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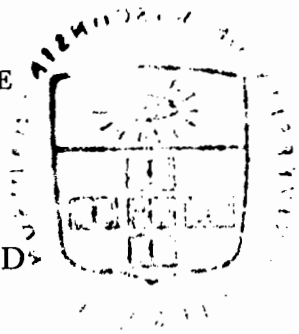

THE "TRIANGULAR TRADE" AND THE ATLANTIC ECONOMY OF THE EIGHTEENTH CENTURY: A SIMPLE GENERAL-EQUILIBRIUM MODEL

RONALD FINDLAY

INTERNATIONAL FINANCE SECTION
DEPARTMENT OF ECONOMICS
PRINCETON UNIVERSITY
PRINCETON, NEW JERSEY

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THE "TRIANGULAR TRADE" AND THE ATLANTIC ECONOMY OF THE EIGHTEENTH CENTURY: A SIMPLE GENERAL-EQUILIBRIUM MODEL

I am deeply grateful to the sponsors of this series of annual lectures in memory of Frank D. Graham, one of the most fertile minds ever to specialize in the field of international economics, for the privilege of being included in the distinguished company of previous speakers. Graham's contributions to the field covered so wide a range that none of the previous lectures given in his name, so far as I am aware, was on a topic that altogether escaped his interests. I had feared that the rather exotic subject matter of my own lecture, the "triangular trade" in slaves, raw materials, and manufactures that connected the continents of Africa, America, and Europe for centuries, would be an exception. Gene Grossman very kindly pointed out to me, however, the following passage in Graham's 1934 monograph on *Protective Tariffs* (p. 73):

> Had a *laissez-faire* commercial policy been pursued in the United States during the whole of the nineteenth century it would, no doubt, have enlarged the relative importance of cotton growing in our economic life. The possible consequent higher ratio of Negro to White population would, from the point of view of most Whites at any rate, have been undesirable, and would seemingly have lowered the national per capita productive capacity.

While one regrets his casual assumption of white superiority, so prevalent a generation ago, this passage is nevertheless salutary in reminding us of the fact that the ethnic composition of the present population of the United States, and indeed of much of the world, is a reflection of past patterns of international trade and migration, both voluntary and forced. It is one of the longest, most momentous, and certainly most horrifying of these historical episodes that provides the subject of this essay.

1 Introduction

The modern world economy, with its complex networks of interdependence, was essentially a consequence of the European voyages of discovery in the fifteenth and sixteenth centuries. This is not to say that international and even intercontinental trade was of no significance prior to that time. Africa had been connected to Europe by the "golden trade of the Moors," vividly described in Bovill's (1970) book by that title. China had been

trading with Europe along the famous Silk Road through the oases of Central Asia since Roman times. It was Columbus, Vasco da Gama, and Magellan, however, who laid the foundations of the present truly global economic system.

The pattern of trade across the Atlantic that prevailed from shortly after the time of the discoveries down to as late as the outbreak of the American Civil War came to be known as the "triangular trade," because it involved the export of slaves from Africa to the New World, where they produced sugar, cotton, and other commodities that were exported to Western Europe to be consumed or embodied in manufactures, and these in turn were partly exported to Africa to pay for the slaves. The earlier impression that a single ship would complete the entire circuit from Liverpool or Nantes carrying textiles, guns, and spirits to Whydah or Old Calabar on the West Coast of Africa, then make the Middle Passage with a cargo of slaves to Kingston or Port au Prince, and return with sugar, tobacco, and cotton to the original port is now known to be generally false. The volume of trade was large enough to make it worthwhile for specialized craft to be constructed for each leg of the journey. The convenient term "triangular trade" will therefore be used here to represent the three-cornered exchange of slaves, raw materials, and manufactures, as represented schematically in Figure 1, without any implications as to the mode of transport.

The intercontinental links were actually even more extensive than those shown in Figure 1. For most of the eighteenth century, the textiles that were exchanged for slaves on the west coast of Africa were manufactured in India and exported by the British and French East Indian Companies. Thus, the "European" manufactures of our schema can be thought of as initially exchanged for these Indian cloths, which were better suited to African tastes and climates. Richardson (1987, p. 127) estimates that 25 percent of English exports to Africa in the third quarter of the eighteenth century were re-exports from India. This additional link in the complex pattern of intercontinental trade in the eighteenth century will be ignored in the rest of this essay.

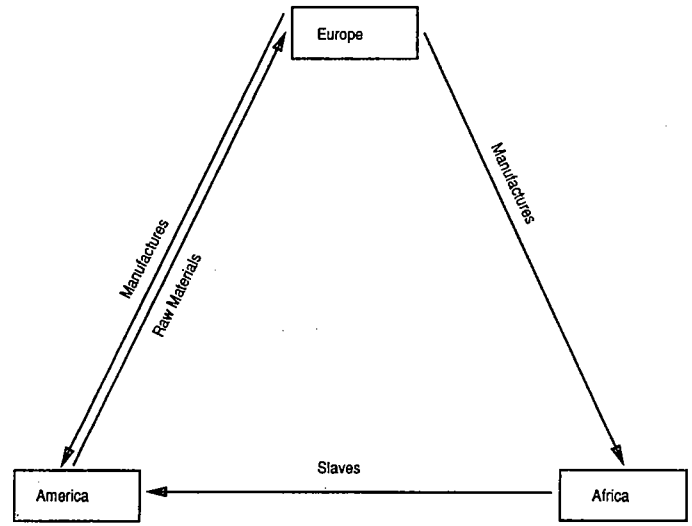
The triangular trade fitted into the "colonial system" of the emerging absolutist monarchies of early modern Europe and was a key element in the pursuit of the twin objectives of "power" and "plenty" to which, according to Viner (1948), the Mercantilist writers considered that all trade and economic activity should be devoted. One of the most systematic and clear-sighted of these writers was Malachy Postlethwayte (1707-67), who in 1745 summed up the significance of the triangular trade for Britain as follows:

> . . . is it not notorious to the whole world, that the Business of *Planting* in our *British Colonies*, as well as in the *French*, is carried on by the Labour of *Negroes*, Imported thither from *Africa*? Are we not indebted to those valuable People, the *Africans* for our *Sugars*, *Tobaccos*, *Rice*, *Rum*, and all other *Plantation Produce*? And the greater the Number of *Negroes* imported into our colonies, from *Africa*, will not the Exportation of *British* Manufactures among the *Africans* be in Proportion, they being paid for in such Commodities only? The more likewise our Plantations abound in *Negroes*, will not more Land become cultivated, and both *better* and greater *Variety* of *Plantation Commodities* be produced? As those Trades are subservient to the Well Being and Prosperity of each other; so the more either flourishes or declines, the other must be necessarily affected; and the general Trade and Navigation of their *Mother Country*, will be proportionably benefited or injured. May we not therefore say, with equal Truth, as the *French* do in their before cited *Memorial*, that the general NAVIGATION of *Great Britain* owes all its *Increase* and *Splendor* to the Commerce of its *American* and *African Colonies*; and that it cannot be maintained and enlarge otherwise than from the constant Prosperity of both those branches, *whose Interests are mutual and inseparable*? (Quoted by Darity, Jr., 1988, p. 1)

This statement cannot be surpassed for its insight into the structure of a complex pattern of economic interdependence among three continents. Nevertheless, the competing ambitions of the major European states made them all intervene in the natural operation of this system by a host of measures affecting trade and navigation that were designed to promote the national advantage at the expense both of their own colonies and of their

FIGURE 1

THE TRIANGULAR TRADE



rivals. Adam Smith's revulsion at the restrictiveness of Mercantilism even led him into logical error when he maintained that British restrictions on the colonial trade harmed not only the colonies and its European competitors but Britain itself (Smith, 1776). It took a chapter by David Ricardo (1817), in which he clearly anticipates the modern "monopoly power" argument for trade restrictions, to set the matter straight. Despite this, Smith's influence, operating in perhaps a subterranean way on later writers, has been such as to create a long-sustained belief that Britain derived no very large benefit, and perhaps even a loss, from its early and intimate association with the slave trade and slavery. The well-known work of Cairnes (1862) is a case in point, since he also regarded slavery in the American South as an inefficient and unproductive system, aside from its moral depravity. Only recently, with the work of Conrad and Meyer (1958) and Fogel and Engerman (1974), have we begun to come to terms with the fact that slavery can be consistent with rationality and efficiency in the pursuit of profit, generating a higher real output and investable surplus than in the absence of the institution.

