

## C THE CAUSES OF TRADE

From an economic perspective, the case for freer trade rests on the existence of gains from trade and most economists typically agree that there are gains from trade. In recent years, however, free trade has increasingly come under fire and it is not uncommon to hear trade sceptics say that economists' arguments in favour of free trade and in particular comparative advantage may have been valid at the time of Ricardo (in the early 19<sup>th</sup> century) but that they are no longer valid in today's globalized world. This section critically assesses the relevance of economic theories of international trade in today's global trading environment. Most trade models are designed to answer two closely related questions: what goods do countries trade and why. While the main focus of this section is on the causes of trade, the discussion often touches upon the question of the patterns of trade.

This assessment of the relevance of trade theories is based on an overview of the theoretical models as well as of the empirical literature. This section begins by examining how robust the theories are and how far they can be generalized. This is an important part of the discussion – in particular, when the traditional approach is considered. This is because the traditional case for gains from trade is largely theoretical. In fact, it could even be argued, as Leamer and Levinsohn (1995) do, that “though obviously important and theoretically robust, the existence of gains from exchange is fundamentally a premise of economics, not a testable implication of a particular model”. Bearing this in mind, this section also reviews empirical work that tests trade theories and that attempts to estimate the relative importance of different types of gains from trade.

The idea that there are gains from trade is the central proposition of normative trade theory.<sup>1</sup> The gains-from-trade theorem states that if a country can trade at any price ratio other than its domestic prices, it will be better off than in autarky – or self-sufficiency.<sup>2</sup> More generally, the basic gains from trade propositions are that:<sup>3</sup> i) free trade is better than autarky; ii) restricted trade (i.e. trade restricted by trade barriers) is better than autarky; and, iii) for a small country (i.e. a country too small to influence world prices) free trade is better than restricted trade.

Samuelson (1939) showed that there are potential gains from trade for small countries provided world

prices diverge from autarky prices. Kemp (1962) showed that restricted trade is better than no trade. He also extended the argument to the large country case, proving that free trade is potentially superior to autarky, in the case when there are many commodities and factors and with variable factor supplies. As noted by Deardorff (2005a), most treatments of the gains from trade say that if trade could potentially benefit all members of a country's population (assuming their preferences and income were identical), it is regarded as benefiting the country because some form of income redistribution among the country's consumers is assumed to be feasible. Beyond the feasibility of income redistribution in the form of lump-sum transfers (which is necessary to avoid market distortions associated with taxes), these results are based on a number of other key assumptions, notably constant returns to scale,<sup>4</sup> perfect competition,<sup>5</sup> no other market distortions, such as externalities,<sup>6</sup> and the flexibility in the prices of factors of production (principally capital and labour) that ensure full employment. While the main message of the gains-from-trade theory remains valid when some of those assumptions are relaxed (for example, feasibility of lump-sum transfers), attempts to relax others (such as constant returns to scale) introduce significant complexities (Corden, 1984).

These basic propositions about the gains from trade, however, are not the end of the story. First, as pointed out by Corden (1984), the divergence between autarky and free trade prices is only an approximate explanation of the gains from trade. A full explanation of those gains should link them to the causes of trade – that is, to the elements that give rise to divergence between autarky and free trade prices. Those elements are the ones that lie behind the sources of comparative advantage. They would include differences in technology or differences in endowments. Second, economic theory points at other forms of gains from trade that are not linked to differences between countries. In particular, countries trade to achieve economies of scale in production<sup>7</sup> or to have access to a broader variety of goods. Also, if the opening-up of trade reduces or eliminates monopoly power or enhances productivity, there will be gains from trade additional to the usual ones. Finally, trade may have positive growth effects.

This section covers the traditional gains from trade and their underlying causes, the gains from trade highlighted in the more recent trade theories, and the dynamic gains from trade. Each subsection starts with a brief presentation of a theory focusing on these specific gains from trade. The robustness of the theories to changes in their main assumptions is examined. Finally, the empirical evidence concerning the proposed rationales for international trade is reviewed.

