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Location Theory and the Size Distribution of Firms

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Abstract

This paper is one of a series of state-of-the-art methodological reviews prepared for the Employment and Enterprise Policy Analysis Project, sponsored by the U.S. Agency for International Development. It examines two questions at the intersection of location theory and industrial strategy. First, what is the spatial content of policy biases which favor large-scale enterprises? Second, do spatial policies contain any implicit distortions which might affect the "market-determined" industrial structure? The issue is whether policies which contribute to the locational objectives of politicians and planners may have adverse consequences for the tax-neutral treatment of different sized firms.

These issues are addressed in two settings. First, the paper considers the argument that the favorable treatment of large-scale enterprises, located in the more advanced or urbanized regions, permits them to undermine the competitive bases of traditional small-scale producers in the less developed areas. Second, there is a discussion of techniques which can be used to estimate the extent to which policies which favor large-scale enterprises encourage the deconcentration of metropolitan manufacturing activity. In particular, the paper suggests the use of multinomial logit models to analyze the relationship between firm characteristics and site choice. The paper also takes a critical look at restricted cost functions, normally used to estimate the deadweight losses of any given spatial policies, and asks whether the technique can be used to estimate the differential impact of policy on firms of different size.

There are two principal conclusions. First, in order to examine the spatial outcomes of any vector of taxes or subsidies, we need to acquire extremely detailed micro-data on specific market conditions and on the profit-maximizing behavior of the larger firms. Second, it seems unlikely that the policies which discriminate as between firms of different size are of more than second order significance for the spatial distribution of manufacturing activity. Especially in the case of the urban-rural margin, macro-policy is likely to be the most important determinant of the spatial distribution of economic activity through its influence on the internal and external terms of trade.

LOCATION THEORY AND THE SIZE DISTRIBUTION OF FIRMS

Jeremy Oppenheim

This paper explores two fundamental questions. First, what is the spatial content of policy biases which favor large-scale enterprises (LSEs)? In other words, are policies which discriminate against small- and medium-sized enterprises (SMEs) inconsistent with policy objectives that focus on the geographic distribution of manufacturing activity? Second, do spatial policies contain any implicit distortions which might affect the "market-determined" industrial structure? The issue is whether policies which contribute to the locational objectives of politicians and planners may have adverse consequences for the tax-neutral treatment of different sized firms? The objective of this paper is to consider these questions in two settings. First, the paper looks at the regional policy issue and examines the analytical content of the proposition that the favorable treatment of LSEs, located in the more advanced regions, permits them to undermine the competitive basis of the traditional SMEs in the more backward regions. Second, the paper examines the consequences of policies which favor LSEs for the deconcentration of metropolitan manufacturing activity.

The paper is organized in five sections. Section 1 introduces two of the broad questions addressed by LDC location theory: the problems of

regional balance and the difficulty of decelerating the rate of metropolitan area growth. Section 2 discusses the methods used to analyze the relationship between regional growth patterns and policies which have a scale content. The aim is to explore the proposition that policies which favor large-scale enterprises (LSEs) have a tendency to discriminate against the economic growth of the relatively backward regions. Section 3 takes a critical look at the techniques used to decompose the different sources of metropolitan growth. The section introduces a logit model to explain the relationship between firm type and site choice. The section will also review evidence from Bogota, Colombia and from Seoul, ROK which strongly implies that small firms have a tendency to cluster in the metropolitan areas (the incubator hypothesis), while rising land prices and congestion externalities are forcing the larger firms to move into "secondary urban centers". Paradoxically, it looks as if certain policies which favor LSEs may result in a shift of industrial activity and employment opportunities out of the central metropolitan areas. Section 4 examines the possibility that spatial policies may contain implicit biases which discriminate against small and medium sized enterprises (SMEs). The section explains the use of a restricted cost function and asks whether the technique, normally used to measure the deadweight costs of alternative spatial policies, accurately estimates the extent to which those policies discriminate between firms of different scale. Section 5 concludes by highlighting the main findings of the chapter and by detailing future research topics.

SECTION 1: THE MAIN QUESTIONS

In many LDCs, modern sector activity remains heavily concentrated in the principal metropolitan areas. Economists argue that, left to themselves, the markets for land, labor and capital will determine the optimal distribution of economic resources, for any given initial spatial endowment. Capital and labor resources will flow to the location where the return to their services is greatest. Simultaneously, the differential marginal productivity of each unit of land will be capitalized and reflected in the underlying structure of relative land prices. In final equilibrium, mobile factors will have no incentive to move and relative land prices will be constant. Only a change in endowments (i.e. the discovery of a new natural resource), a change in technology (the discovery of a new use of land, resulting in a change in relative marginal products) or a change in tastes (resulting in a change in marginal revenue products, assuming the change affects mobile factor returns equally) will lead to a new optimal geographic configuration of economic activity. In the general equilibrium world of the neoclasical theorist, the only room for the policy maker is to correct for divergences between market and social prices. For instance, it is only if the congestion costs of metropolitan area activity are omitted from the market determination of marginal factor returns that the government should intervene with corrective fiscal policies.

Planners and politicians are profoundly unconvinced by this theory, which they tend to regard as economic sophistry. As Alonso (1971) points out,

> "The classical location theory, by assuming complete information and predictability and unlimited managerial and technical manpower, ignores the strongest factors influencing location in developing countries." (p.11)

Even if one accepts the basic insight of the neoclassical model, with its strong equilibrium conditions, Alonso's point is that uncertainty, imperfect information and a whole set of market distortions (whether or not policy induced) justify quite an active role for government in influencing the spatial dimension of market outcomes. Note, however, that he never argues for the introduction of policies which aim at spatial results completely inconsistent with market outcomes. Such policies would not only have highly undesirable side-effects, but would also be unlikely to achieve their stated objectives.

Nevertheless, policy makers in LDCs appear to entertain two main concerns: first that the metroplitan areas are simply "too big", and second that differential regional growth rates are a major cause of political tension. Let us briefly consider each issue.

What is the analytical content of the proposition that metropolitan areas are too big? There seem to be five main components to the claim. First, there is the problem of diseconomies of urban scale. Lurking under the surface of this argument is a notion (as yet unspecified) of the optimal city size. Second, there is a speculative bubble problem. Policy makers claim that incomplete information about spatial alternatives results in excessive speculation in metropolitan land prices (particularly during periods of high inflation). This leads to the

nonproductive employment of scarce investible capital. A more informed market would distribute economic activity between the metropolitan and non-metropolitan areas (NMAs) in a more efficient and also more equitable fashion. Third, there is the fiscal burden problem of the high social overhead costs of metropolitan infrastructural investment in roads, schools, drainage systems, health care, etc. Even if there are some increasing returns to scale in the provision of public goods, the argument remains that per capita expenditure is higher in the metropolitan than in the NMAs. Fourth, there is a problem of spatial crowding out. As metropolitan areas continue to grow, they absorb an increasingly disproportional share of the nation's resources. NMAs are simply unable to compete in the markets for financial or human capital which flows from the periphery to the center. The growth of the metropolitan area undermines the possibility of successful regional policies, in that it overdetermines the possible range of spatial outcomes. Finally, there is concern about the political implications of metropolitan growth. The political entrenchment of vested urban interests combined with the high visibility of social unrest and protest does little for the confidence of LDC regimes, many of whom depend on a relatively narrow base of popular support.

The second source of political concern flows from the growing regional disparities of productivity, output, income and employment. Politicians fear that a very stable pattern of regional inequity is developing over time. This process has severe implications at a number of levels. It can retard the consolidation of a national identity which

prevails over particularist regional interests. It can also result in the allocation of limited public resources on a basis inconsistent with economic rationale. The need to extend the political coalition - and to buy off regional groups - can supersede more broadly conceived economic goals.

Moreover, the problem of regional conflict over central government resources should not be conceived solely in terms of a political constraint on the "socially efficient" allocation of public goods. Unbalanced spatial growth can result in both supply and demand side constraints on the performance of the national economy. Consider what happens when a number of regions trade with each other on the basis of their respective comparative advantage. Assume that inter-regional labor migration is negligible (as it might be in a partial information model). And suppose that due to the inefficiencies of the financial system, regional savings are not "fully mobile". In a country without inter-regional factor flows, differential rates of productivity growth in the different regions might have profound implications for national growth rates. For example, the poor performance of the agricultural sector adversely affects the potential growth rate of the manufacturing sector through higher raw material costs and food prices (which get translated into wages). For countries which are balance of payments constrained, imports of food are likely to be only a short-term answer. In the long run, more balanced regional-sectoral growth patterns may have implications not only for equity, but also for efficiency and the improvement of national factor productivity.

Whatever the validity of the economic arguments, the evidence is sufficiently ambiguous to permit policy makers to justify whatever locational stance they choose. Politicians need to be in favor of regional policy to satisfy their constituency elites and to oppose further metropolitan growth in order to extend their tenure. So long as this remains the political reality, the objective of economic analysis remains to minimize the efficiency side-costs implicit in any set of spatial policies. First, let us examine the implications of policies which favor LSEs for balanced economic growth.

