

# CLASSICAL AND NEOCLASSICAL ROOTS OF THE THEORY OF OPTIMUM TARIFFS

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In current debates with protectionists, pure or unilateral free traders insist that unrestricted commerce is optimally advantageous not only for the world as a whole but for any individual nation, even if it practices it alone. From this idea stems the corollary that a country automatically benefits from the unilateral as well as reciprocal elimination of tariffs. If true, it follows that, far from erecting tariffs, a country should immediately dismantle them and enjoy the benefits of international specialization and division of labor even if other nations do not.

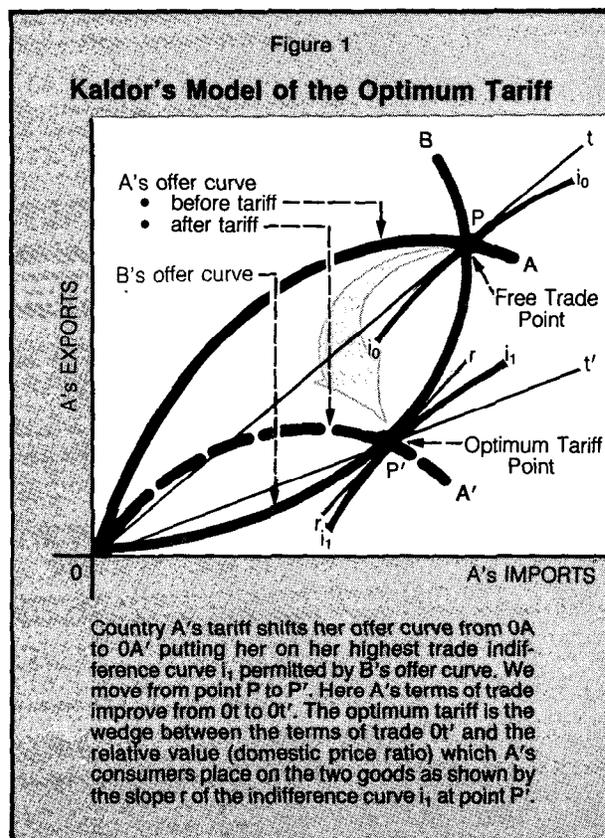
In 1940, however, the British economist Nicholas Kaldor challenged these notions by asserting that a tariff always benefits the levying country provided that the duty is not too large, that the country has monopoly power in world markets, and that other countries do not retaliate with tariffs of their own.<sup>1</sup> Kaldor was here advancing the terms-of-trade or optimum tariff argument according to which trade taxes improve the levying country's welfare by turning the commodity terms of trade (relative price at which exports exchange for imports or the quantity of imports bought by a unit of exports) in its favor, thus giving it a better bargain in world markets. By taxing its imports, the country reduces its demand for those goods thus driving down their world price. Similarly, by taxing its exports it lowers the quantity of those goods supplied on the world market thus raising their price. In other words, it acts as a monopolist exploiting an imperfectly elastic foreign supply of its imports or demand for its exports. In so doing it renders its imports cheaper and its exports dearer such that it obtains a larger quantity of imports per unit of exports given up. Of course this terms-of-trade gain comes at the expense of a loss in real trade volume. The optimum rate of the duty is that which maximizes the excess of the gain from terms-of-trade improvement over the loss from lower trade volume and reduced international division of labor.

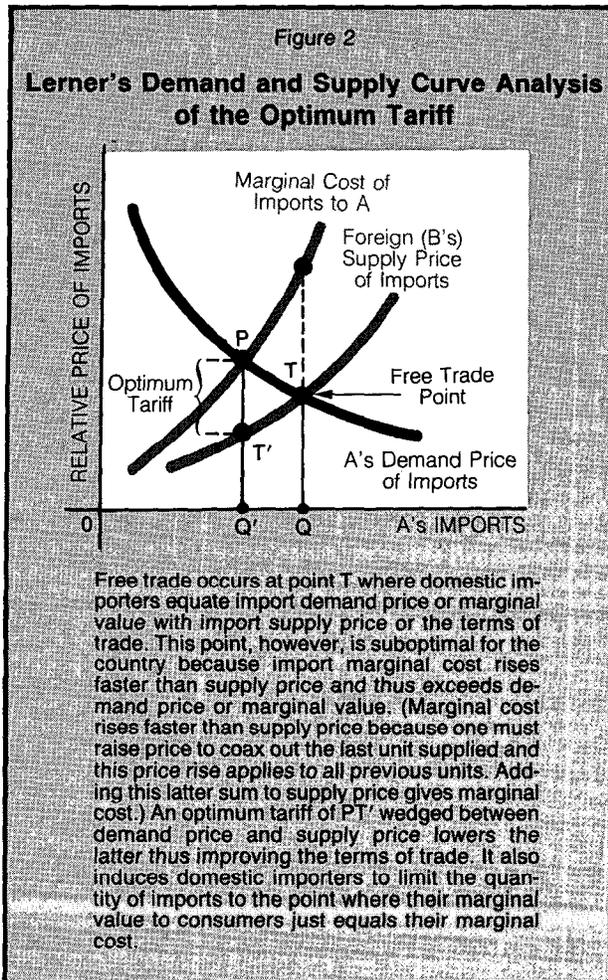
<sup>1</sup> N. Kaldor, "A Note on Tariffs and the Terms of Trade," *Economica*, n.s. 7 (November 1940): 377.

