FREE TRADE IN A WORLD OF INTERNATIONALLY MOBILE TECHNOLOGY:

THE ORTHODOXY THEN AND NOW

Bruce Elmslie
University of New Hampshire

INTRODUCTION

In a recent article, Kemp and Shimomura [1988, 575] draw "attention to a neglected property of the standard Heckscher-Ohlin (H-O) model of international trade." The authors consider a two-country model with most of the standard H-O assumptions except that one country is "advanced" so that it is more efficient in the production of all goods. The results demonstrate that it is in the interest of the "advanced" country to make a free gift of its technology to the "backward" country. "The donor [country] is necessarily better off in the new world equilibrium...." [Ibid.]. Thus, in a H-O world, no country has an incentive to hoard technology which could uniformly expand the production set of another country. "[O]ne would not find that one country holds a global absolute advantage over the other" [Ibid.]. Free transfers of non-sector-specific technology serve to make both the donor and recipient countries better off.

The purposes of this paper are first to point out that the Kemp and Shimomura result has a long history in economic thought and second to demonstrate that the general message of free trade in the presence of technology transfer has been advanced at historical periods which share some common characteristics. In particular, the notion that hoarding technology is not a first-best policy has appeared when debates over free trade in the presence of technological mobility have been particularly lively. The paper begins with a short discussion of the history behind the first attempt to express the basic Kemp-Shimomura result in Ellis [1825]. This is followed by a review of Ellis's work on the subject. Then brief remarks are made on the recent history leading up to Kemp and Shimomura [1988].

COMPARATIVE ADVANTAGE AND TECHNOLOGY TRANSFER

Britain has a long history of restrictions on technology transfer to other countries. This history begins with the early mercantilist writers and the laws developed in that period. The mercantilists generally saw that the benefits of trade with other countries were derived from exports. When this belief is combined with a theory of trade based largely on technological superiority and absolute advantage, it is easy to deduce their policies on technology flows. During the sixteenth century, England developed its laws regulating the economy known as the Tudor industrial codes. In the sphere of international relations, the Tudor codes severely restricted the emigration of skilled artisans and raw materials. Throughout most of the mercantilist period, skills and technology were largely embodied in human beings, not in machines. Therefore, in 1718, 1750 and 1765 Parliament developed restrictive laws centered on skilled craftsmen.[1] Moving on in time to the period of early Classical economic thought and the beginning of the Industrial Revolution, machines began being produced as commodities and the technol-

Eastern Economic Journal, Vol. 19, No. 1, Winter 1993

ogy embodied in them became an additional focus of legislation. As a result of this new focus, in 1774 and 1781 the Tudor laws were expanded to include severe restrictions on the export of machines. This is where our review begins, with William Ellis, a Classical writer[2], arguing for free trade and unrestricted movements in technology in the context of Great Britain's long honored laws restricting such movements.

In 1825 Ellis[3] wrote an article in the *Westminster Review* under the running title of "Exportation of Machinery." This article represented his reaction to the Select Committee on Artisans and Machinery commissioned by the House of Commons. The Committee's purpose was to look at the possibility of amending or repealing Britain's laws restricting the exportation of certain types of machines as well as those prohibiting the emigration of skilled artisans. The article seems to have been written because of Ellis's dissatisfaction with the results of the Committee's deliberations. The Committee reported to the House that while the laws restricting "the combinations of workmen and the emigration of artisans" should be repealed, the effects of the laws on the exportation of machinery required "further inquiry" [Ellis, 1825, 386]. Ellis wanted the Committee to advocate the repeal of machinery export laws as well as the emigration laws. "Witnesses in abundance have been examined, and all the evidence which the subject admits of has been collected - in other words, the materials for consideration have been brought together: it remains only to consider, and to legislate as consideration shall direct" [Ibid.].