SECTION 2: POLICY BIASES, LSES AND REGIONAL GROWTH PATTERNS

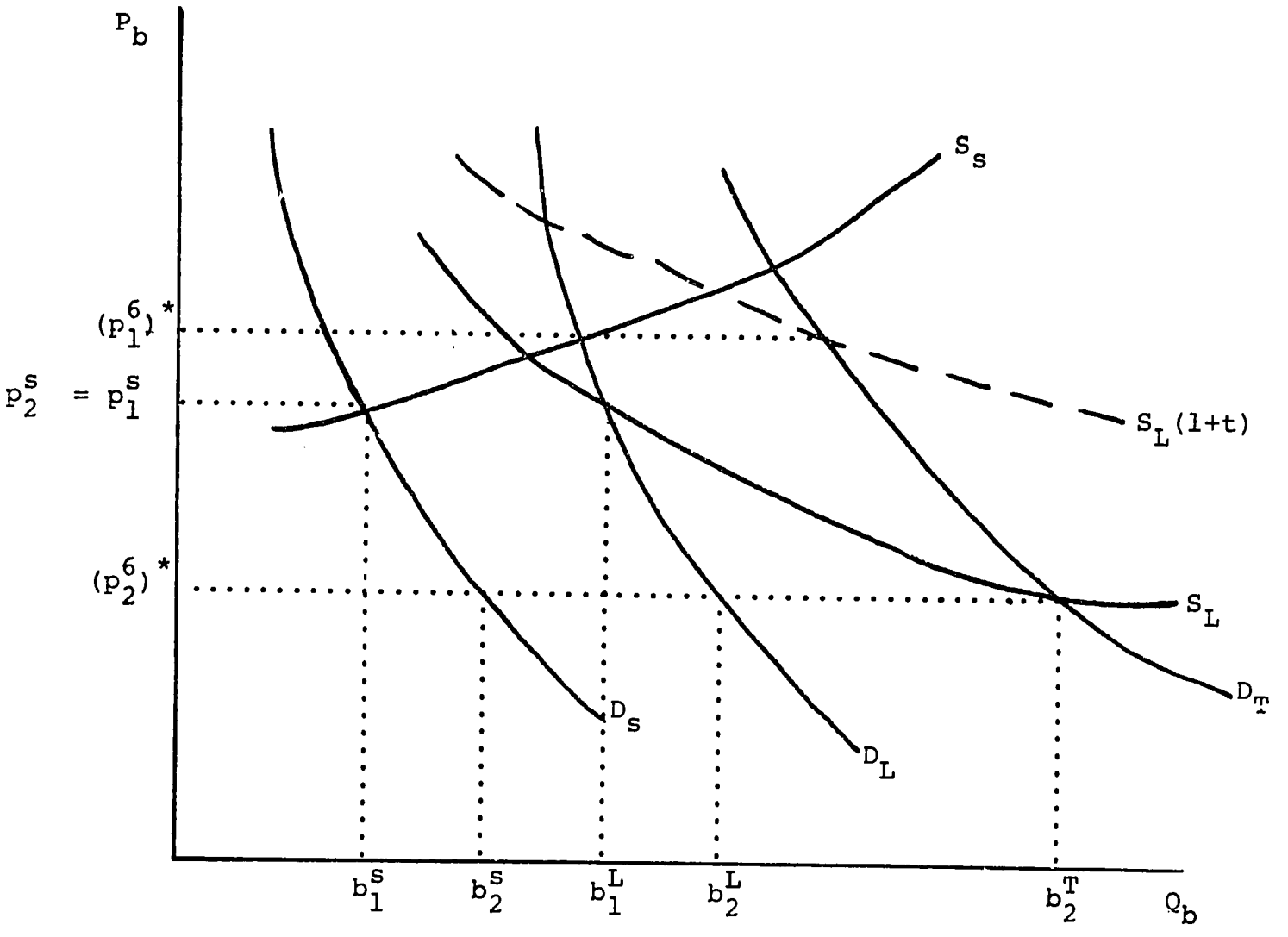
A hypothesis which has often been advanced (especially by writers of the structural school (2)) is that policies which favor LSEs tend to widen regional disparities of growth and income. The hypothesis is that LSEs are able to outcompete SMEs in both the final product and the factor input markets. Since LSEs are principally located in the more modern, faster growing regions, an improvement in national transport and communications systems permits LSEs to penetrate rural markets and to undermine the nonagricultural productive structure (i.e., the traditional industries) of the more backward regions. Accordingly, policies which may favor LSEs are likely to increase their advantages over small-scale producers in the periphery and thereby damage the prospects for regionally balanced growth.

The aim of this section is to examine this argument in somewhat more detail. First, we need to specify a slightly more formal model to bring out the fairly stringent conditions needed to motivate the crowding out result. After demonstrating the theoretical plausibility of the result, it would then be useful to consider the techniques used to determine the empirical validity of the hypotheses.

What then is the theoretical content of the claim that LSEs, by crowding out SMEs, worsen inter-regional income distribution? The basic model is very simple and depends on the principles of comparative advantage. Consider the case of a country with two regions, L and s, where L > s. The large region (L) is assumed to have a higher total income that the small region (s). The two regions in the first time period produce two goods, a and b, where a is produced with a constant returns to scale technology and b is produced under different conditions in L and s. The stylized fact is that b is produced by constant returns traditional technology in the smaller region, s.

In region L, however, b is produced with modern increasing returns to scale technology. In the absence of any international competition, theory suggests that such a good will be produced by a single firm which can reap monopoly profits by restricting output and by limit pricing. If there is potential competition from foreign firms, then the domestic monopolist will be unable to extract pure profits, because that would encourage the import of the good. The consequence is that the domestic LSE has to price at the long run average cost of production.

FIGURE 1



where S_s is the supply curve of producers in the smaller region

S_l is the supply curve of the LSE in the larger region

D_s is the demand curve of consumers in the smaller region

D_L is the demand curve of consumers in the larger region

D_T is the demand curve of the country as a whole (i.e. $D_s + D_L$)

t is the per unit transport cost

(P^i) is the price of good b in the region j in period n

Suppose that initially, transport costs are set precisely at that level which prevents trade between the two regions. In the short run equilibrium, each regional market must clear independently. Consider Figure 1. P^S represents the price for good b in the small region in the non-trade equilibrium. Clearly, $P_1^S < (P_1^L)^*$, which is the price that the region L monopolist could have charged region s consumers, allowing for transport costs. What happens when transport costs fall? The supply curve of the region L LSE shifts down (by the reduction in transport costs). Now, $(P_2^L)^* < P_{s2}$, implying that the region L LSE supplies the entire national market.[2]

In the case where transport costs protect the region s SMEs without any redundancy, they can be represented by

(1) $$t = c_s\ (w, b) - c_L\ (w, b) \quad c_s' \quad 0,\ c_L' \quad 0$$

where t is the distant invariant unit transport costs, c'_s are the increasing marginal costs of the SMEs in the smaller region and c_L' are the declining average costs of the LSE in the larger region. If there is no redundancy in the rate of transport protection, then a fall in transport costs must lead the monopolist to increase its share in the small region market to 100%. Every unit increase in its production run reduces its costs yet further, allowing it to gain a dynamic cost advantage over the SMEs in the smaller region.

If $t' > t$, then a small change in t may not alter the incentives for the x producer to expand production. Similarly, if transport costs are not uniform (or uniformly reduced) between regions L and s, then the situation becomes much more complex. Consider, for example, the following cost function for the L region producer,

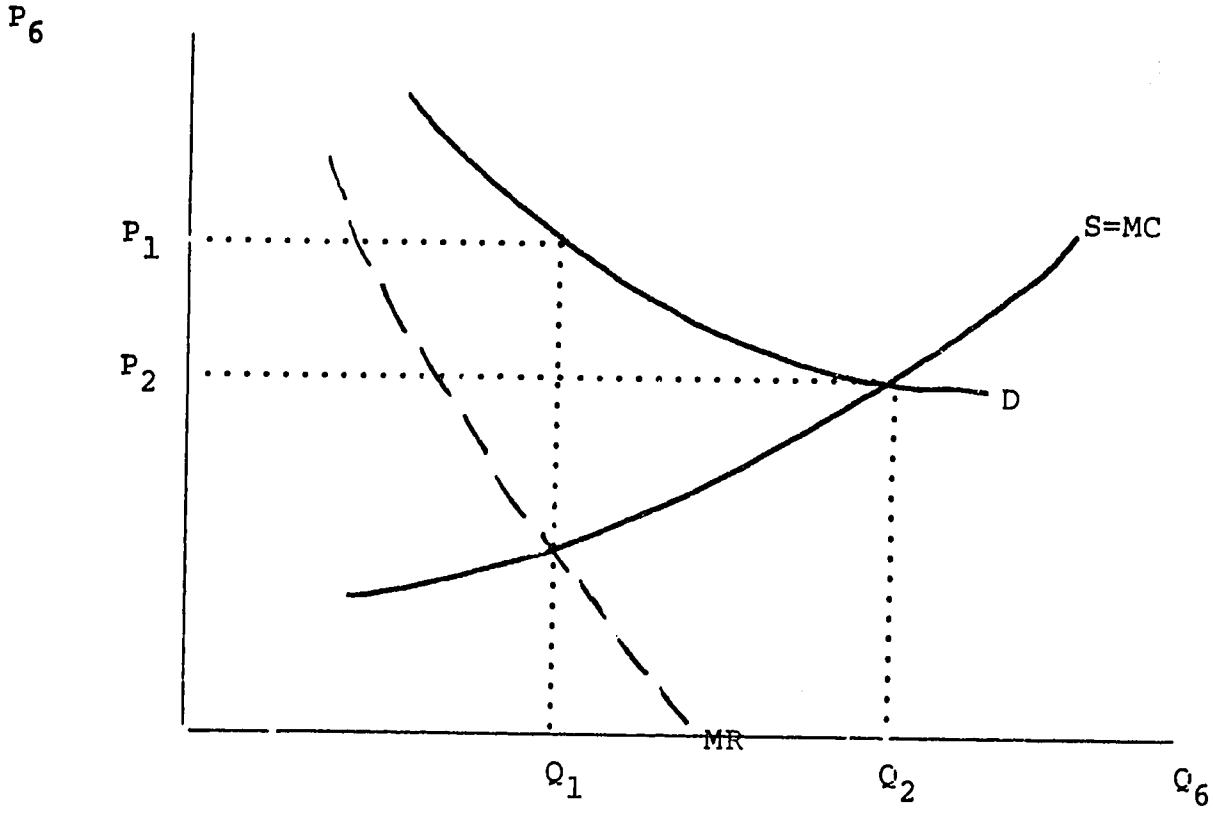
(2)
$$b = c\ (\ b\ (t)\ ,\ t\ (b)\ )$$

Equation (2) describes the case where the output of good b is dependent on the average cost function. This cost function has two arguments. First, it depends on the level of output, which is itself affected by the marginal transport costs. Second, these transport costs are in turn affected by the chosen level of output. If we differentiate (2) with respect to a change in transport costs, we get

