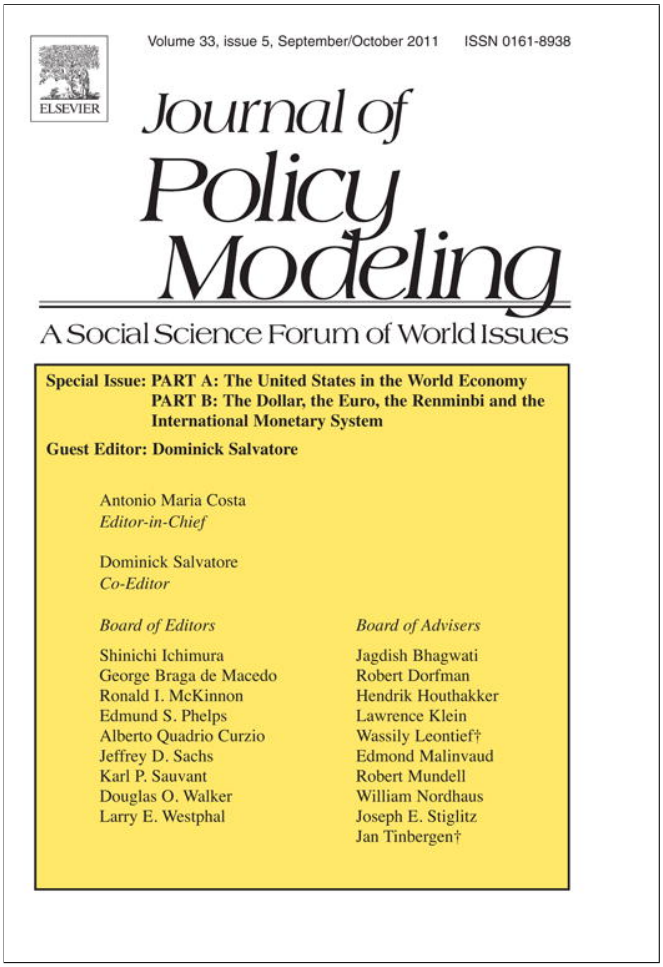

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Trade, education, and innovation: Prospects for the U.S. economy

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Abstract

This paper examines international trade issues as vital indicators of the economic prospects of the United States and other developed economies. In particular, it challenges misuses of the doctrine of mutual gains from trade and instead argues that comparative advantage does not guarantee increases in benefits to both trading partners—especially when one partner seeks to distort the market mechanism in its favor. In the face of such mercantilist or protectionist practices, efforts to advance innovation, without retaining manufacturing jobs, will not ensure continued prosperity, as the number of jobs entailed in the invention process is small compared with the number of jobs associated with manufacturing an innovative product for mass consumption. These matters call for the urgent rethinking of trade policy by the United States and other developed nations, if they are to balance their imports and exports and ensure continued economic growth.

Keywords: Globalization; Free trade; Comparative advantage; China; Innovation; Mutual gains; Trade policy; Mercantilism

1. Introduction

Any considered examination of the prospects for a major economy is dependant, as never before, on that economy's performance in the realm of international trade. In recent decades, traded goods and services have risen from a relatively minor consideration to a critical component

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of any economy, as evidenced by the share of exports in world GDP, which has risen more than thirteen-fold in the last 200 years (Maddison, 1995, p. 38). Considering how rapidly GDP itself has increased over this period, we can conclude that the absolute value of exports has exploded.[1] At the same time, breakthroughs, such as containerization, have drastically reduced the cost and time entailed in the global transportation of goods. Moreover, the Internet now makes it possible for many services to be outsourced to almost any location in the world. This paper, consequently, turns to international trade issues as vital indicators of the economic prospects of the United States and a number of other wealthy nations.

2. On rivalrous policies in international trade

Half a century has passed since the flowering of the literature on optimal trade tariffs. But it must not be forgotten that the tariffs in question were "optimal" not in terms of their contribution to the general welfare but, rather, in terms of their effectiveness in promoting the interests of the countries that adopted them—often at the expense of their trading partners. Today this observation remains pertinent, even though subtler instruments and even happenstance have replaced some of the cruder trade restrictions as the vehicles of choice for the delivery of added gains to one country, at the disadvantage of another. Nevertheless, many of our colleagues, having been nurtured on the doctrine of mutual gains from trade, seem to resist serious consideration of these possibilities and the threat they pose to the welfare of the United States and other countries.

