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Amenities, Nontraded Goods, and the Trade of Lumpy Countries[1]

PAUL N. COURANT AND ALAN V. DEARDORFF

Department of Economics and Institute of Public Policy Studies, University of Michigan, Ann Arbor, Michigan 48109

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The study of urban and regional economics is, in large part, the study of the spatial organization of economic activity.[2] From von Thunen to the latest issue of the Journal of Urban Economics, urban economists seek to understand why it is that different places produce different things; why some places produce many things, some few, and some none; why some places are rich and others are poor. At the same time, of course, there is enormous political interest in these topics. State and local economic development, one of the few growth industries in the public economy of the 1980s and 1990s (with health care and the payment of interest on debt), is crucially concerned with these questions. The premise behind governmental interest, of course, is that the location of economic activity can be manipulated to the profit of local politicians (if not local residents) by public policy.

International trade theory is also centrally concerned with the question of what gets produced where, but the "where" in international trade theory is a country, almost always assumed to be spatially homogeneous internally. Thus, with a few exceptions, intranational variations in economically relevant variables are not considered by trade theorists.[3]

The relationship between urban economics and international trade has been explored, from time to time, by a number of urban economists and

[1]Prepared for delivery at a conference in honor of Edwin S. Mills, Northwestern University, April 10–12, 1992. Much of this paper originated as part of Courant and Deardorff [4], the first part of which has since appeared as Courant and Deardorff [5]. The latter includes acknowledgments of the many colleagues in many places who have made helpful suggestions on this research. We repeat that thanks here, as well as again thanking the Ford Foundation for providing partial support to A. V. Deardorff in writing this paper.

[2]The spatial organization of economic activity, of course, has been central in Edwin Mill's work. Much of his textbook [19] deals with the issue, as does virtually all of his classic monograph [20]. Mills' teaching, starting in 1970, is directly responsible for Courant's interest in the subject and, indirectly, for Courant's longstanding effort to convince Deardorff that international trade should be thought of as a subfield of urban economics, a claim that is advanced in this paper.

[3]See Melvin [17, 18] for two of the exceptions.

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trade economists. J. Vernon Henderson, in a series of writings [11–13], has explored international trade among countries that are made up of systems of cities. Other examples include John D. Wilson [26] who has recently written on the effect of local governments on international trade, and Paul Krugman [15] who has explicitly considered the role of intranational nonhomogeneities in determining the location of activities, and incidentally in determining trade. Jane Jacobs [14] provides a less formal treatment than these other authors, but she is also centrally concerned with the relationships among urban and national economic development and the role of trade therein.

In an earlier paper [5] we established that differences in factor endowments among locations in a country—what we call lumpiness of endowments—can be a cause of international trade that is distinct from other, more traditional determinants of trade such as (international) differences in overall factor endowments and technologies. Here, after a brief recapitulation of our earlier arguments, we show that differences in amenities and in the prices of nontraded goods are extremely likely to give rise to the requisite lumpiness in factor endowments that we assumed in our earlier paper. Thus, these important sources of lumpiness within countries, which are, of course, also important reasons for the formation of cities, can influence the pattern of international trade.

I. REGIONAL FACTOR ENDOWMENTS AND INTERNATIONAL TRADE

If factors of production are distributed unevenly over the countryside, then this of course will give rise to trade among regions within the country, exactly as predicted by the Heckscher–Ohlin (factor proportions) theory of international trade. In Courant and Deardorff [5] we show that if such differences among regions are sufficiently large, then complete specialization of the regions themselves will occur, and this will lead the country as a whole to produce different quantities of goods than it would if factors were more evenly distributed. This, in turn, can alter the quantities, and even the direction, of trade, compared to what it would have been in a more traditional model where regional differences play no role.[4]

[4]We prove this for a small open economy that, if it were regionally homogeneous, would not trade even if it could. If introducing lumpiness then causes the country to trade, we can comfortably ascribe that trade to the effects of the lumpiness. Naturally, a corollary of all of our results is that a country that *would* trade if it were homogeneous could have its pattern of trade altered, perhaps even reversed, by lumpiness. We also assume, to keep things simple, that preferences of all consumers are identical and homothetic, that all markets for both goods and factors are perfectly competitive, and that prices of both goods and factors adjust freely to equate supply and demand. Factor supplies are assumed to be perfectly inelastic, except where we explicitly consider movements of factors across regions, and factors are