(3)
$$db/_{dt} = \left[\partial c/_{\partial t}\right] dt/_{db} + \left[\partial c/_{\partial b}\right] db/_{dt}$$

In other words, the level of output affects transport costs which in turn affect the average cost function. And the transport costs affect the level of output which again influences the average cost function. Note that exactly similar problems arise in the case when transport costs vary not only with the geographic degree of market penetration but also directly with the level of output. Even though there may be increasing transport costs associated with the penetration of the most backward

FIGURE 2



where D is demand in a sub-regional market

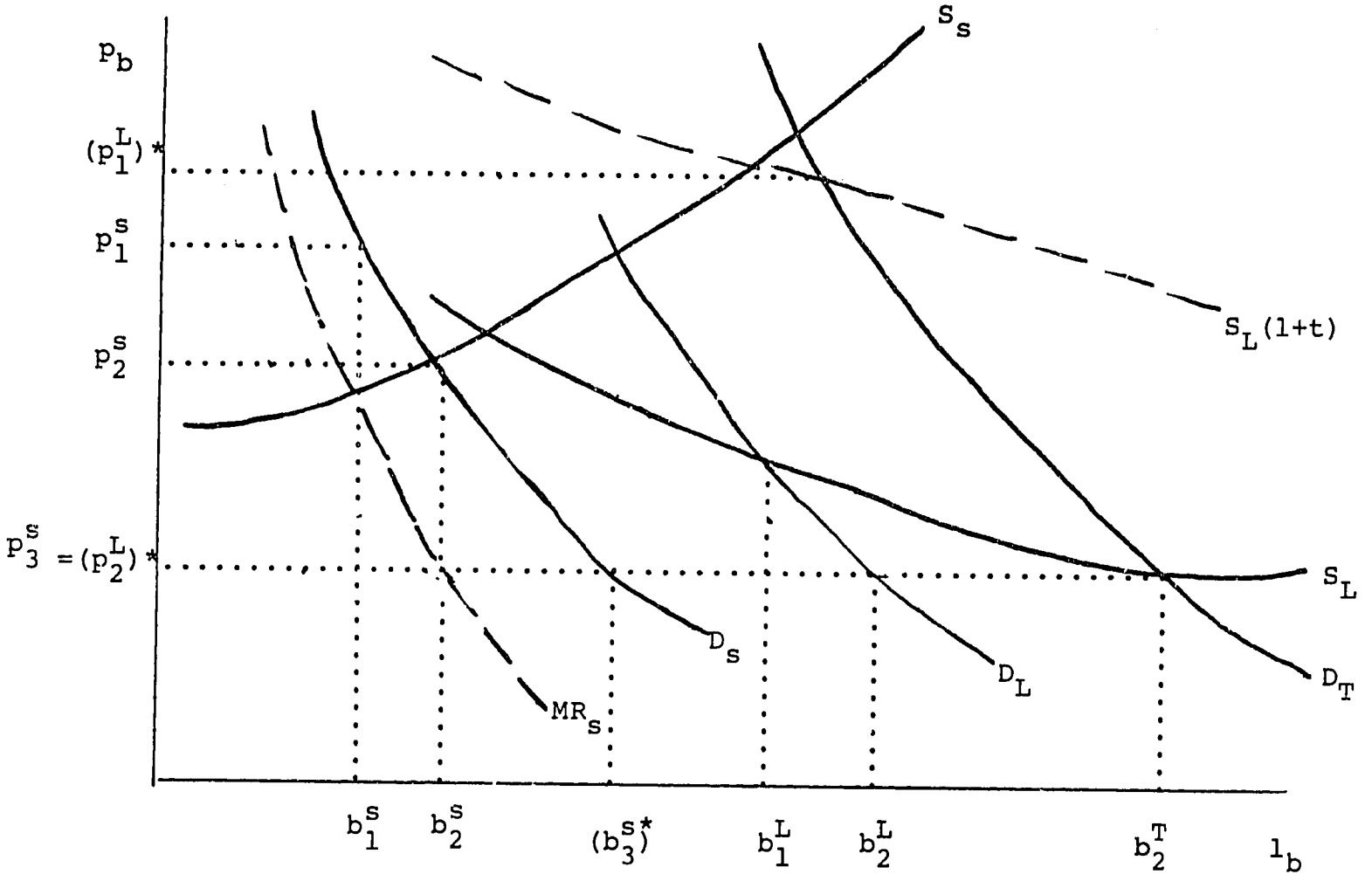
S is the supply in a sub-regional market

areas, these costs may in turn decline as the volume of trade increases. The second important issue raised by equation (1) is that the post-transport equilibrium (and the welfare implications of the change) depend heavily on the initial pricing assumptions. These assumptions are particularly significant in three important respects.

Consider first the assumption that the producers in region s price on the basis of marginal costs. If, on the other hand, small firms producing traditional goods are all serving highly specific "localized" markets, they might well behave like "monopolistic competitors." If the markets within the region are segmented, then producer in each sub-regional market may face a downward sloping demand curve for his goods. Consider Figure 2, where the comparative statics of the argument are presented. The demand curve in the submarket is exhibits short-run inelasticity. So does the supply curve, even in the absence of fixed capital costs. There are a variety of possible explanatins for this -- an inelastic supply of the necessary inputs or a rising opportunity cost of labor, as non-family members get hired at higher levels of output. If intra-regional market segmentation is complete, then the initial equilibrium will be at P_1, Q_1. Suppose that intra-regional barriers to trade fall. Then, in the absence of product differentiation or consumer loyalty, we might expect that intra-regional competition will drive prices down to P_2 and output up to Q_2.

Consider next the consequence of transport improvements between the two regions. Figure 3 illustrates the case. Again, the price falls to

FIGURE 3



where terminology is equivalent to Figure 1.

(b_1^s, p_1^s) is the price, output vector in the smaller region with monopolistic competition in the sub-regional markets,

(b_2^s, p_2^s) is the price, output vector in the smaller region when intra-regional arriers to trade are eliminated and

(p_2^{Lx}, b_2^T) is the price, output vector in the whole economy when all markets are integrated.

(p_3^s, b_3^s) is the price, output vector in the smaller region when there is no transport protection.

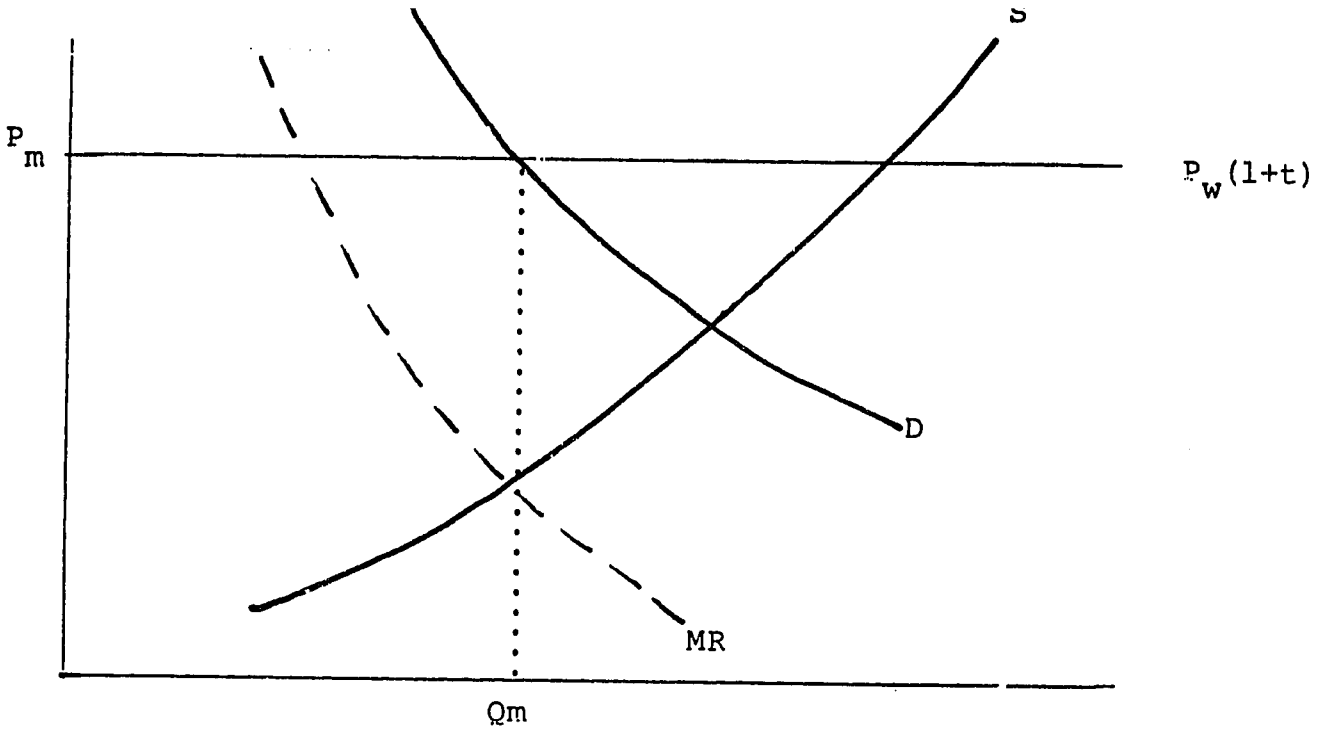
P_3 and the quantity consumed in the small region increases to Q_3. Figure 3 is drawn to present the "worst case," where the entire traditional goods sector in the smaller region is eliminated. What may happen, instead, is that only the more inefficient producers get pushed out by the entry of the LSE into the region s marketplace. The basic point, however, remains. Opening up more backward regions may not result in undiluted social benefits. In the short run, the gain in consumer welfare may be offset by the loss of income. In the long run, the smaller region is likely to remain a backward partner in national development, not least because of the loss of skills and learning implicit in the destruction of its small-scale sector.

