



EKONOMI INTERNASIONAL (PEK439)

PRODUCTION AND TRADE: The Heckscher-Ohlin-Samuelson (Factor Proportions) Model

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Production Conditions of the HOS Model

The Heckscher-Ohlin (HO hereafter) model was first conceived by two Swedish economists, Eli Heckscher (1919) and Bertil Ohlin. Rudimentary concepts were further developed and added later by Paul Samuelson and Ronald Jones among others. There are four major components of the HO model:

- Factor Price Equalization Theorem,
- Stolper-Samuelson Theorem,
- Rybczynski Theorem, and
- Heckscher-Ohlin Trade Theorem.

Eli Filip Heckscher ([Stockholm](#), 24 November 1879 - [Stockholm](#), 23 December 1952)



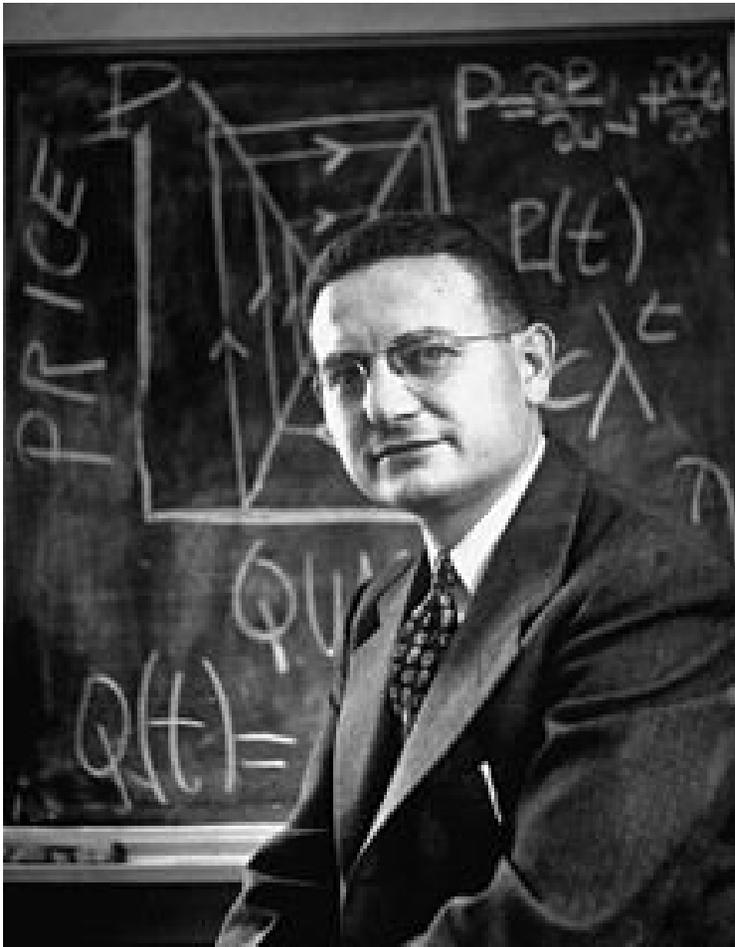
Heckscher was a Swedish economist. He is probably best known for his book "Mercantilist." Although his major interest was in studying economic history, he also developed the essentials of the factor endowment theory of international trade in a short article in Swedish in 1919. It was translated into English thirty years later.

Bertil Ohlin (1899-1979)

Heckscher's student, Bertil Ohlin developed and elaborated the factor endowment theory. He was not only a professor of economics at Stockholm, but also a major political figure in Sweden. He served in **Riksdag** (Swedish Parliament), was the head of liberal party for almost a 1/4 of a century. He was Minister of Trade during World War II. In 1979 Ohlin was awarded a Nobel prize jointly with **James Meade** for his work in international trade theory.