Smith did recognize, however, the enormous benefits that the voyages of discovery had brought to Europe:

> The discovery of America, and that of a passage to the East Indies by the Cape of Good Hope, are the two greatest and most important events recorded in the history of mankind. . . . One of the principal effects of these discoveries has been to raise the mercantile system to a degree of splendor and glory which it could never otherwise have attained to. (p. 141)

Furthermore,

> . . . instead of being the manufacturers and carriers for but a very small part of the world (that part of Europe which is washed by the Atlantic ocean, and the countries which lie round the Baltic and Mediterranean Seas), [the commercial towns of Europe] have now become the manufacturers for the numerous and thriving cultivators of America, and the carriers, and in some respects the manufacturers too, for almost all the distant nations of Asia, Africa and America. Two new worlds have been opened to their industry, each of them much greater and more extensive than the old one, and the market of one of them growing still greater and greater every day. (p. 142)

The discoveries and the associated African slave trade were also emphasized by Karl Marx (1867) in his concept of "primitive accumulation," the early phase of conquest and plunder in the rise of capitalism. In connection with the expansion of the Lancashire cotton-textile industry and its voracious appetite for raw material from the slave plantations, he made this cynical observation: "In fact, the veiled slavery of the wage-workers in Europe needed, for its pedestal, slavery pure and simple in The New World" (p. 759 of the 1967 edition). His vision has inspired authors of the "dependency" school, such as Frank (1978) and Wallerstein (1974) to interpret the expansion of Europe as being largely at the expense of the peoples of the third world.

The most remarkable modern work on the triangular trade and its wider ramifications is undoubtedly that by the late Trinidadian scholar and statesman Eric Williams (1944). With meticulous historical scholarship and a scintillating prose style, he conveys a sweeping vision of the association between the slave trade and early British industrialization. While the so-called "Williams hypothesis" has usually been framed in terms of the role of profits from the slave trade as the source of capital accumulation for the Industrial Revolution, the book as a whole also stresses the role of the New World plantation economies as sources of raw materials and as markets for manufactured products.

Since Williams's book appeared, there has been a vast amount of research on all aspects of the triangular economic relationship. Our knowledge of the supply of slaves from Africa and the volume of the traffic across the Atlantic has been greatly enhanced. The economic conditions of the Caribbean plantations and the American colonies on the mainland are also much better known now than they were when Williams was writing. The last few decades have seen a great expansion in quantitative and analytical work on the Industrial Revolution as well (outstanding examples are Crafts, 1984, and Mokyr, ed., 1985), although its broad outlines and its impact on the British and world economies have not been altered substantially. All this new research has led to continuing reassessment and controversy regarding Williams's seminal contribution.

Nevertheless, the only analytical general-equilibrium model of the triangular trade as a whole now available is Darity's (1982) ambitious specification. Darity attempts to integrate all three components into a comprehensive model of growth and trade in the Atlantic economy. As might be expected, the price of the attempt to be comprehensive is a certain unwieldiness in the resulting formulas and solutions, making it difficult to grasp the reasons for some of the results of the numerical simulations. The alternative model that I present in the next three sections of this essay is simpler and more "streamlined" in structure, but it is clearly indebted to Darity's pioneering effort. I have also benefited greatly from reading his 1988 essay on the subject.

The present essay belongs to the genre of applications of small-scale general-equilibrium models to economic history, of which there are now many examples. The methodological issues involved are discussed with characteristic subtlety and insight by Temin (1971). As to why I should inflict a model of the triangular trade in the Atlantic economy of the eighteenth century on an audience that might well expect more standard fare from a Graham Lec-

ture, I can only quote my wise master, Robert Solow, who observed in a symposium on "Economic History and the Modern Economist": "Few things should be more interesting to a civilized economic theorist than the opportunity to observe the interplay between social institutions and economic behavior over time and place" (1986, p. 24).

2 Initial Version of the Model

In this initial version of the model, each region is completely specialized on the production of a single commodity: "Europe" on manufactures, "America" on raw materials that are intermediate inputs for Europe's manufactures, and "Africa" on slaves, whose exportation contributes to the labor force with which the raw materials are produced in America.

The manufacturing sector in Europe has a familiar neoclassical production function with substitutable inputs of capital and labor governing its output, but it requires in addition a fixed quantity α of raw material per unit of output:

$$M = \min [F(K,L), R/\alpha] , \tag{1}$$

where M denotes the gross output of manufactures and R is the amount of imported raw material used up in production. Capital and labor are denoted by K and L, and the function F is homogeneous of the first degree, having positive first and negative second derivatives with respect to each argument.

The labor force is fixed, and the supply of labor is perfectly inelastic with respect to the real wage. Capital, however, is endogenous in the model. It is assumed that there is a constant rate of time preference, and thus a real rate of interest, denoted by ρ, at which the supply of capital is perfectly elastic in the long run. As in the one-sector neoclassical growth model, capital and output are of the same "stuff," so that the marginal product of capital will be equal to the rate of interest under perfectly competitive conditions. Given the relative price p of the raw material in terms of manufactures, profit maximization will lead to

$$(1 - \alpha p) f'(k) = \rho, \tag{2}$$

where k is capital per worker, $f(k)$ is gross output per worker, and $f'(k)$ is the marginal productivity of capital in terms of gross output, while $(1 - \alpha p)f'(k)$ is the marginal productivity of capital in terms of "value added."

Differentiating (2), we obtain

$$\frac{dk}{dp} = \frac{\alpha f'(k)}{(1 - \alpha p) f''(k)} < 0 . \tag{3}$$

Since

$$M = Lf(k) , \tag{4}$$

it follows that

$$\frac{dM}{dp} = Lf'(k)\frac{dk}{dp} < 0 . \tag{5}$$

Since the raw-material input R is proportional to output, it follows that R also varies negatively with the price of the raw material p. Note that even though the input requirement per unit of output is a constant, we still obtain a downward-sloping demand curve for R as a function of p. The reason is that the rise in p reduces the value added per unit of output, which requires a reduction in the capital/labor ratio to keep the marginal product of capital (in terms of value added) equal to ρ, as required by (2). With the given labor force L and less capital K, gross output M must fall and thus the demand for R will decline in proportion to M, giving us the negatively sloped relationship between R and p.

America is completely specialized on the production of the raw material R, which is produced by a stock of slave labor, denoted by S, according to the production function

$$R = R(S) , \qquad R'(S) > 0, R''(S) < 0 , \tag{6}$$

where the diminishing returns to slave labor S is due to a fixed supply of land. The level of the slave labor force is an endogenous variable that has to be determined by the model.

Slaves are assets, with a real price in terms of manufactures that is denoted by π. We assume, with good historical justification for the most part, that conditions are such that the slave population does not reproduce itself. The reasons are varied, including the unbalanced sex ratio in favor of males in the traffic, the generally unhealthy climate, and the harsh working conditions. We will denote by δ the death rate minus the birth rate, which is thus the rate at which the slave population "depreciates" in the absence of fresh imports. We also assume that the same rate of interest ρ prevails in America as in Europe.

Under stationary, or "steady state," conditions, the following condition must hold for the slave price π to be in equilibrium:

$$(\rho + \delta)\pi = pR'(S) . \tag{7}$$

The subsistence cost of slaves is taken as a constant and is provided by the slaves themselves. Therefore, it does not figure in equation (7).

Given π and p, the asset demand for slaves can be determined from (7), since the marginal physical product of the slave labor force is a decreasing

function of its size. Holding p constant, an increase in π will reduce the asset demand for slaves, since the yield, or "rental," must rise to maintain the same ratio $(\rho + \delta)$ to the price π. Holding π constant, an increase in p must lead to an increase in the asset demand for slaves, to drive the marginal product down in proportion to the rise in p and thus satisfy (7).

