

May 11, 2005

Paul Samuelson's Contributions to International Economics

By Kenneth Rogoff¹, Harvard University.

Prepared for volume in honor of Paul Samuelson's 90th birthday, edited by Michael Szenberg

¹ I am grateful to Pol Antras, Elhanan Helpman and Kiminori Matsuyama for helpful discussions, to Brent Neiman, Karine Serfaty and Jane Trahan for helpful comments on an earlier draft, and to Erkko Etula for compiling the references.

Introduction

Paul Samuelson's contributions to trade theory and international economics are simply breath-taking. Virtually every undergraduate or graduate student, anywhere in the world, will be asked to understand his Stolper-Samuelson and factor-price equalization theorems. These theorems tell us, of course, why trade liberalization tends to benefit the relatively abundant factor of production (skilled labor, in the case of the United States), and why trade in goods can, in many respects, equalize opportunities just as effectively as trade in people and capital. Indeed, it is a very safe bet that whoever the great economist of the 22nd century turns out to be, he or she will be teaching and reinvigorating ideas Samuelson articulated during the middle part of the 20th century.

Achieving eternal life in the pantheon of trade giants is already an extraordinary feat. What is perhaps even more remarkable about Samuelson's trade contributions is their vitality in today's globalization debate. Whereas few taxi drivers in Shanghai have ever been to college much less graduate school (something one cannot assume in Cambridge, Massachusetts), they will still understand that trade with the United States is raising the wages of Chinese workers, just as most Americans understand that the country's shrinking manufacturing base has more than a little to do with international trade. Indeed, the rising wage differential between skilled and unskilled workers in the United States (and throughout the advanced economies) stands as one of the most contentious and difficult economic and political issues of our day. There is still a great deal of disagreement about what drives this growing differential, and in particular how much is due to globalization, and how much is due to changing technologies that favor skilled labor. Regardless, Samuelson's ideas contributed greatly to building the

framework that economists use for asking such questions and for quantifying potential answers.

In this short essay, I will not attempt any technical exposition of Samuelson's core trade theories, since one can find these (at various levels) in any economics textbook, from introductory to advanced (including, of course, the many generations of Samuelson's own celebrated book, first published in 1948). Rather, I will concentrate on highlighting a few main ideas in his work, and saying how they are influencing the contemporary policy debate. My discussion is necessarily selective and will omit some areas others might have chosen to focus on. At the end of the paper, I attach an extensive listing of Samuelson's contributions to international economics and international finance.

II. International Trade

In his earliest work on trade, including [1], Samuelson used his theorem of revealed preference to show that in a representative agent economy (where everyone is the same), free trade must be welfare improving for all parties. If trade were not welfare improving, a country could choose to continue in autarky, ignoring the rest of the world. This may seem like a trivial result, but with it Samuelson began to lay the foundations of the general equilibrium approach he would ultimately use to prove many other trade theorems. For example, later in [14] he was able to show that whereas trade typically generates winners and losers, there is always, in principle, a way for winners to make sidepayments to compensate the losers so that everyone comes out ahead. (Viner and Lerner had earlier intuited this idea, while Kemp (1962) simultaneously published a

closely related analysis.) Even today, this is really the core result around which all trade policy discussions take place. The modern conundrum, of course, is that in practice, it is very hard to find ways to pay off the losers in trade, at least not without creating incentive distortions almost as egregious as the tariff barriers being eliminated in the first place. So all too often, special interests will lobby for trade protection despite the fact that it is a hugely inefficient and expensive way for governments to buy off small groups; see for example Grossman and Helpman (2002). The most spectacular example, really, has to be the agricultural supports that OECD countries lavish on their farmers, making it far more difficult for poor developing countries to export farm products. (One calculation, from a 2003 IMF-World Bank study, showed that the \$300 billion dollars rich countries lavish on farm subsidies would be enough to fly every cow in the OECD around the world first class each year, with lots of spending money left over.)

Perhaps the cornerstone of Samuelson's early trade work, however is his widely celebrated paper [3] with Stolper. This paper was the first to demonstrate the "Heckscher-Ohlin theorem" in a two good, two country, two factor (labor and capital) model. The H-O theorem, of course, shows that with identical technologies at home and abroad, the country with the larger endowment of labor relative to capital should export the labor intensive good. Obvious? Hardly. Even today, it is amazing how many people seem convinced that China (which, with 1.3 billion people, is clearly a labor rich country) is going to export everything to everybody as free trade opens up. Admittedly, demonstrating that the Heckscher-Ohlin theorem holds empirically has proven a lot trickier than anyone expected (see, for example, Trefler, 1995), but the bottom line is that it is extremely helpful for thinking about trade between countries with widely different

