the country should borrow the difference abroad. But looking at a large set of evidence they found that savings and investment were in fact highly correlated. This controversial finding led to a series of empirical and theoretical papers that focused on refuting its empirical validity, but it turned out to be quite robust. Other work focused on theoretically explaining the correlation between savings and investment.

A large body of literature questions the Feldstein & Horioka (1980) findings from an econometric perspective. They perform the regression shown in equation (4.1):

$$(4.1) \quad \frac{INV}{GDP} = \alpha + \beta \left(\frac{SAV}{GDP} \right) + \varepsilon_i$$

where *INV* stands for investment, *GDP* for gross domestic product and *SAV* for savings.

They find a coefficient β close to 1. We would need real interest rates to be equal and (SAV/GDP) independent of ε_i to get a zero coefficient; this requirement is rather strict. Both savings and investment are endogenous and if they respond to a common disturbance (say productivity growth), the estimator of β cannot be interpreted in a causal way. Feldstein & Horioka (1980) address the endogeneity issue by looking at country and period averages.

Aliber's emphasis on prospective capital controls is further analyzed by Dooley and Isard (1980). They build a portfolio model to show how interest differentials are related to the gross stocks of debt outstanding against different governments and the distribution of wealth among different jurisdictions. They look at the period 1970-1973 when a series of capital controls were introduced in Germany. They show how the introduction of capital controls produced a spread between the interest rate on Euromark deposits and the inter-bank mark denominated bonds in Frankfurt. In this paper we follow Dooley & Isard's approach in focusing on the difference between dollar denominated assets issued by the Mexican government and dollar denominated assets issued in the United States.

A comprehensive framework for the analysis of interest rate parity deviations, in the context of the discussion about international capital mobility is provided by Frankel (1991), Frankel & Froot (1987) and Frankel & McArthur (1987). In Frankel & McArthur (1987), the expected real interest rate parity (ERIP) may break down if covered interest parity (CIP) does not hold, if there is an exchange rate premium (ERP) or if the public expects the real exchange rate to depreciate (ERD). As the following decomposition in equation (4.2) shows, ERIP requires all three conditions to hold simultaneously. Uncovered interest parity (UIP) is formed by the CIP plus the ERP conditions.

$$(4.2) \quad r - r^* = \underbrace{(i - i^* - fd)}_{\text{CIP}} + \underbrace{(fd - \Delta s^e)}_{\text{ERP}} + \underbrace{(\Delta s^e - \Delta p^e + \Delta p^{*e})}_{\text{ERD}}$$

$$\underbrace{\hspace{10em}}_{\text{UIP}}$$

$$\underbrace{\hspace{15em}}_{\text{ERIP}}$$

where all variables are expressed in logs, r is the real interest rate, i is the nominal interest rate, fd is the forward discount, Δs^e is the expected rate of depreciation of the domestic currency, Δp^e is the expected inflation rate and asterisks represent foreign variables.

Frankel (1991) shows that the independence between savings and investment, that Feldstein-Horioka were expecting theoretically, is a more stringent requirement than the expected real interest rate parity. The

conditions to comply with Feldstein & Horioka (1980) investment and savings independence are summarized in the following way:

$$\text{Feldstein-Horioka} \implies \text{ERIP} \implies \text{UIP} \implies \text{CIP}$$

As we mentioned above, we can first decompose the expected real interest rate parity (ERIP) into uncovered interest parity (UIP) and expected real depreciation (ERD). For ERIP to hold UIP must hold and purchasing power parity (PPP) must hold too. But, there is now an ample body of evidence that rejects PPP in its crudest forms due to the existence of non traded goods and imperfect competition [see Dornbusch (1988)]. UIP can be further decomposed into covered interest rate parity (CIP) and the exchange risk premium (ERP). Together, these parity conditions rest at the core of any explanation of capital mobility.

In the last decade, deviations from CIP for the major industrialized economies have been small and not statistically significant. Frankel & MacArthur (1987) review the evidence of these components of ERIP deviations. They find that by 1980, deviations from CIP have almost disappeared for major industrialized economies. The other two components, which are labeled together the currency premium, are large for most economies. However, even if CIP holds for industrialized economies it does not hold for LDCs. In his list of offenders, Mexico is the country that shows largest deviations.

For most countries even if CIP deviations are present, they usually represent a small share of the deviations from UIP. In general, the currency premium dominates. In contrast with this general trend, during the early stages of the stabilization program that was launched in 1987 the country premium dominated in Mexico. The focus of the following sections is to analyze the evolution of this country premium.

4.2.2 Efficient Markets.

Macro models that view the exchange rate as an asset price assume that the foreign exchange market is in equilibrium when deposits in different currencies offer the same expected rate of return when expressed in a common currency, possibly adjusting for the existence of a risk premium. The popular overshooting model simplifies the bond market equilibrium condition by equalizing bond yields in domestic currency as shown in equation (4.3).

$$(4.3) \quad i = i^* + \dot{s}^e$$

where i is the interest rate, \dot{s}^e is the expected rate of depreciation and an asterisk represents a foreign variable.

If investors are risk neutral and have rational expectations, then expected depreciation should be equal to the interest rate differential. Tests of

UIP have been done extensively for all major currencies on several time periods. The usual approach is to compute a regression using equation (4.4).

$$(4.4) \quad \frac{S_{t+1} - S_t}{S_t} = \alpha + \beta \left(\frac{I - I^*}{1 + I^*} \right) + \varepsilon_t$$

where S_t is the spot exchange rate.

If UIP holds, we should not be able to reject the hypothesis that $\alpha = 0$ and $\beta = 1$. However as Froot & Thaler (1990) report, a large number of tests reject the hypothesis that $\beta = 1$ and actually find much lower β 's. A β equal to zero is consistent with Meese & Rogoff (1983) idea that the exchange rate is best described as a random walk. β 's below one are difficult to explain, but very common in this type of studies [for a recent survey on this topic see McDonald & Taylor (1991)].

The finding that $\beta < 1$ can be rationalized with the introduction of a time varying risk premium that is positively correlated with the interest rate differential.¹⁷ An alternative test is to use the forward discount as a predictor

¹⁷ In a single regression context if we have the following model:

$$y = \beta_1 X_1 + \beta_2 X_2 + \varepsilon,$$

Running a regression with a missing variable ($y = \beta_1 X_1 + \varepsilon$) yields a biased estimator of β .

of the future spot rate given by equation (4.5) where we express the variables in logs¹⁸.

$$(4.5) \quad s_{t+1} - s_t = \alpha + \beta(f_t - s_t) + \varepsilon_t$$

In equation (5), s_t is the log of the exchange rate and f_t is the log of the forward exchange rate.