Kaldor demonstrated these propositions with a geometrical diagram showing the tariff-imposing country choosing to exchange the combination of exports for imports that allows it to reach its highest attainable trade indifference curve given the offer curve of the foreign country (see Figure 1).<sup>2</sup> Shortly after, in 1944, Abba Lerner in his *Economics of Control* described how the same propositions could be illustrated with conventional demand and supply curves (see Figure 2).<sup>3</sup> Both diagrams quickly worked their way into international trade textbooks

<sup>2</sup> Kaldor, p. 379.

<sup>3</sup> A.P. Lerner, *The Economics of Control* (New York, Macmillan, 1944), pp. 357-59.





where they became the standard model employed in explaining the theory of the optimum tariff. Little was said about earlier work on the subject. From the point of view of the textbooks, the theory to all intents and purposes largely dates from Kaldor's demonstration.<sup>4</sup>

To set the record straight, one must take issue with this view. For, contrary to the impression conveyed by textbooks, optimum tariff theory hardly originated with Kaldor's model but rather long predated it. It can be documented that rudimentary statements of

<sup>4</sup> Texts employing versions of the Kaldor-Lerner model with no mention of its nineteenth and early twentieth century predecessors include R.E. Caves and R.W. Jones, *World Trade and Payments*, 3rd ed. (Boston: Little, Brown, and Co., 1981), pp. 212-13; H.R. Heller, *International Trade: Theory and Empirical Evidence* (Englewood Cliffs: Prentice-Hall, 1968), pp. 145-47; C.F. Kindleberger, *International Economics*, rev. ed. (Homewood, Ill.: R.D. Irwin, 1958), pp. 617-20; D.B. Marsh, *World Trade and Investment* (New York: Harcourt Brace, and Co., 1951), pp. 316-20; and J. Vanek, *International Trade: Theory and Economic Policy* (Homewood, Ill.: R.D. Irwin, 1962), pp. 294-97.

the theory go back at least to the 1830s and 1840s, that these statements were embodied in formal economic models rather than in mere casual remarks, and that virtually all the elements of optimal tariff theory were in place by 1907. In short, the origins of optimum tariff theory are to be found in an earlier vintage of models neglected by the textbooks. A systematic survey of these models helps clarify what economist Murray C. Kemp calls the "confusing and little known early history" of the terms-of-trade argument.<sup>5</sup> It also dispels the notion that all leading classical and neoclassical trade theorists were doctrinaire free traders. True, of the six discussed below, at least four thought that free trade was the best policy from a practical standpoint. On a purely abstract plane, however, all saw the terms-of-trade argument as a valid theoretical qualification to the doctrine that free trade is the best of all possible worlds for each country.

## HISTORICAL EVOLUTION

Early optimum tariff models evolved through five distinct stages. First came the demonstration that import duties improve the terms of trade either through gold flows and their effects on relative national price levels or by restricting import demand. Next came the showing that export taxes accomplish the same result by restricting export supply and that the extent of terms-of-trade improvement depends crucially upon the size of certain demand elasticities. There followed a geometrical restatement of these results using the newly developed tool of offer curve analysis. Next appeared indifference curve and consumer surplus models measuring the gain from terms-of-trade improvement and specifying the tariff rate that maximizes the gain. Finally came a mathematical statement of the theory including a rigorous demonstration that a tariff can improve national welfare and a derivation of the formula for the optimum tariff. Each stage saw at least one different innovator—Torrens, Mill, Marshall, Sidgwick, Edgeworth, and Bickerdike being the key names here—advance the theory.

## ROBERT TORRENS

Priority for being the first to publish a formal optimum tariff model goes to Robert Torrens in

<sup>5</sup> M.C. Kemp, "The Gain from International Trade and Investment: A Neo-Heckscher-Ohlin Approach," *American Economic Review* 56 (September 1966): 788.

1844. Long before then, however, he had perceived that tariffs can turn the terms of trade in favor of the levying country. He stated that idea as early as 1824 in his *Essays on the Production of Wealth* and subsequently elaborated it in a series of letters published in the *Bolton Chronicle* in 1832-33 and reprinted in his 1833 *Letters on Commercial Policy*. Finally, in Letter II and the Postscript to Letter IX of his 1844 *The Budget*, he presented the idea in the form of a hypothetical two-country, two-good model—his famous Cuba case—in which he showed that a 100 percent tariff, via its effect on reciprocal demands, produces an equivalent 100 percent improvement in the terms of trade.<sup>6</sup> This result he depicted in two versions of his model: a monetary version involving specie flows and their effects on local prices and incomes and a pure barter version involving trade in commodities. In the monetary version, terms-of-trade improvement comes from tariff-induced gold movements that raise the price of the protecting country's exports relative to the price of its imports. In the barter version, the same improvement comes from a reduced real demand for imports. Of the two, the monetary version provoked the stronger criticism from Torrens's free trade contemporaries. For that reason, it is described in some detail below.