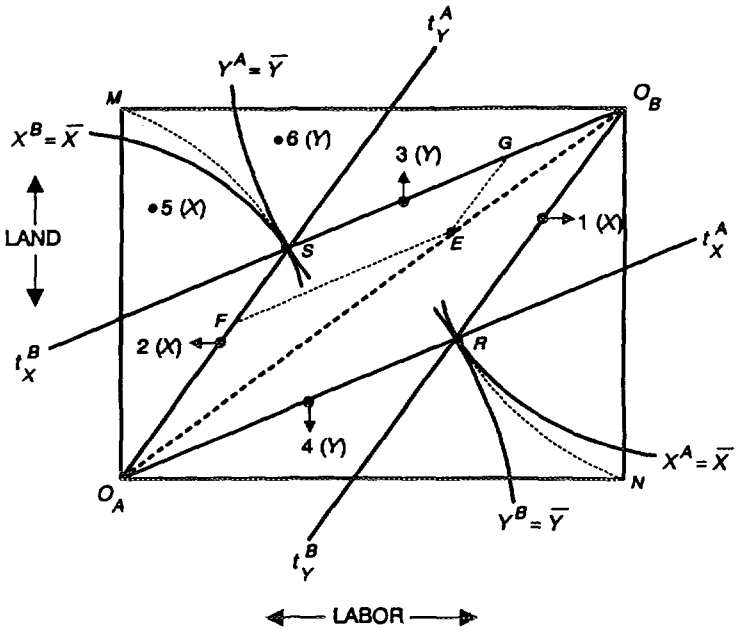

FIGURE 1

The relationship between the country's trade and the allocation of factors between regions is explored in Fig. 1, which is an elaboration of the familiar Edgeworth Production Box Diagram that has been used by Dixit and Norman [8] and Helpman and Krugman [10] to map out regions of specialization and nonspecialization among countries.

As is well known from the Heckscher–Ohlin Model, given the world prices of goods X and Y and assuming the absence of factor intensity reversals, there will exist a single set of factor prices consistent with incomplete specialization and a corresponding pair of least-cost techniques of production for producing goods X and Y. Letting the ratios of land to labor employed by these techniques be denoted t_X and t_Y, we draw rays t_X^A and t_Y^A from O_A and t_X^B and t_Y^B from O_B. For each region only those factor allocations that lie between these rays are consistent with their producing both goods. Therefore in the parallelogram $O_A R O_B S$ lie all of those factor allocations for which both regions can be incompletely specialized. Since factor prices are also equalized (and constant) within this area, we refer to it as the FPE (factor–price–equalization) parallelogram.

immobile internationally throughout. These assumptions make the analysis comparable to most of the literature on the Heckscher–Ohlin trade model.

The particular allocations at S and R will be of special interest. At these points both regions are just on the verge of complete specialization, with, at S say, all of the country's good Y produced in region A and all of its X produced in B. However, because the factor prices and techniques of production are the same here as elsewhere in the parallelogram, these outputs are the same as the totals for the country throughout the parallelogram. Hence the relevant isoquants for X and Y, drawn through S and R, provide convenient indicators of these outputs, which we label $\bar{X}$ and $\bar{Y}$.

We now consider what the patterns of output and trade will be for allocations outside the parallelogram. The diagram is divided into several sections, within each of which we have identified representative locations by numbers 1–6. We have also recorded in parentheses next to these numbers the good, X or Y, that the country as a whole exports at that location.

Consider, for example, point number 1. As indicated by the small arrow leading to it, it can be reached from the parallelogram of nonspecialization by reallocating labor from region B to region A, leaving region A producing both goods but region B producing only Y. Note that, in traversing the small arrow adjacent to point 1, output of X will rise in region A while remaining constant at zero in region B, and the output of Y will fall in both. Hence, the ratio of X to Y produced in the country as a whole will rise, leading it to export X. Similarly, the same reasoning, with the names of the regions interchanged, will imply that the country will also export X at point 2. Points 3 and 4 in the top and bottom of the figure yield analogous conclusions by considering the change in land allocation needed to reach them.[5]

Points 5 and 6 (and their unmarked analogs in the lower right of the figure) must be handled somewhat differently. Using the $\bar{X}$ and $\bar{Y}$ isoquants for reference, it can be seen at point 5, for example, that region A produces less Y than $\bar{Y}$ while region B produces more X than $\bar{X}$. It follows that the country exports X. A similar argument shows that the country exports Y at point 6, with analogous results in the figure's lower right.

In the space between the two isoquants we cannot know the pattern of trade. However, since outputs rise continuously and monotonically as one moves away from the origin, we do know that there will exist a well-defined locus of points in that space where the ratio of the two regions' outputs of X and Y is the same as $\bar{X}/\bar{Y}$. This locus is drawn as the dashed curve SM

[5]Land is of course assumed to be immobile throughout this paper. When we "move land" in our analysis, we are really asking the hypothetical question of what the equilibrium would have been if more of the land had been located in, say, region A.

in Fig. 1. Below it the country exports X, above it the country exports Y, and along the locus there is no trade. The locus SM is drawn as including the corner of the box at M, under the assumption that both factors are necessary to both industries in order to produce any output at all. If that is not the case—if output in either industry remains positive when one of the inputs is absent—then the locus may stop somewhere on the side of the box away from its corner.

This then maps out the patterns of trade for the country quite completely. We take two messages away from this exercise. First factors do not need to be identically distributed across regions for there to be no trade. All that is required to be in the no-trade (FPE) parallelogram is for the factors of production to be sufficiently evenly distributed across regions. On the other hand, it is also clear that there *will* be international trade (and will not be FPE) if the factors are sufficiently *unevenly* distributed across regions. Regardless of the sizes of the two regions (as reflected by distances from the respective origins O_A and O_B), if the distribution of one or both factors is sufficiently uneven, then there will be trade.