Equation (4.5) presupposes that CIP holds. To test the covered parity conditions we use equations (4.6) and (4.7).

$$(4.6) \quad \frac{F_t - S_t}{S_t} = \frac{I - I^*}{1 + I^*},$$

$$(4.7) \quad f_t - s_t = i - i^*$$

where F_t is the forward exchange rate.

$$E(b_1) = \beta_1 + \frac{\text{Cov}(X_1, X_2)}{\text{Var}(X_1)} \beta_2$$

If the true model is $\Delta S_t = 1 \cdot (i - i^*) - 1 \cdot (\rho_t)$ and if $\text{Cov}(i - i^*, \rho_t) > 0 \Rightarrow \hat{\beta}_1 < \beta_1 = 1$

¹⁸ We perform tests of these models expressing the percentage changes in their basic form or as differences in logs. Using the log model gives a much better fit if the sample contains large deviations.

4.3 A Theoretical Perspective on Political and Currency Premia

In this section we develop a model to compare the evolution of three interest rates. The rate of Mexican peso denominated treasury bills (CETES), the rate of dollar denominated Mexican bonds (PAGAFES or TESOBONOS)¹⁹ and the rate of United States treasury bills (TBILLS). Extending Carstens (1987), we formulate a model analogous to the Consumption Capital Asset Pricing Model (CCAPM). We consider the case of a consumer that has to allocate her wealth between foreign bonds and two types of bonds issued by the Mexican government; a peso denominated bond and a dollar indexed bond. The model will help to clarify the conditions that will lead to deviations from CIP and UIP.

4.3.1 Covered Interest Parity

The model assumes that the consumer lives for two periods and has a fixed stock of wealth (W_t). In the first period, she must allocate wealth between consumption (C_t) and three types of bonds: peso denominated bonds, CETES (B_t^0) which yield i_t^0 , dollar denominated bonds issued by the Mexican government, PAGAFES or TESOBONOS (B_t^1) which yield i_t^1 and United States TBILLS (B_t^2) which yield i^* .

¹⁹ PAGAFES were first issued in 1986 and were pegged to the controlled exchange rate. One of their main functions was to be used as guarantee in the forward operations in the *cobertura* market. In 1990, TESOBONOS were introduced. The only difference between this instrument and PAGAFES is that they are pegged to the free exchange rate instead than to the controlled one. In November 1991, the dual exchange rate system that existed was abrogated, a target zone mechanism was established and TESOBONOS replaced the extinct PAGAFES.

In addition to the randomness of the exchange rate, we introduce two possible sources of risk. First of all, a holder of Mexican bonds faces the probability that the government will default (partially or totally) on its liabilities during the tenure period of the bond. $\tilde{\theta}_B$ is a random variable that reflects the expected rate of taxation that will be levied on a government bond in the case of some unexpected event. Furthermore, as the 1982 episode suggests, the government may discriminate between assets of different denominations. $\tilde{\theta}_A$ is a risk variable that captures the possibility that the government discriminates against dollar denominated bonds by being exclusively attached to this type of bonds.

Therefore, if an individual invests B_t^0 in domestic assets he expects to receive $E(B_t^0(1+i^0)(1-\theta_B))$ in the next period. Since for the moment we are interested only in deviations from covered interest parity we can assume that the individual is not interested in speculating in foreign exchange and covers all her purchases in the forward market. Under this setup, the consumer's maximization problem is given by equation (8).

$$(4.8) \quad \begin{aligned} & \text{Max}_{C_t, B_t^0, B_t^1, B_t^2} U(C_t) + \beta E[U(C_{t+1})] \\ & \text{s.t.} \quad W_t = P_t C_t + B_t^0 + S_t B_t^1 + S_t B_t^2 \\ & \quad \tilde{W}_{t+1} = \tilde{P}_{t+1} \tilde{C}_{t+1} \end{aligned}$$

$$\begin{aligned}\tilde{W}_{t+1} = & B_t^0(1+i^0) + F_{t+1}(1+i^1)B_t^1 + F_{t+1}(1+i^1)B_t^1 \\ & - \tilde{\theta}_A F_{t+1}(1+i^1)B_t^1 - \tilde{\theta}_B [B_t^0(1+i^0) + F_{t+1}(1+i^1)B_t^1]\end{aligned}$$

where $\tilde{\theta}_B$ is the risk on government bonds, $\tilde{\theta}_A$ is the Mex-dollar risk, β is the discount factor, P_t is the price level.

We can solve for \tilde{C}_{t+1} from the restrictions of equation (4.8) and get:

$$(4.9) \quad \tilde{C}_{t+1} = \frac{\tilde{W}_{t+1}}{\tilde{P}_{t+1}} = \frac{1}{\tilde{P}_{t+1}} \left((W_t - P_t C_t - S_t B_t^1 - S_t B_t^1)(1+i^0) + B_t^1(1+i^1)B_t^1 \right. \\ \left. + F_t(1+i^1)B_t^1 - \theta_A (B_t^1(1+i^1)F_t) - \theta_B (W_t - P_t C_t - S_t B_t^1 - S_t B_t^1)(1+i^0) \right) \\ \left. + B_t^1(1+i^1)F_t \right)$$

Inserting equation (4.9) into the objective function (4.8) we get the following first order conditions:

$$(4.10) \quad U'(C(t)) = \beta E \left(U'(C(t+1)) \frac{P_t}{P_{t+1}} (1+i^0)(1-\theta_B) \right) = 0$$

$$(4.11) \quad \beta E \left[U(t+1) \frac{1}{P_{t+1}} \left(F_t(1+i^1) - S_t(1+i^0) \right)_t \right. \\ \left. - \theta_A (1+i^1)F_t + \theta_B (1+i^0) - \theta_B (1+i^1)F \right] = 0$$

$$(4.12) \quad \beta E \left(\frac{U'(C_{t+1})}{P_{t+1}} 1 - S_t(1+i^0) + F_t(1+i^1) + \theta_B S_t(1+i^0) \right) = 0$$

In order to simplify the FOC's (4.10), (4.11) and (4.12) we define the implied future exchange rates as:

$$(4.13) \quad F_t^* = S_t \frac{(1+i^0)}{(1+i^1)} \quad \text{and} \quad F_t^1 = S_t \frac{(1+i^0)}{(1+i^1)}$$

Substituting the definitions in (14) into the objective function we can re-express the first order conditions.

$$(4.10') \quad U'(C_t) = \beta E \left(U'(C_{t+1}) \frac{P_t}{P_{t+1}} (1+i^0)(1-\theta_B) \right)$$

$$(4.11') \quad E \left(\frac{U'(C_{t+1})}{P_{t+1}} (F_t - F^1 - \theta_A F_t - \theta_B F_t + \theta_B F^1) \right) = 0$$

$$(4.12') \quad E \left(\frac{U'(C_{t+1})}{P_{t+1}} (F_t - F^* + \theta_B F^*) \right) = 0$$

As in any version of consumption based asset pricing, we are interested in the covariance between the probability of government intervention and the marginal utility of consumption in real terms. To further simplify the first order conditions we can define the risk premium ψ_i :

$$(4.14) \quad \psi_i = E(\theta_i) + \frac{\text{Cov}(U'(C_{t+1})/P_{t+1}, \theta_i)}{E(U'(C_{t+1})/P_{t+1})}.$$

Using the laws of covariance and equation (14) we can further transform the first order conditions into:

$$(4.11'') \quad F_t = F_t^1 \frac{(1 - \psi_B)}{(1 - \psi_A - \psi_B)}$$

$$(4.12'') \quad F_t = F_t^*(1 - \psi_B)$$

where ψ_A is the Mex-dollar risk premium and ψ_B is the political risk premium.