Consider next the assumption that the region L producer priced on the basis of average costs - the contestable market pricing assumption. Particularly in the LDC context, it becomes important to ask what would happen if the trade regime was based on a series of high or prohibitive tariffs. Take the simpler case of a marginally prohibitive tariff. In this example, the monopolist in price-setting is able to ignore international competition and presumably will fix prices and output on the normal basis.

(4)
$$p\,(1 - 1/e) = c'(b)$$

where e is the elasticity of demand for b, and c' is the marginal cost function in the production of good b. Figure 4 illustrates the case. In

FIGURE 4



where P_m is the price charged by the monopolist in the domestic market

P_w is the international price for good b

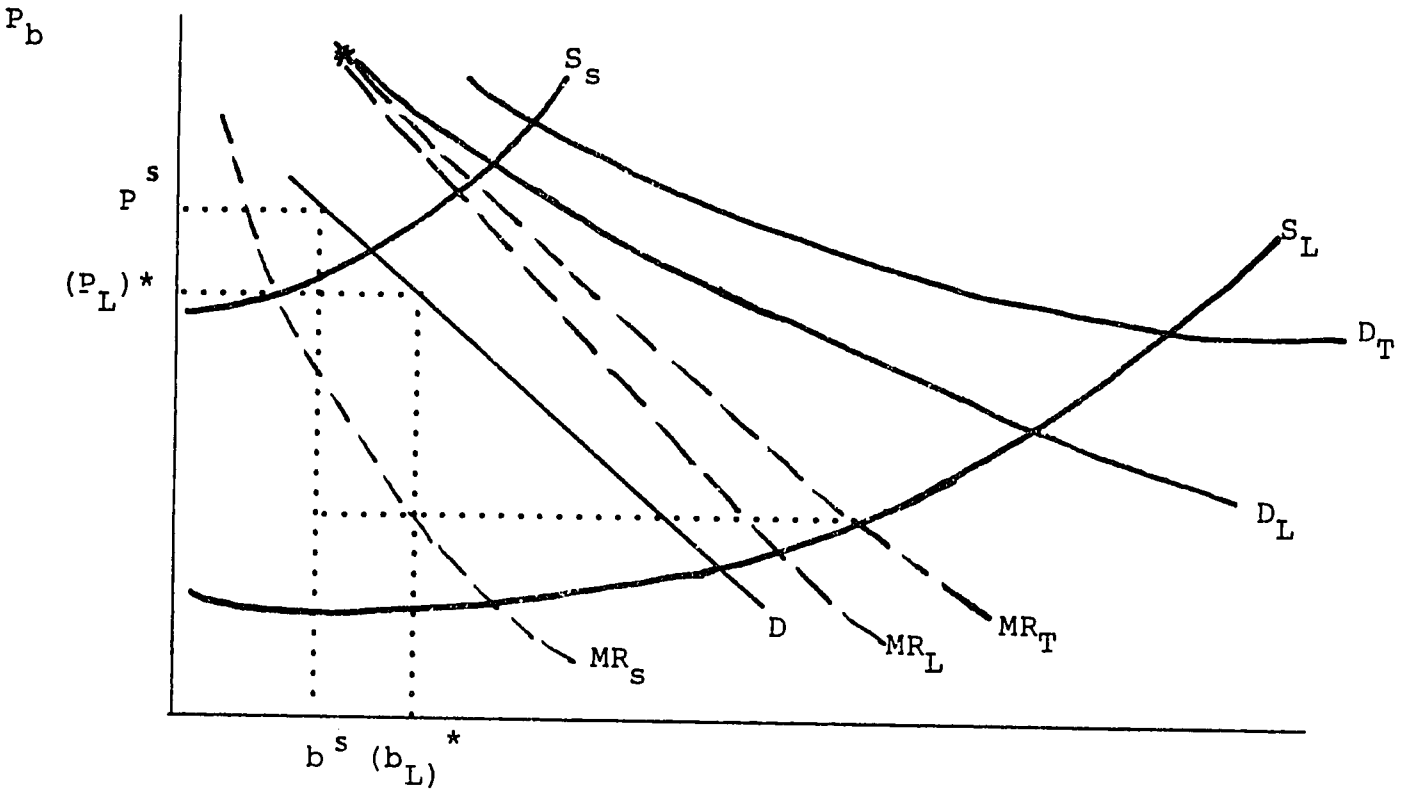
t is the tariff rate

the initial equilibrium, the tariff-inclusive import price of goods permits the LSE in region L to make pure profits. If the tariff were removed, the monopolist could continue to produce at short run marginal costs, provided that in the long run average costs were met.

What happens in the prohibitive tariff case to LSE output when inter-regional transport costs are reduced? In a sense, the only variable which changes is the elasticity of demand for b -from the perspective of the monopolist. There are three important cases. First, consider what will happen if the national market is integrated and the elasticity of demand in the enlarged market falls (i.e. monopoly power increases). This might occur if the monopolist practiced predatory pricing in order to drive out the smaller producers in region s. In that case, national welfare would be reduced due to a rise in the price of b and a fall in its consumption. Second, suppose that the region s producers are able to shelter under the high price umbrella set up by the L region monopolist. In such a case, the welfare implications would appear to be wholly ambiguous.

Third, the LSE could practice price discrimination on the basis that the elasticity of demand differs between the small and large reasons. Suppose that it is lower in region s. This may be because region s consumers are able to buy a more narrow range of substitute commodities. Figure 5 illustrates this case. If the monopolist's price (for region s consumers) is less than that of region s suppliers, then there is a welfare gain to consumers in the short run. In the long run, the limited

FIGURE 5



where b^s, p^s is the output, price vector with output produced by region s traditional manufacturing firms,

$(b_L)^x, (P_L)^x$ is the output, price vector with output produced by region L LSE.

opportunities of alternative employment for displaced small-scale producers may reduce welfare through a fall in real income.

The third significant assumption made in equation (1) is that the economies are internal to the firm. The reason we made that assumption was to emphasize the contrast between the profit maximizing behavior of the LSEs and that of SMEs. However, the modeling of increasing returns to scale in trade theory has often proceeded on the basis that economies are external to the firm but internal to the industry (the classic infant industry assumption). This formulation is favored because it allows one to avoid the problem of market structure: with external economies one can preserve the assumption of perfect competition. Although an analysis based on external economies would not seem to aid an understanding of the consequences of policy biases towards LSEs for the spatial economy, it does offer important insights into the issue of differential regional growth rates. External economies in this refer principally to "agglomeration effects". These fall into two main categories - the massing of reserves and the specialization of tasks within the production process. The massing of reserves embraces the possibility of pooling input inventories (i.e. warehouses becomes a specialized business) along with the availability of a relatively deep, wide pool of labor resources. The specialization of tasks involves the division of labor between production units of the optimal size, so that each stage of the production process can benefit from any available economies of scale. An example would be the "out-house" production of valves by a specialized firm, which then sold the valves as inputs to a number of final goods

producers. In more economically backward regions, these valves would have to be imported or produced inefficiently "in-house". A technical appendix to this chapter explains the appropriate technique for the measurement of these economies.

Although the modeling of agglomeration economies bears only tangentially on the firm size issue, a brief account certainly offers some insights into the difficulties surrounding welfare analysis in this field. Consider the case of a cost function with the following characteristics,

$$c_b = c(w,z) \quad , \quad c'_z < 0 \tag{5}$$

where w is a vector of factor input prices and z is some measure of agglomeration economies. Notice that the cost function is decreasing with respect to an increase in agglomeration economies. In autarky, if we assume that only region L benefits from the agglomeration economies, then it is clear that the price of b in region L is lower than in region s. In all other respects, the cost function exhibits constant returns to scale.