### Torrens's Cuba Model

In the monetary version of his model, Torrens assumed that Cuba specializes in producing sugar and England specializes in cloth, both goods being produced under conditions of constant real costs. He further assumed that each good bears the same duty-exclusive price wherever sold, that the prices of home-produced goods vary directly with the quantity of money in each country, and—of crucial importance to the particular quantitative results he obtained—that each country's demand for the other's export good is of unit elasticity.

Employing these assumptions, he traced a chain of causation from tariff to reduced quantity of imports bought to trade balance surplus to specie inflow and thence to a rise in the price of the protecting country's exports relative to the price of its imports. More precisely, he supposed that, starting from a situation of balanced free trade with England,

<sup>6</sup> On Torrens's Cuba model, see D.P. O'Brien's *The Classical Economists* (London: Oxford University Press, 1975), pp. 191-94; L.C. Robbins's *Robert Torrens and the Evolution of Classical Economics* (London: Macmillan, 1958), pp. 199-203; and J. Viner's *Studies in the Theory of International Trade* (New York: Harper, 1937), pp. 298-99, 322, 463.

Cuba imposes a 100 percent ad valorem duty on imports of English cloth. That good being produced at constant cost, the immediate result is to double its price in Cuba causing the quantity demanded to fall by half, the Cuban demand for cloth being assumed by Torrens to be of unit elasticity. In other words, Cubans' total expenditure (price-times-quantity) on taxed cloth remains unchanged; but only half that outlay goes to English exporters, the other half being intercepted by the Cuban government at the customs house.

But these are only proximate or first-round effects. Later-round effects ensue. For, given the volume of Cuban exports, the halving of her import bill produces a favorable trade balance with England and a compensating specie flow from that country lowering general prices in England and raising them in Cuba. Since the price of each country's exportable commodity moves with its general price level and since identical exportable goods bear the same (duty adjusted) price in all markets, the price of sugar rises in Cuba (and England) while the price of cloth falls in England (and Cuba).

The fall in the price of cloth together with the rise in Cuban money incomes occasioned by the specie flow raises the quantity of cloth demanded in Cuba. Conversely, the rise in sugar prices combined with the fall in English incomes reduces the quantity of sugar demanded in England. Gold continues to flow from England to Cuba, lowering incomes in the one and raising them in the other and likewise lowering cloth prices and raising sugar prices, until the resulting stimulus to cloth sales and check to sugar sales restores trade balance equilibrium.

In the new equilibrium, Cuba imports the original quantity of English cloth at two-thirds the original unit price (four-thirds including duty) but exports only half the initial quantity of sugar at four-thirds the initial unit price. In barter terms, Cuba purchases the same real quantity of imports at the cost of only half the initial quantity of exports given up, her commodity terms of trade having improved 100 percent. England's terms of trade of course deteriorate by the same amount.

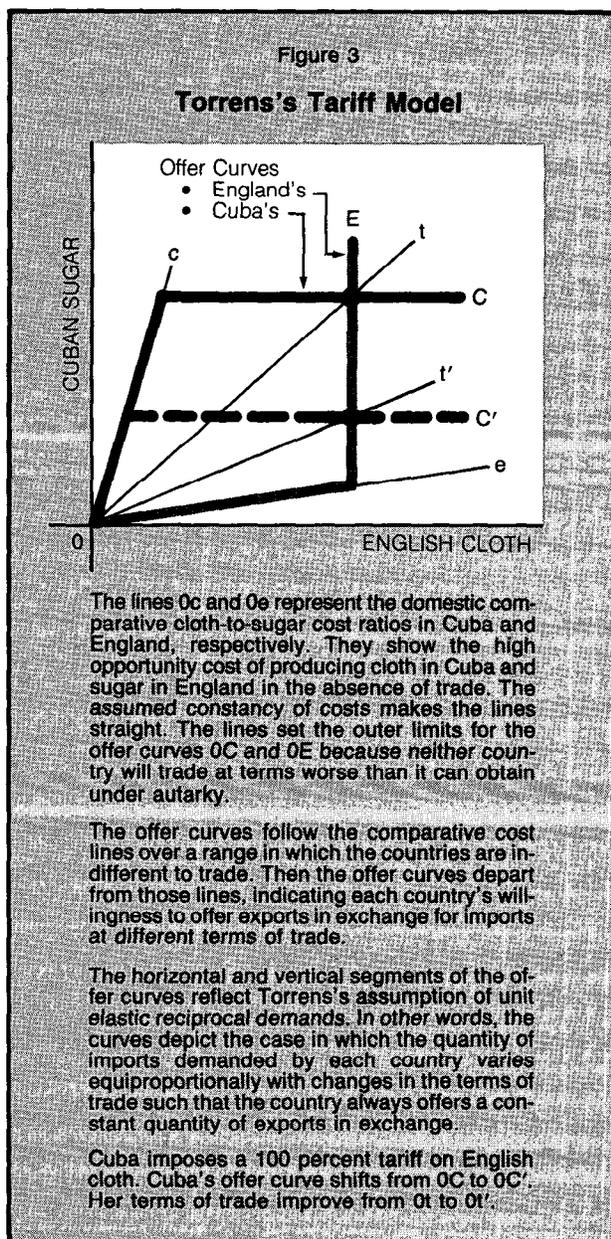
### Barter Version of Torrens's Model

Torrens derived exactly the same results in the pure barter version of his model, which he elaborated with great precision in his Postscript to Letter IX of *The Budget*. There he argued (1) that the equilibrium terms of trade must lie between the comparative cost ratios in the two countries, (2) that the precise location of that equilibrium depends upon each country's reciprocal demand for the product of the other,

(3) that the resulting equilibrium lies most in favor of the country with the weakest reciprocal demand, and (4) that a tariff, by reducing the levying country's reciprocal demand, turns the terms of trade in its favor. Although he drew no diagrams himself, the essentials of his analysis can be depicted with the aid of Marshallian reciprocal demand or offer curves showing the determination of the equilibrium terms of trade by the intersection of the two curves (see Figure 3).

