

Murphy, Kevin M.; Shleifer, Andrei

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Quality and Trade

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QUALITY AND TRADE

Kevin M. Murphy

Andrei Shleifer

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Center for the Study of the Economy and the State
The University of Chicago
1101 East 58th Street
Chicago, Illinois 60637

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Quality and Trade¹

Kevin M. Murphy and Andrei Shleifer

1. Introduction.

Policy-makers in Eastern Europe today are concerned that the volume of trade their countries can achieve with Western Europe is very low. A common explanation of this concern is that the quality of Eastern European goods is so low that West Europeans do not want them, and that Western European consumer goods are too expensive for Eastern European consumers. This concern seems ill-founded in a standard Heckscher-Ohlin model, where very different countries such as those of Eastern and Western Europe should have plenty to gain from trade. In that model, one would expect labor intensive goods to flow from Eastern to Western Europe, and capital intensive goods to flow back.

In this paper, we show that in contrast to the standard model, the policy-makers' concern is well founded when goods have a significant quality dimension. High income countries of Western Europe both produce and demand high quality goods, whereas low income countries of Eastern Europe both produce and demand low quality goods. More specifically, countries rich in human capital produce high quality goods, but also demand high quality goods because human capital makes them wealthier. On the other hand, countries poor in human capital produce low quality goods because they have low skills and so cannot make high quality goods efficiently, and also prefer lower quality goods than rich countries do because they do not want to spend too much on quality. In principle, rich

¹We are grateful to Larry Summers for detailed discussions, and to Michael Mussa and Jose Scheinkman for helpful comments.

countries could produce lower quality goods for export to poor countries in exchange for grain, steel, or other goods, where achieving quality is not as human-capital-intensive. But we argue that countries rich in human capital typically have a comparative disadvantage at lower quality goods relative to high quality goods, and therefore cannot profitably export them to poor countries. Human capital in our model provides the link between tastes and endowments missing in the standard Heckscher-Ohlin model. Because countries tend to be good at producing things close to the ones they prefer to consume, countries with very different stocks of human capital do not trade in our model, unlike in the Heckscher-Ohlin model.

Because countries are good at producing the quality not far from the one they demand, similar countries trade more with each other than very different countries, as suggested by Linder (1961). Linder's result that similar countries trade more with each other has been derived by Markusen (1986), who argued that richer countries produce capital-intensive goods, but also demand capital-intensive goods because these goods have more than unit-elastic income elasticity. Our model is related to Markusen's, but stresses quality rather than capital intensity of goods, as well as human rather than physical capital.

We stress from the outset that our paper has the limited goal of describing the potential for quality upgrading through trade by poorer countries, such as those of Eastern Europe. It does not deal with all the challenges that trade might pose for Eastern Europe, such as the prospective layoffs by inefficient firms as a result of import competition. We also do not describe many possible kinds of trade between East and West, such as interindustry trade in sectors where East is fairly advanced. In light of the backwardness

of most Eastern European consumer industries, however, quality upgrading in exchange for some other goods seems to be a more relevant issue than interindustry trade.

In section 2, we set out a simple model of human capital and trade. In section 3, we describe autarky. In section 4, we present our main trade and no trade results. Section 5 discusses patterns of trade in our model, section 6 deals with national income comparisons and section 7 concludes.

2. A simple model.

Preferences

There are two types of goods in the economy. One is goods for which quality is important such as cars, radios, TVs, stereos, clothes, and other consumer manufactures. The second is goods for which quality does not so much depend on the quality of labor in the country. These goods can be food before it is processed, such as grain. They can also be intermediate goods such as paper, steel or simple chemicals. Obviously, for some foods quality matters a lot. Eastern European butter, for example, is supposedly inferior to Western European butter. Similarly, machinery is an intermediate good for which quality is important. For simplicity, we assume that there is one good for which quality matters, and one good for which it does not. The latter good is taken to be numeraire.

We assume that the representative consumer in each country wants exactly one unit of the quality good. People do not want more than 1 car, TV or stereo; they want better cars, better TVs and better stereos. Our analysis does not require complete satiation with quantity; only that the tradeoff between quality and quantity for quality goods be imperfect.

The utility function is given by:

$$(1) \quad \log(Q) + m \cdot \log(X),$$

where Q is quality of the quality good, and X is the quantity of the numéraire good. We assume that a person can only consume one quality of the quality good and cannot mix qualities. In our model, one cannot drive a BMW 5 percent of the time and a Lada the rest. The quality Q cannot be interpreted as the average quality consumed in a country.

Endowments

Each country is endowed with $L = 1$ unit of labor. However, the quality of that labor, which we call human capital of the country, is given by H_W in one country and H_E in the other, where $H_W > H_E$. For simplicity, there is no physical capital in the model.

Technology

The production function for good X is given by

$$(2) \quad X = H \cdot L_X,$$

where L_X is labor devoted to the production of X , and H is the country's human capital. Countries with better labor produce proportionately more X with the same time input.

To make 1 unit of the good of quality Q , a country with human capital H requires

$$(3) \quad L_Q = C(Q/H)$$

units of labor, where C is the cost function. The higher the human capital, the lower is the labor requirement to produce a unit of a given quality. We assume that the production function for the quality good is constant returns to scale in quantity, so to produce twice as many units of a given quality requires twice as much labor of a given quality.

From the cost function (3), the average cost of a unit of quality in terms of foregone X (which is numeraire) is given by:

$$(4) \quad AC(Q)/Q = HL(Q)/Q = C(Q/H)/(Q/H).$$

We make the important assumption that this average cost of quality curve is U-shaped: there is a quality level for which the average cost of quality (4) is minimized. This amounts to assuming that for each level of human capital there is a level of quality which the country with this human capital is “best” at, and that this level of quality increases proportionately with H . Denote this quality level at $H = 1$ by \hat{Q} and the average cost of \hat{Q} by \hat{C} . For a country with human capital H , the quality at which the average cost of quality is minimized is $H \cdot \hat{Q}$, and the average cost at that quality is equal to \hat{C} . Higher human capital countries are the most efficient at producing higher quality levels. The U-shaped average cost curve builds in our key assumption: as a country’s human capital rises, its comparative advantage in lower quality goods relative to X diminishes while its comparative advantage in higher quality goods relative to X stays constant. West Germany is not very good at making bad cars relative to good cars or to grain.

Figure 1 presents these average cost curves of quality for different levels of H . If countries with all human capital levels existed, then the supply curve of quality would be

horizontal at the level \hat{C} , since for each quality level there would be a country that can produce that quality at the average cost of \hat{C} . The horizontal line at \hat{C} is the locus of minimum average costs per unit of quality just like in the standard long run/short run average cost analysis.

3. Autarky :

In autarky, one unit of the quality good is produced, and the labor used is L_Q given by (3). In equilibrium, it must be the case that in each country $L_X + L_Q = 1$. The question is what quality is produced in a country with human capital H ?