The source of slaves in the model is Africa. The flow supply of slaves, denoted by E_s, is an increasing function of the price obtainable from the world market, which will be equal to π in the absence of trade impediments and transport costs. We thus have

$$E_s = E_s(\pi), \qquad E'_s(\pi) > 0 . \tag{8}$$

The supply of slaves is obtained through capture or tribute by a predatory coastal state that conducts raids into the interior of Africa for the purpose of gaining access to this lucrative source of revenue. The historical evidence in support of this hypothesis is provided in section 5 below.

In a steady state characterized by constant stocks of capital and slaves, the import of slaves into America would have to meet the attrition or depreciation of the existing stock of slaves. The required condition is thus that

$$E_s(\pi) = \delta S , \tag{9}$$

which implies that the larger the slave population, the higher must be the equilibrium price of slaves so as to induce the necessary supply of replacements.

The specification of the model is now complete, and we can turn to the solution of the system, which is conveniently described in terms of Figure 2.

The upward-sloping curve BB' in the upper-right-hand quadrant of Figure 2 is obtained as follows. From (9), we have seen that π is an increasing function of S in the steady state. Using this fact and differentiating (7) totally, we obtain

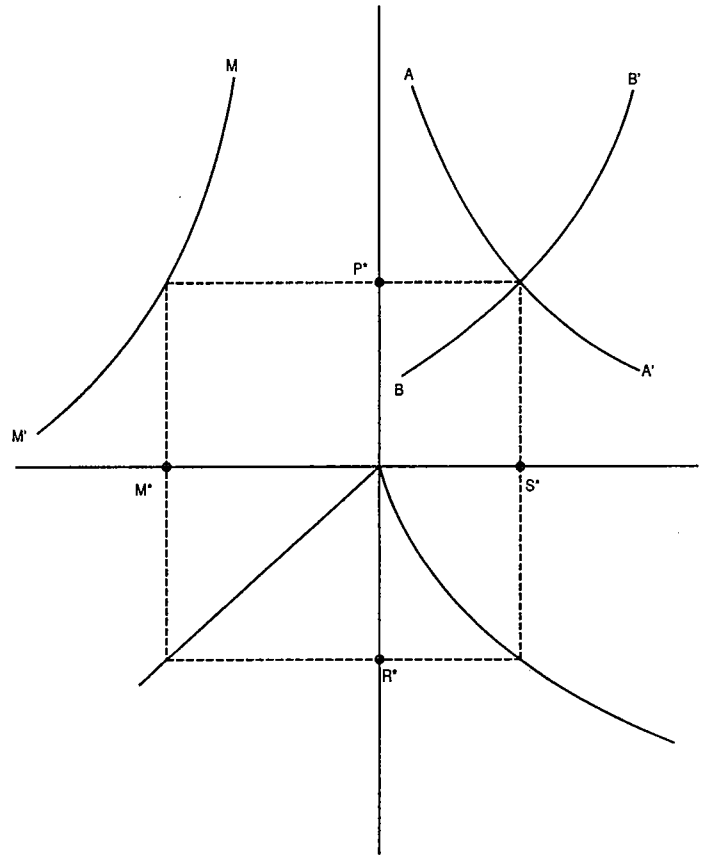
$$\frac{dS}{dp} = \frac{R'(S)}{[(\rho + \delta)\pi'(S) - pR''(S)]} > 0 , \tag{10}$$

which gives us the positive relationship between S and p that is depicted by the curve BB'. This curve illustrates the fact that the higher the price of raw materials in terms of manufactures, the more profitable will it be to hold slaves as an asset in America. An increase in the stock of slaves is required to drive down the rental $pR'(S)$ and raise the supply price of replacements π sufficiently to leave the gross rate of return $(\rho + \delta)$ unchanged, as required by (7).

The downward-sloping curve MM' in the upper-left-hand quadrant depicts the negative relationship between M and p established by (5). The

FIGURE 2

SOLUTION OF THE SYSTEM



proportional relationship between M and R is indicated by the ray through the origin in the lower-left-hand quadrant. The lower-right-hand quadrant depicts R as a concave function of S, as given by (6). Thus, to each p there corresponds a given M, R, and ultimately S. Connecting all these points, we obtain the downward-sloping curve AA' in the upper-right-hand quadrant of Figure 2.

The curve AA' illustrates the fact that the higher the price of the raw material, the less will be the demand for it in the manufacturing center and

therefore the less will be the derived demand for a slave labor force in America. Equilibrium is thus obtained only at the intersection of the two curves AA' and BB', which gives us the magnitudes p^*, S^*, K^*, M^*, R^*, and π^* of all the endogenous variables of the system (where * denotes equilibrium). The equilibrium real wage w^* in Europe and the rental of land in America will also be determined, since the first depends only on p^* and K^* and the second only on p^* and S^*.

The equilibrium national income of each region can be conveniently expressed as follows:

$$Y_E^* = (1 - \alpha p^*)M^* = w^*L + \rho K^* , \tag{11}$$

$$Y_{Am}^* = p^* R^* = p^*\{R'(S^*)S^* + [R^* - R'(S^*)S^*]\}$$
$$= (\rho + \delta)\pi^* S^* + p^*[R^* - R'(S^*)S^*] , \tag{12}$$

$$Y_{Af}^* = \pi^* E_s^* = \pi^* \delta S^* . \tag{13}$$

The equilibrium national income of Europe is equal to the value added in producing manufactures $(1 - \alpha p^*)M^*$, which is divided between wages w^*L and profits ρK^*. In America, the equilibrium national income is equal to the total value of raw-material output p^*R^*. This can be divided between the earnings of the slave labor force $p^*R'(S^*)S^*$, which of course accrue to the slaveholders, and the residual, which is the rent of land. The returns received by the slaveholders is in turn equal to the sum of the depreciation of the value of their assets, which is $\delta\pi^*S^*$, and the return on it at the rate ρ, which is $\rho\pi^*S^*$. The equilibrium African national income is just equal to the value of slave exports, which in the steady state is equal to the replacement requirement of the slave population in America.

The difference between American exports of raw materials to Europe p^*R^* and American imports of slaves from Africa $\pi^*\delta S^*$, assuming balanced trade (i.e., no international borrowing and lending), would be American imports of manufactures from Europe, representing consumption of their income by slaveholders and landowners. Africa's imports of manufactures from Europe $\pi^*\delta S^*$ exactly equal its exports of slaves to America. Europe's exports of manufactures to both Africa and America exactly cover its raw-material requirements p^*R^*, leaving the value added at home to be consumed by workers and capitalists.

3 Effects of Various Exogenous Shocks

An Increase in the Labor Force of Europe

We begin our investigation of the effects of shocks to the system by considering the effects of a rise in L, the labor force in Europe. Observe first that

the MM' curve in the upper-left-hand quadrant of Figure 2, which depicts the negative relationship between the price of the raw material and the output of manufactures, is proportional to the labor input in manufacturing. This is because equation (2) gives a unique value of k, the capital/labor ratio, which is needed to make the net marginal product of capital equal to the given rate of interest ρ. The capital stock K must therefore increase in the same proportion as L and M, since the function $F(K,L)$ in equation (1) is homogeneous of the first degree. The demand for the raw material R must increase in the same proportion as well because of the fixed coefficient α.

The derived demand for slaves in America, however, will increase *more* than proportionately, because of diminishing returns with a fixed supply of land. If we relaxed this assumption of diminishing returns, the demand for slaves would also increase in the same proportion at the original equilibrium price p^* of the raw material (i.e., the AA' curve in Figure 2 would shift to the right in proportion to L). The BB' curve, however, will still be upward-sloping even in the absence of diminishing returns. This follows from equation (10), putting $R''(S)$ equal to zero, since $\pi'(S)$ is positive. Thus, the effect of an increase in the labor force of Europe is to raise the equilibrium price of the raw material p^* so long as the supply of slaves from Africa is not perfectly elastic. But, by equation (2), the rise in the price of the raw material will require a *fall* in the capital/labor ratio k. Hence, the total capital stock and therefore the output of manufactures rise *less* than proportionately to the increase in the labor force. By implication, per capita output and real wages decline in Europe as a result of the adverse shift in the terms of trade with America. The equilibrium price of slaves π^* rises, so that Africa and America are both made better off at Europe's expense when there is an increase in the labor force of Europe. The deterioration in the terms of trade for Europe would be even greater if there were diminishing returns in the production of the raw material, since the shift in the derived demand for slaves would be even greater in that case.