capital labor ratios. From a policy perspective, the major result of [3] was to confirm the intuitive analysis of Ohlin about who wins and who loses when a country opens up to trade. The answer, as we now well understand, is that the relatively abundant factor gains, and the relatively scarce factor loses, not only in absolute terms but in real terms. Thus if capital is the relatively abundant factor (compared to the trading partner), then an opening of trade will lead the return on capital to rise more than proportionately compared to the price of either good, whereas the wage rate will *fall* relative to the price of either good. Admittedly, many of the simple 2x2x2 results do not generalize so easily where there are more factors and more goods but they do typically go through in a weaker sense (e.g., Deardorff 1980), and the broad intuition remains critical to helping us understand how trade impacts welfare.

Whereas Stolper and Samuelson's paper laid the cornerstone of modern trade theory, and contains many of the core results we use today, the real show-stopper in Samuelson's trade contributions has to be his famous factor price equalization theorem [6]. Before Samuelson, economists recognized, of course, that factor mobility would help equalize wage rates and returns on capital across countries, at least up to a point. During the latter 1800s as Britain poured money into the rest of the world (with current account surpluses often topping 9 or 10%), capitalists in Britain garnered higher returns on their wealth, while workers in the colonies saw their wage rates rise. Similarly, the great waves of migration from Europe to the Americas in the 19th and early 20th centuries played a significant role in equalizing rates of return on capital between the old world and new world. Indeed, at times, labor mobility has played a bigger role than capital mobility. But, as is still the case today, international labor and capital mobility is far

from perfect, for a host of reasons (see Obstfeld and Rogoff, 1996 for an overview.) But is this factor mobility the only channel for helping equalize relative wages across countries? Again, leading trade economists understood the possibility that trade in goods might also play a role, if labor-poor countries export capital-intensive goods, and labor rich countries export labor intensive goods. Because free trade equalizes relative prices of various goods (up to trade costs, as Samuelson was always careful to emphasize), the result has to be to put equalizing pressure on relative factor returns as well (or so Ohlin and others conjectured). But could one prove this? Samuelson not only proved this result but much more; he developed conditions under which trade in goods could fully substitute for trade in factors themselves. That is, he demonstrated conditions under which trade in goods, and only trade in goods, could fully equalize wages and rates of return on capital across countries! (One important caveat is that the two countries' endowments of capital relative to labor cannot be too different. Otherwise, at least one country will specialize and the logic of the result would break down). This is one of those rare but powerful insights that just knocks people's socks off when they see it; many were so incredulous they thought that there must be an error in Samuelson's mathematics. But his logic was flawless.

Of course, in practice, one does not typically see factor price equalization, or indeed anything close to it. The 1992 North American Free Trade Agreement between Mexico, Canada and the United States, did not fully equalize wages across the United States and Canada, much less between Mexico and the United States. Numerous factors, including different quality of institutions (Mexico is still a young state where the rule of law is progressively strengthening), different levels of technology and other

factors still drive a wedge that keeps Mexican wages far below United States levels (despite the fact that there are large immigration flows going on at the same time). One assumption of Samuelson's analysis that is perhaps strained in practice is that labor and capital are perfectly mobile across sectors; in practice, workers often require extensive retraining or relocation, and a great deal of capital is industry specific. Nevertheless, the result gives a critical benchmark for illustrating the extraordinary importance and power of free trade. All in all, Samuelson's results still guide the trade debate, and his results still provide the benchmark for the subsequent literature. Indeed, this author has no doubt that if and when interplanetary trade ever commences (say, via radio beam exchanges of technological blueprints and music), economists of the day will quickly find themselves trotting out expositions of Samuelson's 1948 paper.

Though the contribution is more methodological than practical, one can hardly survey Samuelson's contributions to trade without mentioning his clever [11] device of modeling trade costs as "iceberg costs" so that when a good is shipped from country X to country Y, a fraction of it dissipates in transit costs. This simple yet elegant device allows trade economists to introduce trade frictions while keeping their models simple and tractable. Virtually every other trade paper today uses it in some form, and the trick has been widely applied in other fields as well. A small thing, perhaps, but this is precisely the kind of brilliantly clever device that helps propel whole new fields of inquiry.