Consider the indifference curves between quality and price for the quality good in Figure 2. At a fixed price per unit of quality P , the consumer would pick some optimal quality at which his expenditure on quality PQ is equal to his ideal expenditure $H/(1+m)$. Both higher and lower qualities are less attractive yielding the shape of the indifference curves in Figure 2. The locus of preferred qualities at each price defines the consumer's unit elastic locus of preferred qualities at each given price per unit of quality, where the total preferred expenditure on quality is $H/(1+m)$. We loosely refer to this curve as "demand" for quality.

If all the qualities were available at the unit cost of quality \hat{C} , the representative consumer in a country with human capital H would pick the quality Q at the intersection of his demand curve and the unit cost curve \hat{C} , as in Figure 3:

$$(5) \quad Q(H) = \frac{H}{(1+m)\hat{C}}$$

The country might be so lucky that the quality of which it is the lowest cost producer is

exactly equal to the quality $Q(H)$ that it wants to consume. But this only occurs by coincidence.

In general, the two qualities need not be equal. We assume that the quality that a country would most prefer to consume at the unit price \hat{C} exceeds the quality that the country is most efficient at producing:

$$(6) \quad Q(H) > \hat{Q} \cdot H,$$

which is the same as

$$(7) \quad \frac{1}{1+m} > \hat{C} \cdot \hat{Q}.$$

This assumption is illustrated in Figure 3. The optimal expenditure share on quality is higher than the country would spend if it consumed the quality it is best at producing. This assumption says that people would like to upgrade quality relative to what they can produce most efficiently. Assumption (7) gives countries the reason to trade to upgrade quality in exchange for X . Our analysis could also be applied to countries that want to downgrade quality, in which case the poorer countries export lower quality goods.

As figure 3 illustrates, in autarky the country in general cannot produce the quality $Q(H)$ at the lowest unit cost of quality \hat{C} , since the unit cost of $Q(H)$ is much higher. The autarkic equilibrium is given by the tangency between the consumer's indifference curve and the country's average cost curve of quality (Figure 4). At this point, the quality produced in the country is given by Q_a and the average cost of that quality is C_a . The consumer cannot improve his welfare given the country's productive opportunities.

Under the assumption (7), the quality in autarky Q_a is higher than the quality \hat{Q} .

H that the country can produce most efficiently, and therefore the unit cost of quality in autarky is also higher. The expenditure share on quality goods however is still below $1/(1+m)$, since the tangency occurs below the maximum point of the indifference curve. Consumers are better off than they would be if the country produced the quality at which it is the most efficient, but worse off than they would be if they could consume a higher quality at the minimum cost of quality \hat{C} . This analysis illustrates the problem with autarky and the potential gains from trade. The population in a country would like to consume higher quality goods than they can make efficiently, but this is too expensive in a closed economy. As a result, the country ends up producing a level at which it is not an efficient producer. International trade can enable such a country to upgrade its quality by purchasing it from a more efficient producer.

4. Trade

In this section we allow trade between the two countries, West and East, with human capital levels H_W and H_E respectively such that $H_W > H_E$. Under our assumptions, each country in autarky produces a higher quality than it is most efficient at, but a lower quality than it would ideally like to consume at the unit cost of quality \hat{C} . Will these two countries trade and how?

In this section we show that these two countries trade if they are not too far from each other, that is H_W is not too much higher than H_E . If H_W is only moderately higher than H_E , then East can upgrade its quality by exporting X to West in exchange for the higher quality goods. West — the exporter of quality goods — produces a higher quality for itself,

and a lower quality for East. East stops producing quality goods altogether and just specializes in producing X for export and imports quality goods from West. East is thus able to upgrade its quality indirectly by producing and exporting X rather than by making higher quality goods domestically.

Figure 5 illustrates how trade takes place in this model. East imports the quality $Q_I > Q_a$ from West at a price given by West's average cost of quality Q_I in terms of X . The per unit cost of that quality, C_I , is below C_a . All the gains from trade in this model accrue to East, the importer of quality, because the supply of goods from West is perfectly elastic. West just gets its X for exactly the opportunity cost of producing the quality Q_I for East rather than X directly. West continues to produce its own high quality for itself; it reduces the production of X and imports X in exchange for the quality goods it exports. For West, exports of quality goods are an indirect way to obtain X for its own consumption.

The ideal trading partner for East is the country which is the most efficient producer of the quality that the citizens of country 2 most prefer to consume. This ideal partner produces the quality $\hat{Q} \cdot H_W = Q(H_E)$ and sells it to East at its unit cost of quality \hat{C} . In general, unless all qualities are available, East will not be able to obtain its ideal quality. Nonetheless, it can upgrade some of the way and there are gains from trade. These gains from trade rise initially as H_W rises from H_E since the quality that East buys becomes closer to the ideal. This is the case in Figure 5. When $\hat{Q} \cdot H_W = Q(H_E)$, gains from trade are maximized. As H_W rises further, gains from trade fall but remain positive even though the consumers in East are now getting higher quality than they would ideally prefer. Figure 6 illustrates the gains from trade with a significantly better country, but one which is still

desirable to trade with. When East trades with this partner, it actually spends more than its most preferred share of income on buying quality goods, and would like to downgrade its quality, but cannot. Still, trading is better than not trading at all.

Gains from trade are positive as long as Western goods are not of too high a quality. If Western goods are of excessively high quality, then the amount of X that East must give up in exchange for that quality is just too high to make trade worthwhile. As H_w rises, West loses its comparative advantage at lower quality goods relative to X . The qualities that East's citizens would like to import are no longer cheap, and the qualities that are relatively cheap are too good for East's citizens. In this case, the equilibrium exhibits no trade, as illustrated in Figure 7.

Before the two countries are too different for them to trade, there will be an intermediate range. In this range, East's citizens sell some amount of X in exchange for some probability of getting a higher quality good. One can think of this as a lottery for a car, in which many people from East chip in some small amount of X each and with some probability one of them gets a good car. They are too poor for any one of them to buy this car, but are willing to participate in a lottery. This lottery is just a technicality in our model. With many quality goods, in this intermediate equilibrium there will be trade and quality upgrading of some but not all of them. With only one quality good, the equivalent of trade to upgrade a subset of the goods is the lottery. As countries become too different, even the lottery becomes unattractive and there is no trade in equilibrium.

Summary

The difference in human capital endowments makes countries different in two ways. First, the country with higher endowment of human capital would like to consume higher quality goods at given prices. Second, the quality of goods that the country with higher human capital is most efficient at producing is also higher. The two countries would each, if they could, upgrade the quality of goods they consume, but this is too expensive in autarky. When the two countries are not too different and can trade, the poorer country imports quality goods and exports goods for which quality is less important. As the two countries become more different, gains from trade first diminish and then disappear completely because the richer country loses its comparative advantage in lower quality goods that the poorer country wants. Poland and Lithuania will not export grain to get BMWs even if they would export it for Fiats. Unfortunately, West Germany does not have a comparative advantage in Fiats relative to grain. In this case, Poland might export grain to Italy in exchange for Fiats, but not to West Germany in exchange for BMWs.

