Trade and Location:
A Moving Example Motivated by Japan

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ABSTRACT

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If trade costs matter for trade, and if distance matters for at least some trade costs, then location matters for trade. This paper explores that relationship in the context of a simple partial equilibrium model of a single homogeneous good that may be produced and exported or imported by three countries located on a plane. Six equilibrium regimes arise in this model, depending on the sizes of the trade costs among the countries compared to the differences in their autarky prices. These regimes range from complete autarky in which no country trades, through partial autarky in which only two of the three countries trade, to either of two integrated equilibria in which either two countries export to the third, or (a different) two countries import from the third. These regimes are first identified in terms of the parameter values, including trade costs, that are needed for their occurrence. They are then mapped out on the plane where the three countries are located. Given the location of two of the countries, equilibrium regimes and the directions and quantities of trade can be plotted as functions of the location of the third country.

Results of the analysis include the following: Whether a country whose autarky price lies between those of the other countries will export or import the good depends on its proximity to the other countries, exporting if it is close to the high-cost country and importing if it is close to the low-cost country. The location of such a country is also important, not just for its own trade but also for the trade of the other countries. Thus for example, the lowest cost country may not be able to trade at all if the intermediate-cost country, by virtue of its location, takes away the market of the high-cost country. Finally, although a fall in the size of trade costs per unit distance increases, up to a point, the size of the geographic regions within which a country can trade, beyond that point a further fall in trade costs cannot make trade possible for an intermediate-cost country that is too remote to trade.

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I. Introduction

Evidence accumulates that the costs of engaging in international trade are significant.[1] My own interest has turned recently to the effects that trade costs may have, not just on the volume of trade, but on the pattern of trade. That is, to what extent may costs of trade help to determine which goods a country exports and which it imports. In Deardorff (2004), for example, I have shown in several different models how trade costs can figure in the determination of comparative advantage. If trade costs matter, then almost certainly location also matters, since many trade costs are increasing in distance. Therefore a variation of this theme, elaborated in this paper, is to ask how trade patterns depend on the location of countries.

Japan provides what seems plausibly to be a particularly stark example of the potential importance of location. If my reading of the world map is correct, Japan is farther from its nearest developed-country trading partner than any other developed country. And amongst the largest developed countries (thus excluding Australia and New Zealand), Japan is farthest from other large developed countries. At the same time, Japan is geographically very close to quite a number of developing countries that are active in international trade. Therefore, if distance matters for trade costs,[2] if trade costs matter for trade patterns, and if comparative advantage tends to vary with level of development, we might expect the role of comparative advantage in Japanese trade to be different from that of other large developed countries that are closer to rich trading partners and further away from the poor.

But exactly how should location matter? The theory of this does not seem to have been addressed much by trade economists, so in this paper I will examine this question in what seems to me to be the simplest possible context: A partial equilibrium model of a single homogeneous good that is produced and traded in a world of only three countries

* I have benefited from the comments of Bob Stern, Gary Saxonhouse, and others who participated in the preconference in Ann Arbor.

[1] See Anderson and van Wincoop (2003b). Evidence that something must be reducing trade volumes below what it would be if trade were perfectly free and frictionless can be found in Trefler (1995), Obstfeld and Rogoff (2000), Davis and Weinstein (2001), Anderson and van Wincoop (2003a) and the large literature using the gravity model to explain trade flows. See, for example, Frankel (1998).

[2] In the model I will assume that trade costs are simply proportional to distance. But the example of Japan draws special attention to a reason that this is not true: transport costs for many goods are very different over water than over land.

whose costs of production, reflected in their autarky prices, are different. Positioning two of these countries arbitrarily on the map, I will then ask what the trading equilibria are for various possible locations of the third country. For this exercise, then, I will be moving the third country to different locations on the map. This is not of course a realistic exercise, but it is a convenient one for seeing how a country's location may matter. If we think of this third country as being Japan, then we will see how it matters whether Japan is located far from the trading partner whose costs are most similar to it, and close to the partner whose costs are different, just as seems to be the case in the real world.

To anticipate the results somewhat, let me prepare you for what otherwise might be later disappointment. On the one hand, this simple model yields results that are mostly rather obvious. In particular, the model does not suggest that Japan's distinctive location, as I have described it, should matter particularly for the commodity composition of Japanese trade. On the other hand, the predictions of the model for Japan's selection of trading partners (with whom it trades, rather than what it trades), though not surprising, do not seem to match particularly well with present-day reality. I certainly would not offer this simple model as the ideal tool for understanding trade patterns in the real world, for Japan or anybody else.

The reason for doing all this, then, is only to make a start on sorting out the role of location in trade. The model here, though simple, is simple in a very familiar way, and it therefore provides an obvious starting point for thinking about the question. And it turns out that even this simple model requires some effort to solve, so that doing more than this in a single paper is not feasible.[3]

II. Preview of Relating Location and Trade

The exercise here – of moving a country around and asking how its trade pattern varies as a result – is sufficiently odd that it may be helpful to do it first in an even simpler model where the answers are more obvious. Consider, then, a world of only two countries, *A* and *B*, each able to produce and consume (among other things – this is partial equilibrium) a single homogeneous good. Excess supply of country *c* is given by

$$s_c = b_c(p_c - a_c), \quad c = A, B \tag{2.1}$$

where p_c is the price of the good in country *c*; and a_c and b_c are positive constants. The parameter a_c is the price corresponding to zero excess supply, and thus the country's autarky price, reflecting its cost of production and thus comparative advantage. I will assume that $a_A < a_B$ so that country *A* has comparative advantage in this good. These excess supplies are graphed in Figure 1.

The parameter b_c reflects responsiveness of the country's excess supply to price. For a given good, for which this responsiveness may be expected to be the same for individual producers and consumers in different countries, differences in b_c across countries therefore reflect differences in country size. That is, for a given excess, say, of actual price over autarky price, a country that is twice the size of another may be expected to export twice as much of the good and thus to have a parameter b_c that is twice as large.

[3] In Deardorff (2004) I include an exercise similar to this one, except that I use a differentiated-products model that simplifies the task considerably.

If trade costs were zero in this two country model, a trading equilibrium would consist of a single price at which one country's excess supply equals the other's excess demand, or equivalently that the sum of their excess supplies is zero. With a trade cost, however, two kinds of equilibrium are possible. If the trade cost is larger than the difference between the two countries' autarky prices (the a_c's), then they will not trade even though trade is permitted. If the trade cost is smaller than this difference, however, then equilibrium will consist of different prices in the two countries, differing by the amount of the trade cost t, such that, again, the sum of the excess supplies is zero.

Consolidating these possibilities, equilibrium in the two-country model consists of a price in each country, p_c, and a quantity, x, exported from A to B (since $a_A < a_B$), such that

$$s_A = b_A(p_A - a_A) = x = -s_B = -b_B(p_B - a_B) \tag{2.2}$$

and

$$p_B - p_A \le t, \quad x \ge 0, \quad (p_B - p_A - t)x = 0 \tag{2.3}$$

The complementary slackness conditions collected in (2.3) capture the two kinds of equilibrium mentioned, since positive trade, x>0, requires that prices differ by exactly the trade cost, while zero trade (and thus $p_c = a_c$ from (2.2)) requires that $a_B - a_A \le t$.

Now suppose that trade cost depends on distance: $t = \tau d$ where d is the distance between the countries (themselves assumed to be points in space!) and τ is the trade cost per unit distance.[4] Clearly the nature of the resulting equilibrium depends on how far apart the countries are, or specifically whether they are within a distance $d_0 = (a_B - a_A)/\tau$ of each other. That is, solving for x we have:

$$x = \begin{cases} 0 & \text{for } d \ge d_0 \\ (a_B - a_A - \tau d)b_{AB} & \text{for } d \le d_0 \end{cases} \tag{2.4}$$

where $b_{AB} = b_A b_B/(b_A + b_B)$.

Schematically we may think of the two countries as arranged along a line in space, represented by their excess supply diagrams in Figure 2. Holding the location of Country A fixed, we imagine moving Country B along the line away from Country A. The line is then divided into two regions, one within d_0 of Country A and the other outside this bound. There is trade in the first region and none in the second. This is also represented in Figure 3, which graphs trade as well as the two prices as a function of the location of Country B, holding the location of Country A constant at the origin. As drawn in these figures, Country A is larger than Country B, as reflected in its flatter excess supply curve. This manifests in Figure 3 where the price with zero trade cost (zero distance), which is the same in the two countries, is closer to the autarky price of A than of B.

The purpose of this paper is to repeat this sort of analysis for three countries arranged on a plane, rather than for two countries arranged on a line. As in Figure 2 I will seek to subdivide the plane into regions where different sorts of equilibrium and trade patterns occur, based on different locations for one of the countries holding the locations of the other two fixed. And as in Figure 3 I will graph quantities (and also

[4] Again – see footnote 2 – I abstract from trade costs per unit distance being different over different routes, as over water and over land.

directions) of trade over this plane, showing how these too depend on the location of the third country.

III. Equilibrium for Three Countries with Trade Costs

The three-country model has the same structure as the two-country model. That is, three countries, A, B, and C, each have an excess supply curve for the good, defined by parameters reflecting their autarky prices and their sizes.

$$s_c = b_c(p_c - a_c), \quad c = A, B, C \tag{3.1}$$

I will assume throughout that Country A has the lowest cost of the good and Country C the highest, with Country B in between.

$$a_A \le a_B \le a_C \tag{3.2}$$

It will be Country B, whose comparative advantage is therefore ambiguous, whose location I will vary in the analysis below.

For each pair of countries there is a trade cost, which will be specified further below in terms of location on a plane. For now, let $t_{cc'}=t_{c'c}$ be the cost of trading the good in either direction between countries c and c'. The equilibrium consists of a price in each country, p_c, and quantities of trade between each pair of countries – $x_{cc'}$ being the (gross) export of the good from country c to country c' – with several properties: First, the quantities traded must match up with the excess supplies from (3.1). Second, the prices must differ between pairs of countries by no more than the trade cost between them. And third, there can be positive trade between two countries only if their price difference equals the corresponding trade cost. That is, consolidating these properties, we have:

$$s_c = b_c(p_c - a_c) = \sum_{c'\neq c} x_{cc'} - \sum_{c'\neq c} x_{c'c} \quad \forall c = A, B, C \tag{3.3}$$

$$p_c + t_{cc'} - p_{c'} \ge 0, \quad x_{cc'} \ge 0, \quad (p_c + t_{cc'} - p_{c'})x_{cc'} = 0 \quad \forall c \neq c' \tag{3.4}$$

There are six possible types of equilibrium trade pattern, or "regimes," in this model, even given the restriction (3.2). First, if trade costs are high enough, then no country will trade this good at all and there will be complete autarky,[5] which I will call trade pattern #0 since it involves no trade. Second, any one of the three countries may fail to trade this good, while the other two trade it with each other, giving us three possibilities that I number 1=A-autarky , 2=B-autarky, and 3=C-autarky. Finally all three countries may trade, giving rise to two more regimes in both of which the three markets are fully integrated,[6] one with Country B exporting the good (to C) which I call Regime 4=Int-BX and another with Country B importing the good (from A) which I call Regime 5=Int-BM. These regimes are defined by their trade patterns in Table 1.

The model can be solved in each regime for the equilibrium prices and quantities, and to identify the restrictions on parameters needed for the regimes to arise. Table 2 presents these solutions, which are derived in the Appendix.

The conditions listed for each regime are intended to be sufficient conditions. They are also intended collectively (for the six regimes) to map out the entire parameter

[5] Autarky for this good only, of course. In this partial equilibrium model we don't know what trade may be taking place in other goods.