Paul Anthony Samuelson (May 15, 1915 – December 13, 2009)

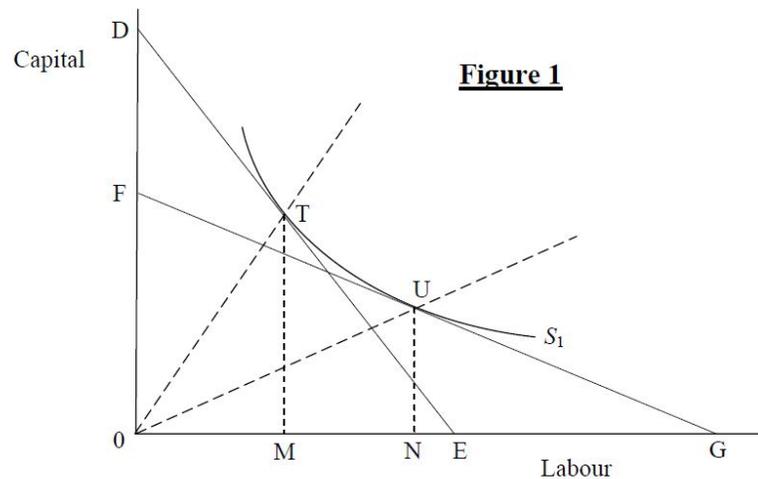


Paul Anthony Samuelson (May 15, 1915 – December 13, 2009) was an [American economist](#), and the first American to win the [Nobel Memorial Prize in Economic Sciences](#). The [Swedish Royal Academies](#) stated, when awarding the prize, that he "has done more than any other contemporary economist to raise the level of scientific analysis in economic theory." Economic historian Randall E. Parker calls him the "Father of Modern Economics", and [The New York Times](#) considered him to be the "foremost academic economist of the 20th century."

Production Conditions of the HOS Model

- Assume: two countries (A and B) producing two goods (Steel and Cloth) using two factors of production (Capital and Labour) under *Constant Returns to Scale (CRTS) technologies that are the same in both countries.*
i.e. the CRTS production function $Z^S = S(K^S, L^S)$ is the same in A and B and the CRTS production function $Z^C = C(K^C, L^C)$ is the same in A and B
- where S and C refer to steel and cloth, respectively, Z denotes output, K denotes input of capital, and L denotes input of labour.
- w and r are the real wage of labour and the real rental rate on capital, so w/r (the wage-rental ratio) is the relative price of the two factors.
- a^{LS} , a^{KS} , a^{LC} , and a^{KC} , are the unit labour and capital requirements of steel and cloth production, respectively. For brevity, let $k^S = a^{KS}/a^{LS}$ and $k^C = a^{KC}/a^{LC}$ denote the capital intensity of production of each good.
- **Steel is produced more capital intensively than cloth, meaning that at any value of w/r , $k^S > k^C$.**

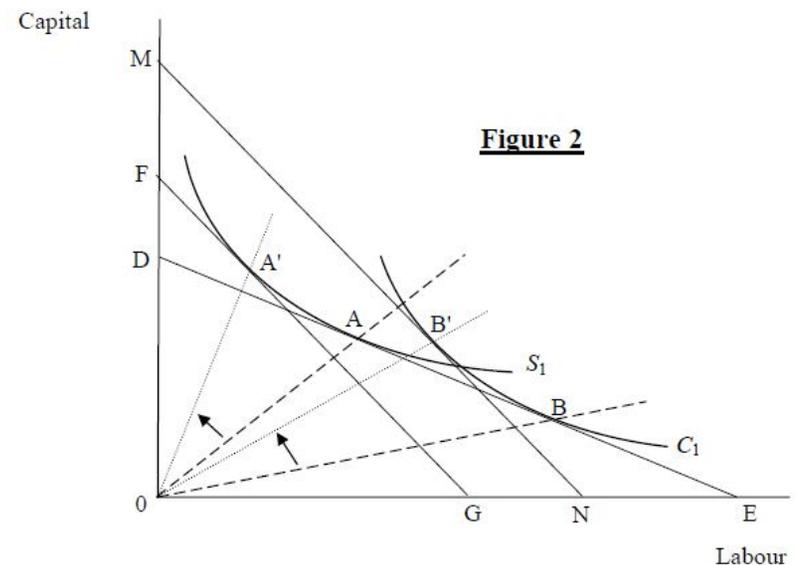
Implications of the Production Conditions