The discussion that follows will raise questions that are clearly pertinent about a number of the received orthodoxies in the field of international trade economics—questions whose answers have profound implications for the prospects of the U.S. economy. Among other contentions, we will argue that comparative advantage does not imply that the gains from trade—or, more specifically, gains from the enhanced productivity of one of two trading partners—ensure increases in benefits that are *mutual*. Moreover, we will argue that U.S. efforts to counter trading partners' gains by dominating the field of innovation provide no guarantee against the threats to U.S. welfare posed by such trading partners. In particular, we will contend that a primary reason these matters are overlooked in much of the literature is inattention to the role of demand in comparative advantage theory and related analysis. Thus, as we will argue, these matters urgently call for the rethinking of U.S. trade policy, particularly where steps have been taken by some of America's trading partners to distort the market mechanism in their favor.

3. On comparative advantage and its misunderstandings: the fallacy of composition

The "law" of comparative advantage is unquestionably a brilliant contribution to the trade literature. Indeed, even now, a careful reading of Ricardo's discussion confirms that he understood the story quite correctly. However, some of his successors occasionally have gone either somewhat astray or, at best, have not recounted his ideas carefully, thereby introducing distortions and inaccuracies.

[1] Indeed, Angus Maddison (1995) has estimated that real world GDP underwent a 40-fold increase between 1820 and 1992, while the value of exports underwent something like a 550-fold increase during that period.

3.1. Return of the fallacy of composition in discussion of gains from trade

The first and most fundamental inference widely drawn from Ricardo is that there *must* be mutual gains from trade, along with the stronger contention that an increase in the productivity of one of two trading partners must benefit them both. In elementary economics textbooks, the argument sometimes proceeds by analogy: Sam will trade five apples for Sally's four pears only if they both prefer what they obtain from the transaction over what they give up in exchange. Even this suggests a somewhat questionable degree of faith in human rationality, but that is not the issue. In international trade, the number of buyers and sellers is massive, and those who export may not be the same as those who use the proceeds of the exports to purchase imports. Indeed, they may know nothing about one another, or may have no way to judge whether or not the value of the imports to a country exceeds the value of that country's exports. What, then, will ensure that the end result will be beneficial to all? Surely, that is recourse to the fallacy of composition that currently has re-raised its head in the politicized discussion of appropriate governmental budgetary policies to use in battling the recession.

3.2. Do both countries always gain from trade under pure competition?

It is easy to show that even under perfect competition, with linear production functions and a single input (labor) where comparative advantage holds—that is, in a theoretical case similar to that used by Ricardo (and subsequently followed in the textbooks), over a wide range of possible outcomes one of two trading partners may well be condemned to gain nothing from trade. Here, we must first take note of the fact that comparative advantage does not imply complete specialization. For example, in the two-good linear case, given imbalance in demand for the two goods (in this illustration, wine and wool), one of the two trading countries (let us call them Portugal and England) will be driven to produce *both* products. In our current world, mired in a global economic downturn and unprecedented abstemiousness, it is not difficult to imagine that the total demand for a luxury like wine may be negligible in both England and Portugal, while the demand for a necessity like woolen clothing will remain abundant. In that case, Portugal will not be able to meet the clothing needs of its inhabitants by exporting only wine in exchange for cloth, and part of its labor force will be driven to domestic cloth production. Fig. 1 demonstrates