In Courant and Deardorff [5] we examine this last point in detail, investigating the relationship between various measures of lumpiness and the pattern of trade. Here we simply note that the pattern of international trade will depend on the weights used in aggregating the regions into a national economy. Both regions are behaving, individually, exactly like the familiar countries of the Heckscher–Ohlin Model. When factors are unevenly distributed, so that one region is land-abundant and the other region is labor-abundant, the two regions become exporters of different goods, and the net trade of the country as a whole depends on the weights attached to the two regions in aggregating them.

Before proceeding to explore various causes for factor lumpiness, which we do in the remainder of this paper, we might pause to consider the plausibility of any real-world countries being sufficiently lumpy so that lumpiness is a determinant of their trade. With our purely theoretical perspective here, we hesitate to claim much empirical applicability for our model without much further study. However, several of those who have commented on our work have found it plausible for explaining various real-world situations.

Jerry Thursby, for example, speculated that lumpiness might have been a contributing cause of the Leontief paradox, in which it was found that U.S. exports were labor intensive in spite of its presumed scarcity of labor. If labor was concentrated in small parts of the country, then our model of lumpiness could predict this result.[6]

[6]Of course, the Leontief paradox is no longer regarded as quite so paradoxical as it once was, both because of recent attention to U.S. exports of skilled labor or human capital-inten-

Charles Becker [1] has also suggested that infrastructure development in the Cap Vert-Dakar area of Senegal has provided both consumption and production amenities (see Sections II and III, below) that have led to results consistent with lumpiness as a cause of trade. In particular, there has been a migration of mobile factors to the region, and Senegal, without any significant change in its overall factor endowments, has become an exporter of labor-intensive goods and services.

Finally, we would note Jim Melvin's [17, 18] observation that Canada, with its long border with the United States, has provinces that engage in quite different patterns of international trade. Melvin concentrates on the interesting role of internal and external transportation costs, but we think it plausible that lumpiness of factors, for the reason discussed here, may also be a contributing determinant of Canada's trade.

II. LABOR MOBILITY AND CONSUMPTION AMENITIES

If labor is intranationally mobile and locates to equalize wages across regions, the results in Section I would seem to be irrelevant: with factor prices equalized, the economy will operate within the FPE parallelogram and there will be no international trade. This result can be turned on its head, however, if interregional equalization of utility implies unequal wages. Suppose, for example, that there is some unspecified "amenity" that matters for consumers[7] and that differs in its availability across regions. One could think of this amenity as being the region's climate, although anything that affects the quality of life could play the role as well.

The basic story is then very simple: Suppose, say, that region B is nicer to live in than region A. Then workers will move there, not until they equalize the wages across regions, but until there is a sufficient real wage differential to induce some of them to stay in region A. This in turn means that we *must* leave the FPE parallelogram, and that labor–market equilibrium will be found *only* amount those regional factor distributions that lead to trade.

Somewhat more formally, assume that the (common) preferences of consumers everywhere are represented by an indirect utility function $V(p, E, \Gamma)$, where p is the vector of prices of goods in some numeraire, E is the level of consumer expenditure in the same units, and Γ is the level

sive goods and because of Leamer's [16] more careful formulation of the Heckscher–Ohlin Theorem in terms of factor contents of production and consumption. There nonetheless remain some inconsistencies between the intensities and the endowments of unskilled labor in U.S. trade, as pointed out by Brecher and Choudhri [3].

[7] But not, directly, for producers. Production amenities are considered in Section III. See Roback [22, 23] and Beeson [2] for discussion of the intranational effects of lumpy amenities that affect both consumers and firms simultaneously.

of the amenity in the region where the consumer lives. Letting w^I and Γ^I be the wage of labor and the level of the amenity in regions $I = A$ and B, respectively, then the condition for labor market equilibrium is

$$V(p, w^A, \Gamma^A) = V(p, w^B, \Gamma^B), \tag{1}$$

where p is the vector of goods prices that is common to the two regions. This equation can be solved for either wage in terms of the other wage, the price vector, and the two amenity levels. However, for simplicity assume that the indirect utility function has properties such that the solution takes the form

$$w^A - w^B = \gamma(p, \Gamma^A, \Gamma^B). \tag{2}$$

Looking now at Fig. 2, we can say more about the location of the labor market equilibria. Figure 2 reproduces portions of Fig. 1, with particular attention to the locus MS that separates exports of X from exports of Y in the northwest corner of the box.

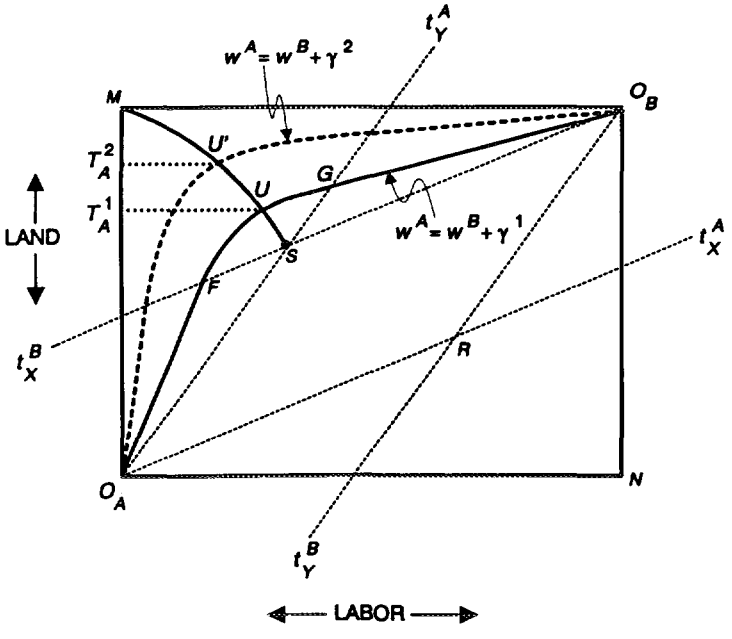

FIGURE 2

Suppose again that region B has the higher level of amenities, so that $\Gamma^B > \Gamma^A$ and labor market equilibrium requires