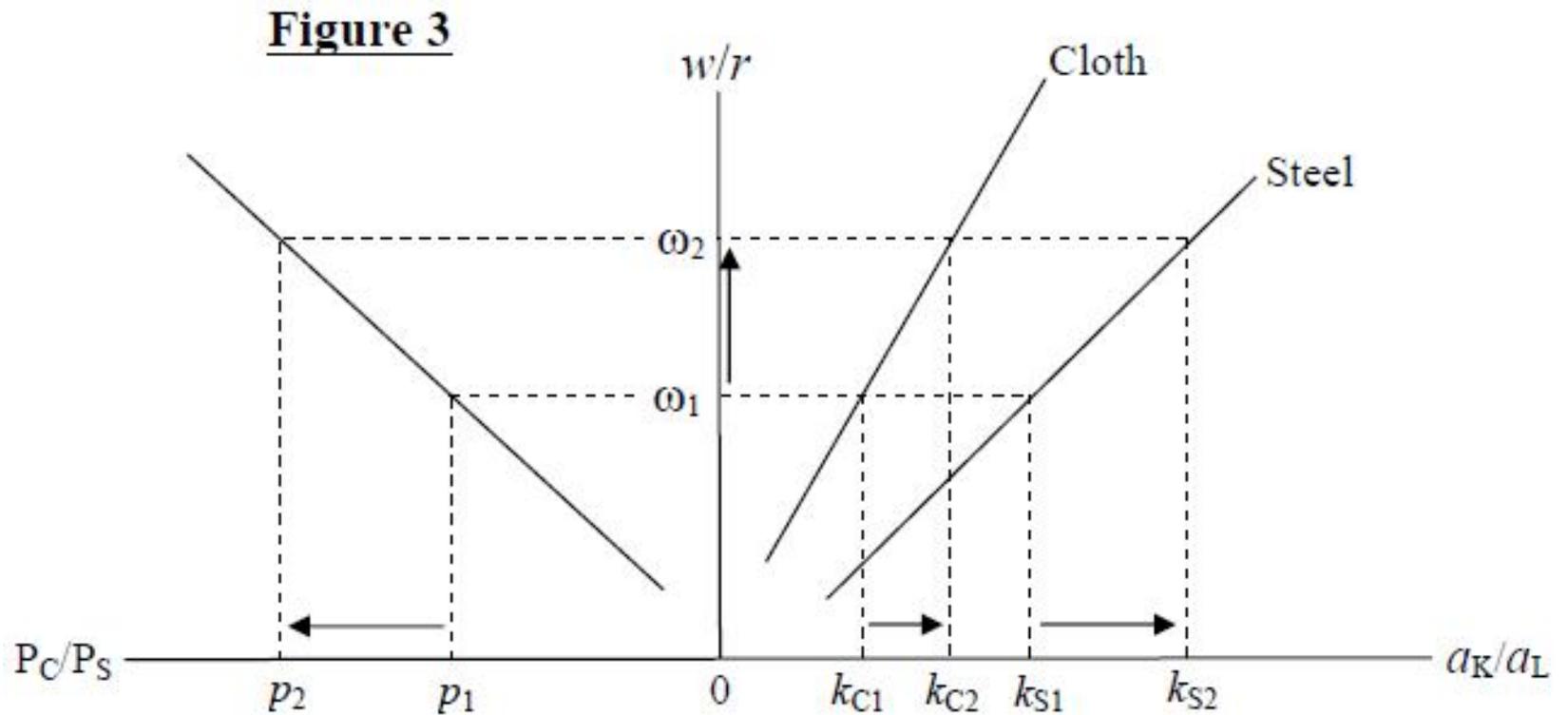
- The slope of the isoquant (the marginal rate of technical substitution between labour and capital) at any point is equal to the ratio of the marginal product of labour (MP^L) to the marginal product of capital (MP^K). That is, if $MP^L = 3$ (units of steel) and $MP^K = 2$ (units of steel), $3/2 = 1\frac{1}{2}$ units of capital would need to be substituted for 1 unit of labour at the margin in order to keep output constant. Cost minimisation requires each factor to be employed up to the point at which its marginal product is equal to its real reward, both expressed in terms of steel, so the *ratio of the marginal product of labour to the marginal product of capital, MP^L/MP^K , must be equal to the wage-rental ratio, w/r .*
- If the wage-rental ratio facing steel producers is $w/r = OD/OE$ in Figure 1, minimum cost production of S^1 units (whatever quantity that may be) will take place with the input combination shown by point T: that is, with $k^S = TM/OM$. At the lower value of $w/r = OF/OG$, minimum cost production requires use of a more labour-intensive technology, at point U with $k^S = UN/ON$.