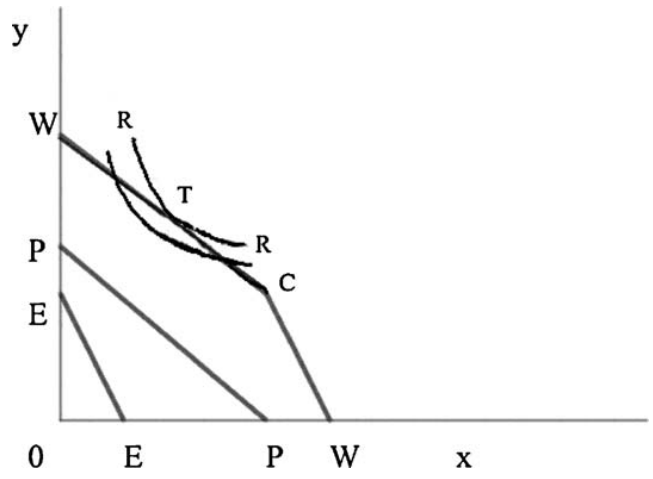

Fig. 1.

that, given the usual premises of the comparative advantage story, this is not a rare and bizarre outcome.

In Fig. 1, *PP* and *EE* are the individual production possibility loci of Portugal and England, respectively, while *WCW* is the locus for their possible world outputs—that is, the locus of maximal output quantities for the two countries, if their production relationships are linear (as in Ricardo and most modern elementary economics texts) and if the countries efficiently divide the task of production between themselves. It is clear at once that at any equilibrium point on line segment *WC* to the *left* of interior corner point *C*, such as tangency point *T* with curve *RR*, Portugal will be producing both goods, labeled *x* and *y*. Similarly, to the *right* of point *C*, the same will be true of England. Only if demand is such as to select the output combination represented by point *C* will complete specialization occur.

Moreover, in a perfectly competitive equilibrium, at any trade outcome other than that represented by corner point *C*, one of the two countries will obtain zero gains from trade. To see this, suppose, as in Fig. 1, that *T* turns out to be the relevant, perfectly competitive equilibrium point—the feasible point at which the value of world output is maximized. This will be point *T* of tangency between the upper boundary, *WCW*, of the feasible region and iso-revenue curve, *RR*. Here, *RR* is given by the demand relationships, $PxX + PyY = k$ (a constant), and the inverse demand functions, $Px = Fx(X, Y)$ and $Py = Fy(X, Y)$. Then, at that point, *T*, by virtue of the tangency shown in Fig. 1, a standard elementary result must be $Px/Py = MCx/MCy$, since the (absolute value of the) slope of *RR* is evidently Px/Py and the slope of *WC* is the ratio of the marginal labor costs. This means that, for Portugal, as a producer of both goods, the ratio of the goods' marginal (fixed labor) costs of production must be equal to the ratio of their prices on the international market. Hence, Portugal can gain no more by changing the quantities of its exports and imports than it can gain by changing the relative amounts of the goods it produces domestically. So, for Portugal, in linear competitive equilibrium, the ratio of the goods that would most beneficially be exchanged in the trade process is the same as it would be in domestic production. As such, Portugal has gained nothing from trade.

3.3. *On unilaterally rising productivity and mutual gains from trade*

Admittedly, the case just described in the prior section is of little practical importance, as the argument depends crucially on there being only two traded goods. It is included here only to demonstrate how easily one can be mislead by small inaccuracies in the telling of Ricardo's comparative advantage story.

A much more important misunderstanding has to do with the part of the comparative advantage story that deals with rising productivity in only one of the trading countries. Although this has been described elsewhere (see, for example, Gomory and Baumol, 2000), a brief recapitulation is surely called for. For this, it is worthwhile to translate the results from the many-industry model used in Gomory and Baumol (2000) into the much more popular and easily understood form of a standard, two-good model. For example, in our large-model work, we showed that it is beneficial for a country with a major advantage in most of the world's goods to lose some small portion of its industries to the development of a very undeveloped trading partner. However, we also showed that if the development of the trading partner continues and the losses become an appreciable part of what the stronger partner had been exporting, then the effect turns around, and any further losses become detrimental to the wealthier economy. It is plausible that the same effect should be found in the familiar two-good model, since each industry can be thought of as an assemblage of

smaller ones of roughly equal size, with the scale of each assemblage reflected in the size of the demand for each of the two goods.