$$w^A - w^B = \gamma^1 > 0. \tag{3}$$

This condition will hold along the locus $O_A FUGO_B$. This locus begins from O_A with a straight segment, $O_A F$, since in this area the wage in region B is constant due to FPE, while the wage in A depends only on the land–labor ratio in A. The locus also ends in a straight segment GO_B for the same reason. Between F and G we know only that it must move, from F, to progressively lower land–labor ratios in both regions in order for both wages to move in the same direction. This is enough to assure that the locus crosses the curve MS only once.

With the distribution of land fixed and labor mobile in this fashion, the equilibrium pattern of trade will be determined along this locus by the given distribution of land. As long as the distribution of land is below point T_A^1 in the figure, the country will export X. Above that it will export Y. As drawn, it appears that the range of possible land distributions that will lead the country to export X is greater than the range that will lead it to export Y, suggesting a bias in favor of exporting the labor-intensive good.

Such a bias is to some extent an artificial result depending on how we happened to draw the figure. However, it becomes more systematic as we now consider differences in amenities that are more and more extreme. For example, if the amenity difference were such as to require a wage differential $\gamma^2 > \gamma^1$, then the locus of labor–market equilibria would be shifted out further from the FPE parallelogram, to something like $O_A U' O_B$. This locus crosses MS higher in the figure, increasing the range of land allocations for which the country will export X. As we consider even larger differences in amenities, therefore, we can conclude that

PROPOSITION 1. *If labor is mobile in response to a difference in consumption amenities across regions, then the larger that difference, the more likely it becomes that the country will export the labor intensive good.*[8]

[8]Charles Becker [1] reminds us that lumpiness of amenities is ubiquitous across countries, and Proposition 1 could thus be interpreted to imply, impossibly, that all countries will export labor-intensive goods. As we discussed in Courant and Deardorff [5], however, in a world of two or more countries it is relative, not absolute, lumpiness that matters, and countries whose factors are relatively evenly distributed across regions will be induced by world market prices to import those goods that the more lumpy countries are exporting. In this context this means, as Becker has stated in his comments, that "countries with the greatest interregional

Congestion

The amenities that we have considered so far have remained constant in their effects even as more and more labor has moved into a region to take advantage of them. For some amenities, such as climate, this may be reasonable. For others, such as recreation facilities, it certainly is not. In any case, once one begins to consider amenities that enhance the quality of life, one should equally well consider the adverse consequences of population density. Therefore in this section we take note of how our analysis would be altered if we were to allow for congestion of the amenities.

The effect is quite straightforward. When labor was allowed to move in response to a "pure public amenity," it had to move all the way outside of the FPE parallelogram in order to create a compensating wage differential. The reason was that within the FPE parallelogram wages do not change at all as factors move. This continues to be true even when we allow for congestion. But what congestion *can* do is to remove the need for any change in wages.

To allow for congestion, we now let the indirect utility function take the form

$$V = V\big(p, E, \tilde{\Gamma}(\Gamma, L)\big), \tag{4}$$

where $\tilde{\Gamma}$, the level of the amenity available to the consumer, is increasing in Γ and decreasing in L, which we assume varies directly with population.

Suppose then that we start with an even distribution of factors across regions, as at point E in Fig. 1, and that the consumption amenity favors region B. Workers will begin to move into region B, as before, but as they do the value of the amenity to consumers will be eroded by congestion. At the same time, as workers leave region A, fewer and fewer people will share the amenity there, and its value to them will be enhanced. It is possible, therefore, that the value to consumers of the amenities will become equalized solely by labor movement, before that movement leads to complete specialization in either region. If so, then trade will remain zero and the original difference in amenities will not have led to trade.

Thus, the role of congestion of a consumption amenity is to reduce the likelihood, for any given difference in that amenity, that it will lead to trade. Recalling that without congestion even the smallest difference in amenities would lead to both complete specialization in some region and trade, it is perhaps reassuring that congestion can somewhat dampen this

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amenity differentials will, ceteris paribus, be exporters of the mobile factor [labor]-intensive good."

extreme effect. Notice that it continues to be true that differences in consumption amenities *can* lead to trade: they merely have to be large enough.[9]

III. PRODUCTION AMENITIES

Amenities do not exclusively affect consumers, of course. In some industries climate is as important for production as it is for the quality of life. In others the proximity to natural resources may serve to reduce costs. In addition, of course, workers' productivity may be influenced by the environment in which they live and work.[10]

To allow in our analysis for such production amenities raises more questions than does the simple consumption amenity discussed in the preceding section. Are production amenities equally important for both industries, or do they favor one over the other? How does the amenity enter the production function of an industry—is it like another factor with respect to which there are diminishing returns, or is it like an efficiency parameter affecting outputs at all scales identically? Finally, what effect does the amenity have on demands for factors—is it labor-saving, land-saving, or neutral, and, if neutral, in what sense? In short, the presence of production amenities raises all of the questions traditionally associated with technological change, and it could therefore lead us into an almost unending proliferation of cases to consider.