Implications of the Production Conditions... cont

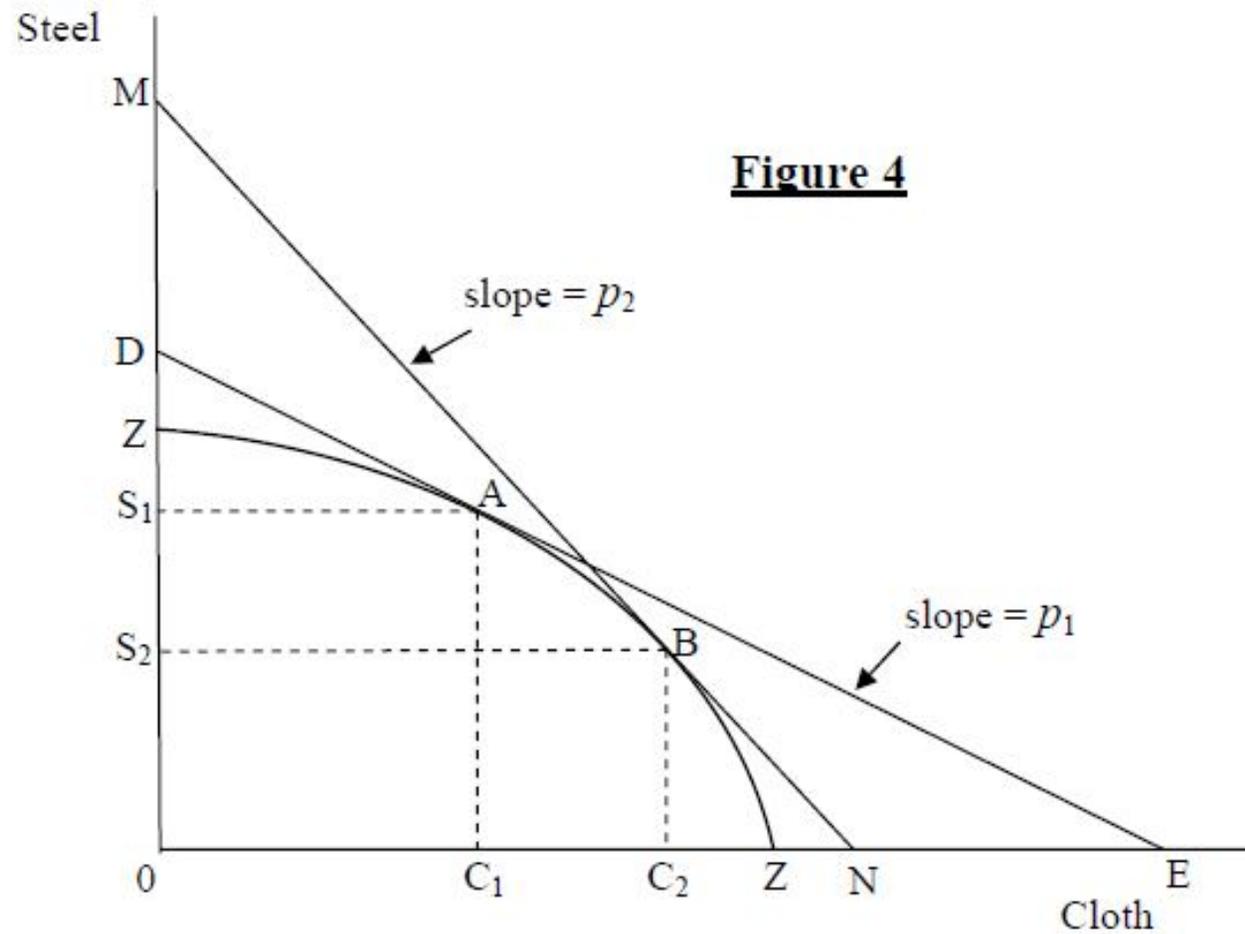
For convenience, define units such that S^1 in Figure 2 shows the combinations of factors that will produce 1 unit of steel and C^1 shows the combinations of factors that will produce 1 unit of cloth. With $w/r = OD/OE$, the iso-cost line DE that would just allow production of 1 unit of steel (with capital intensity given by the slope of OA) would also just allow production of 1 unit of cloth (with the lower capital intensity given by the slope of OB). At this wage-rental ratio, then, the cost of producing a unit of cloth is the same as the cost of producing a unit of steel. Relative commodity prices will reflect this so, with $w/r = OD/OE$, $P^C/P^S = 1$. Now consider a case in which labour is relatively more expensive, with $w/r = OF/OG = OM/ON$. Both goods will be produced more capital intensively than before, with production at A' on S^1 and B' on C^1 , but the iso-cost line that just allows production of 1 unit of steel (FG) now lies below that needed to allow production of 1 unit of cloth (MN), so the cost of producing a unit of cloth is now higher than that of producing a unit of steel. Thus, as w/r rises, the cost of producing the labour intensive good increases relative to the cost of producing the capital intensive good, so P^C/P^S increases.