As drawn, the curves differ from offer curves found in standard textbooks in two respects. First, they

bend toward equilibrium only at the points on the respective internal comparative cost ratio lines at which the countries would operate in the absence of trade. Second, within the range at which trade occurs they take the form of horizontal and vertical straight lines reflecting Torrens's assumption of unit elastic reciprocal demands. Given these elasticities and starting from free trade equilibrium, Cuba's tariff shifts her effective offer curve down to half its initial level thus producing at the original terms of trade an excess world demand for sugar and a corresponding excess supply of cloth. To eliminate these excess supplies and demands England's terms of trade deteriorate by 100 percent. In the new equilibrium England imports half the initial quantity of sugar at the cost of the same initial amount of cloth given up. Here is the key idea of optimum tariff models; namely that trade taxes influence reciprocal demands which determine the terms of trade thus allowing governments to manipulate those terms.



### Money Stock Implications

The foregoing terms-of-trade effects were important. To Torrens, however, they were overshadowed by the impact of Cuba's tariff on England's money stock. In the monetary version of his model he explains how the redistribution of specie occasioned by the tariff produces a one-third expansion of Cuba's money stock and a corresponding one-third contraction of England's. No country, he thought, could endure a monetary contraction of such magnitude. For the resulting collapse of product prices would bring ruinous rises in the real burden of debts, wages, taxes, and other fixed charges whose nominal values are sticky and thus respond sluggishly to deflationary pressure. Economic stagnation, "national bankruptcy, and revolution would be the probable results."<sup>7</sup>

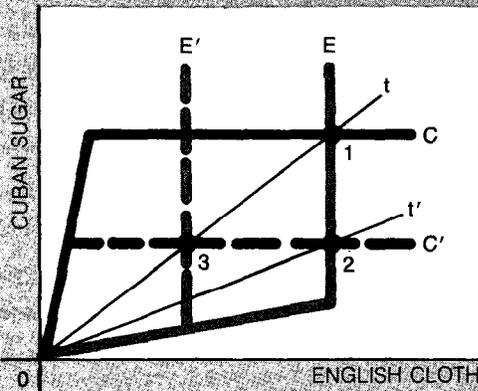
### Reciprocity in Commercial Policy

Having shown how England might lose from foreign tariffs, Torrens next used his analysis to argue for reciprocity in tariff removal. He pointed out (1) that a unilateral abolition of tariffs would, like their foreign imposition, worsen the home country's terms of trade and reduce its money stock, (2) that equal retaliatory duties would cancel the unfavorable terms-of-trade and monetary effects of foreign levies, and (3) that the simultaneous removal of duties by all countries tends to leave money stocks and the terms of trade unchanged (see Figure 4). On these grounds

<sup>7</sup> R. Torrens, Letter II of *The Budget. On Commercial and Colonial Policy*. (London: Smith, Elder and Co., No. 65, Cornhill, 1844), p. 37.

Figure 4

**Torrens on Trade Policy Reciprocity**



Cuba's tariff lowers her offer curve and improves her terms of trade. Trade equilibrium goes from point 1 to point 2. England's countervailing duty shifts her offer curve leftward and corrects her terms-of-trade deterioration (point 2 to point 3).

The same process works in reverse. Unilateral tariff removal by England shifts her offer curve rightward and worsens her terms of trade (point 3 to point 2). Reciprocal tariff removal by Cuba, however, restores the terms of trade to its original level (point 2 to point 1). Simultaneous tariff removal by both countries achieves the same result instantaneously (point 3 to point 1).

Moral: Reciprocity leaves the terms of trade unchanged.

he proposed that Britain counter foreign tariffs with equal duties of her own, that she trade freely only with countries admitting her goods duty free, and that she drop her tariffs only insofar as her trading partners abolish theirs.

**Criticisms**

Torrens's analysis was unsympathetically received by his contemporaries who feared it would undermine the case for free trade. His critics refused to accept policy conclusions drawn from a two-by-two model regarded by them as an inaccurate representation of a world economy characterized by many goods and many countries. Herman Merivale argued that competition from third countries producing sugar for export would limit Cuba's power to manipulate the terms of trade.<sup>8</sup> Also England could

<sup>8</sup> H. Merivale, *Lectures on Colonisation and Colonies*, II, 1842, pp. 308ff. On Merivale's criticisms see Viner, *Studies*, p. 322 and Robbins, *Robert Torrens*, pp. 209-11.

avoid Cuba's tariff by selling to third countries and exporting goods other than taxed cloth, such alternatives being possible in a multi-good, multi-country model. This point was made by Nassau Senior who also noted that what Cuba gains through terms-of-trade improvement might be outweighed by her loss of productivity and competitiveness due to reduced international specialization and division of labor.<sup>9</sup> The most cogent criticism, however, came from George Warde Norman. He noted that England's terms of trade would hardly deteriorate to the extent claimed by Torrens if one dropped the assumption of unit elastic demands. He also argued that the logic of Torrens's model implied that England should levy not equal but higher tariffs than those levied abroad to improve the terms of trade and that such action would intensify the danger of a trade war with all parties losing.<sup>10</sup> These criticisms were telling. For Torrens indeed had overlooked the possibility of trade warfare and the likelihood that highly elastic reciprocal demand schedules would in the long run severely limit the effectiveness of tariffs.

