Production and Distribution Analysis Using Comparative Advantage and Free Trade

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Introduction

The principle of comparative advantage was developed in the early 19th century by David Ricardo. This theory has since been elevated to the law of comparative advantage, which states: as long as the price ratios differ initially between two or more entities (individuals, firms, nations, etc.) each entity has an ability to produce some output at a relative cost disadvantage to other outputs [5]. The facts are that every entity has a comparative advantage in some outputs, but these outputs must be exchanged in the market in order to realize the economic benefits from such production.

This law, and its implementation, has given rise to the concept of specialization, and has advanced the realm of domestic and world trade. Such noted economists as John Stuart Mills and J. H. von Thunen have advanced the specialization theory with their respective "international price lines theory" and "locational analysis" [3]. Modern day economists have incorporated the concept into maximum production models using linear programming techniques [1].

Objective

The purpose of this article is to demonstrate that production horizons can be expanded by the simultaneous incorporation of the law of comparative advantage, specialization, and free trade. It should be noted that all three areas must interact to produce the optimal advantage.

Methods and Procedures

A graphical method of analysis is offered to accomplish the stated purpose, assuming a hypothetical condition. Additionally, the condition of no reserve supplies of outputs is to be held (i.e. supply = consumption), and the assumption of proportionality of activity levels of resources, or constant return to scale, is given. While it is acknowledged that the elimination of the capacity for reserve supplies and the constant return to scale assumption do not conform to some empirical situations, the basic methodology as outlined in this text is unaffected. Further, consideration was given to providing "real world" examples, but due to a variety of conditions and/or policies existing in modern society (ranging from tariffs to production controls) empirical examples that function on purely economic principles were difficult to identify. However, the following examples are offered to clarify and illustrate the theory and the resulting implications.

The first example, as presented in Figure 1,[1] represents a two entity (country) economy in which the United States (U.S.) and the United Kingdom (U.K.) are the exclusive producers and traders, and wheat and corn are the outputs. For illustration purposes, each country is assumed to have two input units and the input factors can be transformed into the outputs in the following manner:

1) The United States can produce 6 units of wheat per input unit per year or 4 units of corn per input unit per year or any feasible combination of wheat and corn.

2) The United Kingdom can produce 3 units of corn per input unit per year or 1 unit of wheat per input unit per year or any feasible combination of wheat and corn.

Initial production is non-specialized in each country with the U.S. using one input unit to produce 6 units of wheat and one input unit to produce 4 units of corn. This production is represented on the graph at point B, with the U.S. production possibilities curve labeled U.S. PPC. The U.S. PPC was established by deriving the maximum output for both wheat and corn that could be produced by employing the given two input units (i.e. 2 * 4 = 8 units of corn and 2 * 6 = 12 units of wheat). By linearly connecting these two extreme points of production the U.S. PPC was established, and it should be noted that it passes through the initial output at point B.

The U.K. is initially using one input unit to produce 3 units of corn and one input unit to produce 1 unit of wheat. This production is represented on the graph at point A, with the U.K. production possibilities curve labeled U.K. PPC. The U.K. PPC was established in an identical mathematical and graphical manner as was the U.S. PPC, except substituting the given production estimates for the U.K. The U.K. PPC likewise passes through its respective initial consumption at point A.

The production possibilities curve for both nations is labeled Total PPC and was derived by summing the possible outputs for both nations as established by their individual production possibilities curves (i.e. 2 + 12 = 14 units of wheat and 6 + 8 = 14 units of corn). The Total PPC passes through point T, which is the current total consumption of outputs (i.e. 7 units of wheat and 7 units of corn).

Using the law of comparative advantage, the United States should specialize in wheat production since the wheat/corn advantage is 6/4 or 1.5:1. Likewise, the United Kingdom should specialize in corn production since the corn/wheat advantage is 3/1 or 3:1. By applying the principle of total specialization in their respective area of comparative advantage, the U.S. will produce 12 units of wheat and no corn, and the U.K. will produce 6 units of corn and no wheat.

With this specialization the new feasible production region is bound by the figure OPT'S. The area QRT' (shaded) represents the increase in total productivity which is available to the specialized nations by employing their respective inputs to their most efficient use.

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[1]Figures are found at the end of this text.