Let us first consider a two-good case using the data. Here our nomenclature, but not our numerical values, echoes David Ricardo. England has a productivity (output per hour) of 1.0 in both cloth and wine, and Portugal, at the start, has a productivity of 0.5 in cloth and 0.25 in wine. We assume that the English productivities of 1 represent the state of the art—the highest possible productivity levels. More importantly, we assume that the demand for cloth is large. Both countries are the same size in terms of the one input, labor, but they spend 2/3 of their income on cloth and only 1/3 on wine. Thus, cloth is by far the bigger industry.

At equilibrium (see Appendix A for the relevant equations), due to its comparative advantage, England produces all of the wine, for which demand is low, while the two countries divide the production of the more important cloth industry. English workers get twice the wage of the Portuguese, which is why cloth, the more demanded good, is produced at the same cost in both countries, despite England's great productivity advantage. England has no gains from trade, as it produces both cloth and wine domestically at the equilibrium price, but Portugal imports wine at a lower cost than it could be produced at home, so Portugal has gains from trade. However, due to the disparity in wages and, hence, in national income, Portugal gets to consume only a small part of what this two-nation world produces, and it remains a poor nation, as shown in Table 1 in Appendix B.

But what happens if the Portuguese tire of being poor and look around for a remedy? They do not have to look far. They decide to improve many of the poor agricultural and winery practices that have made their wine productivity so low, despite their natural advantages. As a result, their productivity in wine rises to 0.75.What is the effect of this change?

At the new equilibrium (see Table 2 in Appendix B), things look different and better. Portugal is now the sole producer of wine, while England is the sole producer of cloth. In short, both countries have gained from trade, with Portugal importing cloth, and England importing wine. The wage rate differential still exists because England makes 2/3 of the product that the world's consumers most want to buy, and cloth consumption in the two countries is unchanged. But wine consumption has increased in both countries—from 0.333 units to 0.500 units in England and from 0.167 units to 0.250 units in Portugal. Despite the loss of the wine industry, which England previously controlled, England's position has improved, overall, and so has Portugal's.

Pleased at their progress, the Portuguese decide on a next step. Their target is now the huge cloth industry that is the sole pillar of England's wealth. Working hard they steadily increase their cloth productivity from 0.50 to 0.85. As productivity rises, Portuguese cloth consumption rises and England's wine consumption falls. At its new cloth productivity of 0.85, Portugal, although still not as productive as England in cloth, has a comparative advantage in cloth and has gained nearly 2/3 of the all-important cloth market. In so doing, Portugal has ceded wine production to England. As a result, Portugal's cloth consumption increases significantly and its wine consumption, the area in which it has gains from trade, also goes up slightly. However, all of Portugal's wine is now coming from England. England, on the other hand, consumes the same amount of cloth as before but in spite of being the sole producer of wine, consumes much less wine (see Table 3 in Appendix B). The improvement in Portuguese cloth productivity has resulted in consumption gains for Portugal in both cloth and wine but has hurt England.

Next the Portuguese planners consider another step to improve their economy. The obvious thing to do is to increase productivity, if possible, in both industries, with the aim of

reaching the technological limit embodied by England's wine and cloth industries. However, a brash and aggressive planner suggests something quite different. He had noticed that the English were better off before the Portuguese raised their cloth productivity. In other words, England would gain if the improved Portuguese cloth productivity fell back to its original, lower value. Building on this thought, the planner produces a model that shows how well-off Portugal would be if it raised its cloth productivity to 1 and simultaneously found a way to lower England's cloth productivity to 0.75. His model's result shows that this outcome is much better for Portugal than merely matching England 1-to-1 in both industries. With this in mind, the planner proposes some traditional mercantilist practices (i.e., subsidies and/or selling below cost for a few years) aimed at cutting down the English industry. At this point, we will leave the Portuguese planners to discuss what their next move should be (see Tables 4 and 5 in Appendix B).

We have illustrated in this two-good model that Portugal's early progress was beneficial to both England and to Portugal, but its later progress was harmful to England. Finally, we left the Portuguese planners discussing whether or not to adopt mercantilist practices that would further benefit Portugal at England's expense.