[6] By "integrated" I obviously do not mean that they share the same price, since prices here differ by the amount of trade costs. The markets are integrated, however, in the sense that a shock to supply or demand in any one of them will cause prices to change identically in all of them.

space except for the borderlines between regimes where the stated conditions would hold with equality. I do not, however, try to prove either of these properties here, since the numerical mapping of the regimes below essentially accomplishes the same purpose.

Turning now to that mapping, I assume that each country is located in two-dimensional space. Let $L^c = (L_1^c, L_2^c)$ be the location coordinates of country *c*. Then the distance between countries c and c' is

$$d(c,c') = \sqrt{(L_1^c - L_1^{c'})^2 + (L_2^c - L_2^{c'})^2} \tag{3.5}$$

As in Section II, let trade cost be proportional to this distance, at a rate of τ per unit distance, so that

$$t_{cc'} = \tau d(c,c') = \tau\sqrt{(L_1^c - L_1^{c'})^2 + (L_2^c - L_2^{c'})^2} \tag{3.6}$$

For any given locations of the three countries, each $t_{cc'}$ can be calculated and substituted into the solutions in Table 2 to determine which of the equilibrium regimes obtains and what the prices and quantities traded in that regime may be.

My approach in the next section will be to position Countries A and C arbitrarily and then to calculate these values for a grid of possible positions for Country B. This will provide a picture of how the patterns and quantities of trade depend on the relative locations of the three countries.

IV. Mapping the Regimes

Figure 4 provides a schematic picture of the mapping exercise. Think of the three countries, represented here by their excess-supply diagrams, being located on a two-dimensional plane. I hold the locations of two of the countries, A and C, fixed, and move the third country, B to various locations on the plane. At each location I solve for the equilibrium regime and the quantity of trade, recording the results for a grid of locations on the plane.

Let Countries A and C be located at positions

$$L^A = (1,1), \quad L^C = (2,1) \tag{4.1}$$

I will calculate equilibria for a grid of locations at intervals of 0.1 throughout the rectangle from (0,0) to (3,2), thus including some 600 locations within about one unit distance of either or both countries. I also fix the production costs in Countries A and C at

$$a_A = 1.0, \quad a_C = 2.0 \tag{4.2}$$

For a_B I will try several values between 1.0 and 2.0, thus remaining consistent with assumption (3.2). For most of the analysis I will let the countries be of equal size, thus setting $b_c = 1.0\ \forall c$, but later I will briefly allow these parameters to differ in order to explore the role of country size in the model.

The trade-cost-per-unit-distance parameter, τ, is critical, of course. As my benchmark case I will set it to 0.9, just small enough to permit Countries A and C to trade if Country B is out of the picture (since their cost difference is 1.0). This may exaggerate the role of location, but it makes it easier to see what the nature of that role is. I will later consider trade costs both higher than this and lower.

Also critically important is the production cost of Country B. Again as a benchmark case, I will start with this half way between the costs of Countries A and C, so that it has neither an obvious comparative advantage nor a disadvantage in the good. Higher and lower production costs will also be examined below.

The Benchmark Case

The mapping of regimes for the benchmark case is shown in Figure 5, in a format that will be repeated below for different parameters. The grid of locations is shown with its horizontal (x) and vertical (y) coordinates over the range indicated above. For all but two cells in the grid, a symbol indicates which of the six regime types occurs in equilibrium at that location. The exceptions are the cells occupied by countries A and B, at (1,1) and (2,1), where small squares enclose the names of the countries. The symbols in the rest of the cells are defined in a key at the bottom-left, with just a blank space for the regime of autarky, which does not occur in the benchmark case. The main parameters of the model are also shown in a key at the top-left, and it is these that will change in subsequent figures as we seek to explore the roles of these parameters.

What the figure shows is the following. First, Country B does not trade at all (the regime is B-autarky, with symbol ".") for locations more than about 0.5 away from both A and B. Within that distance, in what are essentially circles surrounding those two countries, B is able to trade, but the nature of that trade depends on which country it is closer to. If it is closer to country A, then it trades with A and its higher cost relative to A causes it to import the good. If it is closer to country B, then the opposite occurs and it exports.

Within each of these circles, two different regimes obtain, although the trade pattern of Country B is the same for both. For example, in the circle around A, regime 3 has A exporting only to B, while regime 5 has A exporting to both B and C. Thus the location of country B matters for whether country A is able to export to C, and indeed whether Country C is able to trade (in this good) at all. What happens is that A's trade with B raises the price of the good in A, and if it raises it enough – as it will if distance the therefore trade cost between A and B is not large – then A can no longer overcome the cost of trading with the more distant Country C. Note that this argument depends on the distance of B from A, but not on any other feature of its location, so that B's effect on A's and C's trade is the same whether it is to the left of A or to the right (or above or below).

The first of these results – that Country B's direction of trade depends on whether it is closer to A or to C – is a simple example of what in Deardorff (2004) I have called local comparative advantage. That is, with a cost of producing a good that is neither the lowest nor the highest in the world, whether a country has comparative advantage in it or not depends on whether it is closer to an even lower cost country or to higher-cost country.

The second result – that another country's trade may depend on the first country's location – is one I have not seen before, and one that I had not expected. It depends on trade with one country changing your domestic price, and thus altering your ability to trade with another country. This in turn depends on the slopes of the various excess supply curves. Since these slopes reflect country size, the result has an alternative explanation in terms of this. What is happening, in the particular case just looked at, is that the proximity of Country B to Country A has caused A to do most of the trade it is capable of with Country B, reducing its ability to trade with Country C. Had A been larger (as I will check below), it could have continued to trade with both. Indeed this is what happens if Country B is just barely close enough to A to trade with it, in the cells marked “5” in Figure 5. Here, because trade cost keeps trade between A and B very small, A is still able to trade with C.

The Role of Production Cost

Figure 6 shows how the mapping of regimes changes if production cost in Country B is reduced somewhat, from 1.5 to 1.4. There are no surprises here. Country B now has greater comparative advantage relative to C and can trade with it throughout a larger geographic area. It has a smaller comparative disadvantage with A, however, and must now be closer to it in order to trade. Larger changes in B’s production cost, as well as changes in the other direction, produce similarly expected results.

The Role of Trade Cost

Changing the trade cost (for all countries and all trade routes) is more interesting. First, if we increase trade cost even a little, since it was set in the benchmark just below the difference in production costs between Countries A and C, then they will cease to trade. Thus a small increase in trade costs, from 0.9 to 1.0, would leave Figure 5 unaffected except that the 4’s would become 3’s and the 5’s would become 1’s. That is, Country B’s capacity to trade with the other countries is changed only a little, while their capacity to trade with each other disappears.

If we increase the trade cost further, then Country B also finds it harder to trade, and the regions around each country where B can trade with them shrink. This is shown in Figure 7, where the trade cost has been doubled from Figure 5, from 0.9 to 1.8. The diameters of the circles around A and C within which trade takes place are cut in half. And as just mentioned for an even smaller increase in trade cost, Countries A and C are never able to trade with each other. Therefore the only possible trade regimes are ones in which only two of the three countries trade.

If we now decrease the trade cost from the benchmark, you might expect that the regions within which Country B can trade would grow, just opposite to what happened when the trade cost rose. But in fact they do not, as can be seen in Figure 8 where the trade cost is cut by a factor of three, from 0.9 to 0.3. Country B can still trade at all only within a distance of 0.5 from either Country A or Country C. This may be a surprise, since for example B’s autarky cost is 0.5 below Country C’s, so that even at a distance 1.0 and a trade cost therefore of 0.3, you’d think it would be able to export to C.

The reason it cannot is another example of how trade between two countries can alter the potential for trade of a third. In this case, as the trade cost falls over all trade routes, countries A and C trade more with each other, and, more important, their prices move closer together. That means that the price in high-cost Country C falls at the same time that B’s capacity to trade with it from a distant location improves, and these two effects simply cancel out.

The Role of Country Size

Until now I have kept the sizes of the countries, as reflected in their b_c parameters, all the same. The role of differences in country size is examined in Figures 9 and 10, starting again from the benchmark case of Figure 5.

Figure 9 shows the effect of making Country B, the one of intermediate cost, smaller. In Figure 5 we saw that if Country B is close enough to either other country, it can prevent the more remote country from trading the good at all. This appeared as the region of regime 3 (C-autarky) surrounding Country A, and the region of regime 1 (A-autarky) surrounding Country C. In Figure 9 we see that making Country B smaller reduces the sizes of these regions. The reason is that when Country B is smaller, its presence near to another country has a smaller effect on the latter country's price.

Because space is limited I do not show other variations in the size of Country B, but I can report that increasing its size expands these regions slightly. However the effect is limited, since increased size does not enlarge the region within which Country B can trade with these other countries, and so the region of crowding out the remote country can grow no larger than that.

Figure 10 shows the effect of increasing the size of Country A. Again comparing to Figure 5, one sees that this increase expands somewhat the region around Country A from which Country B is able to trade at all, and slightly shrinks the region around Country C from which it can trade. The reason is that expanding the size of Country A pulls down the equilibrium price of the good in both A and C when they alone are trading. This expands the price gap between Countries B and A, while shrinking that gap between B and C. In effect, this expands the extent of B's local comparative (dis)advantage with respect to A, increasing the distance from which it can trade, and likewise reduces its local comparative advantage with respect to C.

Again, space precludes showing more cases, but I can report that there seem to be no surprises as one tries other combinations of changes in country size.

Trade Volumes

The figures so far show only the patterns of trade, not its quantity. This too can be calculated for each location of Country B and displayed. Figure 11, for the benchmark case of Figure 5, shows the total trade of all three countries as a function of Country B's location, simply adding together the exports from A to B, A to C, and B to C. As can be seen, if Country B is too far from the other counties to trade, then world trade in the good is constant at the level of A's exports to C. But if B is moved in closer to either A or B, then world trade in the good expands substantially, even though Country B has a production cost that is just the average of the other two. This, it should be said, is to some extent an artifact of having set the trade cost almost high enough to choke off trade between A and C in the benchmark case, which makes the opportunity for B to trade if it is close to another country look especially large.

Also of interest is the net trade of each country. Figure 12 shows the net trade in the good for Country B as it moves around the plane. As we knew from the trade regimes, Country B's net trade is negative (it imports) in the region around Country A, while it is positive around Country C. And as one would expect, it trades more the closer it is to the trading partner. Indeed, it is this trade that accounts for the peaks in total trade shown in Figure 11

Countries A and C are symmetric, so I show the net trade for Country A only, in Figure 13. What is notable here is the effect already seen in the mapping of the regimes: while A's exports are greatly enhanced by having higher-cost country B located near to it, its exports are reduced, and indeed disappear entirely, if B is located instead close to the highest-cost trading partner. Country A does have the lowest cost of any of the countries, so there is nothing here that could cause it to import the good instead of exporting it.[7] But its low cost is not enough to sustain its trade if trade costs are important and a medium-cost competitor is better located to avoid them.

V. Implications for Japan

As noted in the introduction, Japan's location relative to other countries is rather distinctive, being a large developed country that is rather far away from other developed countries, yet close to many developing countries.[8] If we think of developed and developing countries as having comparative advantage in different kinds of goods, this suggests two distinct locational patterns, in the context of the current model, when applied first to a developed-country product and second to a developing-country product. Following the Heckscher-Ohlin model with factors capital and labor, I will call the former the capital-intensive good and the latter the labor-intensive good, although of course such factor intensities do not appear in this partial equilibrium model. The presumption is merely that the capital intensive good will have a relatively low autarky price in Japan and other developed countries, and a high autarky price in developing countries, while the labor-intensive good will have just the reverse.

Implication for Trade in a Capital-Intensive Good

Thus for a capital intensive good we can think of other developed countries as playing the role of the low-cost country, Country A, in the model, while developing countries play the role of high-cost Country C. Japan, as another developed country, will also have a low cost, which I will set at 1.2, not much above the cost in Country A. But its location will be closer to the developing country, C. This is shown in Figure 14, where Japan is inserted in a cell that matches this description.