Unlike the standard Heckscher-Ohlin setup, tastes and endowments in our model are correlated. Countries with low endowments of human capital prefer to consume fairly low quality goods. This leads to the Linder effect in our model. Very similar countries have a low volume of trade with each other because they make very similar goods (ignoring interindustry trade), and very different countries have a low volume of trade because they demand very different goods. Rich countries do not want to downgrade because they are rich, and poor countries do not want to upgrade because they are poor. The volume of trade is the largest for some intermediate difference in human capital endowments between

the two countries. Countries with very different levels of income do not trade at all.

5. Patterns of trade

The model outlined in the previous sections makes a number of strong assumptions. On the production side, we assumed that the comparative advantage between X goods such as steel or grain and quality goods (at the minimum average cost of quality) stays constant as human capital rises. A rich country does not get either better or worse at X -goods relative to quality goods. Below we discuss important exceptions to this case. On the preference side, we assumed that poorer countries prefer lower qualities than richer countries can produce at the minimum cost. We will discuss cases where poor countries are willing to pay for quality, and where no one is willing to pay for it.

Comparative Advantage in X

As we specified the model, trade does not take place between very different countries because rich countries do not have a comparative advantage in lower quality goods relative to intermediate goods such as steel and grain. We have kept constant the relative efficiency in the production of high quality goods and X . But sometimes rich countries gain a comparative advantage in X relative to quality goods in general. For example, the U.S. has enormous comparative advantage in grain and Japan has a strong one in steel. In this case, trade with poorer countries is even less likely because the amount of X that these countries have to give up to trade is even higher. The average cost curve shifts up as it moves to the right, as shown in Figure 8, making autarky more likely for any given pair of human capital

endowments. Put differently, if countries become better in X relative to high quality goods as H rises, the price they will pay for X in exchange for lower quality goods falls, and therefore exporting X goods will be even less attractive to poor countries. In this respect, we have underestimated the likelihood of autarky when rich countries have comparative advantage in non-quality goods.

Comparative Disadvantage in X

The opposite case to the one just analyzed is that of crops and minerals, such as coffee, cocoa, oil, or coal. The key aspect of these goods is that a country does not become significantly better at producing them in terms of time inputs as human capital rises. As human capital rises, therefore, countries endowed with resources for producing these goods lose their comparative advantage at producing them relative to high quality goods. Unlike in the basic model where the comparative advantage between X and quality stays constant, here the comparative advantage in X relative to quality falls. As Figure 9 illustrates, this means that the average cost of quality curve (in terms of X) shifts down as it shifts to the right. As H rises, the amount of forgone X to produce the optimum quality falls.

As Figure 9 makes clear, this means that the two countries are now more likely to trade than they are in the basic model. The reason for this is simple. As the West becomes richer, the East's comparative advantage at minerals or coffee grows, and therefore trading these goods for even very high quality goods is worthwhile. So even though East might not want to give up grain or steel to get such high quality goods, it is willing to give up coffee and minerals, which West is not as relatively good at, to obtain the high quality. Put

differently, high quality goods from West are much cheaper in terms of coffee and minerals than they are in terms of steel.

This model predicts that countries rich in minerals are much more likely to trade with rich western countries than countries that do not have such natural endowments. Saudi Arabia, Russia, and Brazil might be perfectly able to exchange their endowments for high quality foreign manufactures. On the other hand, Lithuania and Hungary are in a precarious position because they do not have minerals, and so must sell goods they are relatively bad at producing, such as steel and grain, to upgrade the quality they consume.

Crops and minerals are perhaps the clearest case of goods in which a country gains a comparative disadvantage as its level of general human capital rises. Other such goods include handicrafts, such as glass or carpets, even those of very high quality. The point is that skills required to produce these goods are different from general human capital. Nomads make some of the best carpets and primitive tribes make extremely expensive and sought-after art. The human capital in our model is general human capital associated with the capability to perform advanced tasks and therefore with wealth. The skills we described do not require such human capital. As a result, a country gains a comparative disadvantage in handicrafts as its general human capital rises. It can therefore import these high-quality handicrafts in exchange for H-intensive goods. Like crops and minerals, quality handicrafts make it easier for a poor country to trade with a rich country, since it can produce what a rich country wants.

These examples raise the question of how Korea fits into this analysis. In particular, how can Korea export so much to the West even though it is relatively poor and does not

have any minerals or handicrafts? In the case of Korea, the relationship we stress between tastes and technology breaks down: Korea has the ability to make very high quality goods, yet its income does not lead to a demand for these goods. Nevertheless, our model can be used to describe Korea. Korea is just like West in our model, with the United States being East, as far as production of some quality goods is concerned. However, Korea is poorer and so demands lower quality than the US. As a result, Korea exports high quality goods to the U.S. in exchange for X , and then produces lower quality goods for its home consumption. Korean exports are of higher quality than the goods produced for home consumption. This is the opposite of our basic model, where West exports lower quality to East than it makes for the home market. This adaptation of the model seems to describe what Korea actually does: it exports final manufactures in exchange for intermediate goods and agricultural products. Korea also imports some high quality goods that it cannot produce itself. Korea illustrates the restrictiveness of our basic model, in which the level of unique human capital completely determines both productive capabilities and wealth.

Preference for Quality

In our model, poorer countries do not want to spend their resources on very high quality because the amount of X they must give up to obtain this quality is extremely high. For some goods, however, even consumers in poor countries demand the quality of goods produced by the richest countries. These goods might be spare parts, or particular pieces of equipment that cannot easily be replaced by a lower quality, or airplanes. The Soviet Union imports Caterpillar and Kamatsu tractors for heavy construction, and many Japanese

and German machine tools for manufacturing industries. In our model, these cases simply mean that the demand curve for quality of these goods is very far out: the optimum quality at any given unit price of quality is very high. Not surprisingly, this implies that poorer countries trade even with extremely advanced rich countries in these goods. Since poorer countries are willing to give up a lot of X for a high quality, they will trade with countries that produce the very high quality of these particular goods and pay dearly for them. The total expenditure share on these goods is probably still small, expensive as they are.

The other case that the model speaks to is one where consumers are perfectly happy to substitute between quality and quantity, and care only about the aggregate amount of quality times quantity (efficiency units) they get out of a good. In this case, there is no satiation on the quantity margin. In this case, the indifference curves are horizontal lines: all that matters to consumers is the unit price of quality, and at a fixed unit price they are happy to take any quality and compensate with quantity. In this case, each country would want to trade with the lowest average cost producer of any quality, regardless of what this quality is. If the lowest cost producer makes a low quality, everyone will buy that quality but a lot of it. If the lowest cost producer makes a high quality, everyone will buy a small amount of that quality. This case does not appear to be realistic. However, it is important to mention because it corresponds precisely to the Heckscher-Ohlin version of our model, in which each country must have a comparative advantage at something and exports this good in exchange for the goods it is not as good at making.