**JOHN STUART MILL**

Although Torrens's Cuba case was the first optimum tariff model to appear in print, it was hardly the first formulated. Already in 1829-30, some fifteen years earlier, John Stuart Mill had constructed a similar model which he subsequently presented in the first of his *Essays on Some Unsettled Questions in Political Economy*, a volume he published in 1844 in response to Torrens's *The Budget*.

Mill's model possessed most of the features of the monetary version of Torrens's Cuba model, namely two countries, two goods, complete specialization, constant costs, law of one price, Hume's price-specie-flow mechanism, and quantity theory of money. But Mill greatly enriched the model by permitting demand elasticities to range from zero to infinity and by incorporating export as well as import taxes into the analysis. In so doing, he expanded the model's explanatory power thus enabling it to cover a greater variety of cases than con-

<sup>9</sup> N. Senior, "Free Trade and Retaliation," *Edinburgh Review* 88 (July 1843): 12-15, 29-35. On Senior's analysis see O'Brien, *The Classical Economists*, pp. 194-95.

<sup>10</sup> G.W. Norman, *Remarks on the Incidence of Import Duties with special Reference to the England and Cuba Case contained in "The Budget"*, privately printed (London: T. and W. Boone, 29 New Bond Street, 1860), pp. 8, 12-19. On Norman's criticisms, see O'Brien, *The Classical Economists*, pp. 195-96.



## An Exception

Mill admitted but one exception to the rule that export taxes improve the taxing country's terms of trade: the case of an elastic German demand for cloth combined with an inelastic English demand for linen. Here the specie flow from England caused by the tax-induced decline in Germany's spending on cloth is not self-correcting but rather is self-reinforcing. For the faster gold flows abroad to raise the price of German linen, the more England spends on that commodity. And the more she spends, the greater her loss of gold and the greater the resulting fall in the price of her cloth. To restore equilibrium, cloth may have to fall so low in price relative to linen that the terms of trade turn against England by more than the amount of the tax. Such would be the case, Mill thought, should Germany's expenditure on cloth be so insensitive to changes in income that prices alone had to bear the full burden of adjustment.

## Import Tariffs and the Terms of Trade

Having examined the terms-of-trade effects of England's export taxes, Mill next turned his attention to her import tariffs.<sup>12</sup> He concluded that they invariably improve her terms of trade except in the singular case of a totally inelastic English demand for German linen. But as long as England's demand is of greater than zero elasticity, quantity of imports demanded falls as the tariff raises price. Since German exporters producing under conditions of constant cost receive a sum equal to the lower (post-tariff) quantity times the old (pre-tariff) price, it follows that England's import bill falls. The resulting gold flow from Germany to England lowers linen's supply price and raises the price of cloth, thus improving England's terms of trade. No such improvement would occur, however, if England's import demand were perfectly inelastic such that the quantity of linen demanded by that country remained unchanged when the tariff raised its price. With no shrinkage in quantity demanded, the price-times-quantity sum paid to German exporters would be the same as before, which means that there would be no disturbance to the balance of payments requiring gold flows and hence no changes in the absolute and relative prices of cloth and linen. In other words, England's import bill, and hence her terms of trade, would remain unchanged in this case.

<sup>12</sup> Mill, pp. 26-27.

## Views on Tariff Policy

To summarize, Mill, like Torrens, had clearly established the theoretical possibility of a country improving its terms of trade and its welfare through trade restriction. Interestingly enough, however, Mill opposed the application of his optimum tariff theory to commercial policy on practical and moral grounds. Tariffs, he said, invite retaliatory duties that not only nullify the initial terms-of-trade improvement, but also bring costly reductions in the volume of world trade.<sup>13</sup> Even in the absence of retaliation, tariffs are unjust because one country's gain is another's loss. Moreover, as the rest of the world's loss exceeds the dutying country's gain the tariff is inimical to global welfare and cannot be justified from a cosmopolitan point of view. In his words, "if international morality . . . were rightly understood and acted upon, such taxes, as being contrary to the universal weal, would not exist."<sup>14</sup> He did, however, agree with Torrens that reciprocity was a prime consideration in the decision to remove tariffs. "A country," he said, "cannot be expected to renounce the power of taxing foreigners, unless foreigners will in return practice towards itself the same forbearance. The only mode in which a country can save itself from being a loser by the revenue duties imposed by other countries on its commodities, is to impose corresponding revenue duties on theirs."<sup>15</sup>

## ALFRED MARSHALL AND HENRY SIDGWICK

In the 1870s and 1880s Alfred Marshall and Henry Sidgwick constructed optimum tariff models. Marshall's innovation was to transform Mill's model into geometry, expressing his results in terms of reciprocal demand or offer curves showing each nation's desired quantity of exports and imports as a function of the terms of trade. Sidgwick too expressed some of Mill's conclusions in purely barter terms, but without adding much to his analysis.