4. On innovation as the cure

In searching for the cure for America's unbalanced trade, many observers place their faith in Silicon Valley and other centers of innovation. They note that, in the past, technological progress, with its origins in the U.S., constituted a successful defense against the inroads of products supplied by "cheap foreign labor." Based on this, they conclude that the cure for today's and tomorrow's problems stemming from the conditions of trade entails an increase in the number of students in subjects useful for furthering innovation, such as engineering and physics. The sequel to this, it is believed, will be acceleration in the appearance of new products and other innovations in the U.S., which, in turn, will provide more jobs and better wages.

There is evidently some substance to these contentions, but matters are not quite so simple. As we will argue next, these views fail to account adequately for important factors that influence trade, such as demand patterns, the varying productivity performance of different economic sectors, and, more recently, the outsourcing of jobs.

4.1. Does the U.S. need to educate more engineers and applied scientists?

First, let us consider the education component of the proposal that more engineers and scientists will lead to more innovation and, thereby, spur economic growth. It is undoubtedly true that the spectacular innovative performance of the U.S. played an important role in the period after the Second World War and even in the pre-Depression 1920s, when it also was widely noted that the U.S. economy faced the rivalry of "cheap foreign labor."[2]

The U.S. had no shortage of engineers and scientists in these earlier periods, and we may do well to question the need for more now. Some evidence of the answer to this question is, in fact, readily available. The market, working via the supply–demand mechanism, surely does its bit to indicate which occupations are in need of more workers—an item in short supply will dependably

[2] It may be noted, as a fact suggesting how much matters can change, that during these earlier years the standard joke was that products of questionable quality always bore the label "Made in Japan."

be one whose price is relatively high. However, a comparison of the earnings of engineers and physicists with those of doctors, lawyers, and business executives surely indicates that the market for engineers and physicists does not seem to be driven by severe current shortage. True, 2009 data from the Bureau of Labor Statistics suggest that the average engineer actually earns a little bit more than the average business manager, and that the average physicist makes a little bit more than the average lawyer and quite a bit more than the average business manager. But if we compare the average of engineers' and physicists' average hourly wages with the average of doctors', lawyers', and business managers' average hourly wages, we find that the latter is demonstrably higher than the former. In short, there appears to be a good market for the services of those who lead the innovation process, but surely no evidence of a desperate shortage (U.S. Bureau of Labor Statistics, 2009).

4.2. Will continued innovative performance ensure good jobs and high wages?

The recent performance of the Chinese economy indicates that rapid growth can occur in the absence of spectacular invention. Indeed, that country, which arguably was the world's leader of innovation during Europe's Middle Ages, now apparently devotes little effort to inventive activity. Ironically, China benefited little from that earlier outpouring of invention. Only today, with an economy driven by manufacturing, is its growth outpacing much of the world. As China's case hints, if an economy is to have good jobs and high wages, more than rapid innovation growth is required: *A substantial share of the subsequent manufacturing process entailed in supply of the innovative product must remain in the innovator country*. For example, the U.S., though by no means the sole inventor of the automobile, was the creator of the inexpensive version of the vehicle that first attracted an abundant consumer market. But just as important—the U.S. was also the creator of the mass production methods that made continuation of the automobile's affordability possible.

Thus, the number of jobs provided by the invention process is usually minuscule, relative to those that are offered by the manufacturing sector when a particular innovation is produced for mass consumption. This remains true despite the fact that persistently growing productivity in the manufacturing sector is reducing the demand for labor in that sector of the economy, not only in the U.S., but throughout much of the industrialized world. Today, the U.S. continues to be a leader in the innovation process, but much of the manufacturing of its innovations is now outsourced to other countries, where reasonably skilled labor is available at prices far lower than in the U.S.

A second and distinct point follows from this. Americans remain large-scale consumers of manufactured goods—from automobiles, to television sets and computers, to machines of every sort. If we do not make these products ourselves, we must trade for them. However since most trade—and, notably, most of America's imbalance in trade—is in manufactured goods, we are unlikely to be able to shift our negative balance toward a surplus solely by increasing our positive trade balance in services. Thus, without improving its manufacturing performance, Americans eventually will have to curtail their consumption of manufactured goods sharply or else continue to go deeper into debt with America's trading partners—especially China. This process surely will not be allowed to go on indefinitely.