Trade with Multiple Countries

We have dealt with the case of two countries. With more countries, we can imagine chains of trade. An intermediate country exports moderate quality goods and imports X , but then turns around and imports high quality goods from a very high quality country and exports X to that country. More generally, each country, if it trades, will import quality goods from its best available trading partner, meaning the one whose most efficient quality is closest to the country's ideal quality demanded. Sometimes that might not be the country with the level of human capital closest to that country, since gains from trade with the closest country might be lower than gains from trade with a country that is further away.

6. Comparison of living standards

Our model has some implications for comparing living standards between rich and poor countries. Consider two very different countries that do not trade, and that consume goods of very different qualities. Suppose we try to evaluate the standard of living in the poor country using prices from the rich country. In the poor country, wages relative to the low quality non-traded good might be high, but wages relative to the high quality traded goods (which might be traded between rich countries) and possibly X goods might be very low. The point is that the poor country is at an extreme comparative disadvantage with respect to traded high quality goods and X goods. A Western car or stereo costs an extraordinary amount in Russia or Eastern Europe. In terms of the domestically produced non-traded goods, however, the standard of living might not be so low.

Similar reasoning is often applied to services in less developed countries. Services

are cheap in LDCs, but because they are non-traded, real income comparisons that price services using Western prices, or do not price them at all, underestimate the real income in LDCs. In our model, low quality goods unlike services can be traded, but are not traded in equilibrium. In equilibrium, therefore, they are just like services. They are cheap in poor countries relative to wages, and real income comparisons do not fully reflect that. Put differently, people in rich countries would not pay much for these goods, but they are worth significantly more to people in poor countries.

This analysis helps us understand wages in Eastern Europe. Translated into dollars at black market exchange rates, or even at free market rates as in Poland, wages in Eastern Europe vary between 25 cents and \$1 an hour. Looking at how people live, however, it is hard to believe that the standards of living are 40 times lower in Lithuania than they are in the U.S. Maybe 5 or 10 times but not 40. The reason for this is that many Lithuanian goods would not find a market in the U.S. at all, but are fairly suitable for Lithuanians given their incomes. The wage appraisal fails to realize that the prices of the goods that Lithuanians consume are extremely low in world prices also.

7. Conclusion: implications for Eastern Europe

The main implication of our analysis is that similar countries trade with each other because trade enables them to marginally upgrade their quality. Many Eastern Europeans today fear that trade with Western Europe will prove difficult, but are also reluctant to continue trading within Comecon. Our model suggests that the fear is well-founded, but the reluctance is inappropriate. Gains from trade are probably significant within Comecon,

because their citizens, given their incomes, demand what these countries can actually produce. The main way in which Comecon countries can increase their trade with the West (other than follow Russia's path in selling its natural endowments, if they have them) is by substantially upgrading the quality of the goods they produce. But Western Europe is unlikely in the near future to want Eastern Europe's goods. Our model suggests continuation of Comecon trade in the meantime. Even as East European trade increases, it is more likely to be with South European and Far Eastern Countries than with Western Europe.

How will quality be upgraded? If human capital is the answer as our model suggests, it must be experience with modern techniques rather than education since people in Eastern Europe have significant schooling. Presumably then, people in Eastern Europe need industrial experience with high quality production. This argues for policies such as technology transfer, joint ventures, and other ways to accumulate knowledge. In addition, even if knowledge cannot be embodied in workers, there may be possibilities for combining Western knowledge with East European labor. This is the Mexican model of assembly for export abroad. In the language of our model, if you are bad at X you can export L directly. Presumably, using this model will enable East Europeans to import some quality goods, but the amount of quality upgrade they can get from that is limited by the fact that the human capital that earns the returns is not theirs.

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Figure 1
Average Cost Curves