We shall therefore not attempt to pursue the subject of production amenities exhaustively, but rather will examine only the simplest possible case. Our purpose is not a definitive evaluation of the roles that production amenities may play in determining trade patterns, but only to check that they do not necessarily undermine the conclusions that we have already obtained without them.[11]

[9]In an important paper, Henderson [11] argues that the standard trade theorems (Heckscher–Ohlin, Rybczynski, Stolper–Samuelson, and a form of factor price equalization that might be called factor utility equalization) can be derived in a model of countries that are built up from urban areas that have congestible amenities. Henderson's model differs from those developed here in enough ways to make the differences in results difficult to characterize. One of our main results, that factor price equalization is very unlikely to hold when there is lumpiness of amenities, is clearly stated by Henderson [11, p. 337]. The relationship between lumpiness and trade itself is not developed by Henderson, possibly because in his setup each city (or region, in our case) produces only one traded good.

[10]This last point was illustrated by Assar Lindbeck a decade ago. He, we are told, declined an opportunity to move his Institute to more charming quarters on the grounds that his economists would be less productive with all that beauty to look at.

[11]Beeson [2] and Roback [22, 23] consider production amenities in models where only one traded good is produced. This simplification allows for a much more general treatment, using cost functions, than we employ here.

Thus, consider a production amenity that enters as a Hicks-neutral technological shift parameter of the same size in both industries.[12] That is, we write the production functions for X and Y respectively as

$$X^I = \Gamma^I F^X(L_X^I, T_X^I) \tag{5}$$

$$Y^I = \Gamma^I F^Y(L_Y^I, T_Y^I) \tag{6}$$

for regions $I = \text{A}, \text{B}$. Thus the level of the production amenity, Γ^I, serves to determine the numbering of the isoquants for each good, but it does not change their shapes. In addition, we assume that the difference in the amenity has the same percentage effect on both industries.

These assumptions serve to leave the regions of specialization shown in Fig. 1 unchanged. Because only the numbering of isoquants is changed, and because the percentage effects are the same in both industries, it follows that the land–labor ratios consistent with nonspecialization, t_X and t_Y, are the same in both regions despite the production amenity. However, the implications of these patterns of specialization for trade *are* changed by the amenity, as we now discuss.

Figure 3 shows the regions of specialization as before, bounded by the various t_X and t_Y rays. Suppose now that the level of the production amenity is greater in region B than in region A, so that outputs in B, for given inputs, are some $\theta\%$ higher than in region A.

Consider first the diagonal of the box diagram, $O_\text{A}O_\text{B}$. Along it, both regions produce the goods in the same proportions. Hence, even though region B can product $\theta\%$ more of both goods from a given amount of factors, the ratio of the goods produced in the whole economy will be the same. Thus there will be no trade anywhere along this diagonal line.[13] This is the same result that we had without the production amenity.

Off the diagonal, however, things are different. Consider allocations above the diagonal, although still consistent with nonspecialization in both regions, in the triangle $O_\text{A}O_\text{B}S$. Here region A, without the amenity, produces relatively more of the land-intensive good, Y, than does region B, while region B produces relatively more X. Since B has the greater amenity, the output of the entire economy will be biased towards good X. To see this, suppose for comparison that region B did *not* have an amenity advantage over region A, and that its production levels were then X^C and

[12]Such an amenity plan plays the same role in production as a "factor-augmenting intermediate public good." See Feehan [9].

[13]While the ratio of goods produced will be constant along the diagonal, the total amounts produced will not. The closer the economy is to the lower left corner of the box, O_A, the more production will take place in the more productive region B, and the greater will be the country's output of both goods.