As previously mentioned, trade is necessary to re-achieve some balance of output distribution between the two nations, which was present before specialization. If the nations agree to trade 3 units of wheat from the U.S. for 3 units of corn from the U.K., the after-trade supply of the two goods will be equal to 3 units of wheat and 3 units of corn for the U.K. (point A') and 9 units of wheat and 3 units of corn for the U.S. (point B'). Total post-trade supply is equal to total production at point T', and the increased efficiency of production and trade has improved the welfare of all parties involved in the process.

It should be noted that no attempt is made to establish the individual taste patterns of either nation or the aggregate consumers. It is assumed in this model that the outputs are homogeneous in consumer preference, and that any output and consumption increase is preferred.

The terms of trade and the trade ratio of outputs for outputs (wheat for corn) are of notable importance. To achieve the unilateral benefits accruing to all in the previous example, the trade ratio (3 for 3 in the example) should be established by the ratio of possible outputs which is derived from the Total PPC. This ratio is 14:14 or 1:1 in the example given.

Any deviation from this trade ratio will result in the improvement of one trading partner at the expense of the other. This point is graphically illustrated by points A" and B", with the trade ratio used to establish these points being derived from the existing (after specialization) outputs ratios (i.e. 12 wheat and 6 corn). In this instance, the U.S. would trade 2 units of wheat for 1 unit of U.K. corn. The U.K. would benefit, but the U.S. position would be inferior to its pre-specialization position. Clearly, no knowledgeable trading partner would make such an agreement. It should be noted, however, that by using the latter (2:1) trade ratio total supply or consumption still equals specialized production (point T'). In this case total economic welfare has been increased, but not at a Pareto optimal position.

The initial model can be extended to include multi-entities, as illustrated by Figure 2. In this example, the same assumptions are held for the model and for input and output relationships for the United States and the United Kingdom. France is added as an example of a progressive nation wishing to improve its current position through specialization and trade.

The initial French position yields a production of 3 units of wheat per input unit and 1 unit of corn per input unit. They likewise have 2 homogeneous inputs at their disposal, and their initial consumption and production is illustrated by point C. Their production possibilities curve is established as France PPC in the same manner as used in example #1. Since France has a comparative advantage in wheat production (6/2 or 3:1) it is assumed that they elect to specialize in wheat, thus producing 6 units of wheat and no corn.

The Total PPC shifts outward to adjust for the expanded production, and initial total consumption is established (point T). The U.S. and U.K. pre-trade position does not change, but again specialized production exceeds initial production by the area QRT' (shaded).

The shift in Total PPC and a change in its slope has also created a new trade ratio of 20 wheat/16 corn or 1:0.8 W:C. Assuming the 3 nations trade

using the newly established trade ratio and both the U.S. and France trade 3 units of wheat for 2.4 units of corn from the U.K., the new post-specialization, post-trade positions are represented for the U.K., the U.S., and France as points A', B', and C', respectively. Again total consumption (the sum of A', B', C') is equal to total specialized production at point T', and all parties to the transaction have gained.

Upon reviewing Figure 1 and/or Figure 2, the feasible region of production is the area OPT'S, hence this region has as extremes points O, P, T', and S. Since the optimal solution to every linear problem occurs at an extreme point of the feasible region [1], the conclusions are verified. At point O, no production or consumption is possible, so this extreme is eliminated when the choice to produce is made. Point P represents the extreme point of specialized production of corn, and point S represents the extreme point of specialized production of wheat. The optimal solution is reached at point T', where total production and total consumption occur simultaneously.

Summary

The analysis of the previous models illustrates that, through specialization in the production of outputs with comparative advantage and engaging in free trade, total output and total consumption can be increased for all participating entities. Distribution of outputs may be made in an advantageous manner to all entities if the trade ratio is established in relationship to the total possible production of outputs ratio, as defined by Total PPC.

A visual analysis of both graphs may create the impression that the United States is not making an equal improvement when compared to either France or the United Kingdom, but this result may be explained by consideration of the comparative advantage ratios. In example #2, the U.S. comparative advantage was 1.5:1, while both the U.K. and France had 3:1 ratios related to their respective specialty. Since both France and the U.K. benefited to a larger degree than the U.S. from specialization, in this example they increased their benefits at a 2:1 ratio (3/1.5) compared to the U.S.

It should also be noted that in example #2 the U.K. made more improvement in its position than did France, which had an identical 3:1 comparative ratio. The U.K. additional gain resulted from the fact that the U.K. specialized in the output with the lowest potential supply (i.e. the scarcest commodity). Since it is consistent with economic theory for relatively scarce items to command a market premium when compared to relatively more plentiful items (ceteris paribus), this improvement appears to be justified.