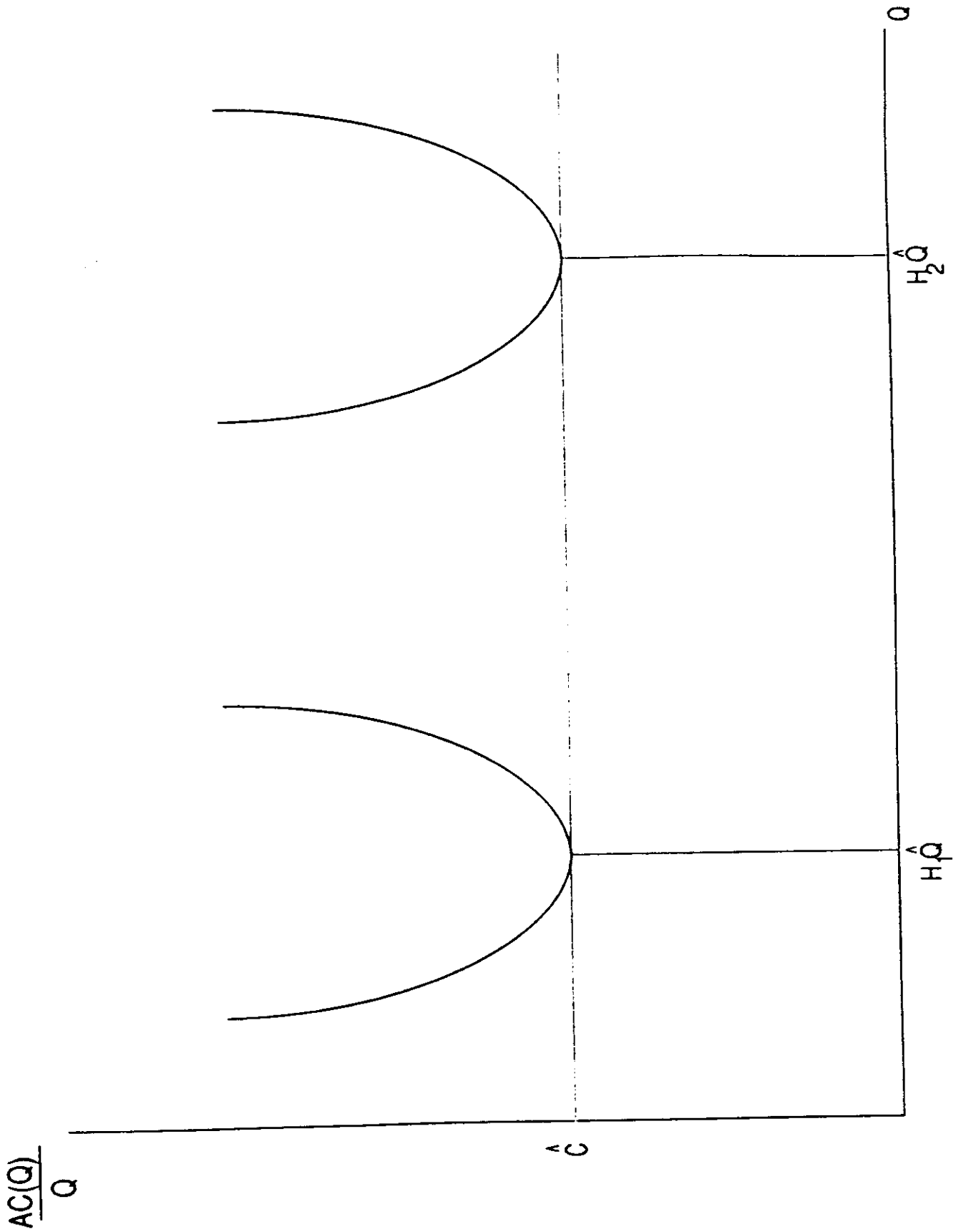


Figure 2
Indifference Curves and Demand

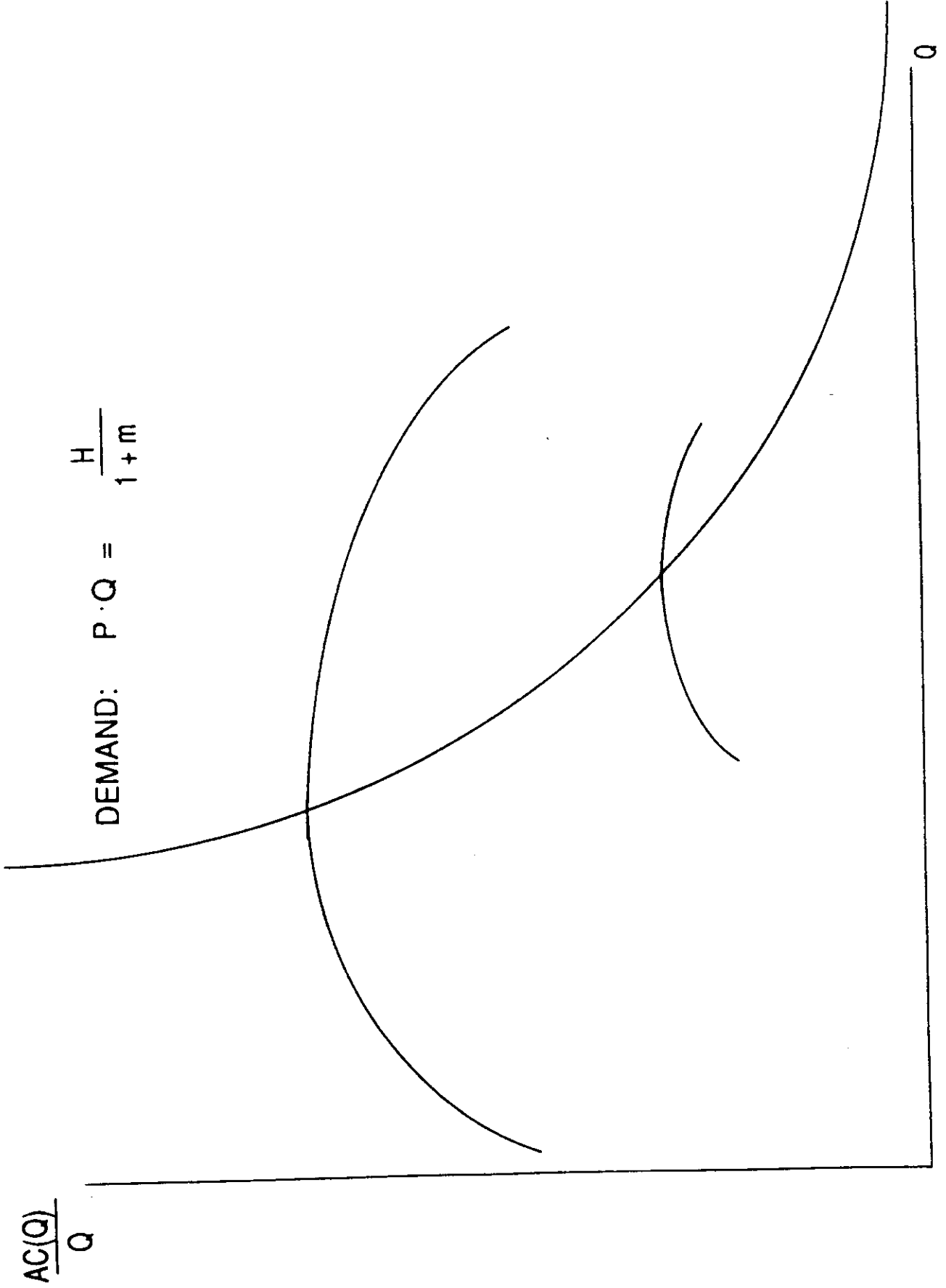


Figure 3
Consumers Prefer to Upgrade Quality Relative to