The rising supply price of slaves from Africa thus acts as a check on purely extensive growth in Europe. Technological progress (i.e., an industrial revolution) is one possible way out of the dilemma for Europe, which suggests the next exercise in comparative statics.

An Industrial Revolution in Europe

The simplest way to depict an industrial revolution is as a Hicks-neutral shift in the production function $F(K,L)$ or $f(k)$ for the manufacturing sector.[1] A

[1] This is the approach I adopted in an earlier attempt (Findlay, 1982) to analyze the relationship between foreign trade and the Industrial Revolution. That model had a domestic agricultural sector in addition to manufacturing in England, but it did not allow explicitly for imported

coefficient λ, initially equal to unity, can be placed outside the production function, and the consequences of an increase in its value investigated.

Equation (2) will now be modified to

$$(1 - \alpha p)\lambda f'(k) = \rho \,. \tag{2'}$$

Differentiating (2') with respect to λ, holding p constant, we obtain

$$\frac{\partial k}{\partial \lambda} = -\frac{f'(k)}{\lambda f''(k)} > 0 \,. \tag{14}$$

Thus, the MM' curve is shifted to the left in Figure 2, since the same labor force is now equipped with more capital per head in addition to the increase in productivity arising from the technical progress itself. The demand for the raw material and the derived demand for slaves both increase as well, so that the AA' curve is shifted to the right more than in proportion to the increase in λ because of the induced capital accumulation and the diminishing returns to slave labor. The BB' curve remains unchanged, so that the effect of an industrial revolution in Europe is to raise the equilibrium prices p^* and π^* of both raw materials and slaves as well as the equilibrium slave population S^* in America.

Since S^* increases, it is clear that R^* and the gross output M^* of manufactures must increase also. The deterioration in the terms of trade with America, however, introduces the possibility of a *reduction* in value added if the deterioration is sufficiently great. In other words, we could have an instance of the Edgeworth-Bhagwati phenomenon of "damnifying" or "immiserizing" growth (see Edgeworth, 1894, and Bhagwati, 1958).

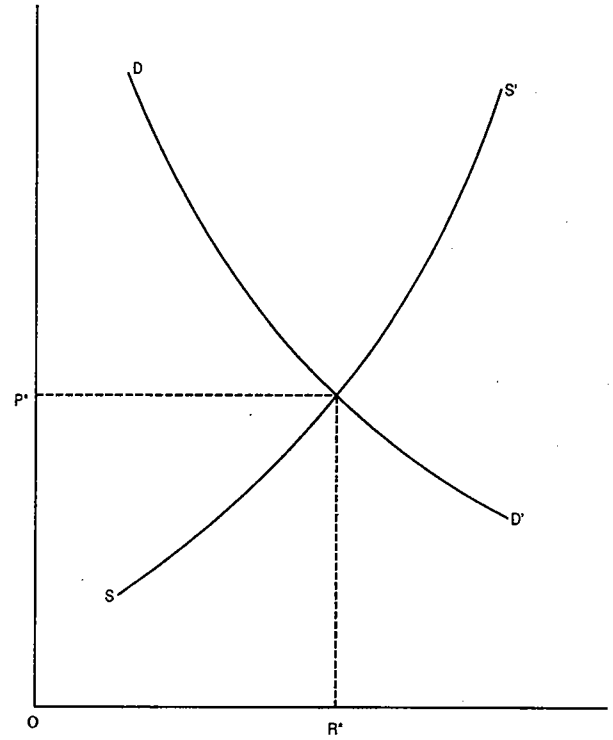
To explore this possibility, we plot long-run supply and demand curves for the raw material in Figure 3. The demand curve DD' follows immediately from the $M(p)$ curve MM' in the upper-left-hand quadrant of Figure 2, since $R(p)$ is simply $\alpha M(p)$. For each p, we find the value of M from MM' and read off the corresponding R in the lower-left-hand quadrant of Figure 2. Thus, K is varying all along DD' in such a way as to satisfy equation (2). The long-run supply curve SS' is obtained by finding the value of S corresponding to each p from the BB' curve in the upper-right-hand quadrant and then finding the R corresponding to that S from the concave production function in the lower-right-hand quadrant. Thus, equations (6), (7), (8), and (9) are all satisfied along SS'. The intersection of DD' and SS' depicts the original equilibrium values of p^* and R^*.

An industrial evolution shifts DD' to the right while leaving SS' unchanged, so that the new equilibrium values of p^* and R^* are higher than

raw materials as a manufacturing input. The extended model in section 4 below, which introduces domestic agriculture, therefore generalizes my 1982 analysis of trade and growth in the Industrial Revolution.

FIGURE 3

LONG-RUN SUPPLY AND DEMAND CURVES FOR THE RAW MATERIAL



before. The extent of the rise in p^*, given the shift in DD', depends solely on the elasticity of the SS' curve. We define

$$e = \frac{p}{R}\frac{dR}{dp} \tag{15}$$

as the long-run elasticity of supply of the raw material.

National income, or value added, in Europe is defined by the first equality in equation (11) of section 2. Differentiating that equation, we obtain

$$\frac{dM}{M} > \frac{\alpha p}{(1 - \alpha p)}\frac{dp}{p} \tag{16}$$

as the condition for the change in national income Y_E^* to be positive. Since M and R are proportional to each other, this condition can be expressed as

$$e > \frac{\alpha p}{(1 - \alpha p)}. \tag{17}$$

Therefore, "damnifying" or "immiserizing" growth (a fall in Y_E^*) requires the long-run elasticity of supply of the raw material to be less than the proportion of raw-material cost to value added in the production of manufactures.

Once again, we see the critical importance of the elasticity of supply of the raw material from America, and hence ultimately of the elasticity of the supply of slaves from Africa, for the well-being of Europe.

Raw-Material Supply Shocks in America

We now examine the effects of a shift in the production function for raw materials in America. This could arise from either an extension of the land frontier in America or an innovation such as the famous cotton gin of Eli Whitney, which actually made it profitable to extend the land frontier as well. In any case, the effect is to increase the output obtainable from a given slave labor force. Once again, we can put a coefficient θ, initially equal to unity, in front of the production function $R(S)$, and then examine the consequences of an increase in θ.

Equation (7) is now replaced by

$$(\rho + \delta)\pi(S) = p\theta R'(S). \tag{7'}$$

Differentiating (7') with respect to θ and holding p constant, we obtain

$$\frac{\partial S}{\partial \theta} = \frac{pR'(S)}{[(\rho + \delta)\pi'(S) - p\theta R''(S)]} > 0. \tag{18}$$

The increase in θ therefore shifts the BB' curve in Figure 2 to the right, that is, owners will want to hold a larger slave population at any given price of the raw material because there has been an increase in the slaves' productivity. The AA' curve, however, is shifted to the left as a result of the increase in θ. Each value of p corresponds to the same values of M and R as before, but the derived demand for slaves is reduced because the same amount of the raw material can now be produced with a smaller slave labor force. The outcome is that the equilibrium price of the raw material p^* must fall as the result of the increase in θ, but the effect on the equilibrium level of the slave population S^*, and hence on the equilibrium price of slaves π^*, is ambiguous.