Ellis develops a number of points in his argument against restrictions of machinery export. First, the existing laws were so vague that no witness to the Committee could clearly identify what machinery was actually restricted. This, according to some witnesses, led to a situation which made the laws "almost inoperative". However, he admitted that the shortcomings of existing laws was an argument of "minor importance".[4] His main objective was "to ascertain, whether the *principle* ought to be admitted upon which it is demanded, that the exportation of machinery should be prohibited" [Ibid., 387, emphasis added]. Therefore, Ellis attacked the fundamental argument of his opponents that the export of machinery would injure British manufacturing by supplying "foreign countries with the means of underselling us [Britain] abroad" [Ibid.]. The tool used for this attack was the newly developed doctrine of comparative cost.[5]

Ellis begins his argument by stating a proposition developed by Adam Smith that the principal gain from international trade is not to be found in exports, but in imports. Therefore, his examples are designed to show that the exportation of machines allows England to increase her imports. His first example is one which allows comparative advantages to be maintained in the face of the elimination of absolute advantages, in which case, trade flows would not be altered or reversed by technical change. He assumes that 100 days of labor in England could produce 1000 yards of silk and 2000 yards of cotton, while 100 days of labor in France could produce 2000 yards of silk and 1000 yards of cotton. Thus, it is profitable for both countries to trade based on their absolute advantages with England exporting cotton in exchange for French silk. Ellis then allows a technical innovation to occur in England which is common to both industries.[6] The specific example given is the development of the steam engine. The invention of the steam engine allows England to produce 2000 yards of silk and 4000 yards of cotton with the same 100 days of labor. France has now lost its absolute advantage in silk, however, trade patterns will not be reversed. England still benefits from trade with France based on each country's comparative cost advantage. "The manufacture of the two countries, by confining themselves... to the manufacture in which they excelled, might produce 4000 [200 days] yards of silk and 8000 [200 days] yards of cotton, but if in a fit of spleen and jealousy they mutually determined to deny themselves the benefits of commercial intercourse, the total produce of the two countries would only be 4000 yards of silk and 5000 yards of cotton...." [Ibid., 388].

By assuming that the benefits of trade are equally divided between countries,[7] Ellis gives an early, clear example of trade based on comparative advantage. But Ellis extends comparative cost theory by asking the question, if the French "avail themselves of the services of this powerful [steam] engine... would the English be sufferers?" [Ibid., 387-88]. By introducing the new technology to France, Ellis assumes that France could then produce 4000 yards of silk and 2000 yards of cotton with the same labor. Therefore, with free trade the two countries could produce 8000 yards of each good, with England's share being 4000 yards of each. Allowing free trade in commodities and machines (technology) enables each country to specialize in what it produces with "comparative facility", and both countries interact to maximize world output. "[T]he wealth of the English is increased by every increase in the powers of production, which they can introduce among their neighbours" [Ibid.]. Thus, England has no economic reason for hoarding this type of technology.

This is the same point that Kemp and Shimomura make (163 years later) for the two-country, non-sector-specific technology case. "Suppose... that α [the advanced country] makes a free gift of part of its technology to β [the backward country] such that the production set of β expands in uniform proportion.... [T]he *donor* α *is necessarily better off in the new equilibrium*; the donor is enriched by its act of generosity" [1988, 575]. In the examples of Ellis, and Kemp and Shimomura, we have a transfer of technology having a uniform impact on both industries so that comparative advantages are not altered. As a result of the expansion of the world's production set, both countries are better off. What has gone around has come around once again. The establishment of this basic free trade result in conditions of internationally mobile technology has now been established in both the Ricardian and Heckscher-Ohlin worlds.