The figure shows Japan as comfortably within the region of "A-autarky." That is, Japan's location permits it to undercut the even lower-cost Country A (representing other developed countries such as the U.S. and Europe), because its production cost is almost as low as theirs and it location gives it the advantage of a lower trade cost. Thus the prediction of the model applied in this stylized way is that Japan will be the sole exporter of capital intensive goods to its neighboring developing countries.

Implications for Trade in a Labor-Intensive Good

[7] However, it is not hard to imagine, if we combine this mechanism with the presence of an additional country of intermediate cost, how the direction of trade of such a country could be reversed by changing the location of another country of intermediate cost.

[8] Again, as in footnote 2 this assumes that only geographic distance matters. Transport costs of many goods are lower across the ocean than across land, so that Japan may well have lower trade cost to the United States than some countries within Europe do to each other.

For a labor-intensive good the assignment of countries A and C is reversed. Now we expect developing countries to have the lowest cost, so I assign Country A to them, letting Country C be the high-cost developed country. Japan now has a high cost, which I set at 1.8, almost as high as in Country C. And again Japan is located close to the developing country, which in this case is A. Figure 15 shows the result.

This time the trade regime is one of "C-autarky," but since the assignment of countries has been reversed, this again means that other developed countries do not trade the good. Once again, now as an importer, Japan's location causes it to dominate the trade of its neighboring developing countries.

Should We Believe This?

Note that finding the developed country in the model to be in autarky in both of these cases not only means that it fails to trade with the developing country C, but also that it fails to trade with Country B, Japan. So the implication is that Japan not only dominates trade of both kinds of good with the developing countries, but that it also does *not* trade with the U.S. and Europe. This of course is laughable as a description of current trade patterns. However, Gary Saxonhouse tells me that it looks much more plausible as a description of Japan's and its neighbors' trade earlier in history.[9]

Be that as it may, it is obviously foolish to expect any model as simple as this one to replicate any reality. The point is only to alert us to possible implications of the model's main features, which in this case include location. The more important lesson for Japan is only that its location may matter, and therefore that those who seek to build a realistic model of its trade patterns should perhaps take it into account.

VI. Conclusions

The broader implications of the model, in which we can place more confidence because they are less specific, are the following:

Implications for Comparative Advantage:

- Except for the two extreme countries, direction of trade depends on location. Admittedly, in this model there was only one such country, but the message surely is correct in models with many countries, in which all but two are likely to have costs of particular goods that are neither the highest nor the lowest in the world. So for a large portion of trade, location is likely to matter.
- Lower production cost for a good in a country expands the set of locations from which the country can export it. This is both rather obvious and not very useful, since actual countries have their locations fixed. But it is suggestive that large international differences in production costs will permit exports from more diverse locations.
- One country's ability to trade with another may depend on the location of a third. This is the result that I had not anticipated from this model, even though it is really a corollary of the result that a country's trade depends on its own location. For if, for example, moderately low-cost countries on the edge of Europe or south of the U.S. border can succeed in exporting to these markets because, in part, of

[9] I have experimented a bit with varying other parameters in this scenario to see if I can get it to look more plausible. For example, making the developing country smaller, and lowering the cost of trade, both seem to be helpful. However, one quickly also senses the futility of trying to match such a simplistic model to reality in any detail.

their locations, then it follows that other even lower-cost countries that lack this locational advantage may be prevented from exporting there as a result. The model merely illustrates this possibility systematically.

Implications for the Role of Trade Costs

- High trade cost contracts the set of locations across which trade is possible. This implies in turn that high trade costs reduce the distance over which trade takes place. This too is obvious. But I can't recall seeing it formally demonstrated with a model, perhaps because it is too obvious to be worth the effort.
- Once other countries are trading, a lower trade cost for all does not expand the distance from which an intermediate-cost country can trade. It only increases the volume of such a country's trade, if it is within that distance. This is the conclusion demonstrated in Figure 8, and I submit that it is hardly obvious. On the other hand, its meaning is also not obvious, which might be a drawback. What it says, for example, is that if a country is unable to compete as an exporter in a particular market because its trade costs are just a bit too high to be competitive with other countries that are exporting there, then it should not hope that a world-wide fall in trade costs will change this. Because the drop in trade costs will help its competitors as much as itself, and leave it still shut out of the market. On the other hand, if the country *is* able to compete in spite of trade costs, then a fall in those trade costs will permit it to export more.

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Appendix: Derivation of Solutions

This appendix derives the equilibrium prices, quantities, and conditions listed in Table 2. It uses the additional notation:

$$b_{cc'} = b_c b_{c'} /(b_c + b_{c'}) \quad \forall c, c' = A, B, C \tag{A.1}$$

$$\beta_c = b_c /(b_A + b_B + b_C) \quad \forall c = A, B, C \tag{A.2}$$

Regime 0: Autarky

In autarky, each country's price is its cost, a_c, and all excess supplies and quantities traded are zero. For this to be an equilibrium each potential exporting country's price (and thus cost) must not be so low as to yield a profit from exporting to a potential importer. Thus, each of the potential export routes permitted by assumption (3.2) – A to B, A to C, and B to C – must be blocked by the exporting-country's cost plus trade cost being no greater than the importing-country's cost.

Regime 1: A-autarky

If only B and C trade, then $x_{BC} > 0$ in (3.4) implies

$$p_B + t_{BC} = p_C \tag{A1.1}$$

Meanwhile, with all other x's zero in (3.3),

$$s_B = x_{BC} = -s_C \tag{A1.2}$$

Combining these in (3.3) we can solve for p_B:

$$\begin{aligned} &b_B(p_B - a_B) = -b_C(p_B + t_{BC} - a_C) \\ &\quad \Rightarrow p_B = (b_B a_B + b_C a_C - b_C t_{BC})/(b_B + b_C) \end{aligned} \tag{A1.3}$$

Substituting into (A1.1),

$$\begin{aligned} p_C &= (b_B a_B + b_C a_C - b_C t_{BC})/(b_B + b_C) + t_{BC} \\ &= (b_B a_B + b_C a_C + b_B t_{BC})/(b_B + b_C) \end{aligned} \tag{A1.4}$$

Substituting (A.1.2) into (3.1) and (A1.2),

$$\begin{aligned} x_{BC} &= -s_C = s_B = b_B\left[(b_B a_B + b_C a_C - b_C t_{BC})/(b_B + b_C) - a_B\right] \\ &= b_B(-b_C a_B + b_C a_C - b_C t_{BC})/(b_B + b_C) \\ &= b_B b_C(a_C - a_B - t_{BC})/(b_B + b_C) = (a_C - a_B - t_{BC})b_{BC} \end{aligned} \tag{A1.5}$$

In Country A, price equals cost, and it remains in autarky if that cost plus its respective trade costs to B and C are above their equilibrium prices from (A1.3) and (A1.4):

$$a_A + t_{AB} > p_B = (b_B a_B + b_C a_C - b_C t_{BC})/(b_B + b_C) \tag{A1.6}$$

$$a_A + t_{AC} > p_C = (b_B a_B + b_C a_C + b_B t_{BC})/(b_B + b_C) \tag{A1.7}$$

In addition, for x_{BC} to be positive in (A1.5), we must have

$$a_C > a_B + t_{BC} \tag{A1.8}$$

Regimes 2 and 3: B-autarky, C-autarky

These are completely analogous to Regime 1 and can be obtained from the above by interchanging notation.

Regime 4: Int-BX

In this regime there are two positive trade flows: $x_{AC} > 0$ implying

$$p_A + t_{AC} = p_C \tag{A4.1}$$

and $x_{BC} > 0$ implying

$$p_B + t_{BC} = p_C \qquad \text{(A4.2)}$$

(3.3) implies

$$s_A + s_B = x_{AC} + x_{BC} = -s_C \qquad \text{(A4.3)}$$

Substituting from (3.1) and (A4.1-2),

$$b_A(p_C - t_{AC} - a_A) + b_B(p_C - t_{BC} - a_B) = -b_C(p_C - a_C)$$

$$\Rightarrow p_C = \left(b_A a_A + b_B a_B + b_C a_C + b_A t_{AC} + b_B t_{BC}\right)/(b_A + b_B + b_C) \qquad \text{(A4.4)}$$

$$= \left(\beta_A a_A + \beta_B a_B + \beta_C a_C + \beta_A t_{AC} + \beta_B t_{BC}\right)$$

Then from (A4.1-2),

$$p_A = \left(b_A a_A + b_B a_B + b_C a_C - (b_B + b_C)t_{AC} + b_B t_{BC}\right)/(b_A + b_B + b_C)$$

$$= \left(\beta_A a_A + \beta_B a_B + \beta_C a_C - (\beta_B + \beta_C)t_{AC} + \beta_B t_{BC}\right) \qquad \text{(A4.5)}$$

$$p_B = \left(b_A a_A + b_B a_B + b_C a_C + b_A t_{AC} - (b_A + b_C)t_{BC}\right)/(b_A + b_B + b_C)$$

$$= \left(\beta_A a_A + \beta_B a_B + \beta_C a_C + \beta_A t_{AC} - (\beta_A + \beta_C)t_{BC}\right) \qquad \text{(A4.6)}$$

Using these prices in (3.1) and (A4.3)

$$x_{AC} = s_A = b_A\left[\left(b_A a_A + b_B a_B + b_C a_C - (b_B + b_C)t_{AC} + b_B t_{BC}\right)/(b_A + b_B + b_C) - a_A\right]$$

$$= b_A\left(-(b_B + b_C)a_A + b_B a_B + b_C a_C - (b_B + b_C)t_{AC} + b_B t_{BC}\right)/(b_A + b_B + b_C) \qquad \text{(A4.7)}$$

$$= \beta_A\left(-(\beta_B + \beta_C)a_A + \beta_B a_B + \beta_C a_C - (\beta_B + \beta_C)t_{AC} + \beta_B t_{BC}\right)$$

$$x_{BC} = s_B = b_B\left[\left(b_A a_A + b_B a_B + b_C a_C + b_A t_{AC} - (b_A + b_C)t_{BC}\right)/(b_A + b_B + b_C) - a_B\right]$$

$$= b_B\left(b_A a_A - (b_A + b_C)a_B + b_C a_C + b_A t_{AC} - (b_A + b_C)t_{BC}\right)/(b_A + b_B + b_C) \qquad \text{(A4.8)}$$

$$= \beta_B\left(\beta_A a_A - (\beta_A + \beta_C)a_B + \beta_C a_C + \beta_A t_{AC} - (\beta_A + \beta_C)t_{BC}\right)$$

From (A4.7), $x_{AC} > 0$ requires

$$(a_A + t_{AC}) < (\beta_B a_B + \beta_C a_C + \beta_B t_{BC})/(\beta_B + \beta_C)$$

$$= (b_B a_B + b_C a_C + b_B t_{BC})/(b_B + b_C) \qquad \text{(A4.9)}$$

This, comparing to earlier regimes, says that Country A as an exporter must be able to undercut the price that would prevail in Country C if A were not to trade.
Similarly, $x_{BC} > 0$ in (A4.8) implies

$$(a_B + t_{BC}) < (\beta_A a_A + \beta_C a_C + \beta_A t_{AC})/(\beta_A + \beta_C)$$

$$= (b_A a_A + b_C a_C + b_A t_{AC})/(b_A + b_C) \qquad \text{(A4.10)}$$

Regime 5: Int-BM

Here again there are two positive trade flows, both originating in Country A: $x_{AB} > 0$ implying

$$p_A + t_{AB} = p_B \qquad \text{(A5.1)}$$

and $x_{AC} > 0$ implying

$$p_A + t_{AC} = p_C \qquad \text{(A5.2)}$$

(3.3) implies

$$s_A = x_{AB} + x_{AC} = -s_B - s_C \qquad \text{(A5.3)}$$

Substituting from (3.1) and (A5.1-2),

$$b_A(p_A - a_A) = -b_B(p_A + t_{AB} - a_B) - b_C(p_A + t_{AC} - a_C)$$
$$\Rightarrow p_A = \left(b_A a_A + b_B a_B + b_C a_C - b_B t_{AB} - b_C t_{AC}\right)/(b_A + b_B + b_C) \quad \text{(A5.4)}$$
$$= \beta_A a_A + \beta_B a_B + \beta_C a_C - \beta_B t_{AB} + \beta_C t_{AC}$$