The lower p^* must result in higher values for K^*, M^*, and Y_E^*, so that Europe definitely benefits from the technical improvement or extension of the land frontier in America. The effect on Africa depends upon whether

the demand for slaves in America goes up or down. The effect on America itself depends on the extent of the deterioration of its terms of trade as a result of the shift in its long-run supply curve of exports. In terms of Figure 3, the SS' curve is shifted to the right while DD', Europe's demand curve for raw materials, remains unchanged. The imports of manufactures that America can consume are given by the area p^*R^* of the rectangle defined by the equilibrium price and quantity of raw material supplied. This area rises or falls depending upon whether the elasticity of the long-run demand curve DD' is greater or less than unity. This is exactly the Edgeworth criterion for damnifying growth in his original model with complete specialization.

A Restriction on Slave Exports from Africa

Finally, we consider the effects of a restriction on the export of slaves from Africa. In 1807, the British and the United States declared the slave *trade* illegal, and the British interdicted slave ships under any flag on the high seas. The traffic across the Atlantic declined but by no means disappeared, because enforcement was not sufficiently comprehensive. Thus, the effects of the British action were analogous to an export tax that shifts the supply curve for slaves from Africa, represented by equation (8), to the left (i.e., each value of π corresponds to a lower export of slaves E_s than before).

The effect in Figure 2 is to shift the BB' curve to the left while leaving the AA' curve unchanged. The relative price of the raw material p^* is raised and the slave population S^* is reduced. Europe will experience a decline in K^*, M^*, and Y_E^* as a result. The price of slaves π^* will rise in America, but the price received by the African exporters will fall, the difference being due to the implicit export tax imposed by the British interdiction.

Thus, both Europe and Africa are adversely affected by the policy of interdiction, since they experience deteriorations in their terms of trade. America's volume of exports R^* declines in response to the decline in the slave population, but its terms of trade with Europe p^* improve. If the elasticity of European demand for the raw material is less than unity, America's consumption of imported manufactures will rise and its welfare improve. In other words, the interdiction could move America closer to the "optimum tariff" level of raw-materials exports. If the European demand elasticity is greater than unity, however, American welfare will also decline.

The only sure welfare gain arising from the interdiction is thus the not unimportant one of fewer inhabitants of the African continent being sold into slavery across the Atlantic every year.[2]

[2] This raises the interesting question of why the British interdiction was introduced if it did not benefit any readily identifiable group in the country. *Prima facie*, it seems to be consistent with a purely humanitarian or "ideological" motivation, as opposed to one based on "interests"

4 An Extended Version of the Model

A limitation of the model we have been using up to now is that it exaggerates the role of manufacturing, and hence of slavery in the New World, on the economy of Europe. In even the most advanced regions such as England in the eighteenth century, the production of wheat and other staples in domestic agriculture was the major occupation of the labor force. Would recognition of this fact affect the qualitative results of the model in any significant way?

To examine this question, we now assume that Europe has a domestic agricultural sector that produces wheat. At that time, trade in wheat or beef did not take place to any significant extent across the Atlantic but was confined to intra-European trade; even for deficit regions such as England, the proportion of imports was still quite small. It is therefore justifiable to treat the output of the agricultural sector as a *nontraded* good for Europe as a whole because of the high transport costs.

The given labor force of Europe must now be allocated between manufacturing and agriculture. As in Jones (1971), we assume that there is a fixed supply of land that is specific to the agricultural sector and that labor is perfectly mobile between agriculture and manufacturing, which has the same technology as before.

We have

$$L_a + L_m = L\,, \tag{19}$$

where L_a and L_m denote labor engaged in agriculture and manufacturing, respectively. The production function in agriculture is

$$A = A(L_a)\,, \qquad A'(L_a) > 0,\ A''(L_a) < 0\,. \tag{20}$$

Equation (2) above will continue to hold in the augmented model, except that the capital/labor ratio k will now refer not to the ratio of K to the total labor force L, but only to L_m. The real wage will be

$$(1 - \alpha p)\,\{f[k(p)] - f'[k(p)]k(p)\} = w(p)\,, \tag{21}$$

where, as before, $k(p)$ denotes the value of k that satisfies equation (2) (i.e., that makes the net marginal product of capital equal to ρ). Thus, given p, the value of w is uniquely determined. In view of (3), it follows by differentiation of (21) that

$$\frac{p}{w}\frac{dw}{dp} = -\frac{\alpha p}{(1 - \alpha p)}\left\{\frac{f(k)}{f(k) - f'(k)k}\right\} < 0\,. \tag{22}$$

of particular groups. The simple model used here does not have enough structure to have any real bearing on this question, but the implication of a gain to British landowners in the extended model of section 4 below is suggestive.

Let q be the relative price of A in terms of manufactures. Then equilibrium in the labor market requires that

$$qA'(L_a) = w(p)\,. \tag{23}$$

Thus, for any given value of p it follows that L_a and hence A is an increasing function of q, because $A''(L_a)$ is negative. In fact, we can specify that

$$A(L_a) = A\{L_a[q, w(p)]\}\,, \tag{24}$$

so that the positive relationship between q and A derived above, holding p constant, can be thought of as a partial-equilibrium supply curve for A.

We can also define

$$C_a = C_a(q, Y) \tag{25}$$

as the demand function for the output of the agricultural sector, with

$$\frac{\partial C_a}{\partial q} < 0\,, \qquad \frac{\partial C_a}{\partial Y} > 0\,, \tag{26}$$

where Y denotes national income and the partial derivatives are the price and income effects on consumption of wheat. It can be seen that

$$Y = (1 - \alpha p)f(k)L_m + qA\,. \tag{27}$$

Thus, for any given value of p we can determine Y and hence trace out a partial-equilibrium demand curve $C_a(q)$ that is negatively sloped for C_a. The equilibrium value of q, for any given value of p, is obtained by setting

$$C_a(q) = A[L_a(q)] \tag{28}$$

and finding the unique value of q that satisfies this equation, which corresponds to the intersection of the demand curve defined by $C_a(q)$ with the supply curve $A[L_a(q)]$.

We now need to investigate the effects of variation in p on the equilibrium value of q obtained from (28). Any change in p will affect $w(p)$ and thus shift the supply curve for A, as well as shift $Y(p)$ and thus shift the demand curve for C_a.

Differentiating (28) totally, taking account of (24) and (25), we obtain

$$\hat{q} = \frac{(\partial C_a/\partial Y)(dY/dp) - [A'(L_a)/A''(L_a)](dw/dp)}{A\,(\sigma + \eta)} < 0\,, \tag{29}$$

where $\hat{q}$ is the proportionate change in q, σ is the supply elasticity of A with respect to q, and η is the price elasticity of demand for C_a with respect to q.

The negativity of $\hat{q}$ is easy to establish. Y is maximized for any given value of p, since there are no distortions in this perfectly competitive economy. Thus, a rise in p must imply a reduction in Y so that the derivative of Y with

respect to p in the first term of the numerator is positive. In view of (23), (24), and (26), it follows that $\hat{q}$ must be negative.

The rise in p shifts the supply curve $A[L_a(q)]$ to the right and the demand curve $C_a(q)$ to the left. The relative price q of the agricultural good must fall as a result of the rise in p. We have thus defined q as a function of p:

$$q = q(p) , \qquad q'(p) < 0 . \tag{30}$$

The effect of the rise in p on the equilibrium output of A, and hence on employment in the agricultural sector L_a, depends on the relative magnitudes of the shifts in the demand and supply curves. Holding the demand curve constant, it follows from (29) that

$$\sigma A\hat{q} + \frac{A'(L_a)}{A''(L_a)}\frac{dw}{dp} = -\eta A\hat{q} > 0 , \tag{31}$$

in which the first term on the left-hand side is the induced decline in the supply of A resulting from the fall in q, and the second term is the positive shift in the supply of A induced by the fall in w associated with the rise in p. Since η is positive, it follows that the right-hand side is positive, so that the induced decline in the supply of A must be less than the positive shift that led to the fall in q. So long as the shift in the demand curve is sufficiently small, this result in (31) would continue to hold. The demand shift is the product of two terms, the marginal propensity to consume wheat out of real income, and the effect on national income of a rise in the price of the raw material for the manufacturing sector. The latter, in particular, is likely to be quite low in view of the relatively low share of manufacturing at the time of the Industrial Revolution. We have therefore established that

$$A = A(p) , \qquad A'(p) > 0 , \tag{32}$$

with q varying to clear the agricultural market as the value of p changes. Since higher p leads to higher A and therefore higher L_a, it must follow that L_m is negatively related to p. A rise in the relative price of the raw material leads to a reduction in manufacturing employment. Since we have already shown in equation (3) above that the capital-labor ratio also varies negatively with p, it follows that K and hence M must also vary negatively with p.