Before considering the simplified theoretical frameworks (models) which focus on any particular source of gains from trade, it is important to emphasize that patterns of international trade typically reflect the interaction of several different causes. International trade theories and specific applications of the theories (models) should not be seen as mutually exclusive. This is of particular importance when trying to assess their relevance. The validity of a particular theory should be assessed on the basis of its capacity to explain trade in its limited domain. North-South trade might be explained by models which link trade patterns to differences between countries, while a model of monopolistic competition may best characterize trade between similar countries.

## 1. THE TRADITIONAL APPROACH: GAINS FROM SPECIALIZATION

Until recently, most trade models explained the commodity pattern of trade in terms of the law of comparative advantage.<sup>8</sup> Before turning to particular models, such as the Ricardian model or the Heckscher-Ohlin model, which focus on particular product and/or country characteristics that determine the relative autarky price, it may be worth restating what comparative advantage means, and what it does and does not imply.

Comparative advantage is one of the most basic ideas in economics. Deardorff (1998) usefully distinguishes between the definition of comparative advantage and two versions of the law of comparative advantage. Comparative advantage can be defined as the “low relative cost of a good compared to other countries in autarky”. The double comparison across both goods and countries is the critical element. It indicates that it is impossible by definition for a country to have a comparative disadvantage in every good. In practice, every country will have a comparative advantage in something. There are two

laws of comparative advantage: one “positive” which predicts what countries can be expected to do and one “normative” which suggests what they should do. The positive version predicts that if permitted to trade, a country will export goods in which it has a comparative advantage. The normative version suggests that if permitted to trade, a country will gain through specialization.

Focusing on the normative side, the main contribution of the law of comparative advantage is to point to the fact that there are many more circumstances under which international trade is beneficial than most people appreciate. This can be illustrated using the example of an engineer and a nanny. Assume that the engineer is a good mother, better than the nanny at taking care of her child. The engineer, however, earns US\$ 500 an hour in her professional capacity while the nanny charges US\$ 12 an hour. Excluding from the question what is best for the child and fun for the mother, it makes economic sense for the engineer to pay the nanny to watch her child. As mentioned, the idea of comparative advantage is incorporated in several theories which are now considered.

### (a) Differences in technology

As already mentioned, differences between countries are one of the main reasons why they engage in trade. The Ricardian model and its extensions point to technological differences as the source of comparative advantage. In order to keep the model as simple and the focus as clear as possible, a number of assumptions are typically made. One of these, i.e. that labour is the only factor of production, is specific to the Ricardian model. Most of the others, such as perfect competition, no trade costs, constant returns to scale, fixed endowments and international immobility of factors are standard in traditional trade models. With labour the only factor of production, differences in technology are modelled as differences in the amount of output that can be obtained from one unit of labour.

Using an example with two countries and two goods, Ricardo showed that even when one of the two countries has an absolute advantage in both lines of production, i.e. it can produce more output with one unit of labour in both sectors, there is scope for mutually beneficial trade if both countries specialize according to their pattern of comparative advantage. A country has a comparative advantage

in the production of good X if it is relatively more productive in the production of this good. More precisely, a country has a comparative advantage in the production of steel, for example, if the opportunity cost of steel in terms of the other good is less than in the other country.<sup>9</sup> See Box 1 for a more detailed presentation of the Ricardian model.

The main results from the simple Ricardian model have been summarized by Deardorff (2005b):

“[...] comparative advantage can be usefully defined in terms of a comparison of relative autarky prices, which also represent marginal

opportunity costs in autarky. A difference in relative autarky prices, and thus the presence of comparative advantage, implies the potential to increase world output by reallocating resources within the two countries. Combined with market structures of perfect competition, comparative advantage also implies that unless policies interfere with market incentives, countries stand to gain from trade in the sense that at least one country will gain and neither will lose. And this gain from trade is achievable only if countries each export the good in which they have comparative advantage.”

**Box 1**  
**A numerical presentation of the Ricardian model**

Along the lines of Ricardo’s own presentation of his model in 1817, a simple numerical example with two countries (A and B), two goods (logs and iron bars) and one single input (labour) can be used to illustrate how countries can gain from trade through specialization according to comparative advantage based on differences in technology.