These conditions imply a relationship between F_t^* and F_t^1 that is given by the following equation:

$$(4.15) \quad \frac{F_t^*}{F_t^1} = \frac{1}{1 - \psi_A - \psi_B}$$

Using small caps to denote a first order log approximation²⁰ we get more familiar interest arbitrage conditions:

²⁰ Small caps denote logs, $\log(1 + \psi) \cong \psi$ for ψ small.

$$(4.16) \quad i^0 = i^* + (f_t - s_t) + \psi_B$$

$$(4.17) \quad i^0 = i^1 + (f_t - s_t) + \psi_A$$

$$(4.18) \quad f^* - f^1 = i^1 - i^* \cong \psi_A + \psi_B$$

Equation (4.16) shows that in the presence of political risk ($\psi_B \neq 0$) the familiar CIP relationship between peso bonds and TBILLS breaks down. Equation (4.17) shows that CIP between domestic bonds breaks down if the public perceives that government bonds will be treated differently in case that the extraordinary events captured in θ actually take place. Finally equation (4.18) shows that the difference between domestic and foreign dollar denominated interest rates is equal to the sum of the two components of political risk.

An interesting case occurs when $\tilde{\theta}_A$ is identically equal to zero. In this case $\psi_A = 0$ and we have the result that CIP for domestic instruments must hold at all times. This further implies that deviations from CIP between peso instruments and TBILLS must be equal to the spread between Mexican dollar denominated bonds and TBILLS.

4.3.2 Uncovered Interest Parity.

The framework elaborated above can be used to analyze deviations from uncovered interest parity. This time, however, we allow the consumer to speculate in the foreign exchange market. We will restrict our attention only to domestic peso bonds (B^0) and foreign bonds. The consumer's problem is described as follows:

$$\begin{aligned}
 (4.19) \quad & \text{Max } U(C_t) + \beta E(U(C_{t+1})) \\
 & \text{s.t. } W_t = C_t P_t + B_t^0 + S_t B_t^1 + S_t B_t^2 \\
 & \tilde{W}_{t+1} = \tilde{P}_{t+1} \tilde{C}_{t+1} \\
 & \tilde{W}_{t+1} = B_t^0 (1 + i^0) + F(1 + i^*) B_t^1 + \tilde{S}_{t+1} (1 + i^*) B_t^2 - \tilde{\theta} B_t^0 (1 + i^0)
 \end{aligned}$$

where B^1 is the stock of bonds that is covered in the futures market and B^2 is the amount that is not covered. $\tilde{\theta}$ is the political risk parameter.

Substituting the restrictions into the objective function and maximizing it, we arrive at the following first order conditions:

$$(4.20) \quad \beta E \left(U'(C_{t+1}) \frac{1}{P_{t+1}} (-S_t (1 + i^0) (1 - \tilde{\theta}) + F_t (1 + i^*)) \right) = 0$$

$$(4.21) \quad \beta E \left(U'(C_{t+1}) \frac{1}{P_{t+1}} (-S_t (1 + i^0) (1 - \tilde{\theta}) + S_{t+1} (1 + i^*)) \right) = 0$$

To further simplify the first order conditions we can define the political risk premium (ψ) and the exchange rate risk premium (φ) in the following manner:

$$(4.22) \quad \psi = E(\tilde{\theta}) + \frac{Cov(U'(C_{t+1})/P_{t+1}, \theta)}{E(U'(C_{t+1})/P_{t+1})}$$

$$(4.23) \quad \varphi = \frac{Cov(U'(C_{t+1})/P_{t+1}, S_{t+1})}{E(U'(C_{t+1})/P_{t+1})}$$

As before, the condition on covered interest bonds gives:

$$(4.24) \quad F_t = F^*(1 - \psi)$$

The condition on speculative purchases of bonds gives:

$$(4.25) \quad E(S_{t+1}) = F^*(1 - \psi) - \varphi$$

Hence, φ is the exchange risk premium from equation (24).

$$(4.26) \quad \varphi = F_t - E(S_{t+1})$$

The exchange rate risk premium (ϕ) results from the conditional covariance between the future spot rate and the real marginal utility of income.

4.4 Empirical Estimation

In this section, we perform an empirical analysis of political risk for the Mexican case. To do this, we use the rate ($F_t = K_t(1+i) + S_t$) implicit in the *cobertura* deals for the analysis of interest rate parity. (Appendix I shows the equivalence between them).²¹

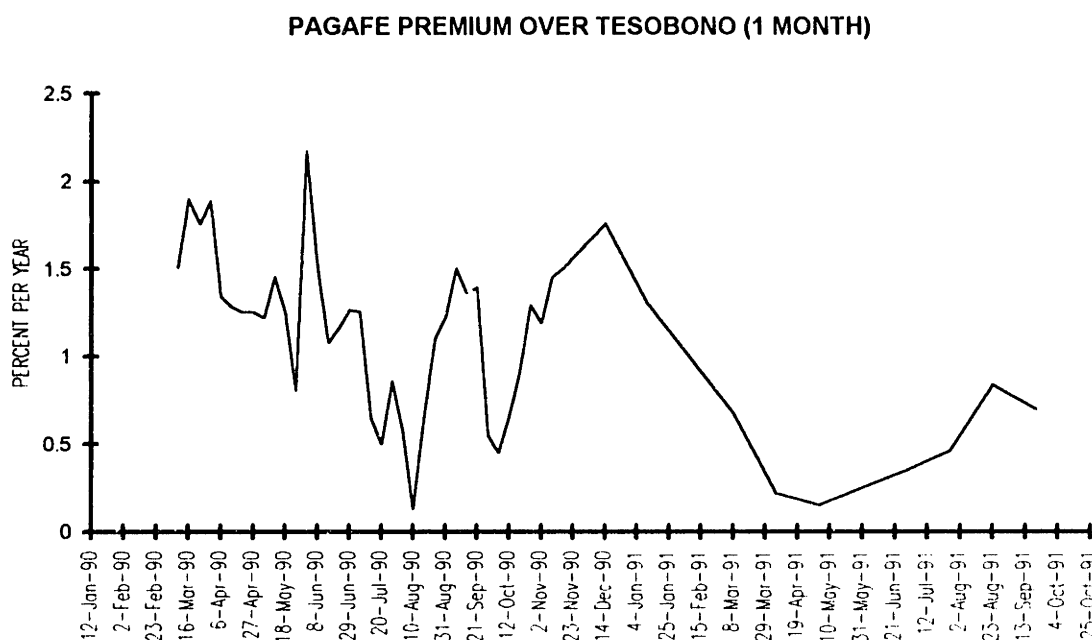
Given the 1982 experience, when the controlled rate was used to redeem Mex-dollar deposits we can expect PAGAFES to pay a premium over TESOBONOS which in fact they do. Between 1990 and 1991 PAGAFES paid an average 1.3 percent more than TESOBONOS (See figure 4) Although this gap does not alter significantly the trend of the political risk premium, it

²¹ The Peso futures market stopped operating in New York on November 1985. However, in 1987 the Central Bank established the *Cobertura Cambiaria* market. The *cobertura* market was devised as an insurance scheme against devaluations but works in a slightly different fashion than a futures or forward market. The main difference between the *cobertura* market and a forward market is that the interest rate spread is paid on the date the contract is signed and not when it expires. In equilibrium, the price of the *cobertura* is the present value of the difference between the expected future rate implicit in the interest rate differential and the current spot rate. K_t , the price of a *cobertura* is determined by the following equation:

$$K_t = \frac{1}{1+i_t} \left(\frac{S_t(1+i_t)}{1+i_t^*} - S_t \right)$$

shows that there is some evidence that the 1982 events remained in the memory of the public. The gap shows how much the public was asking to hold a bond that was to be redeemed at the controlled rate in comparison with a bond indexed to the free rate.