Capabilities

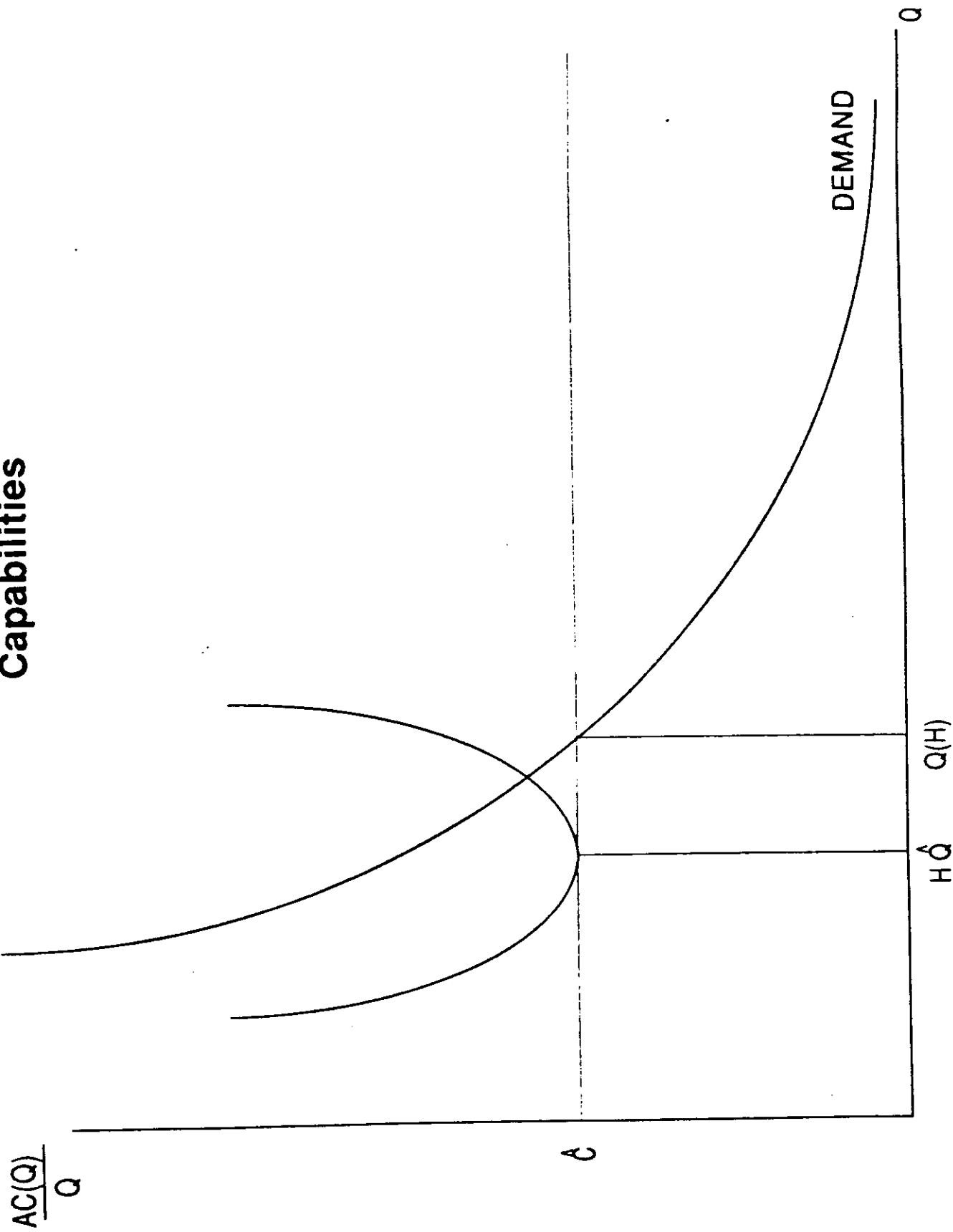


Figure 4
Autarky

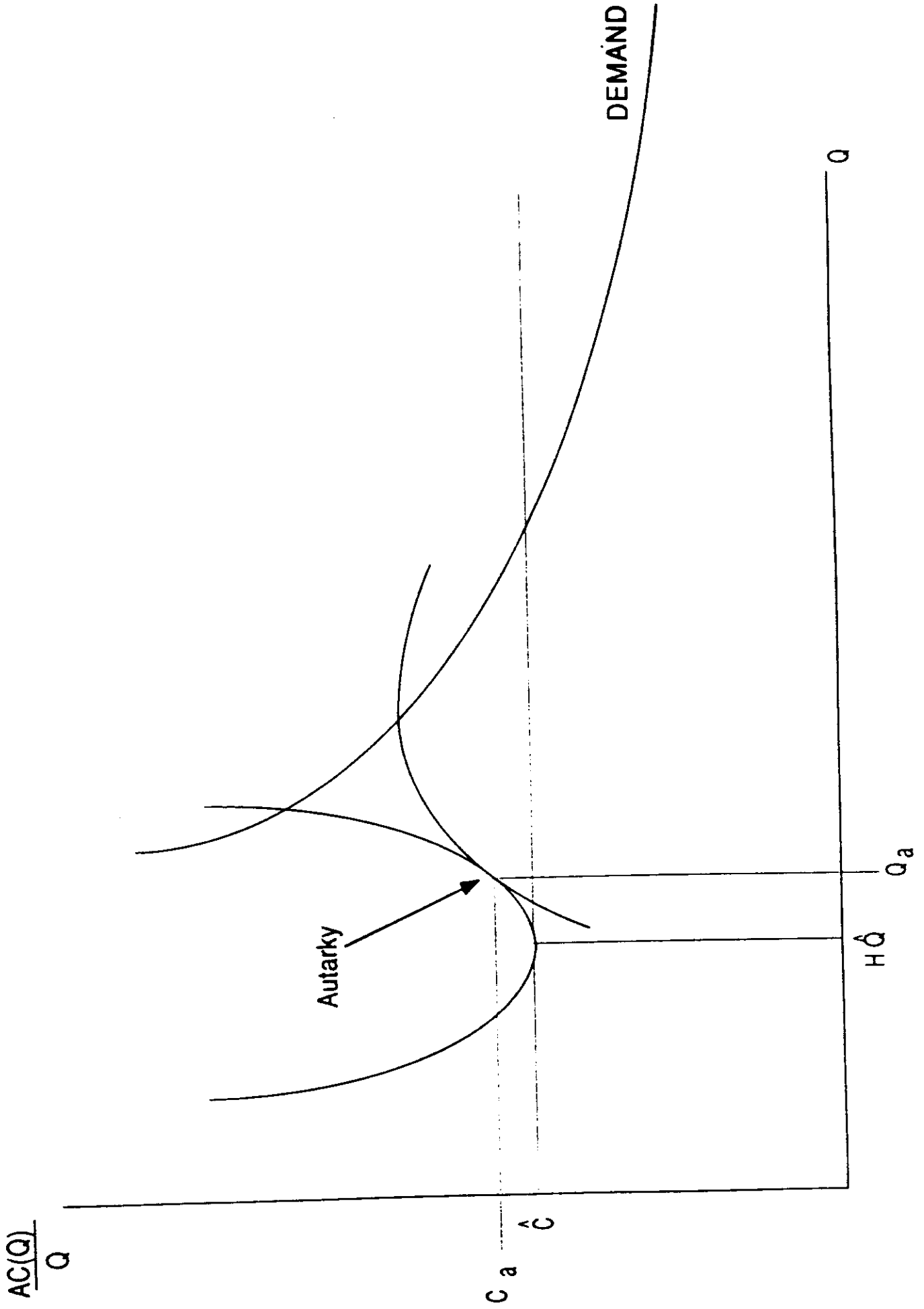


Figure 5
Trade