Then, similar to regime 4,

$$p_B = \left(b_A a_A + b_B a_B + b_C a_C + (b_A + b_C)t_{AB} - b_C t_{AC}\right)/(b_A + b_B + b_C)$$
$$= \beta_A a_A + \beta_B a_B + \beta_C a_C + (\beta_A + \beta_C)t_{AB} - \beta_C t_{AC} \quad \text{(A5.5)}$$
$$p_C = \left(b_A a_A + b_B a_B + b_C a_C - b_B t_{AB} + (b_A + b_B)t_{AC}\right)/(b_A + b_B + b_C)$$
$$= \beta_A a_A + \beta_B a_B + \beta_C a_C - \beta_B t_{AB} + (\beta_A + \beta_B)t_{AC} \quad \text{(A5.6)}$$
$$x_{AB} = -s_B = -b_B\left[\left(b_A a_A + b_B a_B + b_C a_C + (b_A + b_C)t_{AB} - b_C t_{AC}\right)/(b_A + b_B + b_C) - a_B\right]$$
$$= -b_B\left(b_A a_A - (b_A + b_C)a_B + b_C a_C + (b_A + b_C)t_{AB} - b_C t_{AC}\right)/(b_A + b_B + b_C)$$
$$= -\beta_A\left(\beta_A a_A - (\beta_A + \beta_C)a_B + \beta_C a_C + (\beta_A + \beta_C)t_{AB} - \beta_C t_{AC}\right)$$

(A5.7)

$$x_{AC} = -s_C = -b_C\left[\left(b_A a_A + b_B a_B + b_C a_C - b_B t_{AB} + (b_A + b_B)t_{AC}\right)/(b_A + b_B + b_C) - a_C\right]$$
$$= -b_C\left(b_A a_A + b_B a_B - (b_A + b_B)a_C - b_B t_{AB} + (b_A + b_B)t_{AC}\right)/(b_A + b_B + b_C)$$
$$= -\beta_C\left(\beta_A a_A + \beta_B a_B - (\beta_A + \beta_B)a_C - \beta_B t_{AB} + (\beta_A + \beta_B)t_{AC}\right)$$

(A5.8)

From (A5.7), $x_{AB} > 0$ requires

$$a_B - t_{AB} > (\beta_A a_A + \beta_C a_C - \beta_C t_{AC})/(\beta_A + \beta_C)$$
$$= (b_A a_A + b_C a_C - b_C t_{AC})/(b_A + b_C) \quad \text{(A5.9)}$$

This says, in effect, that if Country B were not to trade, it would be able to offer a higher price, net of trade cost, than the price prevailing in Country A (in the B-autarky regime). Similarly, from (A5.8), $x_{AC} > 0$ requires

$$a_C - t_{AC} > (\beta_A a_A + \beta_B a_B - \beta_B t_{AB})/(\beta_A + \beta_B)$$
$$= (b_A a_A + b_B a_B - b_B t_{AB})/(b_A + b_B) \quad \text{(A5.10)}$$

Table 1
Types of Equilibria and Trade Patterns in the Three-Country Model

Regime	Defined by	Nonzero trade flows, $x_{cc'}$
0. Autarky	No trade	None
1. A-autarky	A does not trade; B exports to C	$x_{BC}>0$
2. B-autarky	B does not trade; A exports to C	$x_{AC}>0$
3. C-autarky	C does not trade, A exports to B	$x_{AB}>0$
4. Int-BX	All trade; A and B export to C	$x_{AC}>0$, $x_{BC}>0$
5. Int-BM	All trade; B and C import from A	$x_{AB}>0$, $x_{AC}>0$

Table 2: Solution of Three-Country Model

Regime 0: Autarky

Prices: $p_A = a_A$, $p_B = a_B$, $p_C = a_C$

Quantities: $s_A = s_B = s_C = x_{AB} = x_{AC} = x_{BC} = 0$

Conditions:
$a_A + t_{AB} > a_B$ to prevent A exporting to B
$a_A + t_{AC} > a_C$ to prevent A exporting to C
$a_B + t_{BC} > a_C$ to prevent B exporting to C

Regime 1: A-autarky (No trade by A)

Prices:
$p_A = a_A$
$p_B = (b_B a_B + b_C a_C - b_C t_{BC})/(b_B + b_C)$
$p_C = (b_B a_B + b_C a_C + b_B t_{BC})/(b_B + b_C)$

Quantities:
$s_A = x_{AB} = x_{AC} = 0$
$x_{BC} = -s_C = s_B = (a_C - a_B - t_{BC})b_{BC}$

Conditions:
$a_A + t_{AB} > p_B = (b_B a_B + b_C a_C - b_C t_{BC})/(b_B + b_C)$ to prevent A exporting to B
$a_A + t_{AC} > p_C = (b_B a_B + b_C a_C + b_B t_{BC})/(b_B + b_C)$ to prevent A exporting to C
$a_C > a_B + t_{BC}$ to permit B to export to C

Regime 2: B-autarky (No trade by B)

Prices:
$p_B = a_B$
$p_A = (b_A a_A + b_C a_C - b_C t_{AC})/(b_A + b_C)$
$p_C = (b_A a_A + b_C a_C + b_A t_{AC})/(b_A + b_C)$

Quantities:
$s_B = x_{AB} = x_{BC} = 0$
$x_{AC} = s_A = -s_C = (a_C - a_A - t_{AC})/b_{AC}$

Conditions:
$(b_A a_A + b_C a_C - b_C t_{AC})/(b_A + b_C) + t_{AB} > a_B$ to prevent A exporting to B
$a_B + t_{BC} > (b_A a_A + b_C a_C + b_A t_{AC})/(b_A + b_C)$ to prevent B exporting to C
$a_C > a_A + t_{AC}$ to permit A to export to C

Regime 3: C-autarky (No trade by C)

Prices: $p_C = a_C$

$p_A = (b_A a_A + b_B a_B - b_B t_{AB})/(b_A + b_B)$

$p_B = (b_A a_A + b_B a_B + b_A t_{AB})/(b_A + b_B)$

Quantities: $s_C = x_{AC} = x_{BC} = 0$

$x_{AB} = s_A = -s_B = (a_B - a_A - t_{AB})/b_{AB}$

Conditions: $(b_A a_A + b_B a_B - b_B t_{AB})/(b_A + b_B) + t_{AC} > a_C$ to prevent A exporting to C

$(b_A a_A + b_B a_B + b_A t_{AB})/(b_A + b_B) + t_{BC} > a_C$ to prevent B exporting to C

$a_B > a_A + t_{AB}$ to permit A to export to B

Regime 4: Int-BX (Integrated World, B Exports)

Prices: $p_A = \beta_A a_A + \beta_B a_B + \beta_C a_C - (\beta_B + \beta_C)t_{AC} + \beta_B t_{BC}$

$p_B = \beta_A a_A + \beta_B a_B + \beta_C a_C + \beta_A t_{AC} - (\beta_A + \beta_C)t_{BC}$

$p_C = \beta_A a_A + \beta_B a_B + \beta_C a_C + \beta_A t_{AC} + \beta_B t_{BC}$

Quantities: $x_{AC} = s_A = \beta_A\left(-(\beta_B + \beta_C)a_A + \beta_B a_B + \beta_C a_C - (\beta_B + \beta_C)t_{AC} + \beta_B t_{BC}\right)$

$x_{BC} = s_B = \beta_B\left(\beta_A a_A - (\beta_A + \beta_C)a_B + \beta_C a_C + \beta_A t_{AC} - (\beta_A + \beta_C)t_{BC}\right)$

Conditions: $(a_A + t_{AC}) < (b_B a_B + b_C a_C + b_B t_{BC})/(b_B + b_C)$ to permit A to export to C

$(a_B + t_{BC}) < (b_A a_A + b_C a_C + b_A t_{AC})/(b_A + b_C)$ to permit B to export to C

Regime 5: Int-BM (Integrated World, B Imports)

Prices: $p_A = \beta_A a_A + \beta_B a_B + \beta_C a_C - \beta_B t_{AB} - \beta_C t_{AC}$

$p_B = \beta_A a_A + \beta_B a_B + \beta_C a_C + (\beta_A + \beta_C)t_{AB} - \beta_C t_{AC}$

$p_C = \beta_A a_A + \beta_B a_B + \beta_C a_C - \beta_B t_{AB} + (\beta_A + \beta_B)t_{AC}$

Quantities: $x_{AB} = -s_B = -\beta_A\left(\beta_A a_A - (\beta_A + \beta_C)a_B + \beta_C a_C + (\beta_A + \beta_C)t_{AB} - \beta_C t_{AC}\right)$

$x_{AC} = -s_C = -\beta_C\left(\beta_A a_A + \beta_B a_B - (\beta_A + \beta_B)a_C - \beta_B t_{AB} + (\beta_A + \beta_B)t_{AC}\right)$

Conditions: $a_B - t_{AB} > (b_A a_A + b_C a_C - b_C t_{AC})/(b_A + b_C)$ to permit A to export to B

$a_C - t_{AC} > (b_A a_A + b_B a_B - b_B t_{AB})/(b_A + b_B)$ to permit A to export to C

