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No. 177, March 1990

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
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The author of this Essay, Ronald Findlay, is Ragnar Nurkse Professor of Economics at Columbia University. He is the author of *Trade and Specialization* (1970), *International Trade and Development Theory* (1973), and several articles on trade theory, economic development, and political economy. This Essay was presented as the Frank D. Graham Memorial Lecture at Princeton University on April 20, 1988.

PETER B. KENEN, *Director*
International Finance Section

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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.

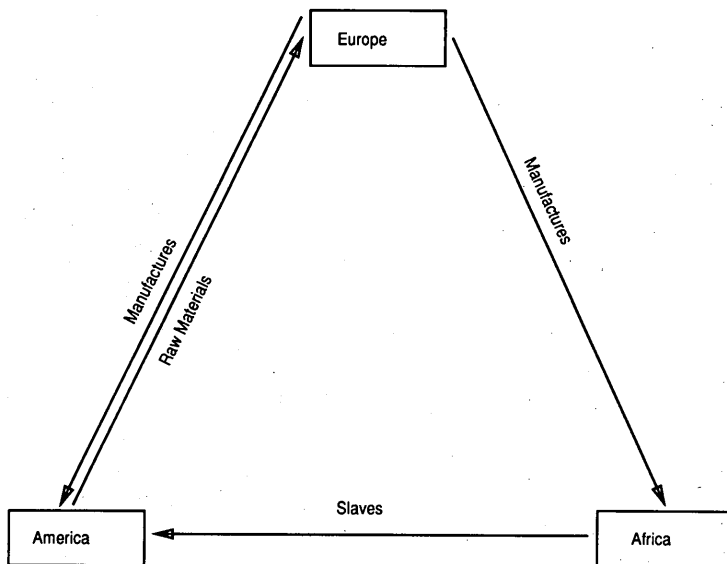
The triangular trade fitted into the "colonial system" of the emerging absolutist monarchies of early modern Europe and was a key element in the pursuit of the twin objectives of "power" and "plenty" to which, according to Viner (1948), the Mercantilist writers considered that all trade and economic 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 "depen-

gency" 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:

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

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

$$(1 - \alpha p) f'(k) = \rho, \quad (2)$$

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

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

Since

$$M = Lf(k), \quad (4)$$

it follows that

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

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 p , 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

$$R = R(S), \quad R'(S) > 0, R''(S) < 0, \quad (6)$$

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 p 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:

$$(p + \delta)\pi = pR'(S). \quad (7)$$

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

$$E_s = E_s(\pi) , \quad E'_s(\pi) > 0 . \quad (8)$$

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

$$E_s(\pi) = \delta S , \quad (9)$$

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.

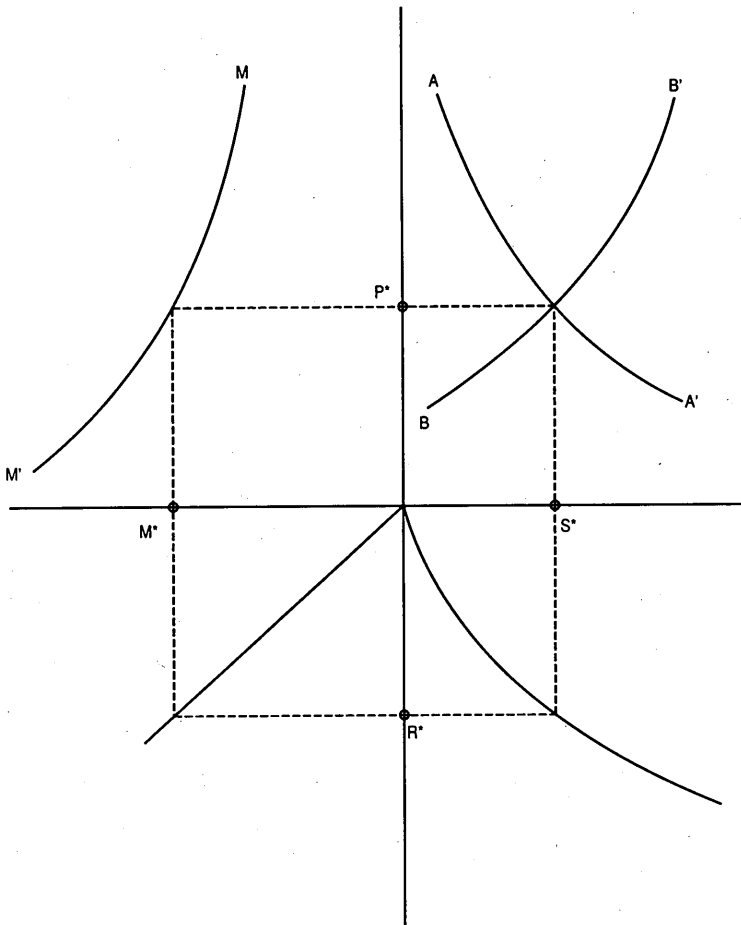
The upward-sloping curve BB' in the upper-right-hand quadrant of Figure 2 is obtained as follows. From (9), we have seen that π is an increasing function of S in the steady state. Using this fact and differentiating (7) totally, we obtain

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

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:

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

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

$$Y_{Af}^* = \pi^*E_s^* = \pi^*\delta S^* . \quad (13)$$

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 p . 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