Although Kemp and Shimomura limit their analysis to the simple two-country case, Ellis actually went further than this by extending his example to allow for three countries. In his particular example, England and France compete with each other to sell manufactures to Brazil in exchange for sugar. He shows that even when England and France compete directly to sell to Brazil, it is in England's interest to export technology to France. The export of machinery cannot hurt English manufacturing because trade is based on comparative rather than absolute advantage. "The interdiction of the exportation of all machinery could not prevent the French from competing with us successfully, from underselling us in some commodity.... A difference in the relative facility of production is essential to interchange" [Ellis, 1825, 391]. During the Classical period, William Ellis's writings are the first and last examples of a defense of free trade in capital goods and technology based on the theory of comparative advantage. Subsequent writers ignored his comparative cost argument that England could not be hurt by exporting machines. By turning away from both Ricardo's general framework and Ellis's specific analysis, later writers either turned away from free trade under these circumstances or relied on faith that England's absolute advantage could be maintained.[8]

THE SOCIAL CONTEXT OF THE DEVELOPMENT OF THEORY

The fact that the basic result, that free trade is still optimal in a simple comparative advantage model with internationally mobile technology, has now reappeared raises an interesting question regarding the social events surrounding the development of theories. What we have in both of these cases is theorists expanding the dominant theory of the day in an attempt to address an important policy question regarding free trade.

Ellis made his Ricardian arguments against restrictions of the export of machines which could transfer technology to industrial rivals in a time of increased debate over the benefits of free trade. This debate resulted in the overturning of laws restricting machinery exports by the early 1830's. It is interesting that Kemp and Shimomura have made their case for free trade under similar circumstances in which new arguments questioning the free trade doctrine have been raised.

The 1980s will probably be remembered by trade theorists as the decade of strategic trade policy. The doctrine of free trade seemed secure while the Heckscher-Ohlin theory dominated research in trade theory and policy. The 1980s saw a tremendous shift of emphasis in the research agenda of many trade theorists.[9] Led by Paul Krugman [1979] and others, research quickly moved into areas of imperfect competition and technological spillover. Under conditions of oligopolistic markets or technological spillover, trade theorists were able to show that strategic trade, as opposed to free trade, could be optimal in certain circumstances.[10] "[I]t is important that policy discussion on industrial targeting proceed... from facts concerning particular industries and the likely effects of targeting policies, rather than from preconceived notions arising, for example, from the traditional competitive trade model, which may not be very relevant in many real industrial situations" [Spencer, 1986, 87]. Trade theorists who seem fundamentally opposed to any strategic departures from free trade responded to this new thinking by pointing out the practical difficulties in making industrial targeting work [Grossman, 1986].

The work of Kemp and Shimomura goes a step beyond this. They adapt the traditional H-O model, which says nothing about technology spillovers, to show that free technological transfer between countries can be optimal. In doing so they do not try to address the issues raised by strategic trade theorists in the case of technological spillover such as sub-optimal investment in R&D. The nature of the debate is completely changed by firmly grounding the issue of technology spillovers between countries in a H-O framework. This is exactly what Ellis did. He adapted Ricardo's model, which ignored the technology transfer question, so that his arguments for free trade in technology could be grounded in the most widely accepted theoretical model of the time. In the process, he ignored the problem which concerned most protectionists — structural unemployment arising from the decline or elimination of some manufacturing sectors. This concern was addressed later by Babbage [1986] only by abandoning the comparative cost model altogether.

The theoretical developments incorporating technology transfer in Ricardo's trade model and the standard H-O model arose in periods of increased debate over the benefits of free trade. The responses of the theorists were remarkably similar. They both adapted a widely accepted trade model to address technological transfer, guaranteeing that the debates over the optimal level of technology flow occurred within the well-established boundaries of the theory. Trade theorists who adhere to the generalized H-O model of trade can now analyze the question of technological spillover on a theoretical level rather than on an *ad hoc* basis, as was attempted by Grossman [1986] in the case of oligopoly. The model developed by Ellis did the same for the cause of free trade in his time.

The laws restricting the exportation of machinery were repealed by 1835. Although the historical record of the period from 1825 to 1835 has yet to be explored sufficiently to gain a full understanding of the effect of Ellis's article on the free trade debates, the repeal of the laws apparently led subsequent authors to ignore his contribution. The free trade debates of today are carried out on a more theoretical level and show no signs of waning. Therefore, the theoretical development of Kemp and Shimomura could become an integral part of the debate over free trade when technological transfer is significant.