Although Samuelson made many other critical contributions to trade theory, perhaps the next truly giant step was [31] his 1977 paper with (much junior) MIT colleagues Rudiger Dornbusch and Stanley Fischer, in which they (henceforth DFS)

developed a so-called Ricardian model of trade with a continuum of goods. By “Ricardian” model, of course, they meant a model with only one factor of production (for Ricardo, that was usually labor), where differences in technology drive comparative advantage. This is in contrast to the Heckscher-Ohlin inspired framework developed in Stolper and Samuelson, where there are two factors (labor and capital) and (in the classic setup), countries have identical technologies. In a Ricardian model, one cannot think of countries as exporting, say, labor-intensive goods, because that is all any country has. Rather, trade arises due to different technologies (which could in turn be traced to different endowments of land or weather.) Of course, a Ricardian model is all one needs to develop the theory of comparative advantage, which Samuelson famously quipped (including in his text) is one of the few results in economics that is simultaneously true and not obvious. The theory of comparative advantage also explains why xenophobic politicians should not worry that China will someday produce everything in the world. Rather, the theory tells us that China will only export what it is *relatively* good at even if, some day, it really does gain an absolute advantage in producing everything. People who have not taken trade theory often seem stunned when they hear the theory of comparative advantage. But, of course, most people in our highly specialized society have come to terms with the principle of comparative advantage in their daily lives (for example, even if a high-paid investment banker is very good at doing her shopping, she may find it advantageous to pay someone to do it in her stead, so as to be able to devote more time to highly paid investment banking activities.)

Prior to DFS, the Ricardian approach had been dormant for years, not because the assumptions were so unreasonable, but because the model had been viewed as intractable

for all but illustrative purposes. Through the brilliant device of introducing a continuum of goods, DFS were able to enormously simplify the standard Ricardian model, and allow one to do comparative statics exercises with an elegance that had previously seemed impossible. At first, DFS was greatly admired, but did not lead to any flowering of new research. In recent years, however, the research line following DFS has become an explosion. DFS has become the starting point for a number of applied papers (see for example, Copeland and Taylor, 1994.) In addition, DFS has formed the basis for an important and exciting resurgence of empirical work in trade; see, for example, Eaton and Kortum (2002) Ghironi and Melitz (2005), Kehoe and Ruhl (2002) and Kray and Ventura (2002), and Yi (2003). One interesting application is Feenstra and Hanson (1996), who apply the continuum of goods model to show how direct foreign investment flows from a capital abundant country to the labor abundant economy may actually increase the skill premium in both countries. Whereas the migrating industries may be skill-intensive from the point of view of the recipient country, they might not be from the point of view of the country losing the industries; a very Samuelson-like result!

III International Finance

Samuelson's has also made important contributions to the field of international finance. First and foremost, in [15] he is co-developer of the famous Balassa-Samuelson theorem (Obstfeld and Rogoff, 1996, note Harrod's (1933) contribution as well, and I will follow their convention here). Simply put, the Harrod-Balassa-Samuelson theorem predicts that fast growing countries will tend to have appreciating real exchange rates, and that rich countries will have high real exchange rates relative to poor countries. Underlying the H-B-S model is a fact that Samuelson had emphasized throughout his

early trade writings: trade is costly and for some goods, it is prohibitively costly. Second, the analysis assumes that fast growing countries tend to see faster rates of productivity improvement in their (highly) traded goods industries than in their (relatively) non-traded goods industries. Assuming that labor and capital are mobile across sectors, factor prices will get bid up by the fast growing traded goods sector. But this, in turn, will make production in the nontraded goods more expensive, and bid up prices there. Then assuming (a third assumption) that traded goods prices tend to be equalized across countries, higher nontraded goods prices must translate into a higher real exchange rate. Simply put, as a poor country gets better at manufacturing, haircuts and hotels will have to become more expensive as the general level of wages in the economy starts to rise. The H-B-S model is useful because it gives a framework for say, trying to understand why the price of McDonald's Big Mac hamburger is five dollars in Switzerland but just over one dollar in China. Again, like the Hecksher Ohlin, the H-B-S theorem is at best a loose description of reality, since many complex forces work together to create price differentials, including pricing to market, slow adjustment of factors across sectors, sticky prices, etc. Also, in a world where many countries have a degree of monopoly power in the goods they produce, the H-B-S result can also become weaker or even stand on its head (Fitzgerald, 2003). Nevertheless, it is a very useful benchmark.

Indeed, the logic of H-B-S is arguably the central idea behind the International Comparison of Prices project that began in the 1950s (see Rogoff, 1996) which later culminated in the celebrated Heston-Summers comparisons of incomes and prices across countries; see Summers and Heston (1991). The Heston-Summers data base, of course, attempts to compare different countries incomes in terms of a common relative price

matrix (the United States). For example, if one measures the relative size of Japan and China using market exchange rates and national prices, then the Chinese economy is only 1/3 the size of Japan's. However, an alternative way to compare these economies uses "PPP" exchange rates, which are constructed to set equal, on average, the values of identical goods in different countries (such as the Big Mac). Using PPP exchange rates, rather than market rates, China is twice the size of Japan (in this case, arguably a better description of its influence in the world). The Heston Summers data set has been very important in empirical research on growth since it allows much more meaningful comparisons across countries than do national income accounts. Increasingly, it has also become important in policy circles as well (for example, the International Monetary Fund *World Economic Outlook* projections for global and regional growth are all based on purchasing power parity aggregations that are motivated by very similar considerations as H-B-S. (Robert Summers, of course, is Paul Samuelson's brother, having once changed his name.)