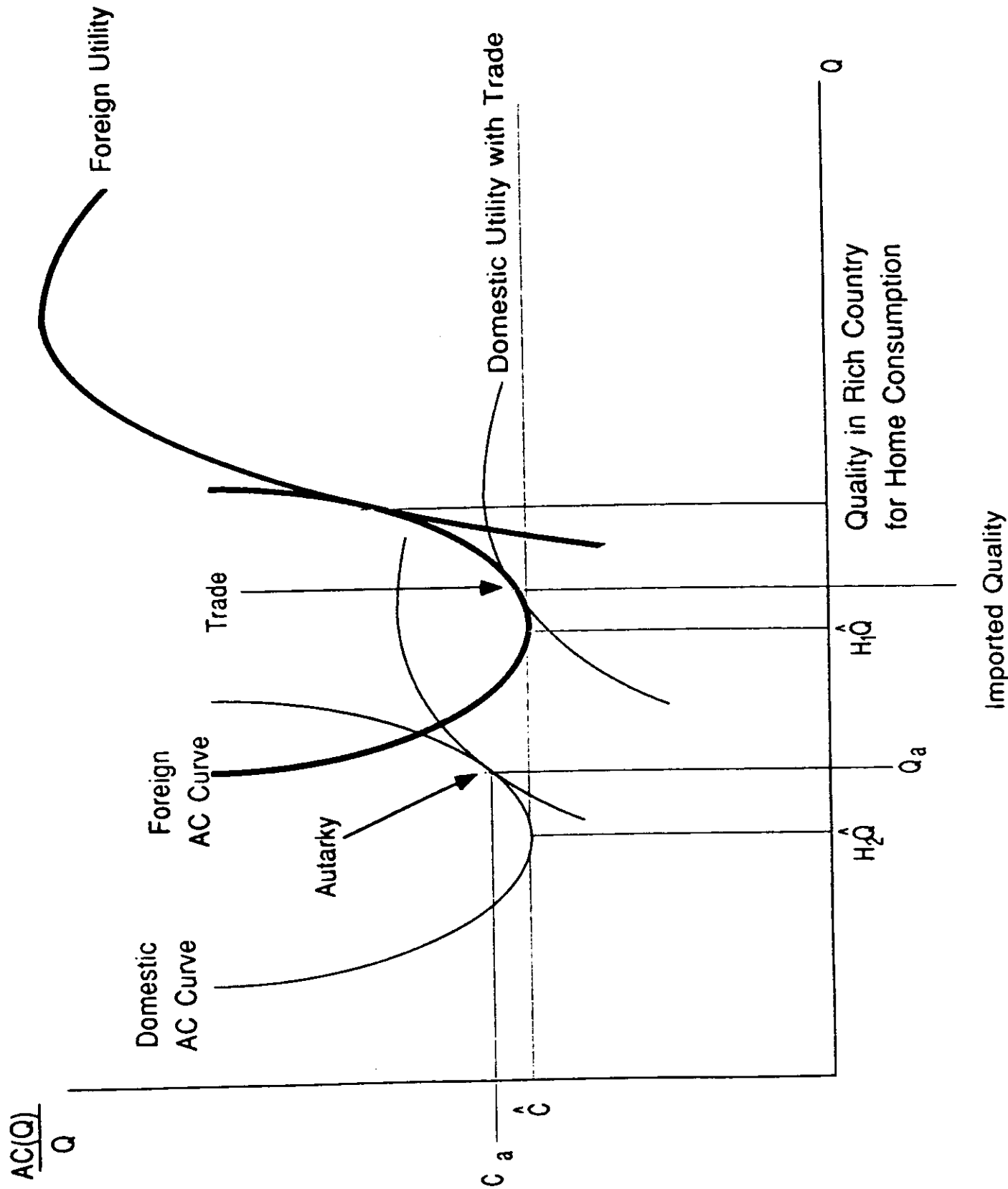


Figure 6
Trade Where Imported Quality Is Above Preferred

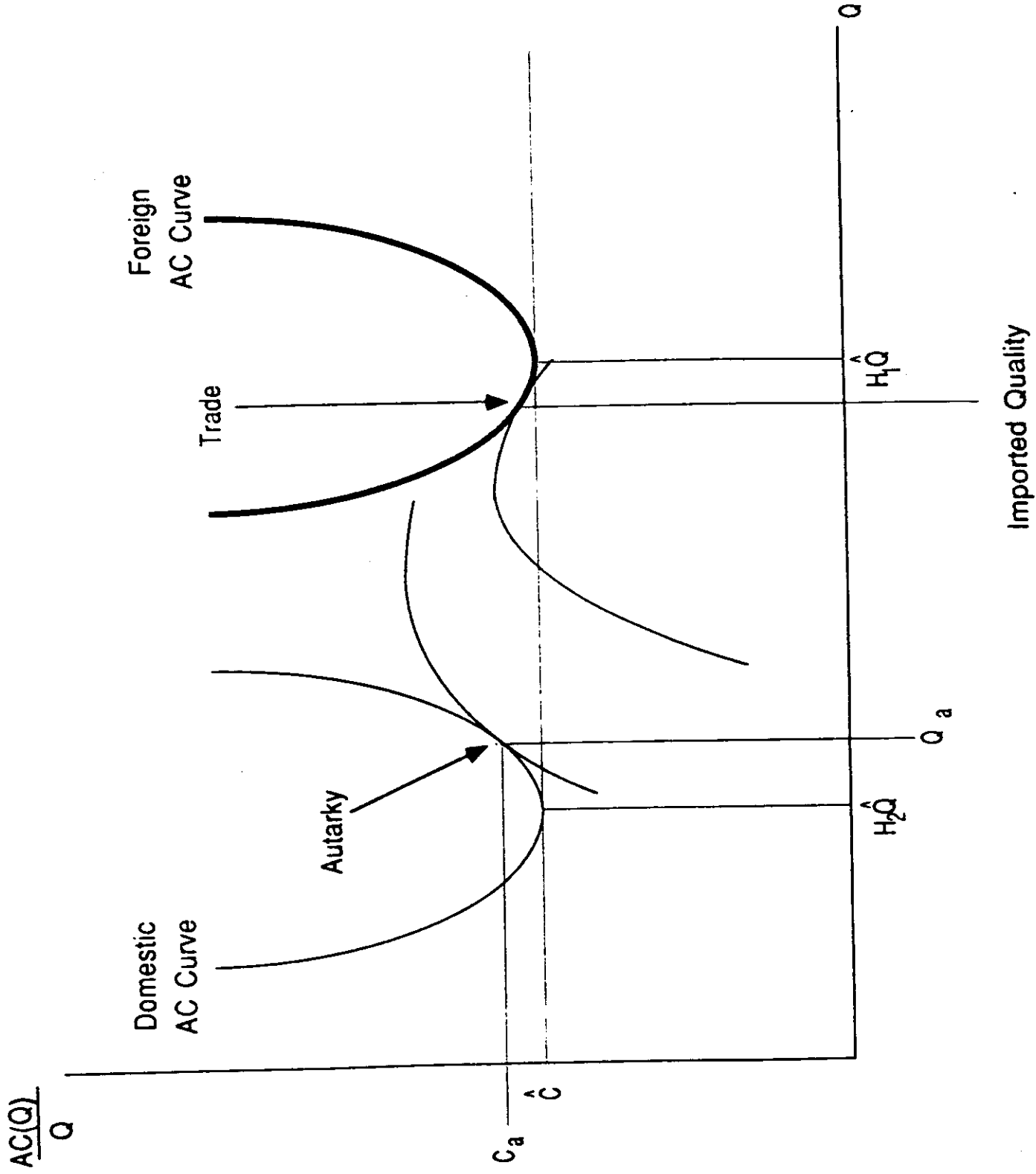


Figure 7
No Trade