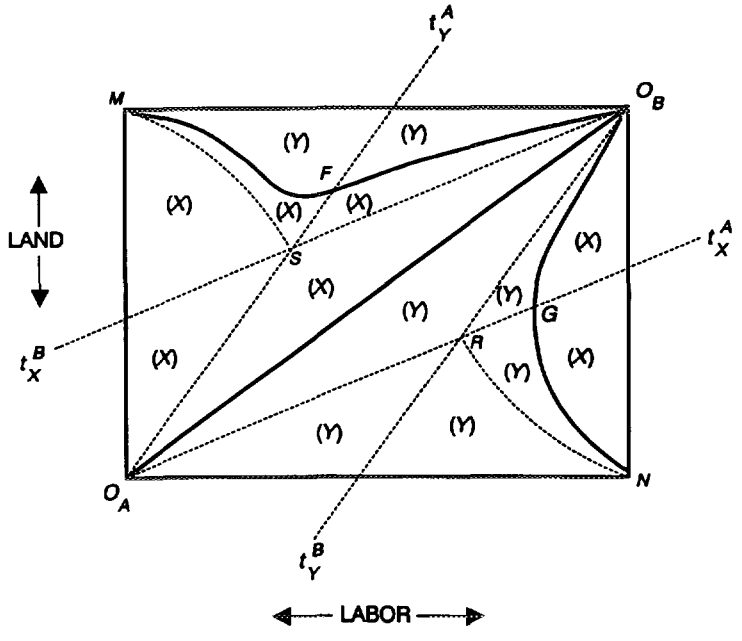

FIGURE 3

Y^C. Letting $\bar{X} = X^A + X^C$ and $\bar{Y} = Y^A + Y^C$ we know from our earlier analysis that $\bar{X}/\bar{Y}$ is the ratio of the goods both produced and consumed along the diagonal. With the amenity advantage, however, $X^B = (1 + \theta)X^C$ and $Y^B = (1 + \theta)Y^C$. Therefore

$$\begin{aligned}(X^A + X^B)/(Y^A + Y^B) &= (X^A + (1 + \theta)X^C)/(Y^A + (1 + \theta)Y^C) \\ &= (\bar{X} + \theta X^C)/(\bar{Y} + \theta Y^C) \\ &> \bar{X}/\bar{Y} \qquad (7)\end{aligned}$$

since $X^C/Y^C > \bar{X}/\bar{Y}$ above the diagonal. Similarly the country will export good Y for nonspecialized allocations below the diagonal. These results are noted in Fig. 3 by recording the identity of the good that is exported in each area in parentheses.

In areas where one or both regions are completely specialized, one needs merely to compare their outputs to the earlier analysis. For example, near the left of the diagram where good X was previously exported, this will still be the case since region B, whose production is elevated by the superior amenity, is already producing a higher ratio of X to Y than

the country as a whole. Similarly, near the bottom of the diagram, where good Y was exported, this too will continue to be true for the same reason.

However, the presence of the production amenity can change the trade pattern from our earlier analysis for those allocations where region B was previously exporting the opposite good of the country as a whole. For points just above point S, for example, without the production amenity we previously had region B specializing in X, but the country just barely exporting Y. With the output of X in B now elevated by the amenity, the country will now export X instead. Thus the borderline between exporting X and exporting Y is now shifted upward toward the top of the box. Similarly, the analogous borderline on the right-hand side is also shifted toward the right. These new borderlines are now shown in Fig. 3 as MFO_B and O_BGN.

The result, then, is that the introduction of a production amenity that differs across regions, even without any mobility of factors, can increase the likelihood of trade. Comparing Fig. 3 to Fig. 1, the area of no trade, which previously included the entire FPE parallelogram, has now degenerated to the diagonal line. We therefore get trade arising for almost all allocations of factors of production. The pattern is largely similar to that without the production amenity, although some of the areas denoting particular patterns of trade have now expanded and encroach on others. In particular, trade continues to result, as in Courant and Deardorff [5], from the uneven distribution of factors across regions, with some tendency for the country to export the good that uses intensively the more unevenly distributed factor. This is supplemented here, however, by another tendency that applies for factor distributions that are closer to even, and that we now state as an additional proposition:

PROPOSITION 2. *When regions differ in both levels of production amenities and relative factor endowments, if the difference in relative endowments is not too great there is a tendency for the country as a whole to export the same good that is exported by the region with the greater amenity, that is, the good that uses relatively intensively the factor with which that favored region is relatively well endowed.*

What is perhaps surprising about this result is that it is true independent of the sizes of the regions. Even if the high-amenity region is quite small in absolute terms, as in the neighborhood of the corner O_B in Fig. 3, it is still true that the country will export the same good exported by region B so long as both regions produce both goods.[14]

[14]Indeed, as is shown in Fig. 3, this trade pattern will also exist for allocations sufficiently *near* to the FPE parallelogram, not just inside it.

Labor Mobility

A consumption amenity had no effect on the country's trade until we also allowed labor to be mobile between regions. As we have just seen, a production amenity gives rise to trade even with both factors immobile. However, it is of interest to note, in passing, how labor mobility would now matter for trade in the presence of the assumed production amenity.

Without any consumption amenity, labor will move between regions to equalize the wage. However, the presence of the production amenity now means that wages cannot become equal while both goods are produced in both regions. With the assumed Hicks-neutral amenities wages (and rents) are elevated along with output and by the same percentage. Thus while the ratio of the wage to the rent on land is the same in both regions throughout the FPE parallelogram O_ARO_BS in Fig. 3, both the wage and the rent are higher in B than in A by the percentage θ. Labor will therefore be induced to move out of A and into B, moving us to the left in the figure, exactly as was the case with the consumption amenity, although for quite different reasons.

As before, labor market equilibrium will be found along a locus very similar to O_AFUGO_B in Fig. 2. That is, equilibrium can only exist outside the FPE parallelogram. To avoid clutter we do not draw this locus in Fig. 3, but it should be clear that its properties and implications are very much the same as was the case in Fig. 2. In particular, for a large range of allocations of land, the production amenity provides an incentive for labor to move the economy to allocations for which it will export the labor-intensive good. In addition, as the difference in production amenities becomes larger, the locus MFO_B in Fig. 3 is pulled upward toward the top of the diagram, and the range of land allocations for which the country exports X Increases. Therefore Proposition 1 is valid also for differences in production amenities. Since many amenities benefit both producers and consumers, this is reassuring, for it means that such mixed amenities will also have a well-determined effect on the pattern of trade. Also, this suggests that production amenities will lead to higher population densities. In other words, places that have natural advantages in production will tend to become cities, a finding that is at the heart of regional and urban economics, and is also consistent with observation.