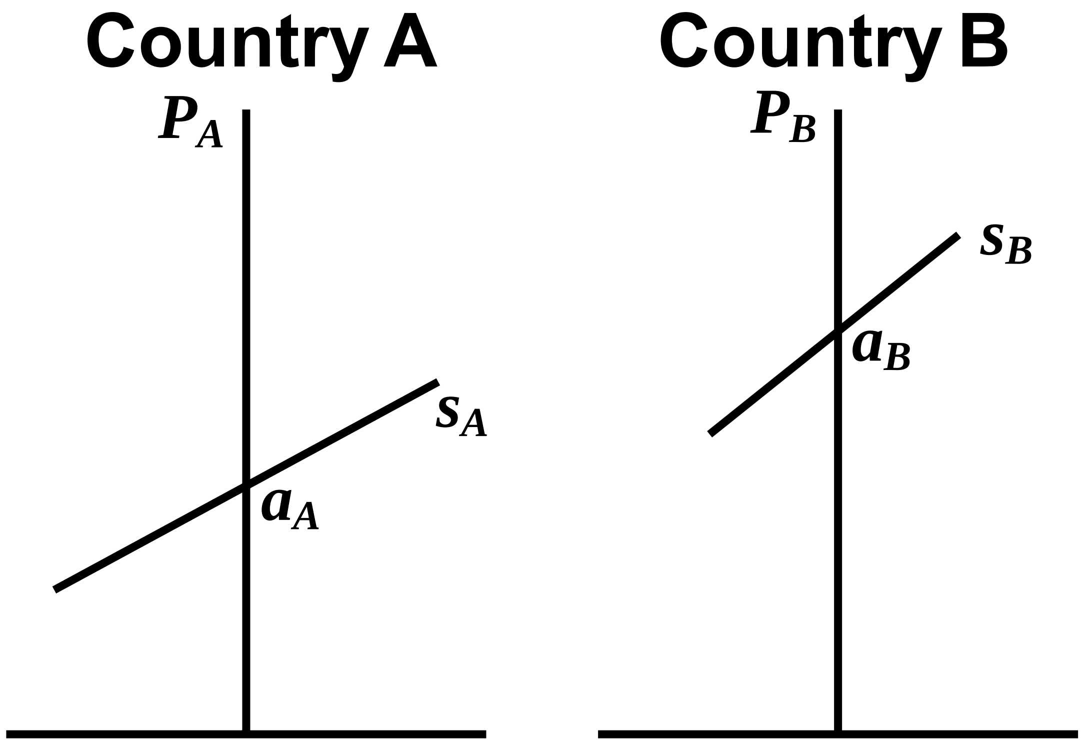

Figure 1
Two-country excess supplies

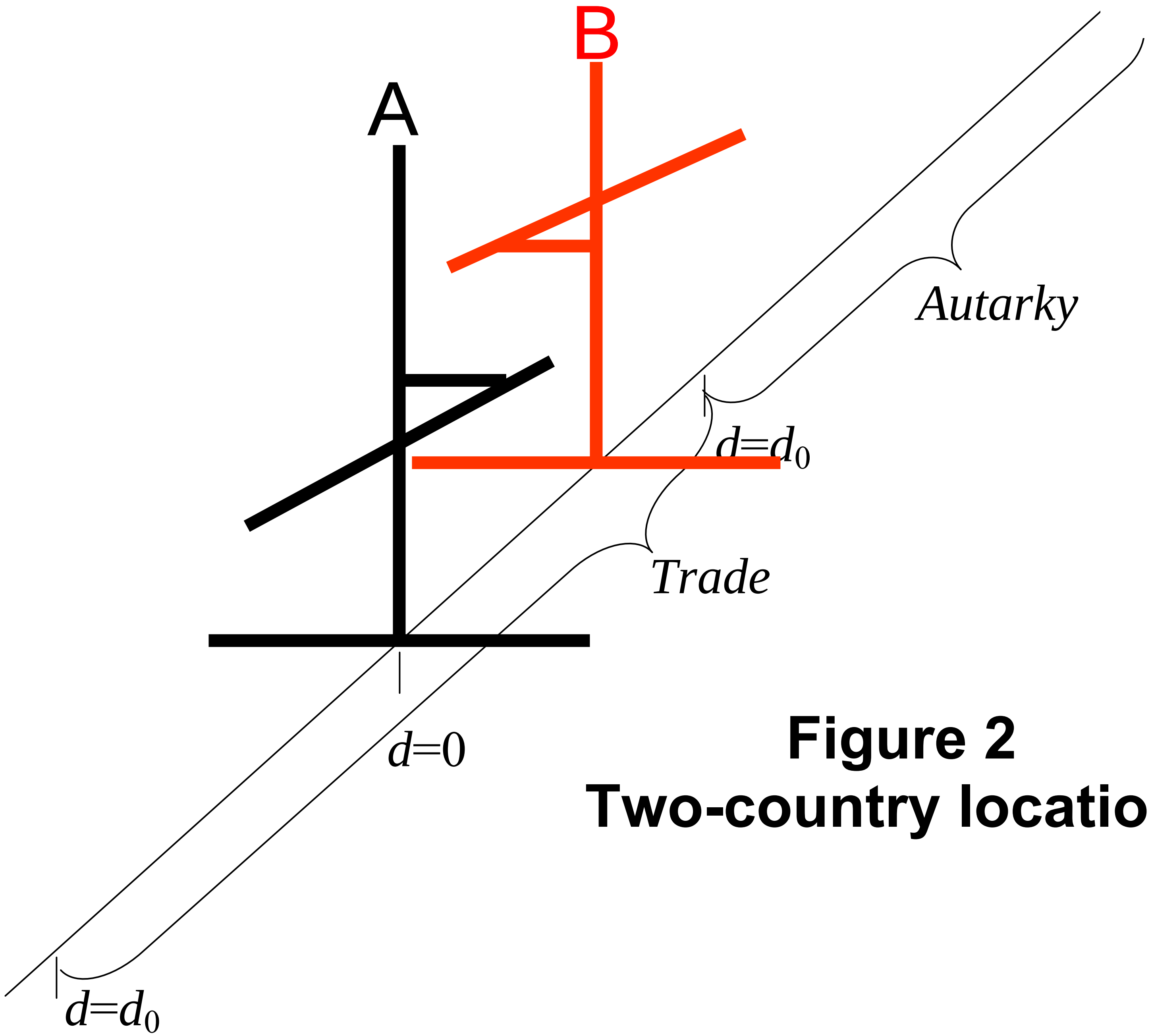

Figure 2
Two-country locations

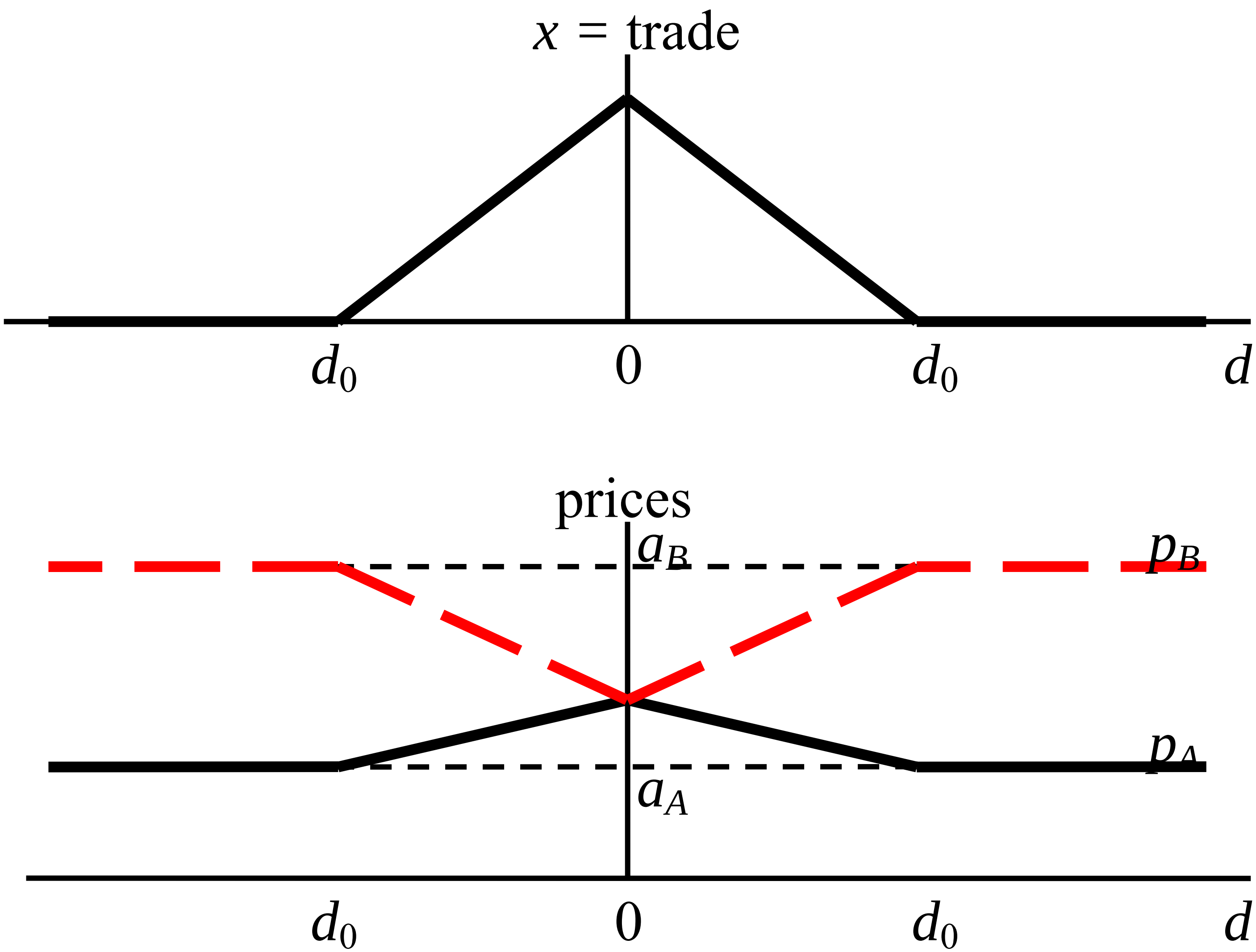

Figure 3
Two-country trade and prices, by location of country B

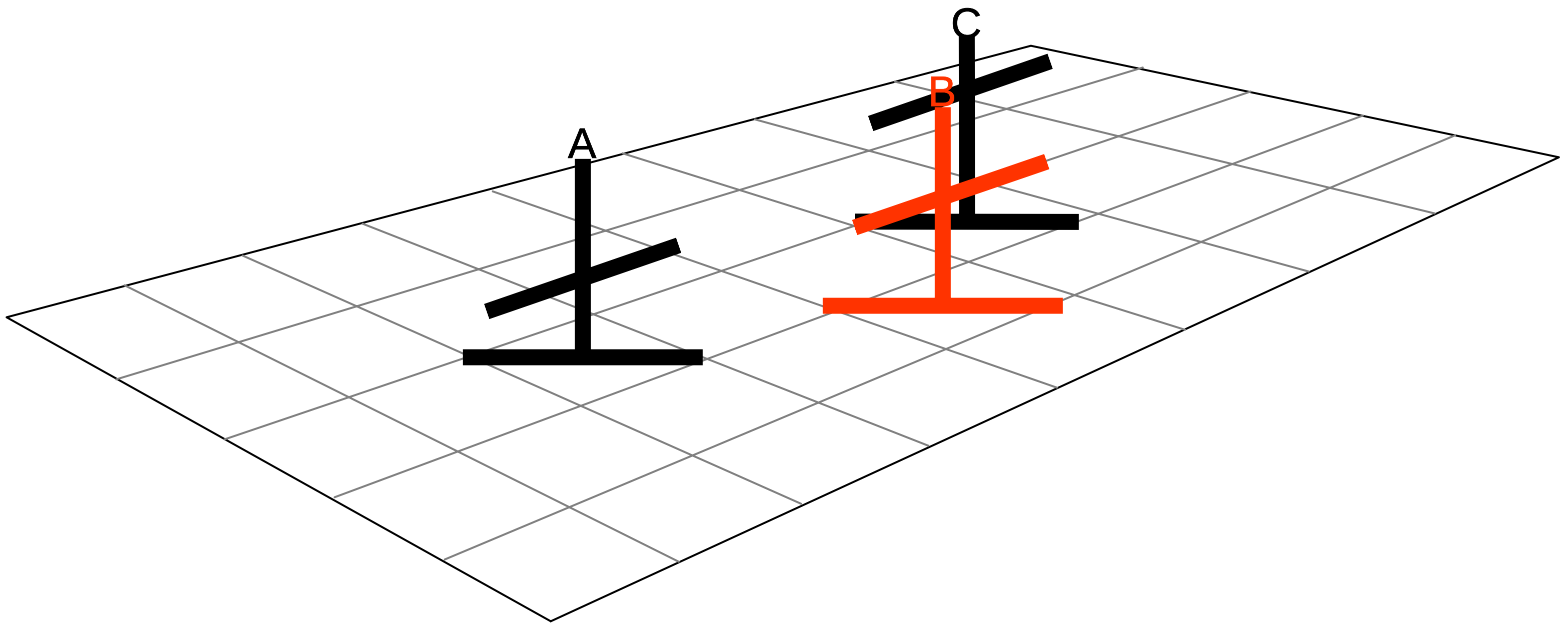

Figure 4
Three Countries on a Plane

Parameters	
τ =	0.9
a_A =	1
a_B =	1.5
a_C =	2

Regimes	
Aut	
A-aut	1
B-aut	.
C-aut	3
Int-BX	4
Int-BM	5

y:																															
2.0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1.9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1.8	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1.7	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1.6	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1.5	.	.	.	.	.	.	.	.	.	.	5	.	.	.	.	.	.	.	.	.	4	.	.	.	.	.	.	.	.	.	.
1.4	.	.	.	.	.	.	.	5	5	5	5	5	5	5	.	.	.	4	4	4	4	4	4	.	.	.	.	.	.	.	.
1.3	.	.	.	.	.	.	5	5	5	3	3	3	5	5	5	.	4	4	4	1	1	1	4	4	.	.	.	.	.	.	.
1.2	.	.	.	.	.	.	5	5	3	3	3	3	3	5	5	.	4	4	1	1	1	1	1	4	4	.	.	.	.	.	.
1.1	.	.	.	.	.	.	5	3	3	3	3	3	3	3	5	.	4	1	1	1	1	1	1	1	4	.	.	.	.	.	.
1.0	.	.	.	.	.	.	5	3	3	3	A	3	3	3	5	4	4	1	1	1	C	1	1	1	4	.	.	.	.	.	.
0.9	.	.	.	.	.	.	5	3	3	3	3	3	3	3	5	.	4	1	1	1	1	1	1	1	4	.	.	.	.	.	.
0.8	.	.	.	.	.	.	5	5	3	3	3	3	3	5	5	.	4	4	1	1	1	1	1	4	4	.	.	.	.	.	.
0.7	.	.	.	.	.	.	.	5	5	3	3	3	5	5	.	.	.	4	4	1	1	1	4	4	.	.	.	.	.	.	.
0.6	.	.	.	.	.	.	.	.	5	5	5	5	5	.	.	.	.	.	4	4	4	4	4	.	.	.	.	.	.	.	.
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0.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
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x:	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3.0