Figure 4.4



Tables 4.3-4.6 contain alternative estimations of interest rate parity conditions. Tables 4.3 and 4.4 show interest rate parity conditions expressing the relationships in percentage terms. Tables 4.5 and 4.6 show the result for the relationship expressed in logs terms. The estimations are done for two different periods: January 1987 through August 1992, and January 1989 through August 92. The distinction in the samples is meant to take into consideration that 1987 and 1988 were dominated by uncertainty and new

information related with the implementation of the Mexican stabilization program PSE that started in December 1987. The selection of these two sample periods is also relevant because many studies of exchange market efficiency find an estimate of $\beta < 1$ in regressions like (4.4). One of the explanations of the breakdown of UIP is the possibility of a peso problem.²² By selecting different sample sizes we can observe what happens with the estimators when a peso event is or is not considered.

The results of the regressions in tables 4.3-4.6 are in line with the general results of the literature that test the efficient market hypothesis; see McDonald & Taylor (1992), Ballie & McMahon (1989). The estimated β 's are smaller than 1 and the regression errors are serially correlated.

Using the framework developed in the previous section we can test several hypothesis. First, we can check if the public perceives government bonds denominated in different currencies as equivalent in terms of their political risk. This question must be framed recalling the 1982 episode when dollar accounts were redeemed at an exchange rate below the prevailing market rate. In terms of equation (18) we are testing if ψ_A is not significantly different from zero. The results for this test appear in columns 1 and 3 of tables 4.4 and 4.6. These columns show the result of regressing the forward discount against the interest rate differential.

²² The Mexican peso received worldwide attention by being sold at a discount against the dollar between 1960 and 1976. The rationale for this result was the possibility that a large devaluation could occur with a small probability.

Table 4.3: Uncovered Interest Parity.

$$\text{Test Equation: } (S_{t+1} - S_t) / S_t = \alpha + \beta \Delta + \varepsilon_t$$

	1	2	3	4	5	6
Period	Feb 87 - Aug 92			Jan 89 - Aug 92		
Constant	-16.62 (-1.70)	-2.09 (-0.17)	-2.55 (0.19)	0.467 (0.04)	-0.393 (-0.34)	-1.087 (-0.93)
$\Delta_1 = (F_t - S_t) / S_t$	1.30 (7.95)			0.51 (8.67)		
$\Delta_2 = (I_C - I_P) / (1 + I_P)$		0.70 (4.59)			0.44 (9.23)	
$\Delta_3 = (I_C - I_T) / (1 + I_T)$			0.62 (4.05)			0.38 (9.55)
NOBS	67	67	67	44	44	44
\bar{R}^2	0.48	0.23	0.18	0.63	0.66	0.67
Wald ($\alpha = 0, \beta = 1$)	3.83	7.24 **	12.44 ***	200.2 ***	521.3 ***	1141.1 ***
Wald ($\beta = 1$)	3.34 *	3.87 **	6.1 ***	64.35 ***	130.0 ***	246.0 ***
Q1	0.30	3.82 *	5.05 **	15.83 ***	13.23 ***	13.41 ***

t-statistics in parenthesis

* = significant at the ten percent level

** = significant at the five percent level

*** = significant at the one percent level

C=CETE rate, P=Pagafe rate, T=T-bill rate

Table 4.4: Covered Interest Parity.

$$\text{Test Equation: } (F_t - S_t) / S_t = \alpha + \beta \Delta + \varepsilon_t$$

	1	2	3	4
Period	Feb 87 - Aug 92		Jan 89 - Aug 92	
Constant	3.48 (1.12)	1.03 (0.27)	-0.57 (-0.65)	-1.57 (1.65)
$\Delta_2 = (I_C - I_P) / (1 + I_P)$	0.69 (17.6)		0.81 (21.65)	
$\Delta_3 = (I_C - I_T) / (1 + I_T)$		0.65 (14.3)		0.67 (20.77)
NOBS	67	67	44	44
\bar{R}^2	0.82	0.75	0.91	0.90
Wald ($\alpha = 0, \beta = 1$)	83.12 ***	101.9 ***	125.24 ***	558.35 ***
Wald ($\beta = 1$)	59.54 ***	58.28 ***	26.61 ***	101.55 ***
Q1	22.41 ***	26.07 ***	14.34 ***	5.76 ***

t-statistics in parenthesis

*= significant at the ten percent level

**= significant at the five percent level

***=significant at the one percent level

C=CETE rate, P=Pagafe rate, T=T-bill rate

Table 4.5: Uncovered Interest Parity.

Test Equation: $s_{t+1} - s_t = \alpha + \beta \Delta + \varepsilon_t$

	1	2	3	4	5	6
Period	Feb 87 - Aug 92			Jan 89 - Aug 92		
Constant	-0.007 (-2.65)	-0.005 (-1.74)	-0.006 (-1.46)	-0.0005 (-0.05)	-0.001 (-1.04)	-0.0016 (-1.66)
$\Delta_1 = f_t - s_t$	1.014 (12.7)			0.573 (8.47)		
$\Delta_2 = i_C - i_P$		0.912 (9.06)			0.605 (9.35)	
$\Delta_3 = i_C - i_T$			0.697 (6.90)			0.455 (9.35)
NOBS	67	67	67	44	44	44
\bar{R}^2	0.71	0.55	0.41	0.62	0.62	0.66
Wald ($\alpha = 0, \beta = 1$)	12.4 **	12.9 ***	46.1 ***	152.2 ***	195.8 ***	804.3 ***
Wald ($\beta = 1$)	0.058	0.752	8.98 ***	39.76 ***	30.61 ***	125.8 ***
Q1	7.1 **	12.5 ***	18.2 ***	15.4 ***	13.2 ***	12.8 ***

t-statistics in parenthesis

*= significant at the ten percent level

**= significant at the five percent level

***= significant at the one percent level

C=CETE rate, P=Pagafe rate, T=T-bill rate

Table 4.6: Covered Interest Parity.