Technology in each of the two countries A and B is summarized by labour productivity in the production of logs and iron bars. Labour productivity is expressed in terms of unit labour requirements. Labour productivity in the log industry in Country A, for example, noted  $a_{AL}$ , is the number of hours of labour required to produce one unit of log. The table below illustrates unit labour requirements in countries A and B.

*Unit labour requirements*

	Logs	Iron bars
Country A	$a_{AL}=1$	$a_{AI}=3$
Country B	$a_{BL}=4$	$a_{BI}=4$

In this example, unit labour requirements for both industries are lower in Country A than in Country B, which means that labour productivity is higher in A in both industries. Thus, Country A has an absolute advantage in both industries. From looking at absolute advantage, it can be concluded that there is no scope for mutually beneficial trade between A

and B. How could producers in B compete with those in A if they are less efficient? Ricardo suggested that what matters is not absolute but comparative advantage. In this example, the ratio of the labour required to produce one iron bar to that required to produce one log in Country A ( $a_{AI}/a_{AL}=1/3$ ) is lower in Country A than in Country B ( $a_{BI}/a_{BL}=1$ ). This amounts to saying that Country A has a comparative advantage in the logging industry. The flipside of this is that Country B has a comparative advantage in the production of iron, as the ratio of the labour required to produce one bar of iron to that required to produce one log in Country B ( $a_{BI}/a_{BL}=1$ ) is lower than in Country A ( $a_{AI}/a_{AL}=3$ ).

Comparative advantage can also be established using the notion of opportunity cost. A country is said to have a comparative advantage in the production of a particular good if the opportunity cost of producing that good in terms of the other good is lower in that country than it is in the other countries.<sup>10</sup> The opportunity cost of one log is defined as the number of iron bars the economy would have to give up producing in order to produce an extra log. Producing an extra log would require  $a_{AL}=1$  unit of labour, which could have been used to produce  $1/a_{AI}=1/3$  of an iron bar. The opportunity cost of iron in terms of logs in Country A is thus  $a_{AL}/a_{AI}=1/3$ , compared with  $a_{BL}/a_{BI}=1$  in Country B. With constant unit labour requirements, these opportunity costs are constant.

In the absence of trade, the relative prices of logs and iron bars in each country would be determined by the relative unit labour requirements. In Country A, the relative price of logs would be  $P_{AL}/P_{AI} = a_{AL}/a_{AI} = 1/3$ . In B it would be  $P_{BL}/P_{BI} = a_{BL}/a_{BI} = 1$ . Opening up for trade between A and B allows producers in A to sell logs at a higher price in B, while producers in B start selling iron bars in A. If  $P_{AL}/P_{AI} > a_{AL}/a_{AI}$ , wages in the logging industry will be higher than in the iron industry, that is  $P_{AL}/a_{AL} > P_{AI}/a_{AI}$ . Workers will wish to work in the higher-wage industry and thus the economy will specialize in the log industry. Eventually trade will equalize the relative prices in A and B. It can be shown that the normal result of trade is that the price of a traded good relative to that of another good ends up somewhere between its autarky prices. In this case, the new relative price of logs will be in the range between  $1/3$  of an iron bar and 1 iron bar.

This pattern of specialization and trade produces gains from trade. Trade can be seen as an indirect method of production that is more efficient than the direct method. In direct production of iron in A, one hour of labour produces  $1/3$  of an iron bar. If, for instance, the after trade relative price of a log in A is  $1/2$  of an iron bar, the same hour of labour can be used to produce 1 log which can then be traded against  $1/2$  of an iron bar. Similarly, in B, one hour of labour would produce  $1/4$  of a

log in direct production, while the same hour could be used to produce  $1/4$  of an iron bar which could then be traded against  $1/2$  of one log. Both countries clearly gain from trade.

It is interesting to examine what this simple example tells us about relative wages. After specialization, which happens to be complete in this simple model, Country A produces only logs. Hourly wage in A must be 1 log, as one hour of labour produces one log in A. Similarly, hourly wage in B must be  $1/4$  of an iron bar since it takes four hours of labour to produce one bar. Assuming that the price of logs is 10 dollars per unit while that of an iron bar is 20 dollars per unit, which corresponds to the terms of trade, then hourly wage in A is 10 dollars while hourly wage in B is 5 dollars ( $1/4$  of 20 dollars). The relative wage of workers in A is  $10/5 = 2$ . Note that this result only depends on the level of productivities and the relative prices. It does not depend on the absolute price of a log or of a bar. The fact that the relative wage lies between the ratio of the two countries' productivities in logging (where A is twice as productive as B and the same ratio in the iron industry, where A is only about 1.3 times more productive) explains why trade is profitable for both countries. In logs, A can compensate its higher wage with its higher productivity while in iron, B can compensate its lower productivity with its lower wage rate.

