

patterns of imports and exports would change

3. THE LEONTIEF PARADOX

The first comprehensive attempt to verify the Heckscher-Ohlin model was made by Wassily Leontief in 1953.⁵ The Heckscher-Ohlin theory states that relatively

of the U.S. exports are labor-intensive

capital-abundant country will export the relatively capital-intensive goods, and it will import the goods in whose production relatively large amounts of its relatively scarce factor labour are required. Leontief in his study reached the paradoxical conclusion that the United States which possesses a relatively large amount of capital and a relatively small amount of labour in relation to the rest of the world, *exported labour-intensive goods and imported capital-intensive goods*. This result has come to be known as the Leontief Paradox.

Leontief started his test of the Heckscher-Ohlin prediction that the United States would export its abundant factor capital in commodity form and import its scarce factor labour in commodity form. To test this prediction, Leontief used the 1947 input-output table of the U.S. economy. He aggregated 200 groups of industries into 50 sectors, of which 38 traded their products directly on the international market. He took two factors, labour and capital. He estimated the capital and labour requirements for production of one million dollars worth of United States exports and also one million dollars worth of United States import-competing commodities. Leontief's main empirical results are summarised in Table 1.

TABLE 1. CAPITAL AND LABOUR REQUIREMENTS IN PER MILLION DOLLARS OF US EXPORT AND IMPORT REPLACEMENTS, 1947

<i>Factor Requirements</i>	<i>Exports</i>	<i>Import Replacement</i>
Capital	\$ 2,550,780	\$ 3,091,339
Labour (man-years)	182,312	170,004
Capital-labour ratio	13,911	18,185

Leontief found that US exports used a capital-labour ratio of 13,9.11 per man-year, whereas import replacements (substitutes) used a capital-labour ratio of 18,185 per man-year. Thus his results showed that the capital-labour ratio in US import-replacement industries was 30% higher than the US export industries. It means that in the US import-competing industries are relatively more capital-intensive than the export industries. As Leontief stated: "America's participation in the international division of labour is based on its specialisation on labour intensive rather than capital intensive, lines of production. In other words, the country resorts to foreign trade in order to economise in its capital and dispose of its surplus labour, rather than vice-versa." Given the proposition that the United States is relatively capital-abundant, it exports labour-intensive goods. This is just contrary to the Heckscher-Ohlin theorem. Thus it is called the Leontief paradox.

These results surprised not only Leontief himself but economists throughout the world. The majority of economists criticised Leontief on methodological and statistical grounds. A few also carried out Leontief-type tests while others tried to reconcile the Leontief paradox with the Heckscher-Ohlin model. We take these issues one by one.

Criticisms of Leontief Paradox

Leontief has been criticised on statistical and methodological grounds. We study some of the points of criticism:

1. 1947 not a Typical Year. Swerling⁶ did not consider 1947 as a typical year for testing the Heckscher-Ohlin model because the post-war disorganisation of production had not been corrected in the world by that year. Moreover, the United States was the only major industrial economy free of devastation of the war. Thus the Leontief study was basically a description of US trade in 1947.

2. Problem of Aggregation. Balogh⁷ criticised aggregation in the input-output matrix for computing indirectly capital-labour ratios. As a result, the labour-intensity of the US export industries might be spurious and attributable to the aggregation of capital-intensive exportable products with similar, non-export, labour-intensive activities.

3. Incompatibility of Input-Output Model. Valavaris-Vail⁸ objected to the Leontief test on the ground that 'input-output models (except with rare-luck) are logically incompatible with international trade.' He argued that the Leontief model, with its fixed input coefficients, was incompatible with a world trade equilibrium in which every country gained from trade, full employment existed and the introduction of trade increased the output of some commodities and reduced that of others.

4. Low Capital-Labour Ratio Industries. Swerling criticised Leontief for including certain industries with low capital-labour ratios. Such industries were fisheries, agriculture and services like transport, wholesale trade, etc. These biased his results. In response to this criticism, Leontief⁹ reworked his study by taking a much wider range of industries but the results were similar to the original study.

5. Consumption Patterns. The Leontief Paradox does not take into consideration the impact of consumption patterns on the US exports and imports. According to Romney Robinson,¹⁰ the demand conditions within a country might be so biased towards the consumption of a commodity that it may produce it with a relatively abundant factor. As per capita income increases, the consumption patterns may be biased towards labour-intensive or capital-intensive commodities. Brown's study¹¹ revealed that the US consumption patterns had

bias towards labour-intensive commodities rather than capital-intensive commodities. This contradicts the Leontief Paradox.

6. Durability of Capital. Buchanan criticised Leontief for using "investment-requirements coefficients" as capital coefficients in his study. He, therefore, failed to take into account the difference in the durability of capital in various industries.

7. Tariffs Ignored. Travis¹² argued that tariffs often distorted the pattern of trade and, thus, reflected relative factor endowments of a country. On this basis, the Leontief results were seriously affected by the US and foreign tariffs. Leontief's weakness was that he did not take tariffs into consideration in his study.

8. Neglect of Natural Resources. Buchanan¹³ criticised Leontief for neglecting the role of natural resources which were very important in determining trade patterns. Studies by Hoffmeyer and Vanek confirmed Buchanan's view.

9. Comparison of Capital Intensity Irrelevant. Ellsworth¹⁴ pointed out that the capital intensity of US import-replacement industries was irrelevant to the comparison. What is required is a comparison of the capital intensity of US exports with the capital intensity of the exports of other countries to the United States. Since the US is a capital abundant country, the goods produced by it to replace imports must be capital intensive. This is what Leontief arrived at in the case of import replacements. But he should have studied whether the goods imported in the United States are capital or labour-intensive in the countries of origin.

10. Labour Productivity. Leontief himself tried to explain his results. He argued that the US was a labour-abundant country relative to the rest of the world because the US workers were much more efficient than foreign workers. The productivity of US workers was three times the foreign workers. Leontief attributed the higher productivity of US workers to entrepreneurship, superior organisation and favourable environment in the United States rather than to the employment of a larger amount of capital per worker. Ellsworth regarded this conjecture of Leontief as "conceptual awkwardness." Bhagwati questions how the efficiency factor of three was arrived at by Leontief. According to him, this argument of Leontief is unpersuasive.

11. Neglect of Human Capital. Leontief has been criticised for not including the value of human capital. He took only physical capital. Kenen¹⁵ in his study found that the Leontief Paradox was reversed when human capital was added to Leontief's physical capital.

12. W.P. Travis, *The Theory of Trade and Protection*, 1964.

13. N.S. Buchanan, "Lines on the Leontief Paradox," *Economic Internazionale*, November 1955.

14. P.T. Ellsworth "The Structure of..."