Marshall, in an unpublished manuscript which Professor John Whitaker dates at 1872-74, employed his reciprocal demand curves to show that when both curves are elastic (provided the foreign curve is not infinitely so) a tax on imports or exports always im-

<sup>13</sup> Mill, pp. 28-29.

<sup>14</sup> Mill, p. 25.

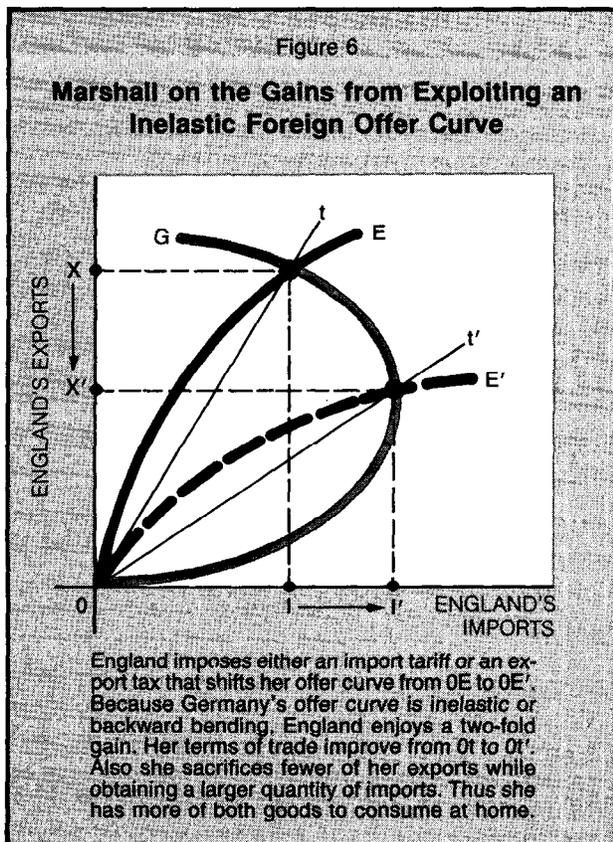
<sup>15</sup> Mill, p. 29.

proves the terms of trade of the levying country.<sup>16</sup> He also showed that when the foreign curve is inelastic—meaning that the foreign country offers a greater total quantity of its exports as its terms of trade deteriorate—then the dutying country enjoys a two-fold gain.<sup>17</sup> Not only do its terms of trade improve, but, by obtaining a larger total quantity of imports and sacrificing a smaller total quantity of its exports, it has more of both goods to consume at home (see Figure 6). A country lucky enough to face an inelastic foreign offer curve, said Marshall, has nothing to lose and everything to gain by exploiting it.

In general, however, Marshall thought that the ability of the taxed country in a multi-country, multi-commodity world to switch its production to nontaxed exports and to trade its goods in nontaxed markets rendered its offer curve so highly elastic as to leave the dutying country little scope for tariff-induced improvements in the terms of trade. He also feared that the pressure of special interests would push tariff rates far above the optimum level such

<sup>16</sup> J.K. Whitaker (ed.), *The Early Economic Writings of Alfred Marshall, 1867-1890*, Vol. 1 (New York: Free Press, 1975), p. 270.

<sup>17</sup> Whitaker, pp. 275-76.



that the dutying country as well as the whole world would lose.

Sidgwick's analysis closely followed that of Marshall, from whose abandoned 1873-77 manuscript on trade theory Sidgwick had printed for private circulation selected chapters under the title *The Pure Theory of Foreign Trade* (1879). In particular, Sidgwick stressed three points previously made by Marshall. First is the importance of monopsony power in achieving terms-of-trade improvement. No country, he said, could expect to improve its terms of trade by means of tariff unless it "supplied a considerable part of the whole demand for the [taxed] foreign products."<sup>18</sup> Second, a tariff affects the terms of trade through its impact on reciprocal demands. Specifically, A's tariff reduces her demand for B's good, thus producing an excess world supply of that good. This excess supply is only eliminated by a deterioration in B's terms of trade.

Supposing trade to be in equilibrium at the time that the demand in A for B's commodities is artificially restricted by import duties raising their price, and supposing that other things—including the demand in B for A's commodities—remain unchanged, one obvious result will be that B will import more than she exports; hence in order to restore the balance of trade, a certain readjustment of prices will be necessary by which B will in most cases tend to obtain a somewhat smaller aggregate of imports on somewhat less advantageous terms.<sup>19</sup>

Third, the effectiveness of A's tariff depends upon the elasticity of B's offer curve. If that curve is almost totally inelastic, as when B urgently requires A's good at any price, the terms-of-trade gain realized by A comes at the cost of little or no shrinkage in her export volume. But if B's offer curve is perfectly elastic, as when she can readily substitute third-country goods for A's good in her consumption mix, A's tariff will have no effect other than diminishing her (A's) real trade volume. Said Sidgwick:

This restriction on B's import trade may possibly not reduce materially the amount of her imports from A, if the commodities supplied by A are strongly demanded in B . . . . On the other hand . . . if the products of A are closely pressed in the markets of B by the competition of other countries, the protection given by A to . . . her industry may very likely have the secondary effect of inflicting a blow upon . . . the exports from A to B.<sup>20</sup>

Here is Sidgwick's recognition of one point stressed by optimum tariff theory, namely that a tariff is powerless to improve the terms of trade when the foreign offer curve is perfectly elastic.