Figure 5
Benchmark Mapping of Trade Patterns

Parameters	
τ =	0.9
a_A =	1
a_B =	1.4
a_C =	2

Regimes	
Aut	
A-aut	1
B-aut	.
C-aut	3
Int-BX	4
Int-BM	5

y: \ x:	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3.0
2.0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1.9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1.8	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1.7	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1.6	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4	4	4	.	.	.	.	.	.	.	.	.
1.5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4	4	4	4	4	4	4	.	.	.	.	.	.	.
1.4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4	4	4	1	1	1	4	4	4	.	.	.	.	.	.
1.3	.	.	.	.	.	.	.	.	5	5	5	5	5	.	.	4	4	1	1	1	1	1	1	1	4	4	.	.	.	.	.
1.2	.	.	.	.	.	.	.	5	5	5	3	5	5	5	.	4	4	1	1	1	1	1	1	1	4	4	.	.	.	.	.
1.1	.	.	.	.	.	.	.	5	5	3	3	3	5	5	4	4	1	1	1	1	1	1	1	1	1	4	4	.	.	.	.
1.0	.	.	.	.	.	.	.	5	3	3	A	3	3	5	4	4	1	1	1	1	C	1	1	1	1	4	4	.	.	.	.
0.9	.	.	.	.	.	.	.	5	5	3	3	3	5	5	4	4	1	1	1	1	1	1	1	1	1	4	4	.	.	.	.
0.8	.	.	.	.	.	.	.	5	5	5	3	5	5	5	.	4	4	1	1	1	1	1	1	1	4	4	.	.	.	.	.
0.7	.	.	.	.	.	.	.	.	5	5	5	5	5	.	.	4	4	1	1	1	1	1	1	1	4	4	.	.	.	.	.
0.6	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4	4	4	1	1	1	4	4	4	.	.	.	.	.	.
0.5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4	4	4	4	4	4	4	.	.	.	.	.	.	.
0.4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4	4	4	.	.	.	.	.	.	.	.	.
0.3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
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Figure 6
Lower Production Cost in Country B