It follows from these considerations that continued good performance in the innovation process is not to be spurned. However, innovation by itself, without the retaining the resulting manufacturing, may not be enough to propel continued prosperity in the U.S. and other developed nations.

5. Toward remedies

As the prior discussion makes clear, the U.S. must consider changes in its trade policy if it is to balance its imports and exports and ensure continued economic growth. But what changes?

We will not recapitulate in any detail here the well-known arguments against tariffs—that tariffs may balance trade, but retaliatory tariffs are then likely to cause that rebalance to entail a lower economic level for both trading partners. Instead, we will focus on several other possible courses of action that merit further investigation. For instance, the U.S. may wish to provide incentives for the domestic production of domestic inventions. As part of this, government support for early investment in innovative ventures and for training in the requisite technical and production skills required to manufacture both innovative products and traditional products in more productive ways.

There is also good reason to search for innovative new solutions to the ongoing U.S. trade imbalance. For example, the U.S. should not reject out rightly Warren Buffet's proposal to adopt the market mechanism for this purpose. An approach similar to carbon trading arrangements, which already have demonstrated considerable effectiveness, may prove helpful here. Such a scheme might award exporters saleable certificates that authorize the holder to import products with a market value that does not exceed that of its exports. The certificates could be traded among importers and exporters on a market, much like those used for the trading of carbon emissions allowances. This surely would ensure a reduction, if not the complete elimination, of trade imbalances and would provide automatic incentives for domestic manufacturers to avoid the added cost of purchasing import licensing certificates for components produced by outsourcing. Moreover, if such an import–export certificates market is sufficiently competitive, the added result will be a set of imports and exports that most effectively fits in with the demands of the consuming public in the U.S.

As noted, this approach already has proven itself reasonably effective and viable in the arena of environmental protection, and it seems reasonable to expect that it would perform just as effectively in balancing U.S. trade. Moreover, when compared with tariffs, it has the peculiar distinction of succeeding in its mission of balancing trade, even if our trading partners adopt retaliatory import certificate programs. Moreover, should any trading partners choose to retaliate by adopting ordinary tariffs to their restrict imports from the U.S., that also would help, rather than hinder, this program by automatically lowering that country's exports to the U.S. and thereby balancing trade. Thus, the incentive structure and likely consequences of the import–export certificate scheme are radically different from those of a program of tariffs.

6. Concluding comment

In closing, let us emphasize that neither extreme view on what unconstrained markets can accomplish is ultimately defensible. Indeed, the trade strategies proposed both by those who have undeviating faith in free trade and the markets and those who instead place their trust in government regulation will produce results that are far from optimal. This is as true in international trade as it is for a domestic economy. Granted, free trade has provided great benefits and will continue to do so. However, it does not follow that markets and free trade are best left to fend entirely for themselves, without some constraining influence by the public sector. In a world in which "what is good for General Motors" is not necessarily best for its home country, it is surely appropriate to recognize and evaluate the dangers to the general welfare discussed above and search for methods

to contain them. This paper is intended as a call for the requisite exploration of these perils and of ways to deal with them.

Appendix A. Equilibrium equations

A.1. Notation

In our standard Ricardian model there are two countries and n industries. The quantity $q_{i,j}$ of good i produced in Country j is determined by linear production function $e_{i,j}l_{i,j}$ with $l_{i,j}$ denoting the amount of labor employed in Country j in producing good i. The size of labor force for each country is L_j. Country j's *consumption* of good i is denoted by $y_{i,j}$ and its *production* of good i by $q_{i,j}$. Country j's production *share* or *market share* of world output of good i is represented by $x_{i,j} = q_{i,j}/(q_{i,1} + q_{i,2})$, so that the vector $x = (x_{i,j})$ describes the pattern of production.

Each of the two countries participating in trade has a given utility function of Cobb–Douglas form with demand parameters $d_{i,j}$.