$$\text{Test Equation: } f_t - s_t = \alpha + \beta \Delta + \varepsilon_t$$

	1	2	3	4
Period	Feb 87 - Aug 92		Jan 89 - Aug 92	
Constant	-0.0008 (-0.75)	-0.003 (-1.90)	-0.001 (-1.39)	-0.0017 (-2.51)
$\Delta_1 = i_c - i_p$	0.974 (29.25)		0.999 (19.09)	
$\Delta_2 = i_c - i_T$		0.814 (18.77)		0.735 (21.8)
NOBS	67	67	44	44
\bar{R}^2	0.92	0.84	0.89	0.91
Wald ($\alpha = 0, \beta = 1$)	4.43	88.6 ***	9.27 ***	516.5 ***
Wald ($\beta = 1$)	0.61	18.23 ***	0.00	62.19 ***
Q1	21.34 ***	31.09 ***	18.6 ***	6.10 **

t-statistics in parenthesis

*= significant at the ten percent level

**= significant at the five percent level

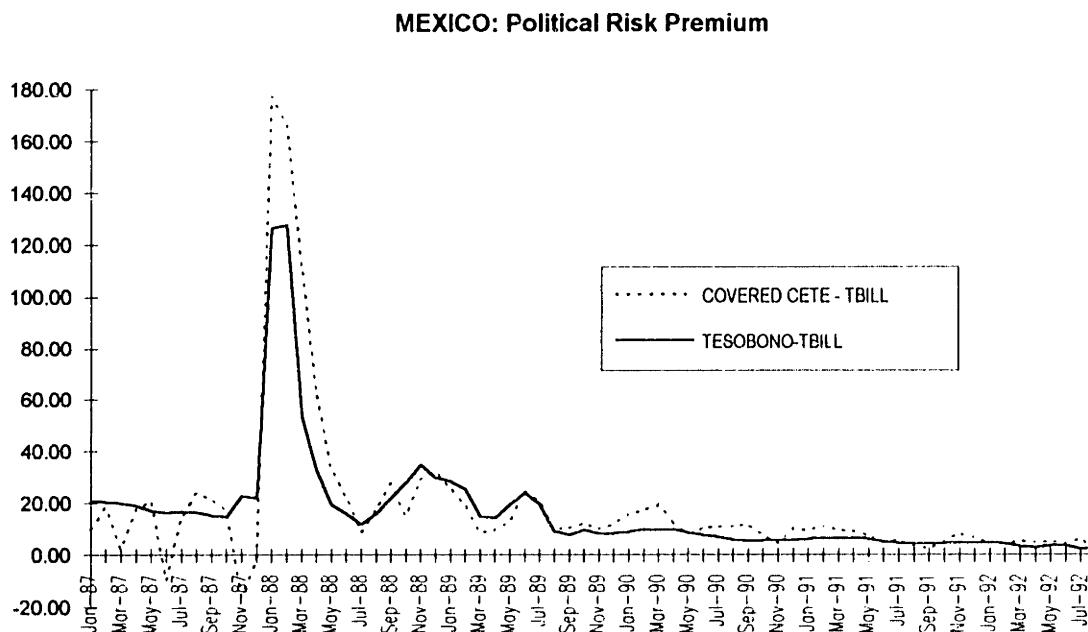
***= significant at the one percent level

C=CETE rate, P=Pagafe rate, T=T-bill rate

Columns 2 and 4 of table 4.6 show how well the forward discount is forecasted by the CETE-TBILL differential. These equations are testing if ψ_B of equation (17) is equal to zero. The regressions show a clear rejection over both sample periods. This result is expected in the case of a significant political risk premium. The existence of a sizable political risk premium is evident in figure 4.3 where we show a decomposition of deviations from UIP.

If $\psi_A = 0$ and $\psi_B > 0$, then we would expect the political risk premium to be equivalent to the difference in PAGAFE and the TBILL rates. Both methods of computing the political risk are plotted in figure 4.5. We can observe that both measures broadly follow each other although there are sizable deviations before and during the implementation of the Pacto.

Figure 4.5



In 1987 both measures do not move closely together and the political risk measured by the difference between PAGAFE and TBILL rates is on average larger than CIP deviations between CETES and TBILL suggesting that for this period ψ_A , the Mex-dollar risk premium, was greater than zero. The large deviations between the two measures may also be a consequence of the thinness of the PAGAFE market in 1987.

In 1987 with the huge surge in real interest rates in the initial phases of the Pacto there are sizable deviations between both measures. After 1988, empirical evidence shows that both measures follow each other closely.

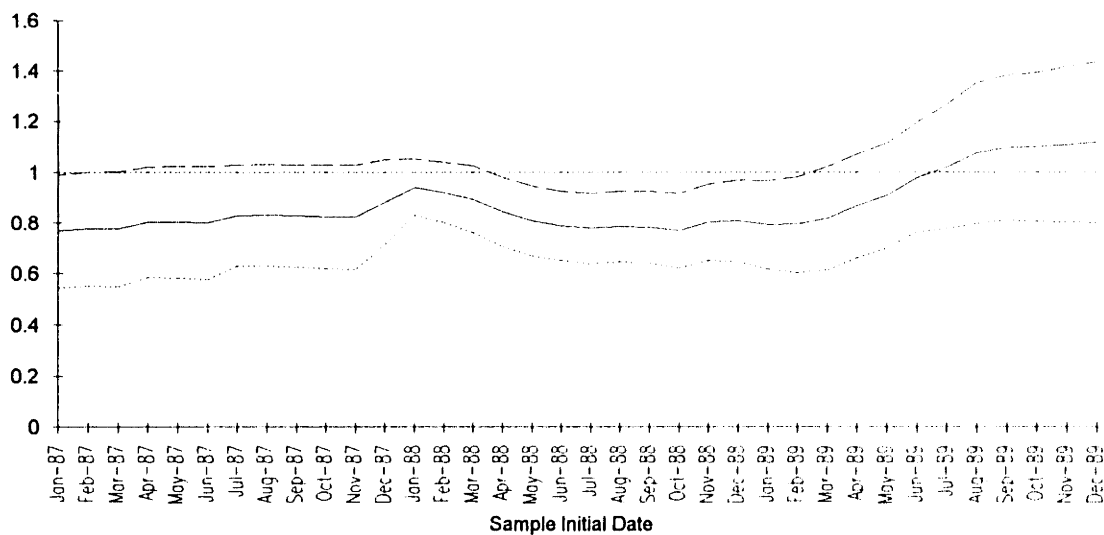
We can test directly the hypothesis that the two approaches are equivalent. If we define the political risks as; $PR = i^0 - i^* - f_t + s_t$ and $PR2 = i' - i^*$, we can test the hypothesis that the two measures are equivalent running equation (27).

$$(27) \quad PR = \alpha + \beta PR2 + \varepsilon_t$$

Figure 4.6 shows the value of β and the 95 percent confidence bands for the regression described in equation (27). Over the whole sample period β is significantly smaller than one, but after 1989 we can not reject the null hypothesis that $\beta = 1$. This result supports our previous contention that after the uncertain initial phases of the Pacto, no arbitrage operations in the CETE-PAGAFE markets were possible.