IV. NONTRADED GOODS

The effect of nontraded goods on international trade depends importantly on whether the factors used to produce them are the same as the factors used to produce traded goods. If so, the mechanism of factor price equalization serves also to equalize the prices of nontraded goods across regions. Even in this case, however, the presence of nontraded goods can

have important effects. As we show in another paper,[15] the presence of nontraded goods reduces the size of the FPE parallelogram and therefore, even without labor mobility, increases the likelihood that lumpiness will affect the pattern of international trade.

Here we consider the polar opposite case: where nontraded goods are produced using only factors of production that are different from those used in traded goods.[16]

Suppose, then, that in addition to goods X and Y there is a third good, N that is nontraded even between regions. Suppose also that production of this good requires neither labor nor land, but instead any number of additional factors of production, denoted by a vector R, that like land are also immobile between regions. Letting the production function for N be $H(R)$, the fixed factors available for its production then imply a fixed amount of it that will be produced. Henceforth, therefore, we regard the supply of N itself as fixed, and ignore the underlying process of production.

Like the amenities that we have considered earlier, nontraded goods may be consumption goods or they may be intermediate inputs to production. We assume the former, leaving the analogous case of intermediate inputs to the reader.

On the consumption side, then, let the indirect utility function be $V(p, q, E)$, where p is the vector of prices of traded goods, q is the price of the nontraded good, and E is total expenditure in the region. This expenditure must include both the incomes of labor and land, plus the income of the resources used to produce N. Since the latter is qN, we have

$$E = wL + rT + qN. \tag{8}$$

Equilibrium in the market for the nontraded good requires that its demand equal its fixed supply, or that

$$\begin{aligned} N &= -V_q(p, q, E)/V_E \\ &= -V_q(p, q, wL + rT + qN)/V_E, \end{aligned} \tag{9}$$

[15]Deardorff and Courant [7]. The effect of nontraded goods on the size of the FPE parallelogram had also been mentioned by Helpman and Krugman [10, p. 19–22].

[16]We realize this case is unrealistic. However, as long as *some* of the factors used in producing nontraded goods are not used to produce traded goods, then our qualitative results below will carry through. This assumption clearly applies, for example, to the factors that allow especially desirable residential neighborhoods to earn their supernormal land rents. See Courant and Deardorff [6].

where V_q and V_E are the partial derivatives of V with respect to the arguments q and E, and V_E, of course, depends on the same arguments as V_q. The fact that the demand for N depends positively on the income generated by its production opens up the familiar possibility of nonunique and unstable equilibria. However, we assume a unique, stable equilibrium, so that this equilibrium condition can be solved for q in terms of the other variables present. As we are interested only in its dependence on N and L, we write this solution and use conventional properties of demand functions to sign its argument as[17]

$$q = q(\bar{N}, \overset{+}{L}). \tag{10}$$

If we now substitute this solution back into the indirect utility function itself, we get

$$V = V(p, q,(N, L), E). \tag{11}$$

Equation (11) is of exactly the same form as Eq. (4), from which it is clear that the nontraded good acts in exactly the same manner as a congestible consumption amenity. If the resources for producing the nontraded good are located disproportionately in one region of the country, then its price will be low there and this will attract an inflow of labor. That inflow of labor, however, serves in turn to raise the demand for the nontraded good, and thus its price, and therefore has the same offsetting effect as congestion of an amenity.

We conclude therefore that we do not need an extensive analysis of this kind of nontraded good. Its effects on trade have already been established implicitly in our discussion of consumption amenities. These effects need merely to be translated into the present context:

PROPOSITION 3. *If regions are disproportionately endowed with the resources needed for producing nontraded goods, and if labor is mobile, then price differences for nontradables will cause labor to move among regions to make the distribution of factors for producing tradable goods uneven. If the difference in resource endowments is large enough, then prices of nontraded goods will remain unequal even after labor has moved, equilibrium will be achieved by complete specialization among tradables in one or both regions accompanied by a compensating wage differential between regions, and the country will trade. The greater the difference in nontraded goods prices that persists after this adjustment, the more likely it is that the country as a whole will export the labor-intensive good.*

[17]Much more precision is possible if preferences happen to be Cobb–Douglas. In that case $q = [\alpha/(1 - \alpha][wL + rT]/N$, where α is the expenditure share of the nontraded good.

V. IMPLICATIONS

In all of the cases considered above (save that of production amenities with immobile factors) the mechanism causing international trade is the same: intranational equilibrium with mobile factors of production requires that real wages differ by region. This directly implies that the national economy must be outside of the FPE parallelogram, and that at least one region must be completely specialized. This specialization causes the total outputs of the country to be systematically different from what they would have been in a homogeneous country, and this in turn alters the pattern of trade.