The price of good i, p_i, and w_j, the wage in Country j, and Y_j the national income of Country j. are all expressed in monetary units. The standard equilibrium equations given below are homogenous in these variables. This means that if we choose a different monetary unit thus replacing any set of p_i, w_j, and Y_j values at an equilibrium by kp_i, kw_j, and kY_j, these values too would satisfy the equilibrium conditions while leaving all the non-pecuniary variables such as $q_{i,j}$ and $l_{i,j}$ unchanged.[3] We eliminate this ambiguity by choosing at each equilibrium the monetary unit, the MU, that that makes the total world income $Y_1 + Y_2 = 1$ MU. The national incomes with this normalization we will refer to as Z_1 and Z_2. We will then have at each equilibrium uniquely determined pecuniary values and the uniquely determined national income, expressed in MU units, satisfy $Z_1 + Z_2 = 1$.

A.2. Equilibrium conditions

For any given vector of productivity parameters $\varepsilon = \{ei, j\}$ there is a stable equilibrium giving a national income Z_j and a utility U_j for each country.

The first equilibrium condition stares that national income or consumption Z_j in Country j must equal the total value of the goods produced in Country j. With a Cobb–Douglas utility each country spends $d_{i,j}Z_j$ on good i, so total world expenditure on the ith good is $(d_{i,1}Z_1 + d_{i,2}Z_2)$. Since the fraction produced in each country is $x_{i,j}$ the balance of the value of production and consumption requires for each country:

$$\sum_i x_{i,j}(d_{i,1}Z_1 + d_{i,2}Z_2) = Z_j. \tag{1.1}$$

Second, we have a zero-profit condition. World expenditure on Country j's output of good i all goes into the wages of the labor $l_{i,j}$ employed in that industry, so:

$$w_j l_{i,j} = x_{i,j}(d_{i,1}Z_1 + d_{i,1}Z_2) \tag{1.2}$$

[3] This is the usual problem of the "numeraire."

Third, is the full-employment requirement for each country. This is expressed as the condition that the wage rate times the country's total labor force equals national income (the wage rate condition):

$$w_1 L_1 = Z_1, \quad w_2 L_2 = Z_2 \tag{1.3}$$

Fourth, we have the requirement that, for each good the value of the output of good i at the equilibrium price p_i equals the total amount consumers are willing to spend on it

$$p_i(q_{i,1} + q_{i,2}) = d_{i,1} Z_1 + d_{i,2} Z_2 \quad \text{or} \quad p_i q_{i,j} = w_j l_{i,j} \tag{1.4}$$

where the second form of (1.4) follows directly from the first by multiplying through by $x_{i,j} = q_{i,j}/(q_{i,1} + q_{i,2})$ and using (1.2).

Finally, we have the conditions that require that in each industry production, or equivalently market share, is always assigned to the producer or producers with the lowest unit cost. For example, if in industry i $w_1/e_{i,1} < w_2/e_{i,2}$, then $x_{i,1} = 1$ and $x_{i,2} = 0$. More generally:

$$\begin{aligned}
&\text{if Country 1 unit cost } \left(\frac{w_1}{e_{i,1}}\right) < \left(\frac{w_2}{e_{i,2}}\right) \quad \text{then } x_{i,1} = 1 \text{ and } x_{i,2} = 0,\\
&\text{if Country 1 unit cost } \left(\frac{w_1}{e_{i,1}}\right) > \left(\frac{w_2}{e_{i,2}}\right) \quad \text{then } x_{i,1} = 0 \text{ and } x_{i,2} = 1,\\
&\text{if unit costs are equal } \left(\frac{w_1}{e_{i,1}}\right) = \left(\frac{w_2}{e_{i,2}}\right) \quad \text{any } x_{i,1} + x_{i,2} = 1 \text{ is allowed.}
\end{aligned} \tag{1.5}$$

It is, of course, the actual producer's unit cost that determines the price p_i. The conditions (1.5) include the familiar comparative-advantage criterion.

Note that because of (1.1) the equilibrium conditions include balanced trade.

Appendix B. Tables[4,5,6]

[4] In Tables 1–5, total demand for cloth—that is the fraction of national income each country spends on that commodity—is 2/3 in both England and Portugal. Total demand for wine is 1/3 in both countries.

[5] In Tables 1–5, the labor force in each country equals 1.