What happens when we increase the possibility of inter-regional trade? There are three effects, all of which serve to improve welfare in both regions. First, region L producers will take over the region s market on the basis of their lower cost structure (i.e. higher

industry-wide productivity). Consumers in the s region will benefit from the lower price of b. Second, as the L industry expands, the possible agglomeration economies may also rise, leading to a lower cost structure for the national economy. Third, it is not necessary to assume that the z factor is region specific. A lowering of transport costs may mean that s region producers receive some of the benefits of the z economies. For example, they may find it profitable to buy specialized inputs from the firms in region L (those which are generating the economies for the b producers). In other words, the exportable nature of the z input may allow s region producers to lower their cost structure and to compete with L region producers on better terms.

On the other hand, it is equally possible that welfare will fall in the s region as a consequence of greater inter-regional trade flows. How would this come about? Suppose that in autarky region s also benefits from some agglomeration economies, however these are not as pronounced or widespread as those in region L:

(6)

$$c_b = c(w,z) \qquad z_L < z_s$$

(7)

$$c_a = c(w)$$

As inter-regional transport costs fall, region L producers will enter the region s market. In a perfectly competitive world where an

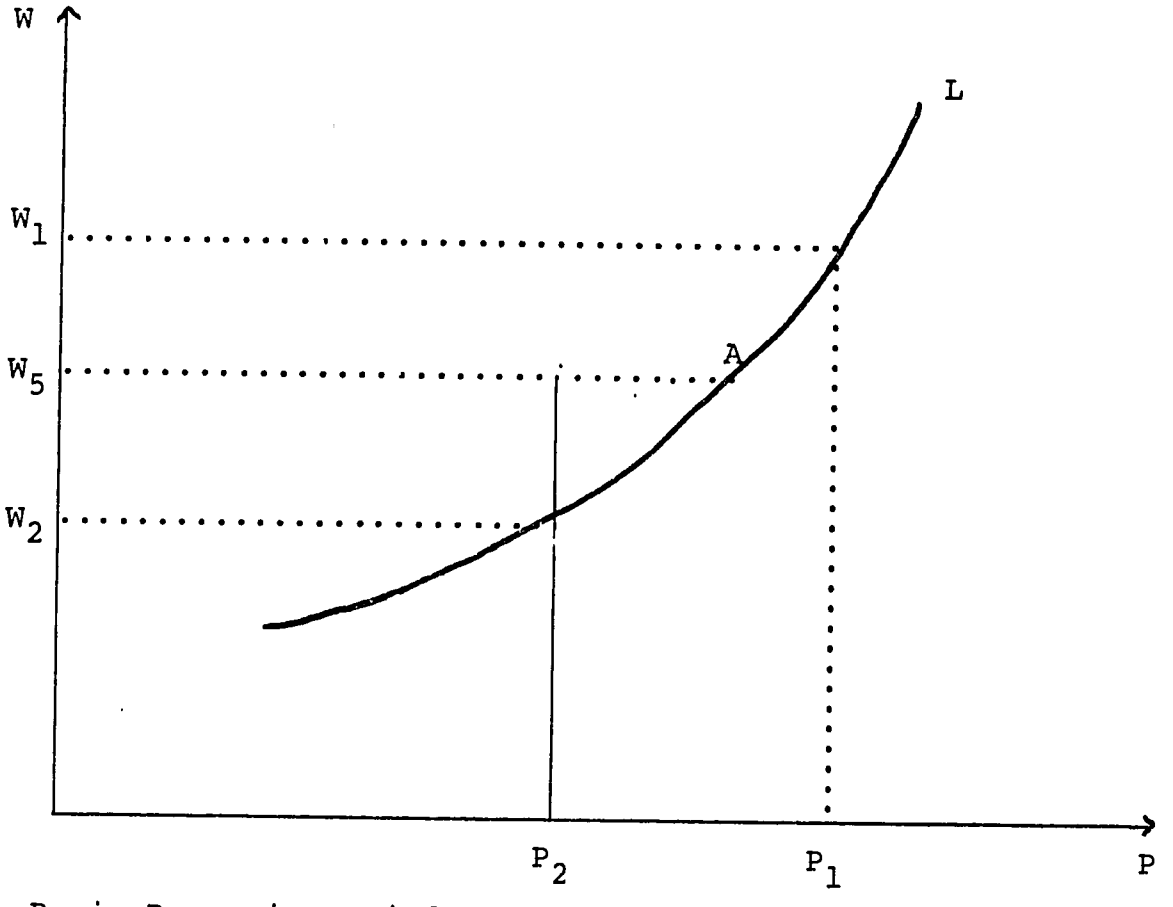
inter-regional trade balance constraint obtains, the trade pattern will imply that it becomes more profitable for region s producers to shift their resources into the production of good a - the good which does not benefit from agglomeration effects. In other words, the trade balance constraint means that resources within region s shift to the activity which has a lower total factor productivity. This means that region s suffers from a loss of income. The net effect on welfare depends on the relative strength of two opposite forces - the former tending to increase welfare through the concentration of b production in its most efficient location, the latter tending to reduce welfare through the shift of resources within region y to the less productive activity.

In summary, there is a very rich menu of models available to examine the consequence of a fall in transport costs for inter-regional patterns of welfare. In particular, we have explored the welfare implications of a fall of inter-regional transport costs on the basis of a series of different pricing assumptions. In all cases except one - where resources in the more backward region shifted to the less productive activity - there was the possibility of "gains from trade", depending on the behavior of producers in the more advanced region. These results depend on three strong assumptions: that inter-regional trade balances, that intra-regional factor markets clear in a world of perfect information and that there are no inter-regional factor flows. However, only the middle assumption of continuously clearing markets damages the general nature of the results outlined in this paper.

Consider the trade balance constraint. If, in fact, the more backward region experiences a net trade deficit, this would imply that the region is gaining more from trade than when "balance of payments constrained". In these circumstances, it would be quite reasonable to suppose that the inter-regional trade deficit is financed by remittances, sent by migrant workers in the more advanced region to their families in the less modern location. Similarly, the possibility of inter-regional factor flows would seem to enhance the positive welfare effects of a reduction in the transport cost structure. These gains occur in two stages. First, an opening up of markets enables the more efficient firms to expand their share of output. Second, factors - both labor and capital - will flow to the region of higher productivity. To recast the story in more familiar trade terms, there will be gains both from an expanded consumption set and from a movement to the national production possibility frontier. The spatial implications of this income gain will depend on the geographic distribution of the owners (or ultimate recipients of the transfer benefits) of the mobile factors.

It is only when factor markets are imperfect that there is a significant probability in a comparative static sense of welfare losses as a result of inter-regional trade expansion. What is the story? Consider the following case where both goods a and b are produced, using only labor inputs. Further, labor is more productive in the advanced region in the production of both goods; however, as a result of agglomeration economies in the production of good b, the following inequality holds;

FIGURE 6



where P_1 is P_b/P_a in period 1,

where P_2 is P_b/P_a in period 2

and W_1, W_2 are the wage outcomes, given labor market-clearing conditions

If W_5 is the subsistence wage, then there will be an underemployment equilibrium of A.

$$(L_b)^L / (L_b)^s < (L_a)^L / (L_a)^s$$

(8)

where $L_a < L_b$ in both L, s.

where $(L_i)^j$ is the unit labor efficient in the production of good i in region j. The principle of comparative advantage would suggest that region L should produce all b in exchange for some of the a (which would be produced in region s). Labor in region s would have to move into the production of the less labor-intensive good. This means that, to ensure full employment of labor, there would have to be a fall in region s wages. But, suppose that wages are already at the subsistence level. This might be the consequence of extremely low labor productivity in the production of both goods, implying a pre-trade subsistence wage. Figure 6 illustrates the point. P, on the horizontal axis, measures the relative price of good b to good a. As P rises, it becomes more profitable to produce b, the labor-intensive good, thereby raising labor demand and the wage rate. The L schedule describes the relationship between P and w, given market-clearing conditions. If w lies above the L schedule, then there is unemployment in the labor market. Suppose w_s is the subsistence wage lebel. In period one (prior to inter-regional trade) $w > w_s$. If the market clearing w falls to less than the subsistence wage, after trade upens up, then an unemployment equilibrium will develop. The net welfare effects then depend on the relationship (in both the short and longer runs) between consumer gains and producer

losses. In other words, do the negative income effects offset the positive subsistution effects.

The outcome of all this theory is that it is extremely hard to specify conditions under which it seems that a reduction in inter-regional transport costs leads to an unambiguous fall in welfare. It is even difficult to specify equilibrium conditions which result in an unambiguous increase in regional unemployment. At the very least, there have to labor market distortions in the more backward region. If the distortion is the result of the low productivity of labor in region s, then the optimal policy would be to subsidize the migration of labor from region y to the more advanced areas of the country. In short, if the underlying economic conditions of the mroe backward region mean that economic growth will always be relatively slow, then it is unlikely that policy biases which favor LSEs will significantly affect the pre-existing trends. Indeed it is possible that such poilicies will increase welfare by reducing the price of good b in region s and by encouraging them to employ region s migrants. The lesson of regional policy experiments in both developed economies and in LDCs provides compelling evidence in support of these theoretical propositions. It is very difficult to alter relative regional private returns in an efficient or sustainable fashion.