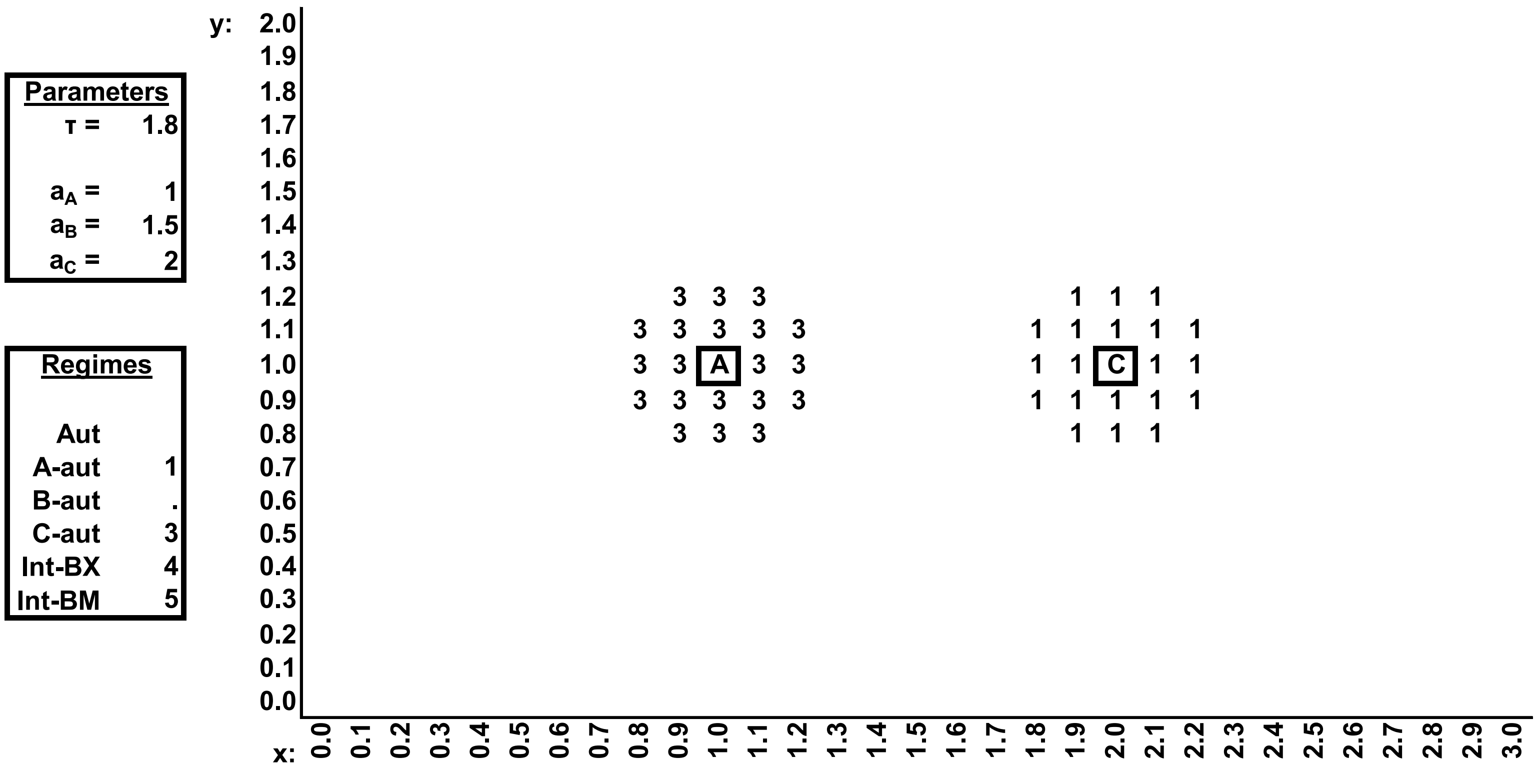

Figure 7
Higher trade cost

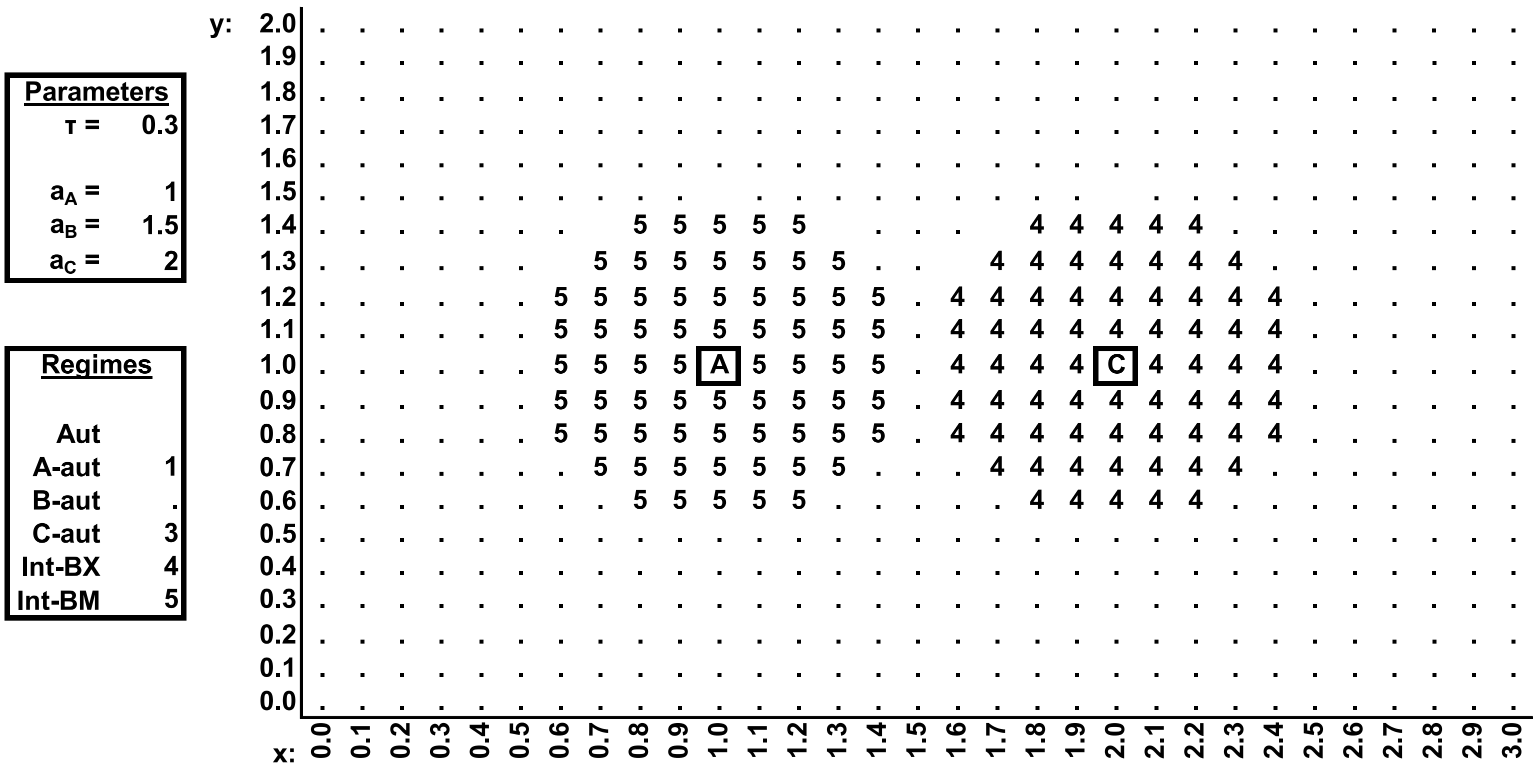

Figure 8
Lower trade cost

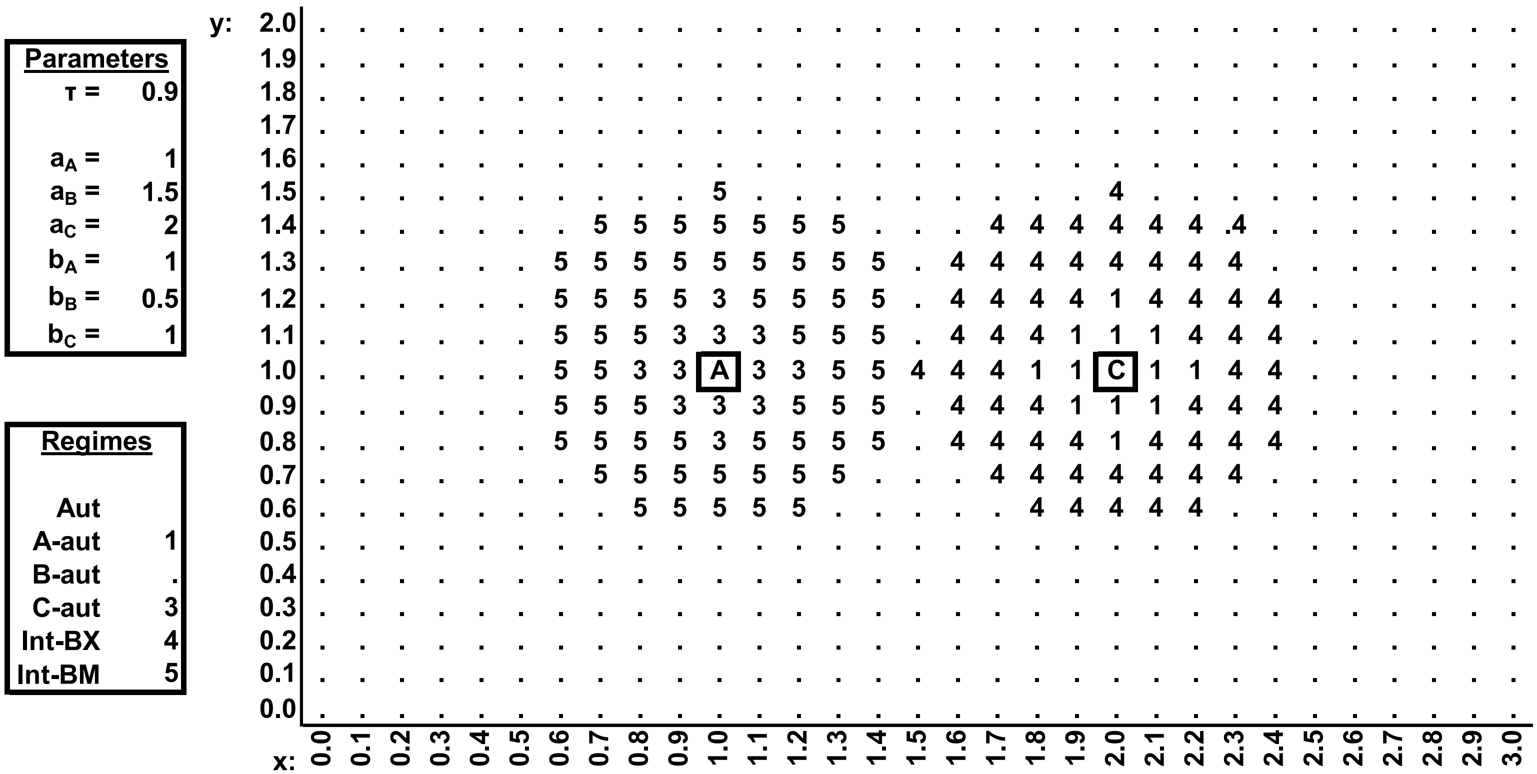

Figure 9
Smaller Country B

Parameters

$\tau =$ 0.9

$a_A =$ 1
$a_B =$ 1.5
$a_C =$ 2
$b_A =$ 2
$b_B =$ 1
$b_C =$ 1

Regimes

Aut
A-aut 1
B-aut .
C-aut 3
Int-BX 4
Int-BM 5

y:																														
2.0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1.9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1.8	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1.7	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1.6	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1.5	.	.	.	.	.	.	.	.	.	5	5	5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1.4	.	.	.	.	.	.	.	5	5	5	5	5	5	5	.	.	.	.	4	4	4	4	4	.	.	.	.	.	.	.	.
1.3	.	.	.	.	.	.	5	5	5	5	5	5	5	5	5	.	.	4	4	1	1	1	4	4	.	.	.	.	.	.	.
1.2	.	.	.	.	.	.	5	5	5	5	3	5	5	5	5	.	4	4	1	1	1	1	1	4	4	.	.	.	.	.	.
1.1	.	.	.	.	.	5	5	5	5	3	3	3	5	5	5	5	4	1	1	1	1	1	1	1	4	.	.	.	.	.	.
1.0	.	.	.	.	.	5	5	5	3	3	A	3	3	5	5	5	4	1	1	1	C	1	1	1	4	.	.	.	.	.	.
0.9	.	.	.	.	.	5	5	5	5	3	3	3	5	5	5	5	4	1	1	1	1	1	1	1	4	.	.	.	.	.	.
0.8	.	.	.	.	.	.	5	5	5	5	3	5	5	5	5	.	4	4	1	1	1	1	1	4	4	.	.	.	.	.	.
0.7	.	.	.	.	.	.	5	5	5	5	5	5	5	5	5	.	.	4	4	1	1	1	4	4	.	.	.	.	.	.	.
0.6	.	.	.	.	.	.	.	5	5	5	5	5	5	5	.	.	.	.	4	4	4	4	4	.	.	.	.	.	.	.	.
0.5	.	.	.	.	.	.	.	.	.	5	5	5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0.4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0.3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0.0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
x:	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3.0