The relationships between relative factor prices, factor intensities, and relative commodity prices.

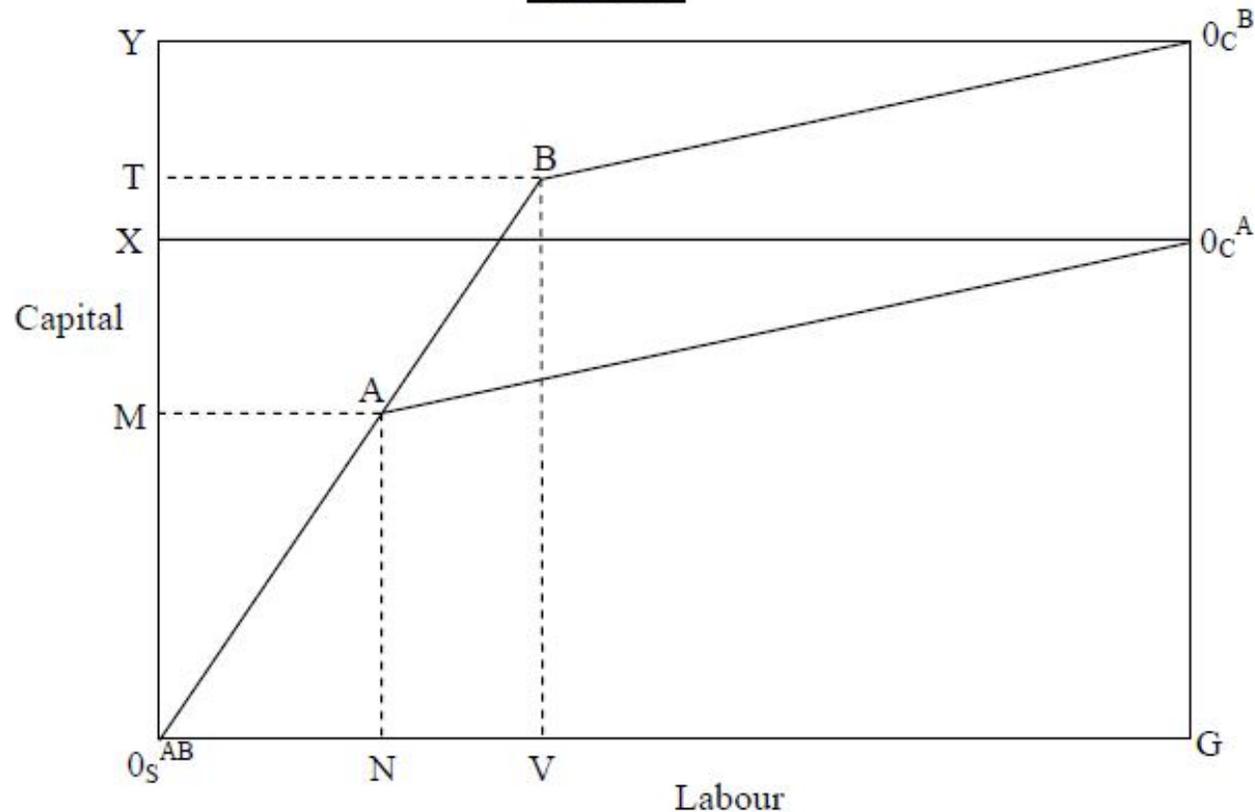


Implications of the Production Conditions... cont.



Production Possibilities and Relative Factor Supplies

Figure 5



The above figure demonstrates what is known as [the Rybczynski Theorem](#) which says that, under the conditions of the HOS model and holding commodity prices constant, an increase in the supply of one of the two factors leads to an absolute increase in the output of the good using that factor intensively and an absolute contraction in the output of the other good.

Production Possibilities and Relative Factor Supplies ... cont.