The simplified two-goods, two-countries presentation of the Ricardian model often fails to convince non-economists who ignore how far it can be generalized and who question its validity in today's world. It is, therefore, worthwhile to examine the robustness of its main results to changes in some of the underlying assumptions. A distinction needs to be made between the robustness of the law of comparative advantage on the one hand, which is not an exclusivity of the Ricardian model, and the idea that comparative advantage is rooted in technological differences on the other hand.

One of the main differences between the Ricardian model and other trade models is the assumption that marginal costs do not change with the level of production. An important ramification of the constant costs assumption is that it implies complete specialization of the trading partners, which is not necessarily realistic. The problem is that with non-constant marginal costs, comparative costs are not uniquely defined. As the discussion of other trade models will show, however, with non-constant costs, countries' behaviour is not very different except that trading countries can continue to produce both goods.

**Box 2**  
**Ricardian models with more goods and more countries**

This box examines how the Ricardian model functions when the two-goods and two-countries only assumption is relaxed.

With N goods and two countries, the Ricardian model can be generalized using the concept of chain of comparative advantage. Numbering the goods in order of Country A's relative labour requirements:

$$\frac{a_{A1}}{a_{B1}} < \frac{a_{A2}}{a_{B2}} < \dots < \frac{a_{AN}}{a_{BN}}$$

where  $a_{Ci}$  is Country C's unit labour requirement for good i, it can be shown that Country A will produce all of the goods for which:

$$\frac{a_{Ai}}{a_{Bi}} < \frac{w_B}{w_A}$$

while B will produce all the ones with a ratio of unit labour requirement larger than the ratio of wage rates.<sup>11</sup>

The Ricardian model can also easily be generalized to more than two countries if the number of goods is kept at two. A ranking similar to the one in the multi-goods case can be constructed over the countries' relative labour requirements:

$$\frac{a_{11}}{a_{12}} < \frac{a_{21}}{a_{22}} < \dots < \frac{a_{M1}}{a_{M2}}$$

where  $a_{ij}$  is Country i's unit labour requirement for good j, where  $i=1..M$  and  $j=1,2$ . In this case, all exporters of good 1 will lie to the left of all exporters of good 2.

The Ricardian model, however, does not generalize as easily to more than two goods and more than two countries simultaneously. Deardorff (2005b) discusses a number of attempts to come up with strong generalizations in the multi-goods, multi-country case. His conclusion is that comparative advantage only predicts trade patterns in simple cases.

To move closer to reality, it is important to consider how the Ricardian model functions when the two-goods-only assumption is relaxed. As explained in Box 2, with multiple goods and multiple countries, the Ricardian model only predicts trade under strong simplifying assumptions. In models with more realistic assumptions, such as trade barriers, intermediate inputs, and large numbers of both countries and goods, it fails to do so.<sup>12</sup> This does not mean that the law of comparative advantage is useless under realistic assumptions. In the more realistic models, comparative advantage continues to predict and explain gains from trade. Even if, as discussed in the introduction, part of the gains from trade results simply from perfect competition, comparative advantage also plays a role. While the basic gains-from-trade theorem indicates that free trade improves a country's welfare if the prices it faces with trade diverge from autarky prices, comparative advantage provides the reason why prices with trade differ from those in autarky and thereby ensures positive gains from trade.

Comparative advantage may not allow strong generalizations under more realistic assumptions,

but it may allow weak generalizations. Indeed, instead of indicating whether any particular good will be exported or imported by any particular country, comparative advantage can provide average relationships such as, for instance, that the trade-weighted average of the country's autarky prices of goods it exports, relative to world prices, is less than the trade-weighted average of the relative prices of its imports (Deardorff, 2005b). Along the same lines, Deardorff (1980) formalizes such average relations in the form of correlations. For instance, he derives a negative correlation between autarky prices and quantities of net exports across all goods and countries.