In terms of the MM' curve in the upper-left-hand quadrant of Figure 2, the augmented model thus serves only to increase its elasticity with respect to p, since employment and capital per worker are now both being reduced by a rise in p. Since all other curves in Figure 2 remain unchanged, we have established that introducing an agricultural sector into Europe does not alter the *qualitative* properties of the original model in any way. This in turn implies that all the comparative-static exercises carried out in section 3 continue to produce the same results in terms of the directions in which the different endogenous variables move. In view of its importance, however, it

would be useful to discuss more fully the impact of the Industrial Revolution in the context of the wider model.

Holding p and thus q constant, the initial effect of technical progress in the manufacturing sector is to raise the capital/labor ratio and therefore to raise the real wage in that sector. With conditions in the agricultural sector unchanged, the rise in the real wage offered by manufacturing will divert labor into that sector. Thus, not only capital per worker but employment as well will increase initially in manufacturing as a result of the Industrial Revolution. At the initial relative prices p and q, there will be an increase in the demands for both raw materials and wheat, while there will be a leftward shift in the supply of wheat. The relative prices of both raw materials and wheat must therefore rise. These price increases will dampen some of the initial increase in the capital stock and employment in the manufacturing sector, though they cannot reverse it.

The extended model also enables us to investigate the effects of the Agricultural Revolution in Europe, which is generally regarded as having accompanied the Industrial Revolution in the eighteenth century. At initially given p and q, and therefore at a given $w(p)$ in manufacturing, the Agricultural Revolution would raise the marginal productivity of labor in agriculture and thus shift the supply curve of wheat to the right. Demand for wheat would also shift to the right, but by less, so that q would fall for given p. At each p, employment, and capital in the same proportion, would be reduced in manufacturing. The MM' curve and hence the AA' curve in Figure 2 would both be shifted to the left, so that p would fall. This reduction in p would induce some increase in capital per head and employment in manufacturing, thereby reversing some of the initial decline in q.

The significance of the Agricultural Revolution is that it prevented large increases in the relative prices of wheat and raw materials from choking off the manufacturing expansion induced by the technological progress of the Industrial Revolution itself. There was no "scissors crisis," the problem of scarcity of urban food supplies that characterized the Soviet industrialization drive of the 1920s and led to Stalin's collectivization of the peasantry. The increased output from domestic agriculture, plus intra-European imports, enabled England to overcome this problem much more successfully. The "primitive accumulation" took place in Africa and America rather than in the local countryside.

5 Implications of the Model and the Historical Record

Now let us relate the implications of the model to the broad patterns of the historical record of the Atlantic economy during the period under discussion.

Volumes and Prices of Slave Exports

In the most authoritative study to date on the numbers involved in the Atlantic slave trade, Curtin (1969) estimates that total slave imports into the New World amounted to 9,566,100 persons from the inception of the trade in the fifteenth century to its end around 1870. The annual level rose from about 13,000 during the seventeenth century to a peak of 55,000 between 1701 and 1810, falling to 31,600 between 1810 and 1870, after the British abolition in 1807. The eighteenth century accounted for about two-thirds of the total number of slave imports into the New World over the entire history of the trade. Many indicators show that the trade peaked between 1780 and 1800 (the period that is usually associated with the onset of the Industrial Revolution in England). Curtin (1969, Table 63, p. 211) reports that slave exports by England, France, and Portugal, the major nations involved, rose from about 470,000 during the decade 1771-80 to 790,000 in 1781-90, stood at 623,000 in 1791-1800, and then fell to 493,000 from 1801 to 1810, no doubt reflecting the effects of the British abolition. In another important study, Eltis (1987) estimates slave imports into the United States at 55,800 for 1781-90, 79,000 for 1791-1800, and 156,300 for 1801-10, while the corresponding imports into the British Americas stood at 100,200 in the first decade, 194,300 in the second, and 105,400 in the last.

There is also strong evidence that slave prices rose faster than the prices of manufactures during the latter part of the eighteenth century; the terms of trade were turning in favor of Africa. Eltis and Jennings (1988, Table 1) report that Britain's gross barter terms of trade with Africa rose from 100 in 1700 to 112 in 1750 and then fell to 40 by 1800. Thus, the prices of slaves (Africa's major export) rose two and a half times relative to the prices of manufactures (Africa's main import). Eltis and Jennings also observe that a slave was worth two muskets at the beginning of the century and no less than fifteen at the end, not to speak of the possible improvement in the quality of firearms that had taken place over this period.

Evidence on the terms of trade also comes from Curtin's (1975) detailed study of the Senegambia region in West Africa, which is cited extensively in an interesting discussion of the triangular trade by Braudel (1984) in the third volume of his massive work. Curtin calculates the terms of trade of this region to have risen from 100 in 1680 to 475 in 1780, a period during which the proportion of slaves in total exports rose from 55 to 86 percent. Referring to this experience, Braudel (1984, p. 439) comments:

> Finally—and here comes the surprise—faced with Europe's still voracious demands [for slaves], Africa in the end reacted according to the classic rules of economics: by putting up its prices.

Why the great French savant should find this surprising I do not know.

The impact of the slave trade on West Africa is discussed imaginatively and convincingly by Hopkins (1973, Chap. 3, p. 105):

> The remarkable expansion of the slave trade in the eighteenth century provides a horrific illustration of the rapid response of producers in an underdeveloped economy to price incentives. . . . [I]t is possible that part of the increase in the price paid for slaves in the eighteenth century resulted from a growing scarcity of labor resources and from better defensive arrangements on the part of those who had become frequent targets of slave-gathering expeditions. In other words, slave suppliers may have experienced increasing *marginal costs* as a result of the growth of external diseconomies which, given the extent of slaving, were inevitable. [italics mine]

Eltis and Jennings (1988) report that textiles constituted 56 percent of African imports in the 1780s, alcohol about 10 percent, miscellaneous manufactures another 10 percent, and guns and gunpowder 8 percent, rising to nearly 15 percent by the 1820s. Firearms could possibly be regarded as an input to the production function for slave acquisition, as the anthropologist Jack Goody (1971, p. 55) implies in his stimulating study:

> . . . the states of Ashanti and Dahomey refused to allow guns and powder to pass through their territories to the inland kingdoms; for it was precisely their control of these weapons that enabled them to dominate the interior and to extract from its peoples the slaves they needed to purchase more guns and to maintain their standards of living.

We shall have to leave to a future occasion pursuit of this link between foreign trade and the formation of predatory states through the import of firearms. In a very interesting paper that came to my attention after the first draft of this essay was written, Fenoaltea (1988) examines the question of the "opportunity cost" of the slave exports in the domestic African economy, as well as other aspects of the supply conditions for slaves from Africa. His approach is largely complementary to mine.

Among the African imports of alcohol was rum from New England. Indeed, the native American version of the triangular trade was the export of molasses from the West Indies and the Southern colonies to New England, from which rum was made and exported to Africa in exchange for slaves, who were then exported to the sugar-producing regions. Thus, in terms of our model, New England has to be viewed as a trans-Atlantic extension of Old England. According to Williams (1944; 1966 ed., p. 80), the rum trade on the slave coast became a virtual monopoly of New England.

Overseas Trade and European Expansion

We now turn our attention from the African corner of the triangle to the European corner. Since data on a continent-wide basis are not available in

any convenient form, we must look at the situation in terms of individual countries, beginning of course with the most dynamic of all, Britain. It used to be commonplace among the more traditional economic historians that a commercial revolution preceded the Industrial Revolution, after which changes in technology, production, and trade merged together.