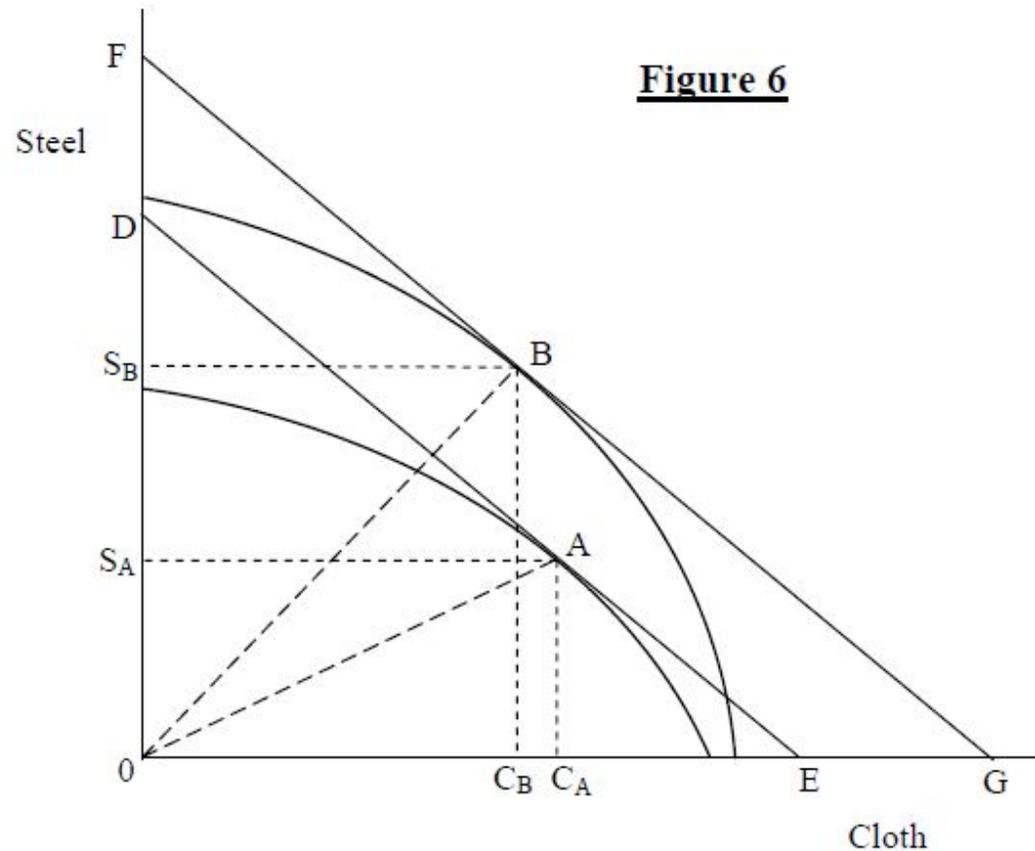