Nevertheless, there are some grounds to believe that policy biases which favor LSEs and which (given certain strict assumptions about profit maximizing behavior) allow them to penetrate backward region markets more rapidly may impose certain social costs. The faster the rate of market

penetration, the shorter the relevant time frame for adjustment. If capital in region s is fixed and if there are certain labor market distortions, then the sector specific model predicts that trade will result in a process of "immiserizing reallocation" of resources. The basic principle (6) is that the costs of adjusting to a new set of relative prices (and thereby rates of return) will be directly related to the extent of factor market distortions. In such a case, the government may need to combine two policy instruments in order to maximize national welfare (in a regionally equitable fashion). First, to deal with the distortion in the labor market (which relates to low productivity), the government should subsidize relocation of workers from region s toregion L. Second, there may be a case for taxing region L producer(s) so that they expand production - with falling transport costs - at a rate consistent with minimizing the social costs of adjustment in region s. In a sense, public investment in inter-regional transport could be made self-financing. The producers in region L who would be one of the principal beneficiary private groups who could be taxed to pay for some of the costs of the new facility. At the same time, this would provide rural producers with a breathing space in which to improve their production practices or to shift resources into a new activity.

On the basis of this argument, it would be useful to have some measure of the competitive advantage which LSEs enjoy as a result of policy biases. The aim is to ascertain the extent to which LSEs are able to price their products on regional markets below the true economic cost of production. The idea is exactly analogous to that employed in the

examinations for dumping or government export subsidies under the principles of GATT. In both cases, the overriding institutional objective is to ensure that production takes place at the location of lowest opportunity cost. Government export subsidies may benefit the consumers of the importing country, but they also lead to a misallocaiton of international resources (at the same time hurting the domestic producers of the importing country). Counter-measures find their justification in the need for an efficient and equitable international distribution of economic activity. Similar considerations apply in the case of inter-regional trade flows.

Our primary interest is to examine the effects of government subsidies, whether explicit or implicit, on the behavior of LSEs. In particular, we want to see whether government subsidies give LSEs enterprises, assumed to be located in more advanced regions, an unfair advantage in the marketplace of the more backward regions. The question is whether government subsidies bear any systematic relationship with the deviation between the social costs and market prices for the products of LSEs in the less developed regions. A second interesting issue is whether different forms of government subsidy have different spatial implications. In other words, do certain types of subsidy lead to greater social/private cost deviations? And do subsidies lead to different forms of profit-maximizing behavior? There is no necessary connection between the total value of any given subsidy package and the social cost/private price deviation.

What we need to do, therefore, is to develop two measures: a deviation index and a translation index. The idea of the deviation index is to determine the extent to which, on a percentage basis, LSEs are able to price on regional markets below the true economic costs of production:

$$(9) \qquad (c^s - p^m) / c^s$$

$$c^s = \text{social AC} = p^m \text{ in the absence of any subsidy}$$

where c^s are the average social costs of production (since we are dealing with a price assumed to be subject to increasing returns to scale) and p^m is the price charged on the regional market (which is assumed to equal the average private costs of production). If, as a result on market conditions, it is clear that the firm is able to extract a monopoly rent, then it becomes necessary to examine more closely what price they would have charged in the absence of the subsidy. In such a case c^s needs to be replaced with a careful estimate of the price that would have been profit-maximizing in the absence of a government subsidy package. How then does one estimate the deviation index? Since p_m is observable (though a mean may have to be taken), the only problem is the estimation of c^s. First, we have to estimate a cost function from the production technology. Then the cost function has to be reestimated on the basis of social costs. Note that we do not need to make an estimate of the restricted profit function, because of the assumption that prices equal average costs. Introducing the profit function in order to estimate the profit-maximizing regional price, with and without

subsidies, only over-sophisticates the estimation for inadequate basic data.

More formally, the estimation process uses the production function,

(10) $b = b (v ; z)$ where v = vector of inputs,

z = agglomeration of economies

in order to calculate a cost function,

(11) $c = c (w, b ; z) \quad , c'_b < 0 \quad c'_z < 0$

which is then calculated on the basis of social and private costs. If the transport-adjusted average cost on the basis of private input prices approximates the observed market price, then it is reasonable to base the deviation index on an estimate of average social costs. It is advisable to use a modified transcendental logarithmic function in order to estimate the cost function. Once the c^s is calculated, then it is easy to obtain a measure of the competitive advantage enjoyed by LSEs in rural markets as a result of government subsides.

What happens if, on the other hand, it appears that the estimation of average private costs is not approximately equivalent to the observed price in the regional market? In such a case, it is clear that the LSEs are not pricing on a basis consistent with the contestable market

scenario. Consider the following set of facts. The observed price in the regional markets is above the average private costs of production. In such a case, it is apparent that the LSE is able to take advantage of inelastic demand conditions in the regional market. One example already discussed in this paper is that regional differences in market conditions can afford the opportunity to LSEs to act as discriminating monopolists. If the LSE were to price above average private costs, then it would be transferring only a certain percentage of the per unit subsidy paid by the government. There are two consequences of the behavior. First, it is no longer accurate to use the deviation index as a measure of the competitive advantage which government subsidies confer on LSEs. Second, it would be helpful to develop an index which indicates the proportion of the per unit government subsidy which is transferred on to the consumer. A translation index might be constructed as follows:

(12) $$(c^s - p^m) / (c^s - c^p)$$

Where c^p = private costs of production.

As p^m rises above c^p, as a consequence of market power, the LSE translates less and less of the public subsidies into private consumer welfare gains. The index is also a good proxy for the degree of market power a LSE is able to exercise in a regional market. We can then modify the deviation index to take account of the exercise of market power by the LSE. Equation (9) becomes,

(9a) $$\left[c^{s}\left(\frac{c^{s}-c^{p}}{c^{s}-p^{m}}\right)-p^{m}\right]\Big/c^{s}\left(\frac{c^{s}-c^{p}}{c^{s}-p^{m}}\right)$$, which can be rewritten as

(9b) $$\left(c^{s}-p^{m}\left[\frac{(c^{s}-c^{p})}{(c^{s}-p^{m})}\right]\right)\Big/c^{s}$$

Despite appearances, (9b) is extremely straightforward. All that it does is to adjust the p^m component of the original deviation index by the inverse of the translation index. This makes intuitive sense in that as market power increases, the proportion of the subsidy translated into a fall in the regional price decreases and the deviation index will decline. The LSE can benefit from the government subsidy without needing to outcompete the regional producers.

SECTION 3: LSES AND METROPOLITAN GROWTH PATTERNS

Section 2 examined a number of issues concerning the consequences for relative regional growth rates of policy instruments which favor LSEs. The section reached 3 main conclusions. First, the conditions under which these biases lead to a fall in the welfare in the more backward regions require that region L LSEs choose a marketing strategy which involves undercutting the local small-scale producers at the taxpayers expense. Moreover, the fall in income due to reallocation costs and

inter-regional labor immobility must more than offset the increase in consumer benefits due to the change in relative goods prices. The second finding was the construction of a deviation index which measures the extent to which the market price of goods produced by LSEs is lower than the opportunity cost of its production by SMEs. Note that this is not a straightforward measurement of the difference between the observed market price and the social opportunity cost. Such an index would measure the social opportunity cost by the world price of the good, converted into domestic currency terms by the unofficial exchange rate. However, this would not measure the effect of distortions which differentiate between LSEs and SMEs. To calculate that distortion, we reestimated the LSE cost function at SME input prices. The third finding was a translation index, which measures the extent to which government subsidies to LSEs are converted into consumer gains. The calculation of the index for different industries with differing subsidy packages might be an interesting exercise.

This section deals with somewhat different issues. The aim is to find out how policy biases twoards LSEs might affect metropolitan growth patterns. The strategy is to develop a probabilistic model (7) which explains the likelihood that a firm of a particular type or size will choose a production site. The technique allows us to decompose the relative importance of the various characteristics of the location. We can then use the analysis to consider the effects of certain policy packages on the relative incentives for LSEs and SMEs to locate outside the metropolitan center. Consider the production function,

(13)
$$Q = f (L , X ; Z)$$

where Q is output, L is the lot size, X is the vector of all other inputs and Z is a vector of "local public goods". Assume that factor markets are competitive and that tariffs are not prohibitive. Accordingly, the firms profit function is described by,

(14)
$$\pi = pf - RL - wX \qquad f'_L = R/P \quad , f'_X = w/p$$

where R is rental on land, w is the price of all other factors. On the basis of standard duality results, it is simple to derive a restricted profit function,

(15)
$$\pi^* = \pi^* (p , R , w ; Z)$$

If t is the unit transport cost for the shipment of output, then p-t is the factory price of output. With p as numeraire, then in locational equilibrium,

(16)
$$\pi^* = g (1 - t^* , R^* , w^* ; Z) = \text{a constant}$$

The point is that profit rates should be equal across activities and space - so that equilibrium means that no firm want to change location or activity. If t is constant within an urban area and if profit rates are even, then there will exist a precise relationship between the stream of earnings which accrue to activity on any site and its price. In other words, the relative attractiveness of different sites for differing manufacturing activities should be perfectly (and uniquely) reflected in the matrix of relative land prices. All differences in marginal productivity are completely capitalized. If they were not, certain sites would be under-valued.