Figure 4.6

**Political Risk
CIP vs. Dollar Rate Differential**



Tables 4.3 and 4.5 show evidence on UIP. For the whole sample period, the unbiasedness hypothesis holds in regressions that include the forward discount (column 1) or only domestic instruments (column 2). β estimates of the interest rate differential between CETES and TBILL are less than one. This result is expected due to the inclusion of political risk in this rate. In the restricted sample period β estimates are below one, showing evidence of a peso problem if we restrict our sample not to include the 1987 devaluation. The estimated β for different initial sample sizes of the regressions in column one and two of table 4.3 are plotted in figures 4.7 and 4.8.

Figure 4.7

Forward Discount

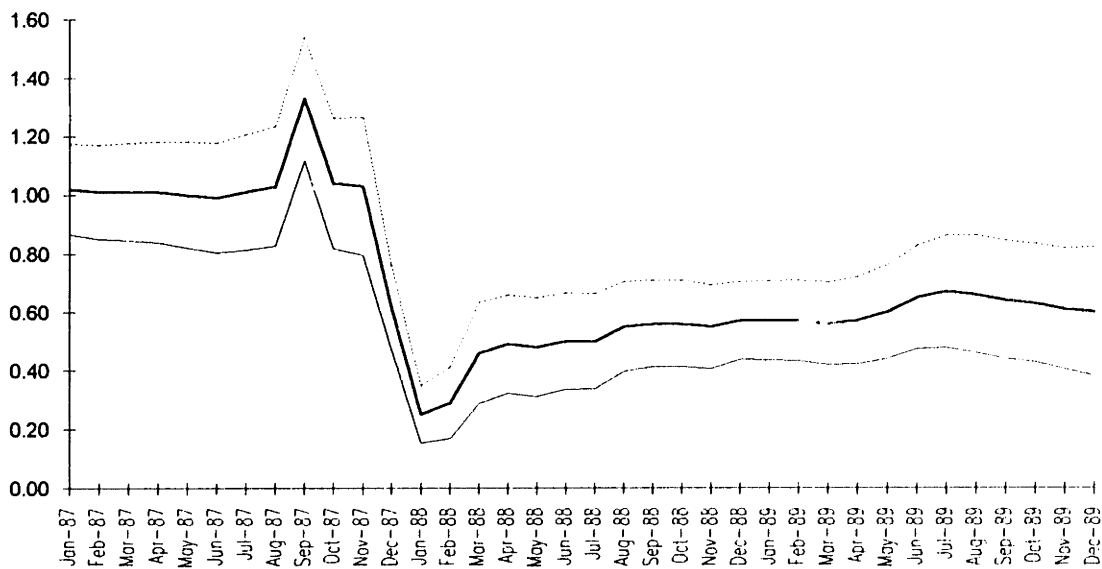
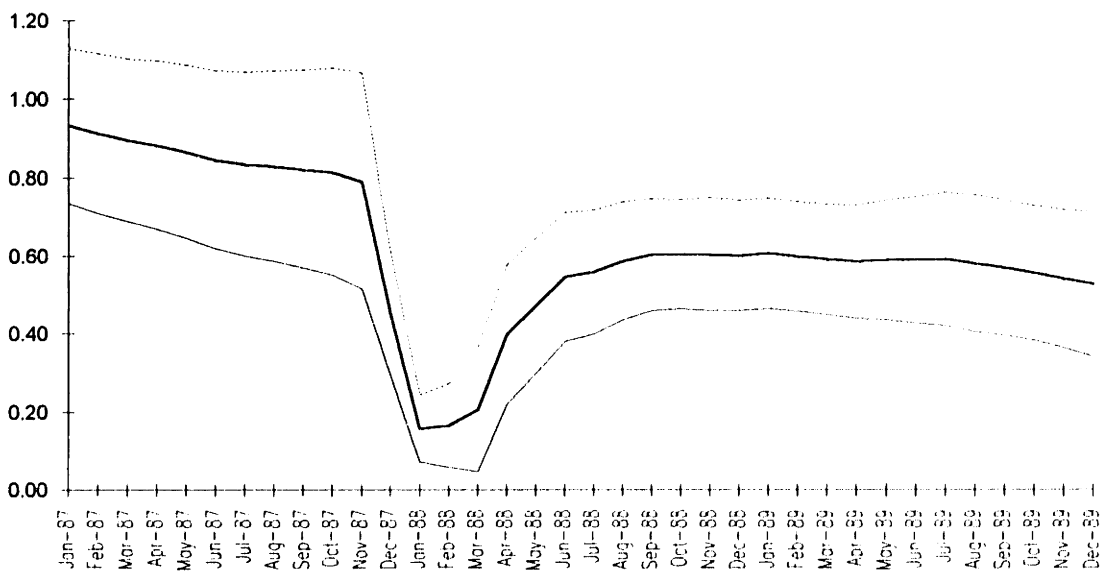


Figure 4.8

Cete-Pagafe Rates



Both figures show that the reason why we do not reject the unbiasedness hypothesis for the whole sample period is that the regression results are dominated by large swings between November 1987 and March 1988.

Summarizing, we find evidence that CIP does not hold across boundaries. Internal CIP is evidence of a well integrated financial market.²³ If the internal financial market is efficient then the political risk premium can be measured as the difference in the domestic dollar rate and the foreign dollar rate. Both measures appear to be converging in the case of Mexico. Our tests of UIP show how a peso problem may be the main reason why so many studies find a coefficient of β in equations 4 and 5 to be less than one. In regressions that include a peso event we are not able to reject the null hypothesis of unbiasedness but if the event is not included the coefficients fall to values significantly below one.

Deviations from CIP arise from existing or expected capital controls. Yield differentials denominated in the same currency net of the exchange rate premium can be read as a measure of effective capital mobility. Alternatively, the difference in dollar yields can be used to rate the quality of an investment

²³ There is evidence that this integration extends also to the external debt market. Khor & Rojas-Suarez (1991) find evidence that PAGAFES and the yield on external debt are cointegrated.

in pesos.²⁴ In figure 4.9 we plot the political risk premium against the extra average yield of BAA rated Bonds (Moody's) over long period (30 years) treasury notes. Although the comparison is not accurate due to the difference in maturities in the two bonds considered, the comparison shows the order of magnitude of the fluctuations in the political premium in Mexico.

²⁴ Country risk analysts working for banks and other financial institutions look at a set of political and economic variables to rate a country. An example of this type of index is *Euromoney's* risk ranking system. This system is based on questionnaires that are sent to several specialists that study the financial situation of each country. The evaluation is done according to a series of categories which include production growth variables, risk of default, credit ratings and access to bank finance. In addition, to pool resources so that small banks could have access to this type of analysis risk evaluation operations like the Institute for International Finance were created. A risk evaluation operation is invariably a step in the decision to provide credits to LDCs. Banks decide first on the maximum degree of exposure they want to have on a particular country before deciding the amount they are willing to lend it. Thus the role of risk analysts and the methods they use in calculating those risks have become a crucial part of the capital allocation to LDCs. See "How to Rate a State" *Euromoney*, September 1992.