The empirical and theoretical literature on intercity and interregional real wage differences abound with compelling reasons to believe that the basic mechanism discussed in this paper operates in the real world. In addition to amenities and nontraded goods (which would include natural resources) there is also the possibility that produced nontradables (e.g., the services of local governments, including, but not limited to, development policies) could lead to differences in factor prices.[18] Amenities can have much more complicated effects than those considered here when different types of labor respond to them differentially.[19] Crucial to the message of this paper, however, these complications would add further reasons why factor prices should vary intranationally in equilibrium, thereby affecting the pattern of international trade.

That factor prices, especially wages, do vary is also well established in the empirical literature.[20] Roback [23] is especially important in this regard, because she shows that much of this variation can be attributed to what we here call lumpiness in amenities, implying that the wage differences are equilibrium phenomena.

Our findings here suggest strongly that it is not factor endowments at the national level, but the (equilibrium) distribution of those endowments within a nation that matter for determining its pattern of production. Indeed, in this view, countries are (except perhaps in the case of island nations) arbitrary aggregations of regions and cities, whose endowments of amenities and nontraded goods, both natural and produced, are the fundamental determinants of the location of production and the pattern of

[18]That public laws and regulations, as well as goods and services, can act as amenities has long been understood by politicians. For example, James Madison, in arguing for separation of Church and State in Virginia, claimed that the establishment of religion should be opposed, among other reasons, because it would "hinder immigration [and] foster emigration." (See Wills [25, p. 375].)

[19]See Roback [23] and Beeson [2]. More generally, Tiebout models imply that there will be geographic lumpiness of preferences.

[20]See, for example, Treyz [24] and Montgomery [21] among many others.

trade. National boundaries may delimit sets of cities and regions among which factors are mobile, but that minor political point aside, international trade is simply a special case—a particular aggregation—of interregional and intercity trade.

REFERENCES

1. C. M. Becker, Comments on an earlier draft of this paper, presented at the Conference in Honor of Edwin Mills (1992).
2. P. E. Beeson, Amenities and regional differences in returns to worker characteristics, *Journal of Urban Economics*, **30**, 224–241 (1991).
3. R. A. Brecher and E. U. Choudhri, The Leontief paradox, continued, *Journal of Political Economy*, **90**, 820–823 (1982).
4. P. N. Courant and A. V. Deardorff, International trade with lumpy countries, Seminar Discussion Paper No. 242, Research Seminar in International Economics, University of Michigan (1990).
5. P. N. Courant and A. V. Deardorff, International trade with lumpy countries, *Journal of Political Economy*, **100**, 198–210 (1992).
6. P. N. Courant and A. V. Deardorff, Migrant landlords and trade of lumpy countries, manuscript, The University of Michigan (1992).
7. A. V. Deardorff and P. N. Courant, On the likelihood of factor price equalization with nontraded goods, *International Economic Review*, **31**, 589–596 (1990).
8. A. K. Dixit and V. Norman, "Theory of International Trade," Cambridge Univ. Press, London (1980).
9. J. P. Feehan, Pareto-efficiency with three varieties of public input, unpublished manuscript, University of Western Ontario (1989).
10. E. Helpman and P. R. Krugman, "Market Structure and Foreign Trade: Increasing Returns, Imperfect Competition, and the International Economy," MIT Press, Cambridge, MA (1985).
11. J. V. Henderson, Systems of cities in closed and open economies, *Regional Science and Urban Economics*, **12**, 325–350 (1982).
12. J. V. Henderson, The sizes and types of cities, *American Economic Review*, **64**, 640–656 (1974).
13. J. V. Henderson, "Economic Theory and the Cities," 2nd ed., Academic Press, New York (1977).
14. J. Jacobs, "Cities and the Wealth of Nations," Random House, New York (1984).
15. P. Krugman, "Geography and Trade," MIT Press, Cambridge, MA (1991).
16. E. E. Leamer, The Leontief paradox, reconsidered, *Journal of Political Economy*, **88**, 495–503 (1980).
17. J. R. Melvin, Domestic taste differences, transportation costs and international trade, *Journal of International Economics*, **18**, 65–82 (1985).
18. J. R. Melvin, The regional economic consequences of tariffs and domestic transportation costs, *Canadian Journal of Economics*, **18**, 237–257 (1985).
19. E. S. Mills, "Urban Economics," Scott, Foresman, Glenview, IL (1972).
20. E. S. Mills, "Studies in the Structure of the Urban Economy," Johns Hopkins Univ. Press, Baltimore, MD (1972).
21. E. Montgomery, Evidence of metropolitan wage differences across industries over time, *Journal of Urban Economics*, **31**, 69–83 (1992).
22. J. Roback, Wages, Rents, and the quality of life, *Journal of Political Economy*, **90**, 1257–78 (1982).

23. J. Roback, Wages, rents, and amenities: Differences among workers and regions, *Economic Inquiry*, 23–41 (1988).
24. G. Z. Treyz, Causes of changes in wage variation in states, *Journal of Urban Economics*, **29**, 50–62 (1991).
25. G. Wills, "Under God: Religion and American Politics," Simon and Schuster, New York (1990).
26. J. D. Wilson, Trade and the distribution of economic well-being in an economy with local public goods, *Journal of International Economics*, **29**, 199–216 (1990).