How do we use this insight to explain the locational preferences of different types of firms? Assume that firms which move to new sites are the marginal firms in the sense that they determine the value of the site attributes. The notion is that, in a land auction, they are the firms for whom the characteristics of the location represent the highest expected earnings stream. The estimating technology comes in three stages. First, we distinguish between firms of different types. Then we define sites in terms of their economically relevant characteristics. These variables are likely to emphasize general accessibility, localization economies and the quality of available services, such as water and electricity supply. Finally we specify a logit model in order to determine the probability that a firm of type t will locate at a site with characteristics Z:

$$(17) \qquad p(t/Z) = \exp(h_t(Z)) \;/\; \Sigma \exp(h_t(Z))$$

where $h_t(Z)$ is the function which defines the relationship between the location choice of firm t and the site characteristics. The values of the RHS variables show the relative importance of the different attributes of the site in the location decision.

What are the implications of this analysis for the firm scale issue? The World Bank has carried out a number of metropolitan studies (in Bogota, Sao Paulo and Seoul) (8), all of which have reached substantially similar conclusions. First, it looks as if LSEs have stronger incentives to "suburbanize". Multi-source inputting and multi-locational marketing mean that LSEs are relatively footloose. In other words, it is increasingly difficult to choose optimal location on the basis of minimizing transport costs. The evidence seems to suggest that large firms tend to be more export-oriented (from the metropolitan area) and require more space with modern production technology. For LSEs, land and plant space available at lower cost in outer areas is more important than access to local markets. Large firms also tend to be more sensitive to the quality of public utilities than SMEs. By way of contrast, the location preferences of SMEs within the metropolitan area seem to confirm the predictions of the "incubator hypothesis". This states that SMEs are more likely to locate in the metropolitan centers because their cost functions are particularly sensitive to agglomeration economies. This

makes a lot of intuitive sense. LSEs are better able to internalize certain operations that SMEs. By definition, they benefit principally from economies internal to the firm, whereas SMEs rely more on economies internal to the industry but external to the firm.

The implications of this analysis seem clear. If the policy makers' concern is that there is an excessive concentration of manufacturing activity in the core metropolitan area, then policies which favor LSEs may not be the culprit. Indeed, policies which promote SMEs may be counterproductive in their spatial effects. However, we should not jump to this conclusion so quickly. First and foremost, it is not reasonable to assume that equivalent social costs are attached to one unit of LSE and of SME activity. If (to take the limiting case) only LSE production imposes social costs in the form of congestion and pollution, then any policies which favor LSEs involve the taxpayer subsidizing a reduction in welfare.

Suppose that there are three types of site characteristic - those favored by only SMEs, those favored by only LSEs and those favored by both. Since LSEs can afford to bid up the price of type 3 characteristics, SMEs are forced to substitute towards more type 1 sites. The net result is a Pareto-inferior locational equilibrium, because of capital market imperfections. The results of the logit analysis are best interpreted as a relative intensity of constrained preferences regarding site attributes. Third, a decomposition of the policy biases in favor of LSEs may reveal that each type of subsidy has a

specific spatial content, depending on the nature of the production process. Certain subsidies may have a spatial content whose consequence is to encourage LSEs to stay in the metropolitan centers...and vice versa. The next section discusses the technical apparatus needed to examine this issue.

SECTION 4: THE SPATIAL CONTENT OF LSE BIASES AND THE LSE BIAS OF SPATIAL POLICIES

This section examines two questions. First, do spatial policies contain implicit biases toward LSEs? Second, where would LSEs locate in the absence of policy biases in their favor? Since the first question is inherently easier to answer, let us start there.

What we need to do is to specify a restricted cost function for both LSEs and SMEs. Then we have to estimate the function in the presence and in the absence of explicit spatial subsidies. It is then easy to see whether spatial policies are implicitly biased toward LSEs. More formally, we need to use a form of the translog cost function, modified to take account of the cost reducing effects of local public goods:

(18)

$$
\begin{aligned}
{}^{l}{}_{n}\, C \quad &= \alpha_o + \alpha_s \ln Y + 1/2\ Y_{ss} (\ln Y)^2 + \Sigma\alpha \ln P \\
&+ 1/2 \sum_{i}\sum_{i} Y_{i_i} \ln P_i \ln P_i + \Sigma\, Y_{si} \ln P_i \\
&+ \sum_{k} h_i \ln q_i + 1/2 \sum_{k}\sum_{l} B_{kl} \ln q_k \ln q_i \\
&+ \sum_{i}\sum_{k} Y_{ik} \ln P_i \ln q_k \\
&+ \sum_{k} \Theta_k \ln q_k \ln
\end{aligned}
$$

Where Y is output, P_is are the prices of the factor inputs and the q's measure the quantity of publicly provided inputs in the production process.

Equation (18) differs from the normal translog cost function only by the inclusion of the q variable. Once this input is included, we then have to measure the consequence of a small change in its provision for scale economies and for the amount of other (privately provided) inputs. We also need to have some idea of the degree of substitution between the different public inputs.

We can then work out the subsidy which the firm receives by contrasting the cost function with and without the policy. If B is the subsidy received by the firm,

(19a) $$B = C(p^m, s, q) - C(p, q, s) = \Sigma p_i^m \frac{\partial c}{pi} - \Sigma p_i \frac{\partial c}{p_i}$$ or

(19b) $$B = C(p, s, q^m) - C(p, q, s) = \Sigma q_i^m \frac{\partial c}{q_i} - \Sigma q_i \frac{\partial c}{q_i}$$

where p^m is the market price of the subsidized private input and q^m is the economic cost of the publicly provided input. If the B which LSEs received from the explicit spatial policies were greater than the SMEs benefits, then it would appear that spatial policies have firm scale implications. Equations (19a) and (19b) permit the decomposition of the firm scale effects of the different elements of the location policy package. It would be interesting to consider the trade-offs between the undesirable firm scale effects with the desirable spatial implications of different explicit location policies.

The second question is where would LSEs locate in the absence of policies which operate in their favor? Alternatively, how do policies which favor LSEs affect the probability that they will choose one site over another? In other words, do certain site attributes become more attractive with than without the subsidies? The question is extremely difficult to answer, even with the CGE model. Consider the example of a LSE which is able to buy imported equipment at official exchange rate prices. This has two immediate consequences. First, the LSE may be able

to expand production and output. Second, the LSE will be able to substitute imported equipment for other inputs - labor, domestic equipment and land. If the use of imported equipment does allow the LSE to substitute away from the use of land, then it is still difficult to answer how the logit function changes. Ideally, we would like to reestimate the logit probability function on the basis of shadow prices (or at least those prices faced by SMEs) in order to see the "true" preferences of LSEs with respect to site attributes. However, there are no observations of firm movements under the true cost conditions.

A less theoretically satisfying, but perhaps more practical approach is available. The policy problem is an over-concentration of manufacturing activity in the metropolitan centers. We need not be concerned, therefore, with LSEs that have suburbanized. Consider instead the example of a LSE which continues to operate in a socially undesirable location. The relevant empirical question becomes to what extent are policy biases which favor LSEs discouraging the firm from moving to a more peripheral urban location. Assume that the principal factor influencing location choice for the LSE is land costs. One measure of "relocation disincentive effects" is the reduction in land input costs due to the subsidy. What we want to measure is the difference between land costs, for a given location, with and without the government subsidies. Take the example of a firm which is more capital intensive than is socially optimal, as a result of a subsidized interest rate. Not only is there a production distortion, but there is also a location distortion. Normally we are interested in measuring the production

distortion. But this time we want to measure the location distortion. The method is as follows. First calculate the cost share of land on the basis of private prices. The estimation is given by,

(20) $$S_i = \frac{P_i}{C} \frac{\partial c}{\partial P_i} = \alpha_i + \Sigma \alpha_{ij} \ln_j + \sum_k s_{ik} \ln q_k + s_i \ln$$

Then recalculate equation (20) on the basis of the prices faced by SMEs. If S* is the factor cost share of land on the basis of social prices, then the relocation disincentive effects can be measured by,

(21) $$(S^* - S) / S^*$$

The closer is the index to one, the less the distortion. Clearly, in the case of firms whose land costs are a large percentage of total costs and who enjoy a high elasticity of substitution between land and other inputs, there is a significant risk that production distortions will be associated with equally undesirable spatial distortions.

The important idea that lies behind this index is that it provides a rough measure of the public incentives given to LSEs not to relocate. One implication is that policies which encourage LSEs to stay in metropolitan countries may limit the ability of SMEs to compete for central locations. The index does not, however, answer the question where the firm would have been located in the absence of the subsidy.

Two interesting studies could be attempted. First, some confirmation of the index might result from a comparison between firms that have moved and those which have not. If, for a given set of production distortions, the location distortions were significantly lower for those firms that had relocated, then the index at least has some predictive accuracy. Second, it would be worthwhile to measure the "relocation disincentive effects" of individual policy measure, rather than the whole policy package. We could determine, for example, whether foreign exchange subsidies resulted in greater spatial distortions than interest rate subsidies. If there are good policy reasons for favoring large firms, then it might be possible to minimize the adverse spatial side-effects.

V. CONCLUSIONS AND FUTURE RESEARCH

This paper has considered the consequences of LSE biases for inter-regional and intra-metropolitan growth patterns. It has also tried to address the question whether spatial policies contain implicit LSE biases. Two sets of problems have emerged from the discussion. At the level of theory, we need to think more deeply about the profit-maximizing behavior of LSEs under a wide range of pricing assumptions. Otherwise, it will be very difficult to develop workable hypotheses about the consequence of LSE biases. We also need to reexamine the nature of competition between LSEs and SMEs in the regional (and metropolitan) markets. Predatory pricing by LSEs makes sense only if their products are good substitutes for the regional SME products. The chapter also raises a number of complex methodological questions. In particular, how

do we estimate "social cost functions" in a world where many markets are imperfect. In other words, the problem of estimating shadow prices cannot really be addressed with a partial equilibrium model.