Having derived the more general correlations, it is interesting to examine how robust they are. Deardorff (2005b) discusses a number of assumptions, distinguishing between those that are consistent with comparative advantage correlations, including gains from trade, and those that are not. Starting with the ones that are consistent, he notes that both the gains from trade and the average relationships continue to hold in the presence of restrictive trade policies as well as with transport

and other real trade costs. The correlations also hold for all types of goods (final, intermediate or both) and even for services. Differentiated products can be accommodated as long as markets are perfectly competitive. Also, the correlations remain valid for all sorts of preferences. The two main assumptions on the other hand that cause problems for the theory of comparative advantage, both as a source of gains from trade and as a predictor of patterns of trade, are domestic distortions caused by externalities or market power, for instance, and increasing returns. These assumptions do not reverse the story but rather complicate it.

### (b) Differences in resource endowments

The Ricardian model assumes that labour is the only factor of production. Under this assumption, the only possible source of comparative advantage is differences between countries in labour productivity. Clearly, differences in labour productivity are not the only source of comparative advantage. Differences in resource endowments must play a role. Countries that are relatively better endowed with fertile land than others are likely to export agricultural products. The idea that international trade is driven by differences between countries' relative factor endowments is at the heart of the Heckscher-Ohlin model. This model, named after the two Swedish economists – Eli Heckscher and Bertil Ohlin – who developed it, is probably the most influential model of international trade. The Heckscher-Ohlin model provides an alternative explanation of trading patterns. Because it takes into account more than one factor, it also has implications for the internal distribution of income. The gains from trade in the Heckscher-Ohlin framework, however, are of the same nature as in the Ricardian model. They are gains from specialization that arise because of differences between countries. The Heckscher-Ohlin model only focuses on another source of comparative advantage.

The standard version of the Heckscher-Ohlin model assumes that there are two countries, two goods and two factors of production. It also assumes that technologies and tastes are identical across countries, that factor endowments differ and that factors are mobile between industries but not between countries. Under those assumptions, four core propositions can be derived:<sup>13</sup>

1. The Heckscher-Ohlin theorem states that a country has a production bias towards, and hence tends to export, the good which uses intensively the factor with which it is relatively well endowed.
2. The Stolper-Samuelson theorem states that an increase in the relative price of one of the two goods raises the real return of the factor used intensively in producing that good and lowers the real return of the other factor.
3. The Rybczynski theorem states that if goods prices are kept constant, an increase in the endowment of one factor causes a more than proportionate increase in the output of the commodity which uses that factor relatively intensively and an absolute decline in the output of the other commodity.
4. The factor-price equalization theorem states that, under certain conditions, free trade in final goods is sufficient to bring about complete international equalization of factor prices.

Using a simple example with two countries – A (assumed to be well endowed with labour) and B (assumed to be relatively rich in capital) – and two goods (automobiles, the production of which is assumed to require relatively more capital, and clothing, that requires more labour), the four propositions can be illustrated in the following way. The Heckscher-Ohlin theorem tells us that A exports clothing and imports automobiles. The Stolper-Samuelson theorem tells us that a tariff on clothing (more likely in B, which imports clothing) would raise real wages and reduce real return on capital. The Rybczynski theorem tells us that immigration would raise the output of clothing more than proportionately and reduce the output of cars. Finally, the factor-price equalization theorem tells us that even without allowing for international mobility of labour and capital, trade alone would, under certain conditions, equalize wages in A and B and rates of return on capital in A and B.

Again, the question arises whether the core propositions that have been derived in the standard basic model can be generalized. This question is important because together with the law of comparative advantage, the four core propositions can be seen as the central body of international trade theory. Among the extreme assumptions

which underpin the core results are that of low and even “dimensionality”. The sensitivity to higher dimensions of the basic propositions, because it is a key issue for the practical relevance of the dominant trade theory, has been an area of active research since the 1940s. The two-goods, two-factors model is special not only because of the assumption regarding the number of goods but also because this number of goods equals the number of factors.