Figure 10
Larger Country A

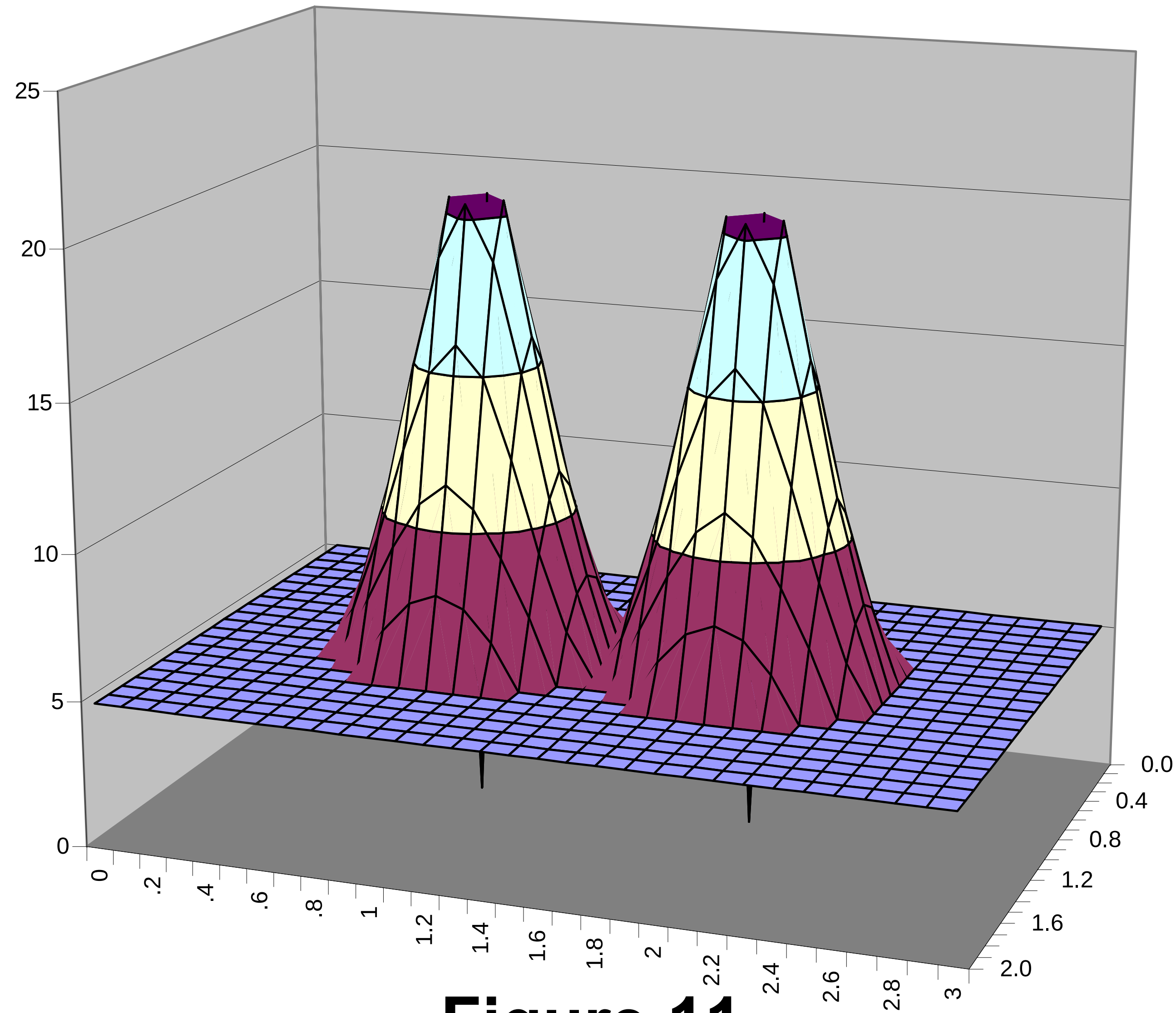

Figure 11
Total Trade Volume in Benchmark Case

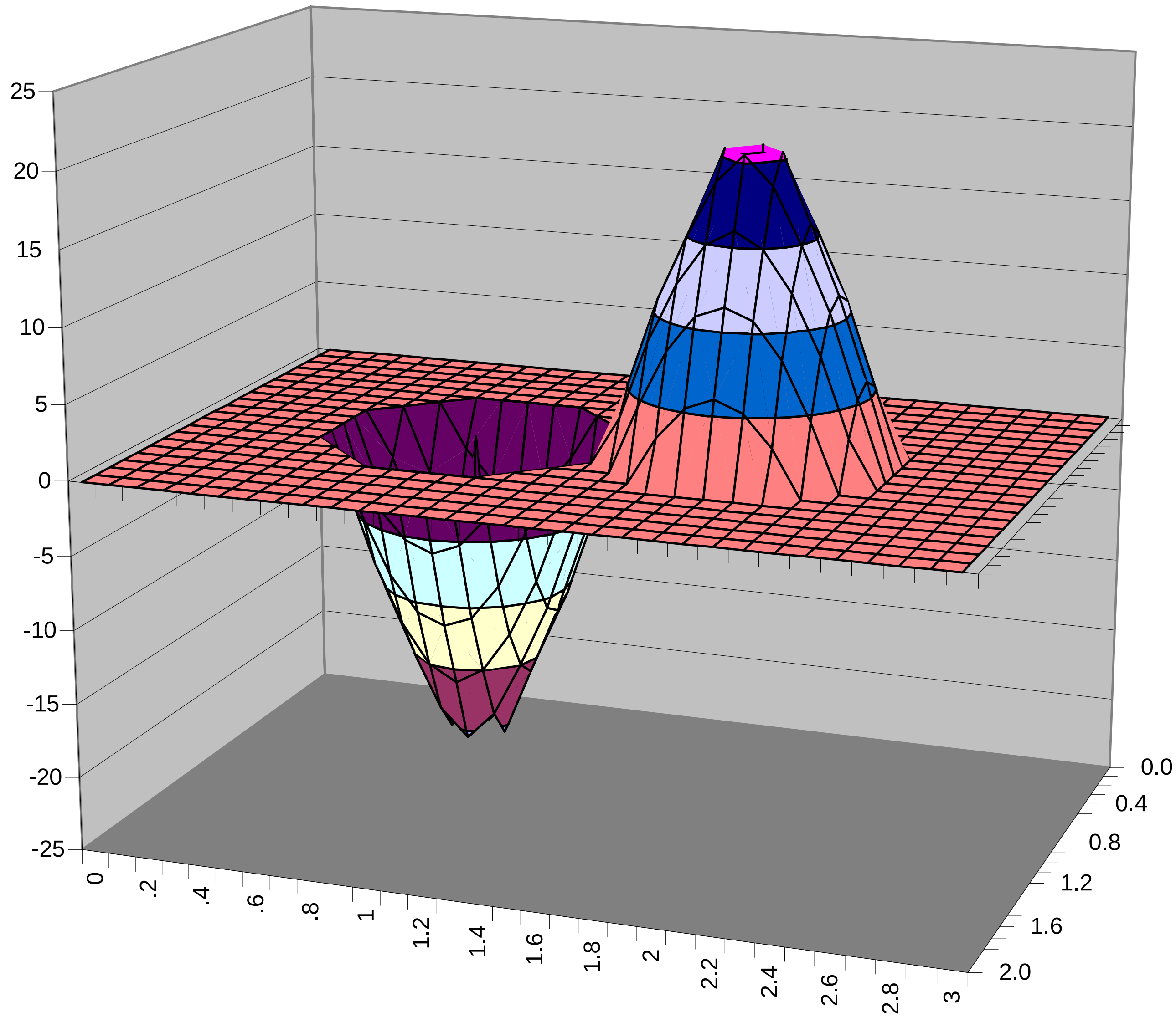

Figure 12
Net Trade of Country B in Benchmark Case

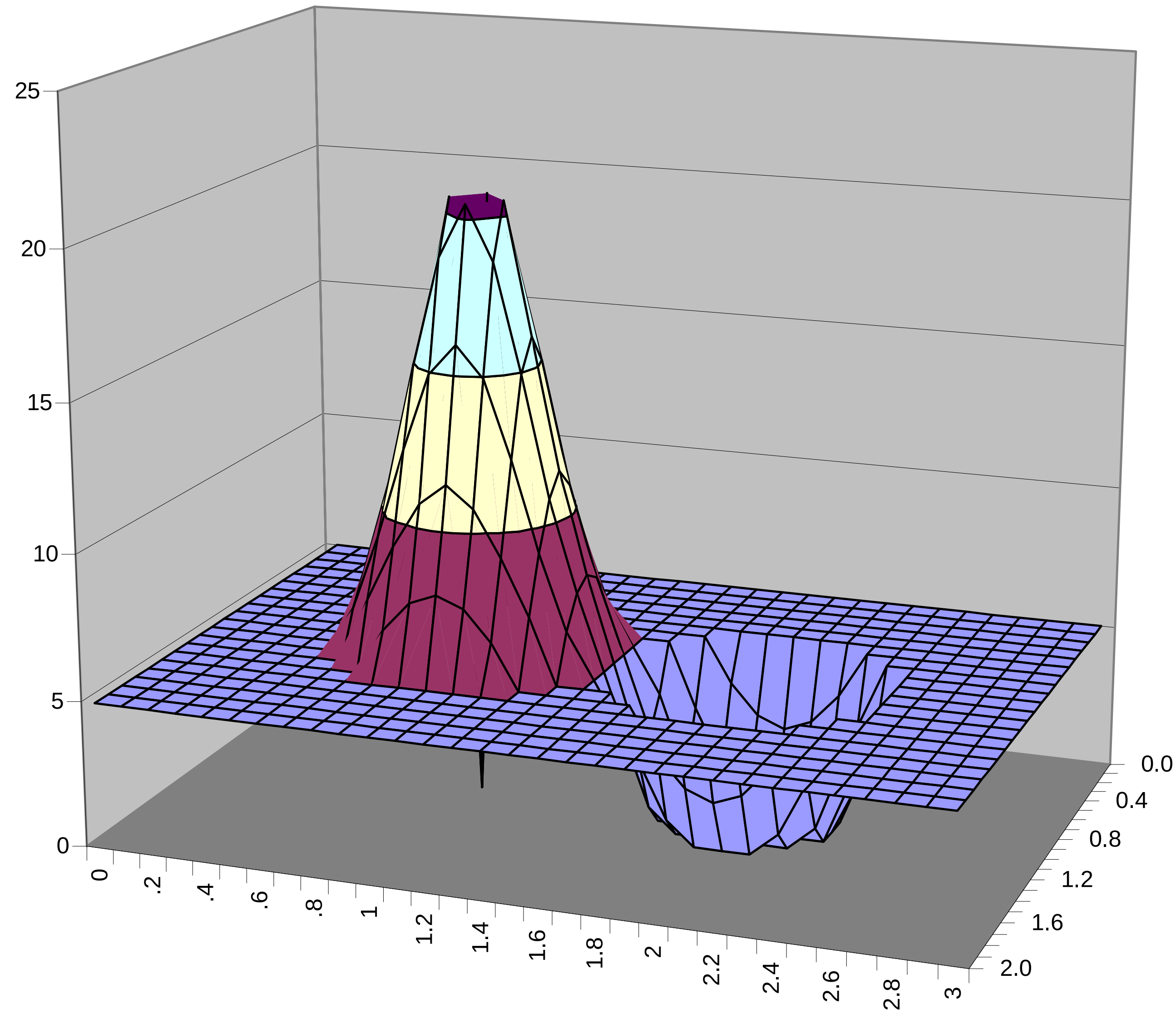

Figure 13
Net Trade of Country A in Benchmark Case

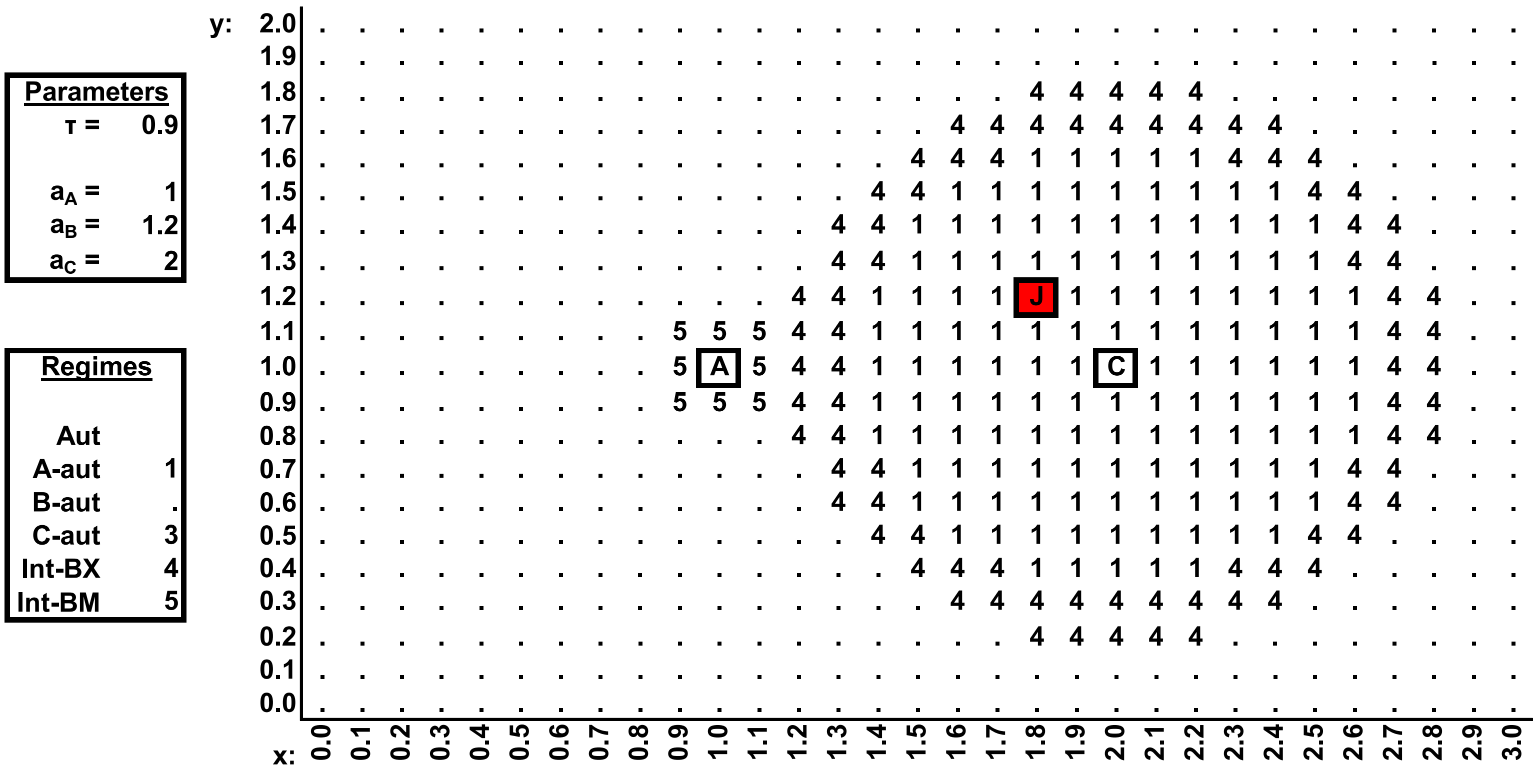

Figure 14
Trade of Japan in a Capital-Intensive Good
(A=DCs, C=LDCs)

Parameters	
τ =	0.9
a_A =	1
a_B =	1.8
a_C =	2

Regimes	
Aut	
A-aut	1
B-aut	.
C-aut	3
Int-BX	4
Int-BM	5

y: \ x:	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3.0
2.0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1.9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1.8	.	.	.	.	.	.	.	.	5	5	5	5	5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1.7	.	.	.	.	.	.	5	5	5	5	5	5	5	5	5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1.6	.	.	.	.	.	5	5	5	3	3	3	3	3	5	5	5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1.5	.	.	.	.	5	5	3	3	3	3	3	3	3	3	3	5	5	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1.4	.	.	.	5	5	3	3	3	3	3	3	3	3	3	3	3	5	5	.	.	.	.	.	.	.	.	.	.	.	.	.
1.3	.	.	.	5	5	3	3	3	3	3	3	3	3	3	3	3	5	5	.	.	.	.	.	.	.	.	.	.	.	.	.
1.2	.	.	5	5	3	3	3	3	3	3	3	3	J	3	3	3	3	5	5	.	.	.	.	.	.	.	.	.	.	.	.
1.1	.	.	5	5	3	3	3	3	3	3	3	3	3	3	3	3	3	5	5	4	4	4	.	.	.	.	.	.	.	.	.
1.0	.	.	5	5	3	3	3	3	3	3	A	3	3	3	3	3	3	5	5	4	C	4	.	.	.	.	.	.	.	.	.
0.9	.	.	5	5	3	3	3	3	3	3	3	3	3	3	3	3	3	5	5	4	4	4	.	.	.	.	.	.	.	.	.
0.8	.	.	5	5	3	3	3	3	3	3	3	3	3	3	3	3	3	5	5	.	.	.	.	.	.	.	.	.	.	.	.
0.7	.	.	.	5	5	3	3	3	3	3	3	3	3	3	3	3	5	5	.	.	.	.	.	.	.	.	.	.	.	.	.
0.6	.	.	.	5	5	3	3	3	3	3	3	3	3	3	3	3	5	5	.	.	.	.	.	.	.	.	.	.	.	.	.
0.5	.	.	.	.	5	5	3	3	3	3	3	3	3	3	3	5	5	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0.4	.	.	.	.	.	5	5	5	3	3	3	3	3	5	5	5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0.3	.	.	.	.	.	.	5	5	5	5	5	5	5	5	5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0.2	.	.	.	.	.	.	.	.	5	5	5	5	5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
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Figure 15
Trade of Japan in a Labor-Intensive Good
(A=LDCs, C=DCs)