The principal point in distribution is made by the fact that post-specialization, post-trade positions are consistently improved for each nation, hence an improvement in national and total welfare (i.e. A'>A, B'>B, C'>C, T'>T).

The application of these sample principles may be made to any combination or number of entities, provided trading is limited to said group. The concept may be theoretically extended to non-linear production functions, but an adjustment in the trade ratio may be necessary depending on the concavity of the function.

References

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Figure 1. Two Entity Example

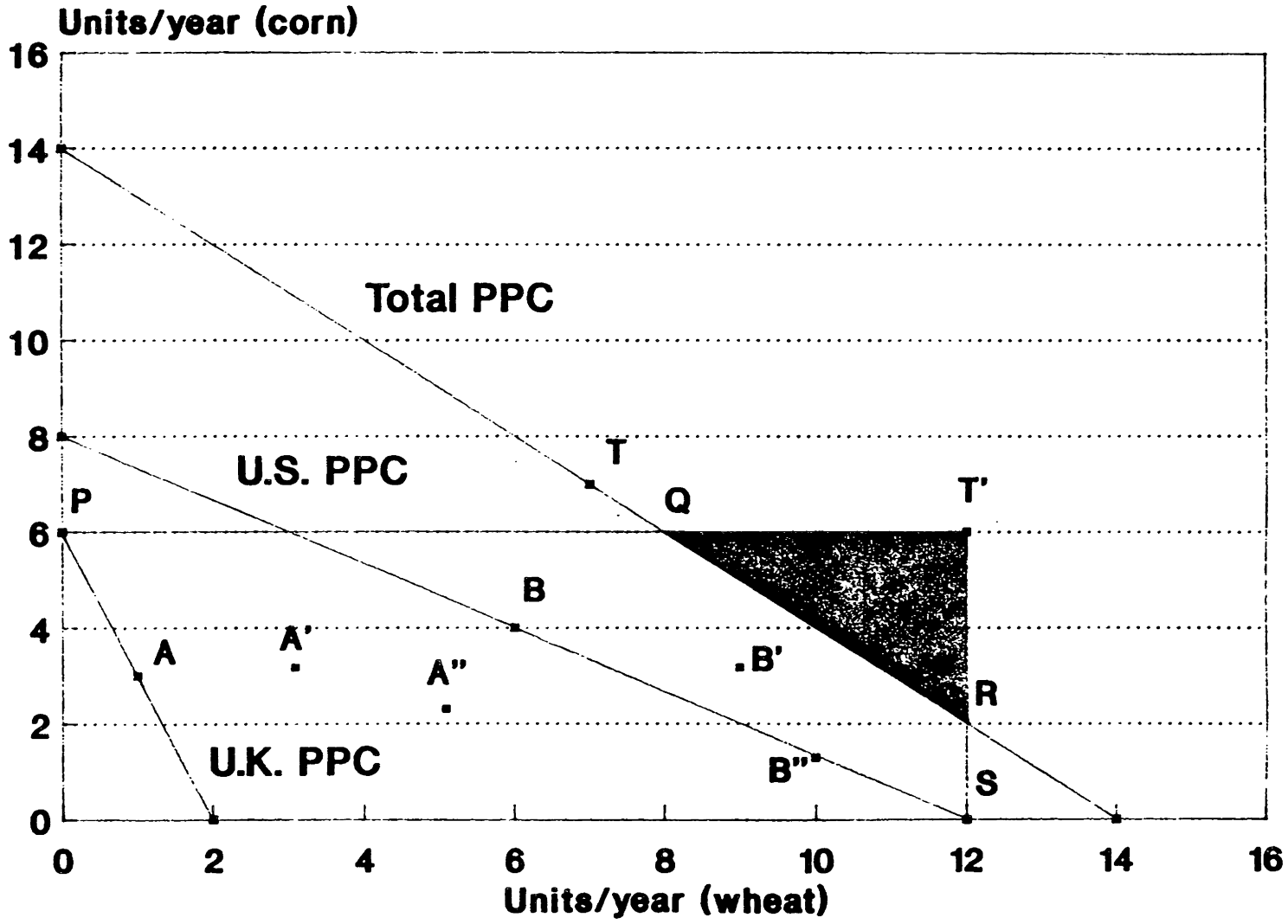

Figure 2. Three Entity Example