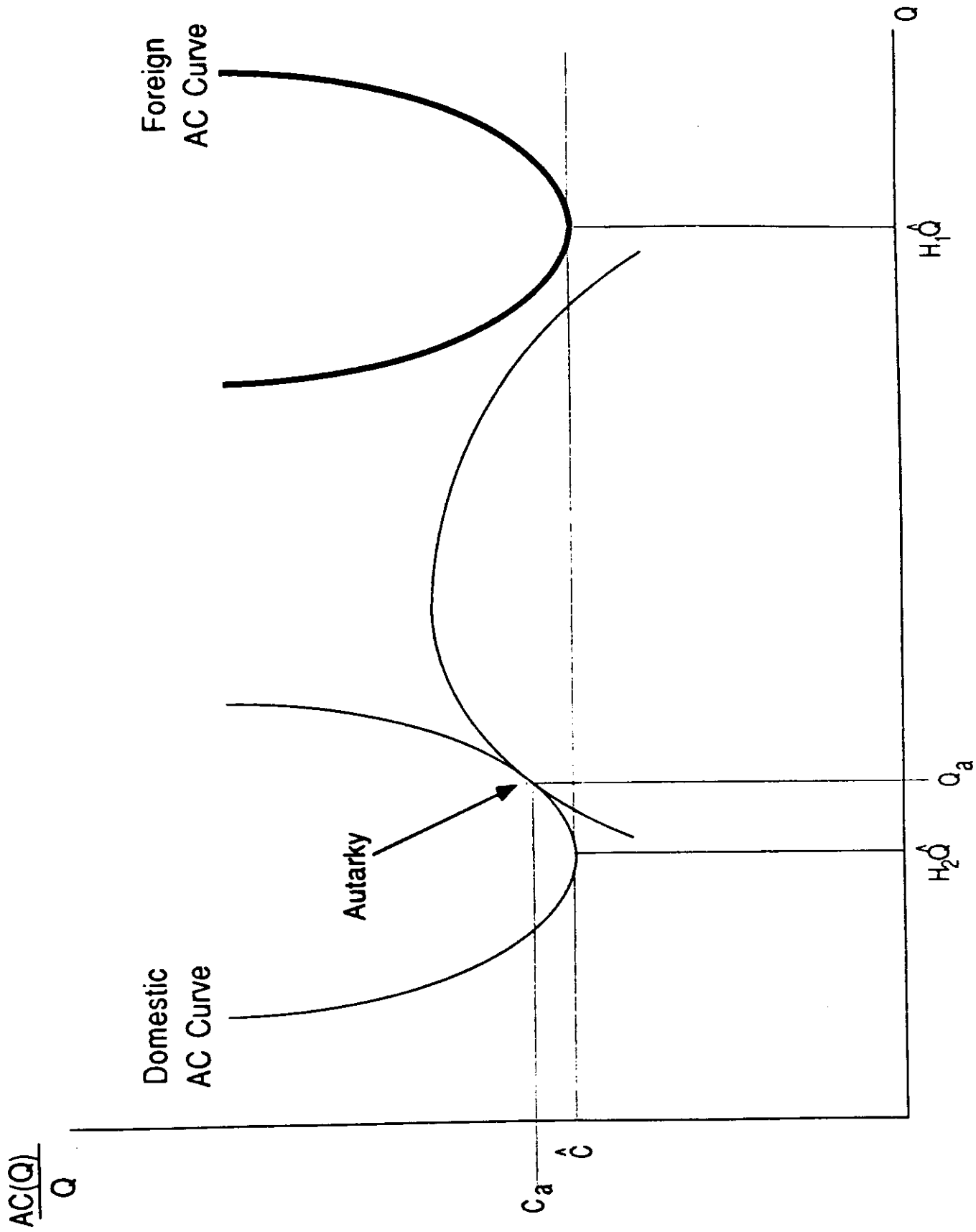


Figure 8
Increasing Comparative Advantage in X

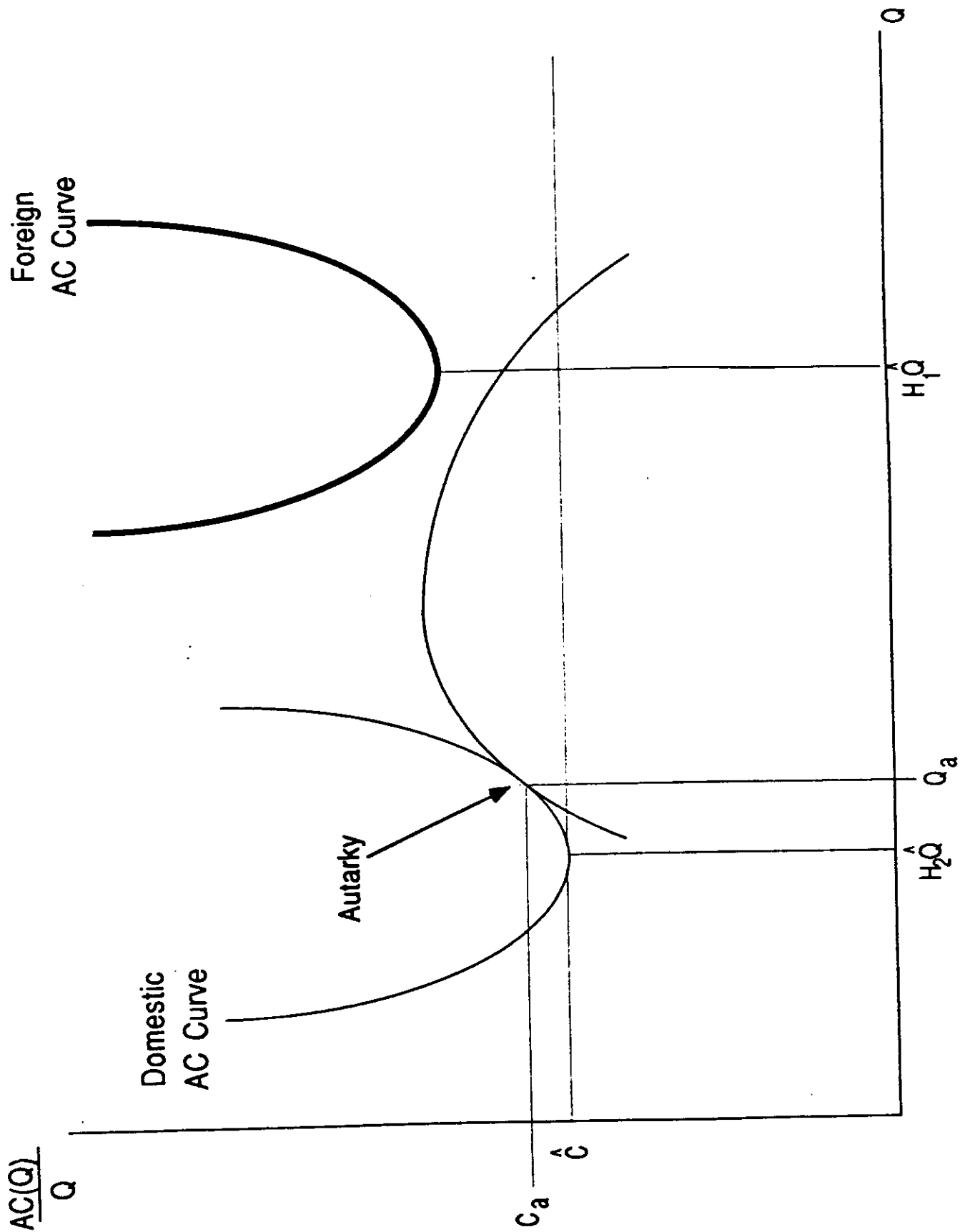


Figure 9
Diminishing Comparative Advantage in X