It is interesting that the issue of trade in a world of international technological spillovers has led trade economists to extend an endowments-based approach to trade well beyond the standard H-O framework. The newest literature on this subject, written largely by Grossman and Helpman [1991] has developed new tools of analysis that often extend well beyond the more traditional approach set up by Kemp and Shimomura. This is a recognition of the complexities involved in the analysis of technology transfers that requires economists to address non-sector-specific technologies. If Kemp and Shimomura's results are ignored by theorists as Ellis's seem to have been, it will be because the scope of the debate has passed the analysis by, rather than because of a resolution of the debate itself. In the 1830s and 1840s the issues involved in trade in technology led prominent theorists such as Charles Babbage and even John Stuart Mill to abandon the dominant trade theory of Ricardo. In the 1990s the issue may be having the same effect on traditional Heckscher-Ohlin theory.

NOTES

The author wishes to thank Richard England, Antoinette James, William Milberg, Neil Niman, W.D. Sockwell, and two anonymous referees for helpful comments.

1. An article written in *The Scots Magazine* [On Neglect of Trade and Manufacture, 1740] gives a clear statement of the mercantilist position. Also see Morris [1981]. As early as 1699, "the Board of Trade urged Parliament that workers engaged in the manufacture of woolens be prohibited from leaving England" [Ibid., 23].
2. William Ellis was a disciple of Bentham and a longtime associate of John Stuart Mill. He was a frequent contributor to the *Westminster Review* and a coauthor of one article with Mill in 1825. Ellis's passion was the improvement of political economic education in the schools. In Mill's *Autobiography*, Mill proclaimed Ellis to be "an original thinker in the field of political economy, now honorably known by his apostolic exertions for the improvement of education...." [Mill, no date, 66].
3. I use the name Ellis on the authority of Frank Fetter [1962] and Jacob Viner [1975] who attribute two anonymous articles in the *Westminster Review* to him, [Ellis, 1825, 1826]. Ellis's biographer, E. K. Blyth [1892] also attributes the articles to Ellis.
4. He also makes the claim that foreigners will always obtain England's machines at a disadvantage because of transport costs. Therefore, English manufacturers still maintain an advantage over foreigners using imported English technology [Ellis, 1825, 393].
5. Prior to Ricardo's, and Torrens's, development of the theory of comparative costs, Hume [1985], and Smith [1965] had forcefully argued against restrictions on technology exports. Hume concluded that, "the encrease of riches and commerce of any one nation, instead of hurting, commonly promotes the riches and commerce of all its neighbours; and that a state can scarcely carry its trade and industry very far, where all the surrounding states are buried in ignorance, sloth, and barbarism"[1985, 328].