Economists have analyzed all possible cases: those with an even number of goods and factors, those where the number of goods is larger than the number of factors, those where the number of factors is higher, and finally the general case with  $N$  goods and  $M$  factors. Several authors have surveyed this large volume of theoretical work.<sup>14</sup> Their conclusions are relatively nuanced. In general, dimensionality matters in the sense that many of the results from the basic  $2 \times 2$  model are lost with higher dimensions. Generalizations run into difficulties in all cases, even or uneven. Ethier (1984) nevertheless optimistically concludes that the basic messages of elementary theory still come through to a relatively large extent. Like the law of comparative advantage, the Heckscher-Ohlin theorem survives as a correlation or in an average sense, while the Stolper-Samuelson and Rybczynski theorems survive in undiluted strength but they only apply to some factors or goods but not necessarily to all.

As mentioned above, a number of other assumptions underpin the Heckscher-Ohlin theory. The ramifications of those regarding intersectoral and international factor mobility as well as of those regarding the nature of the products traded are discussed below. Models with economies of scale, imperfect competition and differentiated products are considered in sub-sections 2 and 3. Another important assumption of the model is that factor markets are perfect. Realizing that factor market imperfections can be significant in some countries, economists have examined the effect of three major types of distortions: wage differentials, generalized “sticky”<sup>15</sup> wages and sector-specific sticky wages. These distortions introduce various types of “pathologies”.<sup>16</sup> Brecher (1974), for instance, shows that the minimum wage country levels of employment and welfare may be less with free trade than with no trade. This would be the case if trade leads the minimum wage country to export the capital-intensive good under incomplete specialization. If, on the contrary, free trade leads

the home country to export the labour-intensive good, employment and welfare increase regardless of the degree of specialization.

### (c) Empirical evidence

In the introduction to their 1995 review of empirical evidence on international trade theory, Leamer and Levinsohn (1995) note that “international microeconomics is primarily a theoretical enterprise that seems little affected by empirical results”. In their view, the reason for this is neither a lack of empirical work by economists, nor a lack of appropriate data. Rather, their review is premised on the idea that economists “have not done the job right”. Why is that? In his earlier survey of empirical tests of trade theories, Deardorff (1984) identifies the difficulty of constructing sound theoretical tests of trade theories as the major obstacle to their testing. This difficulty, in his view, arises from the nature of the theories themselves, which “are seldom stated in forms that are compatible with the real world complexities that empirical research cannot escape”. It is not clear what the Heckscher-Ohlin model in its standard form with two goods, two countries and two factors tells us about the real world where there are many of all three and it therefore has been difficult to agree on a valid test.

While progress has been relatively limited with regard to the testing of trade theories, there have been some improvements in empirical applications of these theories. The available evidence, though it does not prove much, sheds some light on the factors that contribute most to the understanding of international trade. This sub-section provides a brief overview of empirical work on the traditional models of international trade. It first considers evidence regarding gains from trade and comparative advantage and then summarizes the main results of empirical tests of the Ricardian and Heckscher-Ohlin models.

Very little is known about the empirical magnitudes of the gains from international trade and the mechanisms that generate these gains. In particular, very limited evidence is available on how much specialization according to comparative advantage can contribute to an economy’s overall income. This may come as a surprise given the flurry of estimates of gains from trade liberalization obtained through the use of Computable General Equilibrium (CGE) models. However, while CGE models can be a very

useful tool for policy analysis, they do not provide hard evidence on the gains from trade. This is because CGE models are typically “theory with numbers” in the sense that they rely on a number of behavioural and other assumptions and offer assessments of potential gains from trade.

A relatively recent study by Bernhofen and Brown (2005) provides the first piece of hard evidence on the magnitude of the static gains from trade resulting from comparative advantage. The specificity of Bernhofen and Brown’s study is that it embeds the analysis of the gains from trade within a theoretical framework that also identifies the underlying cause of international trade. They use Japan’s 19<sup>th</sup> century trade liberalization as a natural experiment to estimate the effects of trade on national income. They first provide supportive evidence that Japan’s trading pattern after its opening up was governed by the law of comparative advantage and then take the next step and estimate the gains from trade resulting from comparative advantage. They estimate that at most the gain in real income was 8 to 9 per cent of GDP.