This view is expressed in a most illuminating and convincing way by Deane (1965, Chap. 4). Not only did domestic exports and retained imports in Britain rise about fivefold in the course of the century, picking up speed in the second half, but this substantial overall growth was accompanied by a pronounced shift in the geographical pattern and commodity composition of trade. In 1700, the rest of Europe took 85 percent of Britain's exports and provided 66 percent of its retained imports. In 1798, Europe's shares had fallen to 30 percent of exports and 43 percent of retained imports. North America, the West Indies, and Africa, the "triangular" component, took only about 12 percent of exports and provided about 20 percent of imports in 1700. By the end of the century, however, their shares had risen to 60 percent of exports and 32 percent of retained imports. In other words, the intercontinental triangular trade had expanded much more rapidly than the intra-European component of British foreign trade.[3]

While colonial trade grew faster than total trade for Britain in the eighteenth century, total trade grew more than twice as fast as national income. Deane and Cole (1969, Table 19, p. 78) indicate that the index number of total real output rose from 100 in 1700 to 251 in 1800, while the index number of output of export industries rose from 100 to 544 over the same period. Export industries also grew faster than total industry and commerce, which rose from 100 to 387. There is therefore little doubt that British growth in the eighteenth century was "export-led" and that, among exports, manufactured goods to the New World and re-export of colonial produce from the New World led the way.

For most of the eighteenth century, the key import into Britain was sugar. We are used to thinking of sugar as a final consumer good, but the sugar exported by the West Indian plantations was in the form of unrefined brown ("muscovado") sugar, syrup, and molasses. In good Mercantilist fashion, the final processing into refined white sugar and the distillation of molasses into rum were reserved for the industry of the mother country. New England was able to get into the rum trade in a significant way only because of the inconvenience of transporting molasses across the Atlantic. Differentiated tariffs provided the necessary "effective protection" for hundreds of sugar-refining establishments in Bristol, Glasgow, and London, which was the main center. Per capita consumption of sugar in Britain, stimulated by association with tea and coffee, rose sharply, and re-export of refined sugar to the Continent was also a lucrative business. According to Davis (1973, p. 251), raw sugar comprised a fifth of total imports in 1774, far exceeding any other item. The anthropologist Sidney Mintz (1985) provides an interesting account of the role of sugar in the European economy and society.

[3] The original source of much of Deane's information is Davis (1962).

Production of sugar in the New World, which stood at about 50,000 tons in 1700, rose to 200,000 tons by the end of the American Revolution. The growth of sugar production was closely correlated with slave imports and the size of the slave population. A graph in Craton (1974, p. 54) reveals the first point very clearly. Craton also reports (p. 139) that the slave population in the British West Indies rose from 100,000 to 600,000 during the eighteenth century, while production of sugar rose fivefold from 25,000 to 125,000 tons. There is thus a close conformity between the growth of sugar production in the West Indies, the foreign trade of Britain, and the traffic in slaves across the Atlantic, which is also brought out very clearly in the fine piece by Richardson (1987).

France, the other heavyweight of the European economy, followed the same trends as Britain with respect to growth and foreign trade in the course of the eighteenth century, as reported by Crouzet (1967). Not only was the over-all growth rapid, but there is the same pronounced structural shift in favor of the Caribbean. Saint Domingue (the present-day Haiti) was the main French sugar colony, experiencing an explosive growth in its slave population, which doubled from about 240,000 to 480,000 in 1791, just before the outbreak of the famous slave revolt led by Toussaint l'Ouverture. Re-exports of colonial produce, especially sugar and coffee, were an important component of total trade, and trade with its colonies constituted almost 40 percent of total French trade. France was even able to displace Britain in supplying sugar to the rest of Europe; the British sources were Barbados and Jamaica, where soil exhaustion had led to higher costs, making Britain less competitive and even requiring protection within the British market.

Britain and France were also important sources of manufactured imports by Brazil and Spanish America. In the usual Mercantilist fashion, Portugal required its colonial possessions to direct their trade through the mother country, but it was unable by itself to meet the rising Brazilian demand for manufactured goods. Brazil's demand was stimulated first by sugar cultivation and later by the boom in gold production in Minas Gerais, which was also dependent on slave labor. British exports to Portugal, the famous exchange of Cloth for Wine in Ricardo's example, were to a considerable extent undertaken for the ultimate satisfaction of Brazilian and not Portuguese demand. This example demonstrates how the statistics cited earlier concerning the shift in British trade to the triangular (as compared with the intra-European) component actually *understate* the true shift, because an

export to Portugal was to a large extent really an export to Brazil. Britain obtained Brazilian gold from Portugal by running a surplus in its exports of woolen and other manufactured goods to Portugal over its imports of wines and other primary products. The surplus was used to maintain the operations of the gold standard and thus contribute to the monetary basis of British prosperity. The Anglo-Portuguese trade, interestingly described by Fisher (1963) and Sideri (1970), had its counterpart in the Franco-Spanish relationship, which provided an outlet for French manufactures in the American possessions of Spain.

Sugar continued to be the main commodity involved in the triangular trade up to the 1780s. Fogel and Engerman (1974) state that up to 60 or 70 percent of all slave imports went into one or the other of the European sugar colonies. For both climatic and economic reasons, slave mortality was particularly high in the sugar colonies, with the rate of natural decrease (the δ of our model) varying between 5 and 2 percent in these regions for most of the century. The British and French possessions in the Caribbean each took 17 percent of all slave imports, and Spanish America took another 17 percent. Brazil took as much as 38 percent, and the rest was about evenly divided between colonies of the smaller European states and the North American mainland. This share of only 6 percent for the region that was to become the United States, with its large slave population at the time of the Civil War, is surprising. The explanation is that from the outset of colonization on the mainland, the better climate and the absence of the ravages of sugar production resulted in a surplus of births over deaths for the region's slave population.

Cotton was a comparative latecomer to the triangular trade, becoming significant only in the 1780s. The technical innovations in the Lancashire cotton-textile industry that we normally associate with the Industrial Revolution led to an explosive growth in the demand for raw cotton from the New World and created a boom in all aspects of the Atlantic trade. Lancashire trebled its imports of raw cotton in the 1780s compared with the previous decade, and imports doubled in each subsequent decade up to an annual average of about 60 million pounds in the first decade of the nineteenth century (see Mathias, 1969, Table 34). Initially, the cotton came from the West Indies and Brazil, but ultimately the United States was the major source of raw material for Lancashire, right up to the outbreak of the Civil War.

Cotton exports from the United States were only 189,000 pounds in 1791 but grew by leaps and bounds to an average of about 70 million pounds for the three years prior to the outbreak of the War of 1812, continuing to grow rapidly after a brief interruption due to this event. The terms of trade of the United States also improved sharply during this period. The invention of

the cotton gin by Eli Whitney in the 1790s was a major stimulus to the extension westward of the area under cotton cultivation. The role of cotton in the antebellum U.S. economy is a large subject that lies beyond the scope of this essay. Nevertheless, it is worth asking what might have happened if the abolition of the slave trade and the natural increase of the slave population had not cut off the link to Africa and prevented the Atlantic economy from behaving as predicted by our model during the nineteenth century. The importation of slaves did in fact continue, particularly into Brazil and Cuba, but on a much smaller scale than predicted by the model. In the United States, the growth of cotton cultivation would surely have furnished a new and far more dynamic basis for the slave trade. This is a clear case where one would not wish life to imitate art. Eltis and Jennings (1988, p. 959) state unequivocally:

> If the slave trade had not been abolished the impact of overseas trade [on Africa] would have been larger in the nineteenth century. . . . [R]ising European needs for raw materials from plantations would have prompted an expansion of the traffic that might well have dwarfed the nineteenth-century migration from Europe. . . . [S]lave prices would have increased substantially but this would not have prevented massive expansion of the traffic.