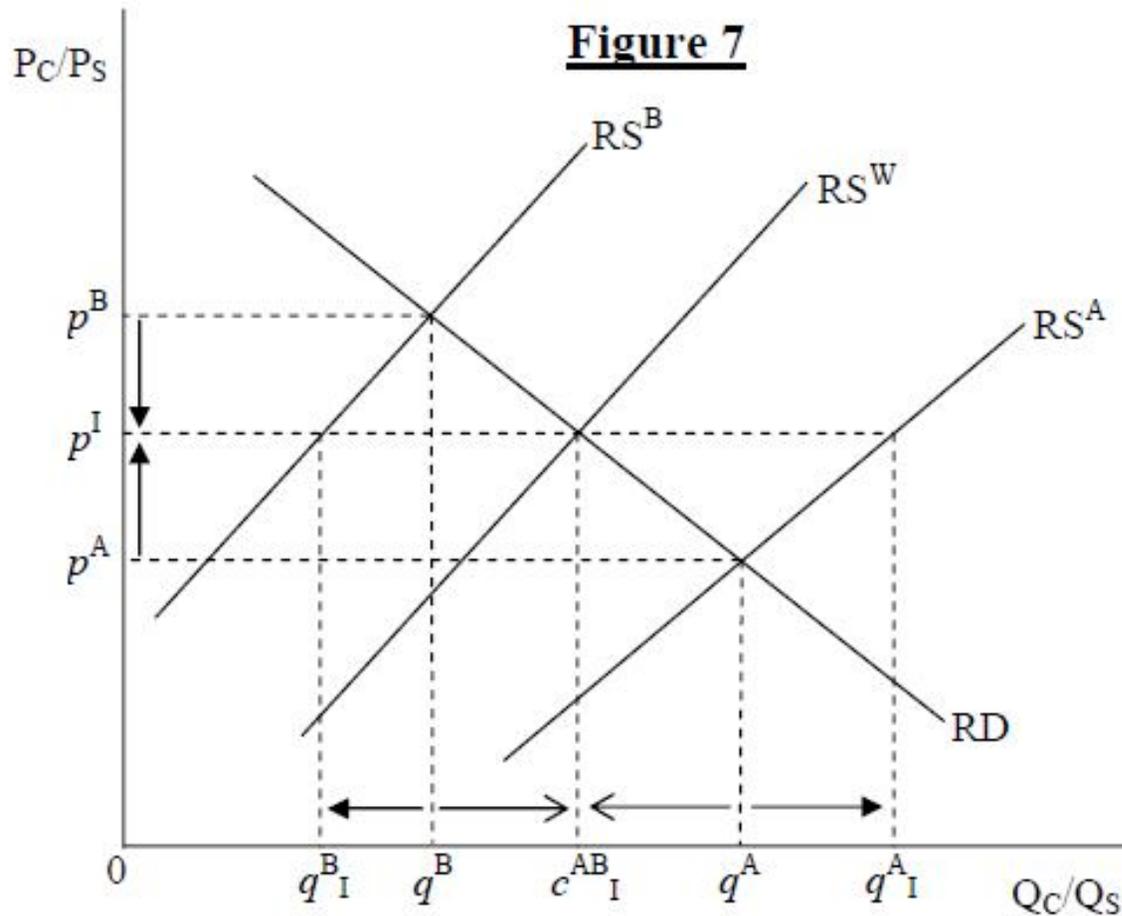