Another area of international finance where Samuelson's work remains widely cited and enormously influential is in studies of the "Transfer Problem", famously debated in the early 1920s by Keynes and Ohlin. The central question of the Keynes-Ohlin debate was whether the vast war time reparations being demanded from Germany would lead to a secondary burden due to induced price effects. In [10] and [11], Samuelson basically settled the issue, showing that neither of them were quite right. On the one hand, Samuelson showed that from a policy perspective, Keynes was right in the sense that, under reasonable assumptions, the real cost of Germany's post-war reparations would likely be magnified by price effects. Lower wealth in Germany would reduce

domestic demand for German goods, but higher wealth abroad would increase demand for its goods. However, since Germans tend to prefer their own tradeable goods to imports (a home bias), they consume a disproportionately large amount of them. So as Germany transferred money to the Allies, higher foreign demand for its goods would not fully substitute for reduced domestic demand and the relative price of German goods would fall. On the other hand, Samuelson showed that Ohlin was right from a methodological viewpoint in that income effects are what matter most. To understand how the wealth transfer would impact prices, one needed to know who is giving money and who is receiving, and how, at the margin, the two groups will tend to adjust to these income changes. Samuelson's work on the transfer problem is enormously influential today in theory and policy. For example, transfer problem type analysis underlies the analysis of Obstfeld and Rogoff (2004, 2005). Their analysis strongly suggests that when the United States trade deficit finally closes up from its astounding current 6% of GDP value, the real value of the trade-weighted dollar will almost surely plummet. Foreign demand for American goods will rise, but not by as much as American demand will fall, and foreign demand will not substitute at all in the case of nontraded goods. Hence, at least until factors can migrate across sectors, (which will take years if not decades), large relative price movements are needed, which in turn implies large movements in exchange rates if central banks are stabilizing overall inflation rates.

IV Conclusions

It is impossible in this brief space to do justice to Paul Samuelson's stunning contributions to international economics, or to adequately characterize their profound policy impact. I trust, however, that the reader will at least gain a flavor of the remarkable span of ideas this man has generated, and the profound policy influence he has had. Finally, I have not even mentioned Samuelson's role as a teacher in trade; I will leave that for others in this volume.

**Paul A. Samuelson's
Main Articles on International Trade and Finance**

1. "Welfare Economics and International Trade" (*The American Economic Review*, June 1938)
2. "The Gains from International Trade" (*Canadian Journal of Economics and Political Science*, May 1939)
3. "Protection and Real Wages," with W.F. Stolper (*The Review of Economic Studies*, November 1941)
4. Review of Jacob L. Mosak, *General Equilibrium Theory in International Trade* (*The American Economic Review*, December 1945)
5. "Disparity in Postwar Exchange Rates" (Seymour Harris, ed., *Foreign Economic Policy for the United States*, Harvard University Press, 1948)
6. "International Trade and Equalization of Factor Prices" (*Economic Journal*, June 1948)
7. "International Factor-Price Equalization Once Again" (*Economic Journal*, June 1949)
8. "A Comment on Factor-Price Equalization" (*The Review of Economic Studies*, February 1952)
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13. "Intertemporal Price Equilibrium: A Prologue to the Theory of Speculation" (*Weltwirtschaftliches Archiv*, December 1957)
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23. "Deadweight Loss in International Trade from the Profit Motive?" (*Leading Issues in International Economic Policy: Essays in Honor of George N. Halm*, C. Fred Bersten and William G. Tyler, eds., Lexington, Mass., D.C. Heath and Co., 1973)
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25. "Trade Pattern Reversals in Time-Phased Ricardian Systems and Intertemporal Efficiency" (*Journal of International Economics*, Vol. 5, 1974, 309-363)
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27. "Interest Rate Equalization and Nonequalization by Trade in Leontief-Sraffa Models" (*Journal of International Economics*, Vol. 8, 1978, 21-27)
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31. "Comparative Advantage, Trade and Payments in a Ricardian Model with a Continuum of Goods," with Rudiger Dornbusch and Stanley Fischer (*American Economic Review*, Vol. 95, No. 2, September 1980, 203-224)
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