[6] In Tables 1–5, national income and the prices of cloth and wine have been normalized, as described in Appendix A.

Table 1

	Cloth productivity	Wine productivity	National income	Utility	Cloth market share	Wine market share	Cloth price (per unit)	Wine price (per unit)	Cloth consumption (units)	Wine consumption (units)	Wage	Cloth produced (units)	Wine produced (units)
England (free trade)	1	1	0.667	0.529	0.5	1	0.667	0.667	0.667	0.333	0.667	0.5	0.5
Portugal (free trade)	0.5	0.25	0.333	0.265	0.5	0	0.667	0.667	0.333	0.167	0.333	0.5	0
England (autarky)	1	1	–	0.529	–	–	–	–	0.667	0.333	–	–	–
Portugal (autarky)	0.5	0.25	–	0.210	–	–	–	–	0.333	0.083	–	–	–

Table 2

	Cloth productivity	Wine productivity	National income	Utility	Cloth market share	Wine market share	Cloth price (per unit)	Wine price (per unit)	Cloth consumption (units)	Wine consumption (units)	Wage	Cloth produced (units)	Wine produced (units)
England (free trade)	1	1	0.667	0.606	1	0	0.667	0.444	0.667	0.5	0.667	1	0
Portugal (free trade)	0.5	0.75	0.333	0.303	0	1	0.667	0.444	0.333	0.25	0.333	0	0.75
England (autarky)	1	1	–	0.529	–	–	–	–	0.667	0.333	–	–	–
Portugal (autarky)	0.5	0.75	–	0.303	–	–	–	–	0.333	0.25	–	–	–

Table 3

	Cloth productivity	Wine productivity	National income	Utility	Cloth market share	Wine market share	Cloth price (per unit)	Wine price (per unit)	Cloth consumption (units)	Wine consumption (units)	Wage	Cloth produced (units)	Wine produced (units)
England (free trade)	1	1	0.541	0.529	0.311	1	0.541	0.541	0.667	0.333	0.541	0.383	0.617
Portugal (free trade)	0.85	0.75	0.459	0.450	0.689	0	0.541	0.541	0.567	0.283	0.459	0.850	0
England (autarky)	1	1	–	0.529	–	–	–	–	0.667	0.333	–	–	–
Portugal (autarky)	0.75	0.75	–	0.431	–	–	–	–	0.567	0.25	–	–	–

Table 4[7]

	Cloth productivity	Wine productivity	National income	Utility	Cloth market share	Wine market share	Cloth price (per unit)	Wine price (per unit)	Cloth consumption (units)	Wine consumption (units)	Wage	Cloth produced (units)	Wine produced (units)
England (free trade)	1	1	0.5	0.529	0.75	0	0.5	0.5	0.667	0.333	0.5	1	0
Portugal (free trade)	1	1	0.5	0.529	0.25	1	0.5	0.5	0.667	0.333	0.5	0.333	0.667
England (autarky)	1	1	–	0.529	–	–	–	–	0.667	0.333	–	–	–
Portugal (autarky)	1	1	–	0.529	–	–	–	–	0.667	0.333	–	–	–

[7] Due to the identical productivities of Portugal and England, there is a range of market shares that satisfy the equilibrium conditions, in addition to the ones shown in this table. All of them yield the same outcomes as autarky, in terms of the cloth and wine consumption of England and Portugal.

Table 5

	Cloth productivity	Wine productivity	National income	Utility	Cloth market share	Wine market share	Cloth price (per unit)	Wine price (per unit)	Cloth consumption (units)	Wine consumption (units)	Wage	Cloth produced (units)	Wine produced (units)
England (free trade)	0.75	1	0.429	0.437	0.143	1	0.571	0.429	0.5	0.333	0.429	0.167	0.778
Portugal (free trade)	1	0.75	0.571	0.582	0.857	0	0.571	0.429	0.667	0.444	0.571	1	0
England (autarky)	0.75	1	–	0.437	–	–	–	–	0.5	0.333	–	–	–
Portugal (autarky)	1	0.75	–	0.481	–	–	–	–	0.667	0.25	–	–	–

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