Figure 4.9

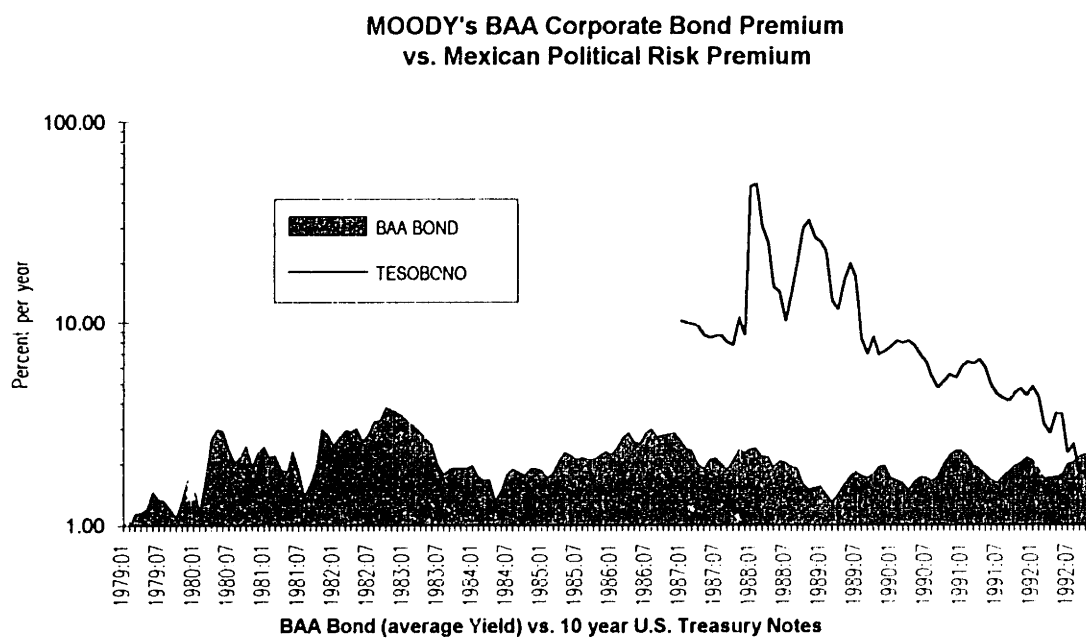
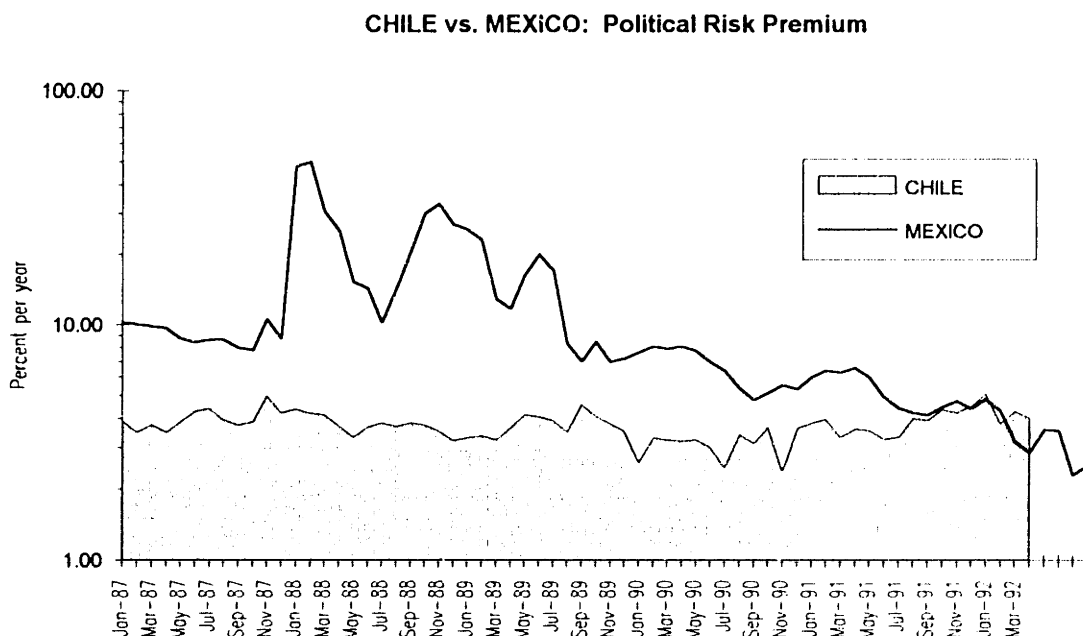


Figure 4.10 shows the same comparisons between the premium over LIBOR of a three month Chilean deposit denominated in dollars.

Figure 4.10



In the last years, the Mexican market has become more integrated with the international financial markets. The premium was around 10 percent per year in 1987 and fell to a level of around 2 percent in 1992. This reduction in the premium represent substantial savings for the government. Over the same period, internal debt represented nearly 15 percent of GDP, the reduction in the political premium therefore represents a reduction in public sector expenditures of around 1.2 percent of GDP ($.15(.10-.02)=0.012$).

The observed tendency of the Political risk premium to get close to zero can also be interpreted as a more efficient integration with the world financial system. The reduction in the premium an be considered as a process of capital account opening. How fast is the country converging towards a complete removal of capital controls?

Using the fact that deviations from covered interest parity (or the difference in PAGAFES and TBILL) shows considerable first order autocorrelation, in equation (4.28) we postulate the data generating process for CIP deviations (setting $PR1 = d_t$).²⁵

$$(4.28) \quad d_t = \kappa + \gamma t + \sum_{i=0}^{\infty} \rho^i \varepsilon_{t-i}$$

We use weekly data to compute d_t . The data are expressed in annual terms. The deterministic component $\kappa + \gamma t$ is the unconditional political risk premium. The premium has a trend change of γ basis points per week. Equation (4.28) can be estimated by the following AR(1) process:

$$(4.29) \quad d_t = \kappa(1 - \rho) + \gamma\rho + \gamma(1 - \rho)t + \rho d_{t-1} + \varepsilon_t$$

The estimates of equation (4.29) appear in Table 7. We perform the regression for 3 sample periods. All three sample periods begin in the first week of the year that appears in the period row and end in the last week of August 1992. The constant component of the political risk premium is positive and statistically significant in all three regressions. It captures the average premium over the sample period. The trend term is negative and statistically significant as well for all three sample periods. It is difficult to

²⁵ See Obstfeld (1991) for an analysis along similar lines for European currencies in the Bretton Woods era.

interpret this coefficient directly since it measures the reduction in the risk premium that takes place every week. The row labeled year shows the compounded effect of γ over a year. For the whole sample period, convergence took place at a rate of 2.8 percentage points per year. The average premium of 19.2 percent per year would disappear in 6.7 years.

Table 4.5: Capital Market Integration

$$\text{Estimated Equation: } d_t = \kappa(1 - \rho) + \gamma\rho + \gamma(1 - \rho)t + \rho d_{t-1} + \varepsilon_t$$

	(1)	(2)	(3)
	1987-1992	1988-1992	1989-1992
κ	0.1926 (5.58)	0.2878 (6.76)	0.1775 (6.81)
γ	-0.00053 (-2.69)	-0.00099 (-4.48)	-0.0005 (-4.05)
ρ	0.7365 (18.75)	0.7636 (14.75)	0.7567 (16.54)
Year	-2.8 %	-5.3 %	-2.2
SEE	0.076	0.057	0.024
Durbin's h	-1.49	.7139	2.004
N	294	243	195

t-statistics in parenthesis.