<sup>18</sup> H. Sidgwick, *The Principles of Political Economy*, 2nd edition (London: Macmillan and Company, Ltd., 1887), p. 492.

<sup>19</sup> Sidgwick, pp. 494-95.

<sup>20</sup> Sidgwick, p. 495.



these factors into account, free trade, he thought, remains hands down the best and most practical policy for a nation to follow.

### C. F. BICKERDIKE

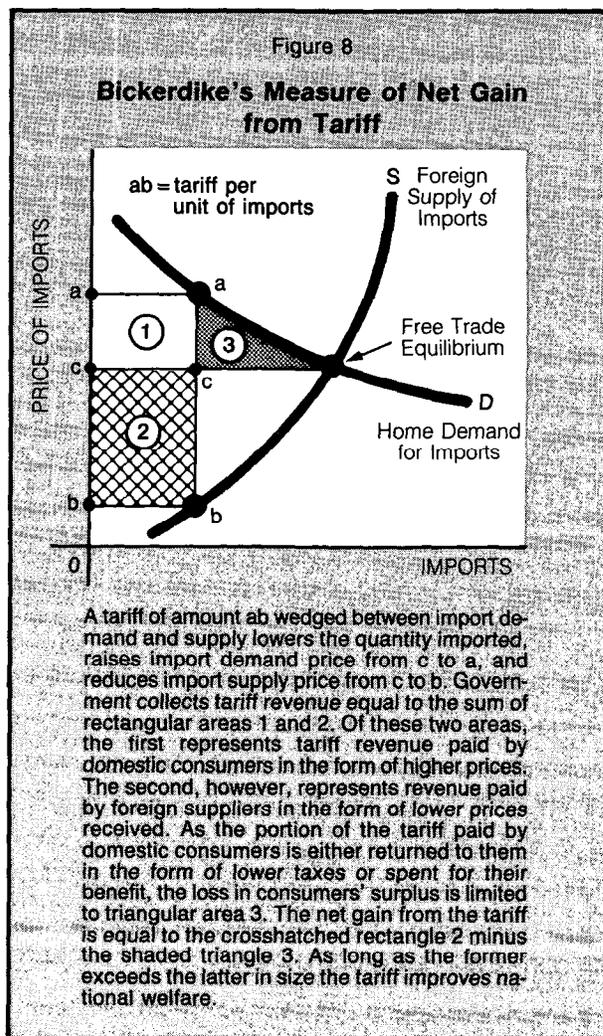
The last economist to be considered is C. F. Bickerdike, who in his 1906 *Economic Journal* article on "The Theory of Incipient Taxes" and his 1907 Review of A. C. Pigou's *Protective and Preferential Import Duties* contributed at least four innovations to optimum tariff theory. First, he emphasized the similarity between the theory of monopoly and the theory of tariffs. He noted that when an individual exporter expands his sales he drives down the price received by other exporters. An export tax, he claimed, corrects this tendency for competition among exporters to lower the price obtained by all. It does so by extracting from the gross price received by exporters the amount by which an extra unit sold lowers the price on all previous units. In so doing, the duty forces exporters to behave as if they take account of their collective influence on prices paid by foreigners. The result is that the country acts as a single monopoly unit that fully exploits its bargaining power to improve the terms of trade.<sup>23</sup> In effect, the export tax acts to form competing exporters into a cartel.

Second, he specified anew the welfare gain from trade restriction. As an alternative to Edgeworth's indifference curve measure, he defined the net benefit of an import duty as the sum of the tax revenue collected from foreigners through lower import prices less the deadweight loss in consumers' surplus caused by the shrinkage in trade volume. This welfare gain he illustrated in a Marshallian demand-and-supply curve diagram (see Figure 8) in which crosshatched rectangular area 2 measures tariff revenue collected from foreigners and shaded triangular area 3 is the deadweight loss in consumers' surplus.<sup>24</sup> To avoid Torrens-Mill type specie flow and price level movements—complications that could shift the demand and supply curves in Figure 8—he assumed that each country operated with an inconvertible paper currency of constant purchasing power. As noted by John Chipman, this assumption effectively transformed a partial equilibrium diagram into a consistent general equilibrium model.<sup>25</sup>

<sup>23</sup> C.F. Bickerdike, "The Theory of Incipient Taxes," *Economic Journal* 16 (December 1906): 530-31.

<sup>24</sup> Bickerdike, p. 533-34.

<sup>25</sup> J.S. Chipman, "Bickerdike's Theory of Incipient and Optimal Tariffs," unpublished paper, 1987.



In any case, Bickerdike concluded from his diagram that a tariff benefits the dutying country whenever rectangle 2 exceeds triangle 3 in size, which will be the case provided the tariff is small enough, the demand curve is of greater-than-zero elasticity, and the import supply curve is not infinitely elastic. He also concluded that the tariff is more beneficial the more elastic the levying country's demand for imports. This is true because the more elastic the demand curve the larger the foreigner's tariff-burden rectangle relative to the deadweight loss triangle. In the limiting case of infinitely elastic demand, foreigners would bear the entire burden of the tariff and deadweight loss would be zero.