The focus of this chapter has been extremely narrow. We have addressed the spatial questions using only the micro-tools of neoclassical analysis. The insights acquired with these techniques need to be supplemented in at least two ways. First, the big shifts in inter-regional spatial incentives are rarely the result of spatial policies. More often, they are the side-effect of broader macropolicy instruments. Shifts in the internal and external terms of trade have major implications for the spatial distribution of economic activity. An increase in rural incomes through an improvement in the relative price of agricultural products is the best way to help the livelihood of small and medium sized rural firms. Second, an analysis of intra-firm corporate behavior would certainly inform theories about suburbanizing LSEs. We need to get inside the corporate "black box" to understand the spatial organization of production in LSEs. Systems theories of corporate behavior, structural models which deal with the spatial political economy of macropolicy and good neoclassical analysis of the shifts in micro-spatial incentives all offer complementary insights on the relationship between industrial policy and spatial objectives.

TECHNICAL APPENDICES

Appendices A, B, and C consider three different techniques for measuring aspects of the spatial economy. The Theil and Herfindahl indices measure the extent to which the spatial distributions of population and industrial activity diverge. The shift-share measure decomposes regional growth into three elements: the first reflecting the aggregate growth of the national economy, the second reflecting changes in the regional industrial structure, and a residual which takes account of those changes that may be attributable to plant or company-specific factors, interacting with local area or region-specific factors. Changes in the residual will therefore reflect shifts in the relative locational advantage of a region for economic growth. Appendix C will explain the steps by which OLS estimations, using plant data, can measure urbanization and localization effects.

APPENDIX A

Maximum and Minimum Values of Hirschman-Herfindahl and Theil Indices

Definitions:

P_i: Percentage share of a regional i in total value added in manufacturing

q_i: percentage share of a region i in total population

N: number of regions

Hirschman-Herfindahl (HH) Index: $\sum_i p_i^2/100$

Theil Inequality Index: $\sum_i p_i \log(p_i/q_i)$

The maximum value of the HH index is 100 when the entire manufacturing sector is located in one region. The minimum value is obtained when industrial value added is distributed equally in all regions. Then the value of the index becomes 100/N.

The maximum value of the Theil inequality index is infinitely large when $p_i > q_i = 0$ for some i. Intuitively, there is an enormous divergence between the share of a region in industry and its share in population. On the other hand, when $p_i = q_i$ for every i, i.e., the

shares of regions in both industry and population are exactly equal for every region, the index attains a minimum value of 0.

Since the two indices are constructed on entirely different lines, it is obvious that any value of one index cannot be compared with that of the other. It is valid to compare only values of the same index and these must also be seen in relation to the maximum and minimum values of that index.

The Theil inequality index has certain advantages over the HH index. The chief advantage relates to its "aggregation" properties. It is beyond the scope of this appendix to elaborate on this; a detailed explanation is provided in Theil (1967).

APPENDIX B

A Shift-Share Analysis of Inter-Regional Industrial Growth Patterns

In explaining divergences in the industrial performance of different regions, one of the important factors is the product mix of industry in the region. A technique of isolating this factor is "shift-share analysis." The method is best explained by Armstrong and Taylor (1980):

"Shift-share analysis is a method of calculating the extent to which the difference between a region's growth and the nation's growth can be explained by the region's industry-mix. The method is easily explained. We start with three definitions.

1. Regional growth rate (g_r)

$$g_r = \frac{\sum_i r_i^t - \sum_i r_i^o}{\sum_i r_i^o} \qquad 1$$

where:

r_i = regional employment in industry i

$\sum_i r_i$ = sum of employment across all industries in the region

t = final year of study period

o = initial year of study period

2. <u>National growth rate</u> (g_n)

$$g_n = \frac{\sum_i n_i^t - \sum_i n_i^o}{\sum_i n_i^o} \qquad 2$$

where:

n_i = national employment in industry i

$\Sigma_i n_i$ = sum of employment across all industries in the national economy.

3. <u>Regional growth at national growth rates per industry (grn)</u>

$$g_{rn} = \frac{\sum_i \{r_i^o (n_i^t/n_i^o)\} - \sum_i r_i^o}{\sum_i r_i^o} \qquad 3$$

This is the crucial calculation. It is the growth rate that <u>would</u> have occurred in the region if each industry had grown at the same rate as the corresponding national industry during the study period. In other words, national growth rates are applied to the region's industry mix as it existed at the beginning of the study period.

With the help of these three definitions, the regional growth rate can be divided into three separate elements:

$$g_r = (g_r - g_{rn}) + (g_{rn} - g_n) + g_n \qquad 4$$

Taking the elements in reverse order, the third element (g_n) is the region's "share" of national growth. The faster the national growth in employment, the faster we expect the region to grow. The second element ($g_{rn} - g_n$) is the structural component. It is the difference between:

(i) the rate at which we expected the region to grow (given its industry mix and given national growth rates for each industry), and

(ii) the national growth rate.

Thus, if the region possesses a "favorable" industry mix we would expect this element to be positive, since g_{rn} would exceed g_n in that case. If the region is endowed with an "unfavorable" industry mix we would expect this element to be negative, since g_n would exceed g_{rn}. Finally, the first element ($g_r - g_{rn}$) is simply that part of the region's growth that remains unexplained. It is a residual, or a "rag-bag" which can be given a wide variety of interpretations. A positive residual ($g_r > g_{rn}$) means that the region's growth rate exceeded the growth rate that would have occurred if each industry in the region had grown at the same rate as its national counterpart. A negative residual ($g_r < g_{rn}$) means the reverse."[1]

APPENDIX C

OLS and Agglomeration Economies

The essential objective of the exercise is to specify a production function which will be amenable to OLS estimation and to F and t tests of agglomeration economies. Studies of spatial differential in labor productivity, returns to scale and their relation to size externalities have been characterized in the form of a combined function:

$$q = g^{*} f(k,l) \qquad 5$$

where q is output, g is a function relating size to productivity and f is typically a Cobb-Douglas form. The basic specification suggests that size effects are Hicks neutral. The CD form of (1) is

$$q/l = A k^{\beta} l^{\alpha} \qquad 6$$

where k is the capital labor ratio. Returns to scale (i.e. l and α) are invariant over the output range. The marginal rate of substitution depends only on relative factor proportions.

Equation (2) has to estimate in a way that permits the separation of three effects: city size, industry size and industry effects not related to size (which may have an effect on productivity). It would also be advisable to test whether the agglomeration effects were Hicks

neutral. Greytack and Blackeley (1985) offer the following specification:

$$q/l = A\, k^{\beta}\, l^{\alpha_1+\alpha_2 \ln S_1+\alpha_3 \ln S_2}\, S_1^{\beta_3}\, S_2^{\beta_4}\, \Omega^{DV} \qquad 7$$

where S_1 = industry size, S_2 = urban size,

DV = industry dummy variable

The significance of industry size can be evaluated with a partial F test for the hypothesis that $\alpha_2 = \beta_3 = 0$. The net impact of industry size is measured by $\alpha_2 \ln s_1 + \beta_3$, both evaluated at the mean of ln l and expected to be positive if localization economies are present. A positive size for α_2 would indicate that localization effects raise the marginal product of labor relative to capital. The same analysis applies to urbanization effects. Henderson (1982) points out that the CD function really measures physical quantities and may have to be adjusted if there are significant spatial variations in price. Greytack and Blackley (1985) also point out that there are data problems involved in the measurement of both capital and labor--a particular problem in the context of developing countries where technology vintage and labor quality will vary substantially. Control variables should be included in the final estimating equation:

$$\ln (q/l) = \ln A + \beta_1 \ln k + \beta_2 \ln l + \beta_3 \ln S_1 + \beta_4 \ln S_2 + DV + e$$

where $\beta_2 = \alpha_1 + \alpha_2 \ln S_1 + \alpha_3 \ln S_2$ 8

FOOTNOTES

(1) The problem here is exactly parallel to that addressed in the optimal currency area literature. A good coverage of the alternative theories is in Tower and Willet, Princeton Special Papers no. 11.

(2) The structural school of location theory addresses the issues of regional growth paths and of growing spatial income disparities with exactly the same tools as the center-periphery analysts of the international political economy.

(3) See Baumol W.J. et al, "Contestable Markets and the Theory of Industry Structure" (1982) for the mechanics of this pricing unit.

(4), (5) The principal reference here is Helpman E. and Krugman P., Market Structure and Foreign Trade, 1985.

(6) See Neary J. P., "Intersectoral capital mobility, wage stickiness, and the case for adjustment assistance," in Bhagwati, J.N. "Import Competion and Respones, 1985.

(7) This estimation technique is developed by Kyu Sik Lee, "A Model of Intra-urban employment location: An Application to Bogata, Colombia," Journal of Urban Economics 12, 263-279 (1982).

(8) These studies are part of an IBRD research project, "An evaluation of Industrial Location Policies for urban Deconcentration," dir, Kyu Sik Lee (RPO 672-91).

(9) These techniques are developed by Murray, M.P., "Here, There, Where? A Strategy for evaluating industrial location policies in Korea." (1982) IBRD, RPO 672-58, UDD-6. In this paper, we reverse Murray's objectives. He examines the production distortions of spatial policies. We want to examine the spatial distortion of production policies which favor LSEs.