6 The Williams Hypothesis

While a detailed examination of the Williams hypothesis lies beyond both the scope of this essay and the scholarly capabilities of its author, I cannot resist the temptation to make some remarks on the continuing debate surrounding this fascinating subject, using the model and the summary of historical experience presented here. Williams argued that Britain's participation in the slave trade and in the plantation system of the New World played a significant, if not even indispensable, role in the emergence and financing of the Industrial Revolution. The link that has been stressed in much of the subsequent debate is the reinvestment of profits from the slave trade itself or, more broadly, from the plantation system as a whole, in the cotton mills of Lancashire and other industrial projects associated intimately with the Industrial Revolution. Williams's evidence to this effect is largely anecdotal, the citing of particular instances where such financing took place. He did not venture to make an informed guess about the proportion of industrial investment in Britain that was financed in this way.

Engerman (1972) made an ingenious calculation designed to provide an upper bound for this critical proportion. Taking profits from the slave trade alone, he calculated that in 1770 the proportions came to 0.54 percent of British national income, 7 to 8 percent of total investment, and 38.9 percent of commercial and industrial investment. If profits from sugar plantations

are added, the total rises to possibly as much as 5 percent of British national income, compared with a share of about 7 percent of total investment in national income. Engerman felt that these numbers were sufficiently low to reject the Williams hypothesis, but I agree with Solow (1985) in finding them remarkably high, particularly when considered as a proportion of industrial investment. This is not, of course, to say that the Williams hypothesis is correct, only that it cannot be refuted by these calculations alone.

Williams also stresses the channels that are emphasized in our model, the role of the New World plantations as both sources of raw material and markets for finished manufactures. As Williams says (p. 71):

> Manchester received a double stimulus from the colonial trade. If it supplied the goods needed on the slave coast and on the plantations, its manufacturers depended in turn on the supply of the raw material. Manchester's interest in the islands was twofold.

This broader hypothesis about the role of Africa and America in European expansion is vigorously disputed by O'Brien (1982). Conducting an Engerman-style exercise in this extended context, he claims (p. 18) that ". . . for the economic growth of the core, the periphery was peripheral" (his terms "core" and "periphery" correspond to our Europe on the one hand and Africa and America on the other), and that attempts to assign a major role to the periphery in the expansion of the core "founder on the numbers" (p. 16).

Once again, it seems that smallness lies in the eyes of the beholder. Table 1 of O'Brien's paper presents some numbers that appear to me to be as high as the most enthusiastic Williams supporter could hope for. His "Estimated Flows of Profits to British Capitalists Engaged in Trade and Commerce with the Periphery" for 1784-86 give a figure of £5.66 million as compared with gross investment for the same period of £10.30 million, or over 50 percent. If investment in industry and commerce is taken as the usual 20 percent of the total, this means that these "colonial" profits were two and a half times as high as industrial investment. In other words, a propensity to save out of such profits of 40 percent could have financed all industrial investment. Once again, this does not confirm the Williams hypothesis, but it is hard to see how O'Brien can claim that the "periphery was peripheral" and that the hypothesis "founders on the numbers" in the light of his own estimates. His corresponding calculations in the same table for 1824-26 put colonial profits at £15.95 million and gross investment at £34.30 million, a slight decline to just below 50 percent.

O'Brien's impression that the triangular trade and colonial trade were generally quantitatively insignificant to Europe seems to be based essentially on the smallness of the ratios of foreign trade and trade-dependent

industrial output, such as Lancashire cotton textiles, to national income. In common with all less developed countries, the bulk of Europe's activity in 1800 was in agriculture, where most of the output went into domestic consumption. He cites estimates that foreign trade was about 4 percent of national income for Europe as a whole at this time, implying that trade with Asia, Africa, and America could not have amounted to much more than 1 percent of national income. The cotton-textile industry in Britain at the height of the Industrial Revolution accounted for only about 7 percent of national income.

Dividing by national income can stop almost any conversation or debate in economics, including free trade vs. protection and direct vs. indirect taxation. If the bottom line is always going to be "What difference does a particular variable make relative to national income as a whole?" the simple answer is usually going to be "Not much." But is it relevant or appropriate in every case to divide by national income?

Clearly, what is crucial in this case is not Europe as a whole but the more dynamic and progressive part of Europe at the time, meaning Britain, followed by France. Furthermore, crucial as improvement in agriculture was to the acceleration of "modern" economic growth, agriculture was not the leading sector in this advance. As we saw in section 5, foreign trade grew substantially faster than national income in both Britain and France during the course of the eighteenth century, and the colonial trade of both grew substantially faster than total foreign trade. Lancashire exported over two-thirds of its output of cotton textiles to overseas markets and obtained all of its raw materials from them. Even the more traditional woolens industry was highly dependent on exports, much of it to colonial markets. While the cotton-textile industry may have brought in just 7 percent of national income (which is "large" by any standard, particularly for an industry totally dependent on imported inputs), it was, as everyone knows, the pioneer in terms of technology and factory organization for the rest of British industry, then for Europe, and ultimately for the world. On the other side of the Atlantic, the cotton-growing sector in the American South provided the "engine of growth" for the U.S. economy as a whole from 1790 to 1860, as even a modified version of North's (1966) hypothesis suggests.[4]

In view of the fact that the colonial trade and the cotton supply were hardly conceivable without slavery, it is very surprising indeed to have O'Brien say (p. 9), ". . . a hypothetical British edict abolishing the slave trade in 1607, rather than two centuries later, could not have made that much difference to the levels of wealth and income achieved in Western Europe in 1807." In the absence of any likely alternative overseas markets,

[4] See Lee and Passell (1979, Chap. 7) for a balanced discussion of North's hypothesis and its critics.

O'Brien presumably feels that the West European economy would have achieved these levels on its own, with industries other than cotton providing the initial stimulus. Conceivably, cotton could have been supplied from the Middle East, but it is clear that the volume of supplies would have been much smaller and relative prices much higher. O'Brien relies extensively on technical progress, which he seems to regard as an exogenous force that operates independently of the exigencies of markets and sectors, and of the advantage to later comers of emulating successful pioneers.[5]

As Inikori (1987) has argued in an imaginative and stimulating contribution, even the surge of population growth in Britain in the second half of the eighteenth century can be related to the better wages and employment prospects opened up by the expansion of international trade, which induced a rise in fertility by lowering the age of marriage. The technical improvements that took place in agriculture could be a response, in the fashion of Boserup (1981), to the pressures generated by this increase in the rate of population growth. In denying the role of the periphery, and hence of slavery, O'Brien is driven to deny the entire stimulus that the maritime orientation of the European economy of the eighteenth century gave not only to commercial and industrial changes but to financial and institutional changes as well.

The fallacy of attempting to "deduce significance from size," as Barbara Solow (1985, p. 103) elegantly puts it, was dealt with long ago by no other than Mantoux (1962, p. 103), the great pioneer in the study of the Industrial Revolution:

> . . . if we may borrow an analogy from natural science, only a negligible quantity of ferment is needed to effect a radical change in a considerable volume of matter. The action of foreign trade upon the mechanism of production may be difficult to show, but it is not impossible to trace.

To avoid misunderstanding, I should make it clear that I emphatically reject the view that it was solely through the plunder and pillage of Africa and other areas of the "periphery" that Europe in the eighteenth century was able to create the foundations of the modern industrial world. Plunder and pillage of one society by another goes back into the mists of antiquity without leaving any traces of even an incipient industrial revolution. Thus, slavery is certainly not sufficient to explain the emergence of the Industrial Revolution in Britain. Nor do I think that it was even necessary, in the sense that, without it, the Industrial Revolution would never have taken place. What I *do* believe is that slavery was an integral part of a complex intercontinental system of trade in goods and factors within which the Industrial Revolution, as we know it, emerged. Within this system of interdependence, it would make as much or as little sense to draw a causal arrow from slavery to British industrialization as the other way around, as I have tried to illustrate in the structure of the simple general-equilibrium model. Nevertheless, those who would dismiss slavery as essentially irrelevant ought at least to specify the necessary counterfactual experiments postulating the sources of tropical products and the markets for manufactured goods that the triangular trade provided.

[5] Berrill (1960), for example, points to the role of large foreign markets in encouraging investments that embody new technology, while Landes (1969) emphasizes the role of "emulation" or "diffusion" in the spread of the Industrial Revolution from Britain to the Continent.

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