Third, he provided the first mathematical proof that a country could gain from a tariff. To obtain his proof he constructed a two-country, two-commodity algebraic model consisting of five groups of equations. These included (1) export and import demand and

supply functions, (2) a trade-balance equilibrium condition, (3) a law-of-one-price equation stating that the foreign exchange rate must be such as to equalize the common currency price (tariff-adjusted) of each good across countries, (4) a tariff equation defining the percentage tariff wedge inserted between the prices domestic importers pay and foreign suppliers receive, and (5) a collective utility function defining national welfare as the excess of the total utility from consuming import goods over the cost of obtaining that utility through the production of exports.<sup>26</sup> Having constructed his model, he then had to demonstrate that national welfare increases upon a small increase in the tariff. This he accomplished by substituting equations (1) through (4) into the utility function, differentiating that function with respect to the tariff, and then showing that the resulting first derivative is positive. His expression reveals the welfare gain as depending critically upon export supply and import demand elasticities at home and abroad.

Last but not least he expressed the optimum tariff rate in terms of a mathematical formula, being the first to do so. To derive his optimum tariff formula he set the foregoing first derivative of utility with respect to the tariff rate equal to zero as required for a maximum and solved for the tariff rate (or more precisely for the reciprocal of one plus the tariff rate—this term being his measure of the tariff wedge). The result was

$$T = \frac{1 - (1/\eta_d)}{1 - (1/\eta_o)}$$

where  $T$  is the reciprocal of one plus the optimum tariff rate  $t$ , or  $1/(1+t)$ , and  $\eta_d$  and  $\eta_o$  denote the export demand and import supply elasticities of the foreign country.<sup>27</sup> Solving this formula for the tariff rate  $t$  yields the expression

$$t = \frac{1/\eta + 1/\epsilon}{1 - 1/\epsilon}$$

where  $\eta = -\eta_o$  and  $\epsilon = \eta_d$ . Here is the classic formula for the optimum tariff later made famous by R. F. Kahn, J. de V. Graaff, and Harry G. Johnson in the 1940s and 1950s.<sup>28</sup>

<sup>26</sup> Bickerdike, *Review of Protective and Preferential Import Duties* by A.C. Pigou, *Economic Journal* 17 (March 1907): 100.

<sup>27</sup> Bickerdike, *Review*, p. 101.

<sup>28</sup> See R.F. Kahn, "Tariffs and the Terms of Trade," *Review of Economic Studies* 15, no. 1 (1947): 16; J. de V. Graaff, "On Optimum Tariff Structures," *Review of Economic Studies* 17, no. 1 (1949): 53; and H. G. Johnson, "Alternative Optimum Tariff Formulae," in his *International Trade and Economic Growth* (London: George Allen and Unwin, 1958), p. 60.

## CONCLUSION

The impression conveyed by textbooks notwithstanding, economists hardly had to wait until the 1940s to obtain theoretical models of the optimum tariff. On the contrary, the key components of such models already had been assembled long before. Robert Torrens in the 1840s supplied two elements, namely the notions that reciprocal demands determine the terms of trade and that tariffs affect those reciprocal demands thus giving policymakers a means of manipulating the terms of trade. John Stuart Mill showed in an essay published in 1844 that an export tax works as well as an import tariff to improve the terms of trade and that the extent of the improvement depends crucially on the size of the coefficients of elasticity of demand. Alfred Marshall in the 1870s translated the Torrens-Mill analysis into graphical form thus establishing the reciprocal demand or offer curves used in modern models of the optimum tariff. To Marshall's reciprocal demand schedules Edgeworth in 1894 added trade indifference curves thus allowing one to identify in principle the particular tariff rate that maximizes national gain. Finally, C. F. Bickerdike in the early 1900s added three more components to the theory: he proved mathematically that a tariff could improve national welfare, he presented alternative measures of the resulting gain, and he derived the algebraic formula for the optimum tariff rate. He also showed that the optimum tariff restrains competition among individual importers and exporters so that the dutying country acts as a cartel exploiting its market power to improve the terms of trade.

Except for Torrens and Bickerdike, these same economists also specified the basic shortcomings of optimum tariff theory. The theory, they noted, assumes unrealistically (1) that foreign countries will not retaliate with tariffs of their own, (2) that elasticities of supply and demand in foreign trade are not so large in the long run as to render the tariff ineffective, (3) that the optimum tariff rate can be precisely identified and skillfully administered, and (4) that politicians can resist pressures to raise tariff rates above the optimum level. None of these assumed conditions, they felt, were likely to be realized in practice. They further pointed out that a tariff can benefit no nation except at the cost of greater injury to others and is thus unacceptable from a cosmopolitan point of view. For these reasons they remained convinced that, despite the theoretical

case that could be made for an optimum tariff, free trade was the best policy from a practical and moral standpoint. In other words, they established virtually all the arguments for and against the use of an

optimum tariff long before modern analysts rediscovered the issue. Here is a prime example of classical and neoclassical economists formulating theories relevant to current trade policy analysis.

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