6. This is an important assumption made by both Ellis, and Kemp and Shimomura. If the technology is specific to one industry, it is easily demonstrated that technology hoarding may be beneficial. Thus, the argument for free trade with internationally mobile technology is limited to non-sector-specific technology.
7. This directly follows Ricardo's analysis in Chapter 7 of his *Principles*. It was not until J.S. Mill's writings that the analysis of trade based on comparative cost advantage considered the distribution of the gains from trade relating to changes in the terms of trade.
8. The two most prominent examples of these arguments were Charles Babbage [1986], and John Stuart Mill [1974]. Babbage argued (straight from the pages of the *Wealth of Nations*) that the dynamic consequences of free trade in machinery would benefit both England's machinery industry and its general manufacturing industries. He concluded that free trade would expand the division of labor, improve productivity, and increase the pace of technological progress in the machinery producing industry. Moreover, it would benefit general manufacturers because English machinery manufacturers tend to sell first to their "nearest and best customers". As the pace of technological progress quickens in the machinery industry, English manufacturers receive the latest and most sophisticated machines, while foreigners are sold older models for prices between 5 to 25 percent higher than English prices [Babbage, 1986, 370-71]. A clear implication of Babbage's argument is that England would lose if absolute advantage is lost through trade in technology. J.S. Mill's analysis of the trade in machinery question, similarly, left his free trade ideals in doubt. He argued that trade in advanced machinery could harm the technology exporting country if the technology is used in the importing county's import competing good. However, Mill argued, with no clear justification, that the competitive process causes each country to "employ it [the imported machinery] above all in the production of those articles, in which they had already the greatest natural advantages..." [Mill, 1974, 32]. Mill's own insecurity with this argument caused him to retreat from an unequivocal free trade position. Trade in machinery, may "be a proper subject for adjustment with other nations on the principle of reciprocity" [Ibid.].
9. A methodological assessment of this research is taken up in Bensel and Elmslie [1992].
10. While debates over the optimality of free trade have never been anything but lively, it was not until the 1980s that widely accepted models were developed demonstrating that strategic trade may dominate the free trade result. This put added pressure on H-O theorists to adapt so as to better respond to the challenge to free trade. Economic theory is not developed in a vacuum, it responds both to external anomalies and to purely intellectual challenges.

REFERENCES

Anonymous. On the Neglect of Trade and Manufacture. *The Scots Magazine II*, 1740, 47.

Babbage, C. *On the Economy of Machinery and Manufactures*. Clifton: Augustus M. Kelley, originally published (1835), 1986.

Bensel, T. and Elmslie, B. Rethinking International Trade Theory: A Methodological Approach. *Weltwirtschaftliches Archiv*, 1992, 249-65.

Blyth, E. K. *Life of William Ellis*, 2nd ed. London: Kegan Paul, 1982.

Ellis, W. First, Second, Third, Fourth, Fifth and Sixth Reports of the Select Committee on Artizans and Machinery. *Westminster Review*, 1825, 386-95.

_____. Effect of the Employment of Machines &c. Upon the Happiness of the Working Classes. *Westminster Review*, January 1826, 101-30.

Fetter, F. W. Economic Articles in the *Westminster Review* and Their Authors, 1824-1851. *Journal of Political Economy*, 1962, 570-96.

Grossman, G. Strategic Export Promotion: A Critique, in *Strategic Trade Policy and the New International Economics*, edited by P. Krugman. Cambridge: MIT Press, 1986, 47-68.

Grossman, G. and Helpman, E. *Innovation and Growth in the Global Economy*. Cambridge: MIT Press, 1991.

Hume, D. *Essays: Moral, Political, and Literary*, edited by E. Miller. Indianapolis: Liberty Classics, 1985.

Kemp, M. C. and Shimomura, K. The Impossibility of Global Absolute Advantage in the Heckscher-Ohlin Model of Trade. *Oxford Economic Papers*, 1988, 575-6.

Krugman, P. Increasing Returns, Monopolistic Competition, and International Trade. *Journal of International Economics*, 1979, 469-79.

_____. ed. *Strategic Trade Policy and the New International Economics*. Cambridge: MIT Press, 1986.

Mill, J. S. *Essays on Some Unsettled Questions of Political Economy*. Clifton: Augustus M. Kelley, 1974.

_____. *The Autobiography of John Stuart Mill*. Garden City, N.Y.: Doubleday & Company, Inc., originally published (1873), no date.

Morris, R. B. *Government and Labor in Early America*. Boston: Northeastern University Press, 1981.

Smith, A. *An Inquiry into the Nature and Causes of the Wealth of Nations*. New York: The Modern Library, 1965.

Spencer, B. J. What Should Trade Policy Target?, in *Strategic Trade Policy and the New International Economics*, edited by P. Krugman. Cambridge: MIT Press, 1986, 69-89.

Viner, J. *Studies in the Theory of International Trade*. Clifton: Augustus M. Kelley, 1975.