The sample of the second regression starts in the first month of the Pacto, when the political and exchange rate premia reached record highs. This sample yields a much higher average premium and a much faster speed of convergence. The results for the sample size starting on January 1989 are similar to the ones obtained for the whole sample, with the difference that the constant component is two percentage points smaller.

These regressions are in line with our conjecture that the Mexican financial system is integrating more efficiently with the U.S. This has two implications. A more efficient integration, provides capital at a cheaper cost and substantial savings in the servicing of the internal debt. On the other side, a more open capital account may induce excessive speculation and could affect adversely the evolution of the economy. In a recent survey of capital account liberalization experiences, Calvo, Leiderman & Reinhart (1992) and Mathieson & Rojas-Suarez (1992) observe that increased capital flows induced appreciation of the currency. The most notable of these experiences is the Chilean experiment of the early 1980s. The Mexican real exchange rate has appreciated dramatically in the last few years.

4.5 Conclusion.

In the last 5 years, Mexican CETES (Treasury Bills) have paid a significant premium over American TBILLS. This premium can be interpreted as the compensation that an investor must receive for facing two types of risk while holding Mexican bonds. In the first place, an investor must be

compensated for the probability that the peso will be devalued during the life of the bond causing a significant capital loss to the bondholder. Second, the investor faces a probability that the government will default on its internal debt or that some sort of capital control will be imposed reducing the benefits of holding this type of bond.

Interest rate parity conditions give us useful information about the efficiency of the Mexican financial markets. Covered interest parity between domestic instruments holds for large periods if we exclude episodes of excessive financial instability. Thus we may argue that the domestic market has evolved toward better integration over time. After the financial deregulation measures taken in 1989, where banks were allowed to set rates competitively, deviations from CIP in domestic instruments became smaller.

In contrast, deviations from CIP between domestic and foreign instruments are large and statistically significant. The interesting fact is that these deviations have been falling in absolute size. The current trend indicates that they should vanish completely in approximately five years.

Tests of uncovered interest parity give support to the idea that in the case of Mexico, the reason for the rejection of the unbiasedness hypothesis is the existence of a peso problem. If we perform tests of UIP looking only at the exchange rate risk we find that if the sample includes a peso event (the devaluation of November 1987) then we are not able to reject the

unbiasedness hypothesis (although serial correlation still presents a problem).

The fast rate at which the political premium has fallen tells us that the extent of capital account liberalization in the last years has been formidable. This situation calls for caution on the side of policy makers since the benefits of a fully open capital account are not so clear cut if we consider previous historical episodes. Further research is needed on this issue, but it is likely that the fast pace of integration with the world financial system is behind the overvaluation that the Mexican peso is experiencing .

Appendix E. Arbitrage in the *cobertura* market.

Consider the case of an agent performing arbitrage operations in the *cobertura* market. This agent expects the peso to devalue and wants to find the maximum price at which it is profitable to buy *coberturas*.

The agent contracts a dollar loan in the domestic market and buys *coberturas* for $(1+i^*)$ dollars which will be her balance in period $t+1$. The remaining portion of the loan is invested in peso denominated bonds $(S_t - K_t(1+i^*))$. The net cash flow zero. In period $t+1$ she has to pay the loan $-S_{t+1}(1+i^*)$, receives the exchange rate $(1+i^*)(S_{t+1} - S_t)$ and receives yield from domestic bond $(S_t - K_t(1+i^*))(1+i)$.

If $E\left(\left(S_t - K_t(1+i^*)\right)(1+i) + (1+i^*)(S_{t+1} - S_t) - S_{t+1}(1+i^*)\right) > 0$ then it is profitable to buy a *cobertura*. Using this condition we find in equation (A1) the maximum price an arbitrageur would pay for a *cobertura*.

$$\begin{aligned} E\left(S_t - K_t(1+i^*)\right)(1+i) + (1+i^*)(S_{t+1} - S_t) - S_{t+1}(1+i^*) \\ = \left(S_t - K_t(1+i^*)\right)(1+i) - S_t(1+i^*) > 0 \end{aligned}$$

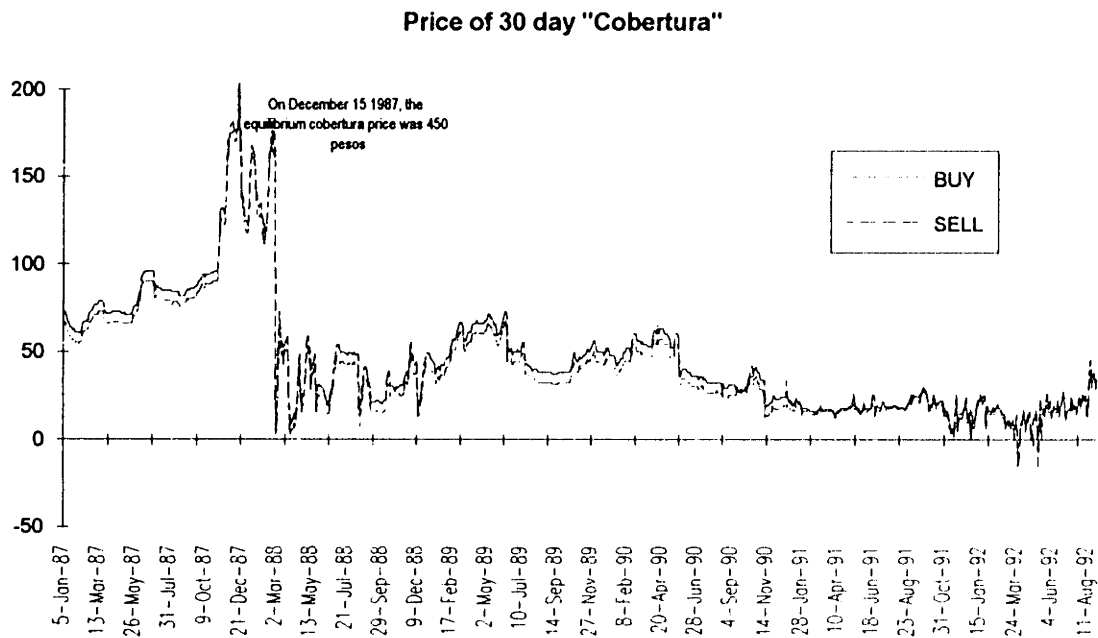
$$(A1) \quad K_t < \left(\frac{S_t(1+i)}{1+i^*} - S_t\right) \frac{1}{1+i}$$

Using a similar approach to define the minimum price at which to buy, the equilibrium price for *cobertura* is given by equation (A2).

$$(A2) \quad K_t = \frac{1}{1+i} \left(\frac{S_t(1+i)}{1+i'} - S_t \right)$$

Figure A.1 shows the prices of *cobertura* for the period under study. See Beauregard (1992).

Figure A1



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