Figure 6 shows the production possibility frontiers of the two countries depicted in Figure 5, where the PPF for country B lies everywhere outside that for A but is relatively "skewed" in favour of the capital-intensive good, steel. Consequently, when both face the same commodity price ratio, $P^C/P^S = 0D/0E = 0F/0G$, B produces more steel and less cloth than A.

Relative Factor Endowments, Relative Goods Supply and the Heckscher-Ohlin Theory



The preceding story is that, under the production conditions of the HOS model and assuming preferences are 'not too dissimilar' across countries, the relatively labour abundant country (A) will specialise in production and export of the labour intensive good (cloth), while the relatively capital abundant country (B) will specialise in production and export of the capital intensive good (steel). This is the **Heckscher-Ohlin Theory**, that the basis for international trade specialisation is different relative factor endowments, with countries having a comparative advantage in production of goods that use their relatively abundant (and consequently cheap) factor relatively intensively.

Income Distribution and Trade in the HOS Model

- As illustrated in Figure 7, the more labour abundant country (A) has the lower autarky relative price of the labour intensive good (cloth). Consequently it has a lower real wage of labour and a higher real rental rate of capital under autarky than country B. Opening the two countries to trade raises the relative price of the labour intensive good in A and reduces it in B, with the result that the real wage is increased in A (and reduced in B), while the real rental rate is reduced in A (and increased in B), so the effect is to reduce the differences in real factor rewards between the two countries. In fact, under the free trade conditions we have been assuming (and in the assumed absence of transport and other transactions costs) relative commodity prices are *equalised across countries (equal to p^f in Figure 7) and this means that real factor rewards will also be equalised. This is the **Factor Price Equalisation Theorem, which says that under HOS production conditions and in the absence of transport and transactions costs, completely free trade will lead to the complete equalisation of real factor prices across countries.***
- Now suppose each of our economies consists of two distinct groups. 'Workers' own labour time which they hire out in exchange for the real wage, while 'capitalists' own capital which they hire out in exchange for its real rental rate. When the two countries move from autarky to free trade, the real wage in rises in A and falls in B, so workers are made better off in the initially low wage country but worse off in the initially high wage country. Similarly, capitalists are made better off in the initially low rental rate country (B) and worse off in the initially high rental rate country (A).
- In this case, then, the overall gain from trade in each country, illustrated by the move from a lower to a higher community indifference curve in Figure 8, reflects the fact that the gainers (workers in A and capitalists in B) *could compensate the losers (capitalists in A and workers in B) and still remain better off than under autarky.*
- However, so long as that compensation remains purely hypothetical, the claim (in country B) that the removal of trade barriers causes "living standards of working people to be reduced by competition from cheap foreign labour" has substance.



Summary

Factor Price Equalization Theorem: under HOS production conditions and in the absence of transport and transactions costs, completely free trade will lead to the complete equalisation of real factor prices across countries.

Stolper-Samuelson Theorem: for a country producing both goods under HOS conditions, an increase in the relative price of the labour-intensive good will unambiguously increase the real wage of labour and decrease the real return to capital.

Rybczynski Theorem: under the conditions of the HOS model and holding commodity prices constant, an increase in the supply of one of the two factors leads to an absolute increase in the output of the good using that factor intensively and an absolute contraction in the output of the other good.

Heckscher-Ohlin Trade Theorem: the basis for international trade specialisation is different relative factor endowments, with countries having a comparative advantage in production of goods that use their relatively abundant (and consequently cheap) factor relatively intensively.