Irwin (2001) uses another of the few historical examples where a country has moved from self-sufficiency – or autarky – to free trade or vice versa rapidly enough to allow the use of time series data to estimate the gains from trade. He calculates that the welfare cost to the United States of the nearly complete embargo imposed by the US Congress on international trade between December 1807 and March 1809 was some 5 per cent of GDP. This cost, however, does not represent the total gains from trade because trade was restricted in the pre-embargo situation.

Bernhofen and Brown’s work on Japan is remarkable because it provides the first and to our knowledge only direct test of the theory of comparative advantage. Direct testing of the theory of comparative advantage is notoriously difficult because it involves relating trade flows and specialization patterns to autarky prices which, by their nature, are almost always unobservable. Bernhofen and Brown (2004) test a weak formulation of the law of comparative advantage using the natural experiment of Japan’s opening up to trade in the 1860s.<sup>17</sup> They carefully verify that Japan in the mid-19<sup>th</sup> century met the requirements needed to apply the theory. In particular, they show that before 1854 Japan was completely closed to trade while by the late 1860s it had fairly free trade and no export subsidies.

Their results provide a strong empirical case for the prediction of the theory.<sup>18</sup>

If direct tests of the law of comparative advantage are so difficult, what about testing the theories that explain comparative advantage? As explained above, the Ricardian model attributes comparative advantage entirely to differences in labour requirements of production. Unfortunately, testing the Ricardian model turns out to be as problematic as testing the law of comparative advantage. The main problem is that the Ricardian link between trade patterns and relative labour costs is much too sharp to be found in any real data set. Because of the complete specialization that the model implies, for instance, relative labour requirements ought to be unobservable. Deardorff (1984) discusses tests of a weaker link and concludes that they are deficient. Overall, while the Ricardian model can be seen as an important reminder that technological differences can be a source of comparative advantage, the one-factor model is too simple to study the impact of technologies on trade flows (Leamer and Levinsohn, 1995).<sup>19</sup>

The literature on testing and estimating Heckscher-Ohlin models is both voluminous and complex. While an exhaustive and systematic overview of this literature clearly falls beyond the scope of this Report, the following provides a quick summary of its main results.

Leontief (1953) is the earliest and probably the best known attempt to confront the Heckscher-Ohlin model with data. Given the United States’ relatively high capital-labour endowments ratio compared with other countries, in particular in the late 1940s, the Heckscher-Ohlin model would predict that the United States exported capital-intensive goods and imported labour-intensive goods. Surprisingly however, comparing the amount of factors of production used to produce US\$1 million worth of exports with the amount used to produce the same value of US imports, Leontief found that US exports were less capital intensive than US imports. This result, which contradicted the Heckscher-Ohlin theorem, came to be known as the Leontief paradox. A wide range of explanations were offered for this paradox, of which several concerned the fact that Leontief focused only on two factors of production, ignoring land and human capital.<sup>20</sup> In the following years, a number of studies redid the analysis, taking into account those factors.

The paradox persisted in the data from the earlier decades but seems to have disappeared since the early 1970s (Deardorff, 1984). Leamer (1980) provided the definitive critique of the Leontief paradox. He showed that Leontief had performed the wrong test. Even if the Heckscher-Ohlin model is true, the capital/labour ratios in exports and imports need bear no particular relationship to relative factor endowments if trade is unbalanced.

Leontief (1953) may be interpreted as an application of the so-called “factor content” version of the Heckscher-Ohlin theorem. Empirical application of the theorem has been of two forms, corresponding roughly to two versions of the theorem. The “commodity version” says that countries tend to export those goods which use relatively intensively their relatively abundant factors of production. The “factor content” version developed by Vanek (1968) (also termed the Heckscher-Ohlin-Vanek theorem), says that countries will tend to export the services of their abundant factors, embodied as factor content in the goods they trade. The test performed by Leontief was a partial test of the “factor content” version (Feenstra, 2004).

The first complete test of the “factor content” version of the Heckscher-Ohlin theorem was by Bowen et al. (1987). For a sample of 27 countries and 12 factors of production, they showed that the test failed. Their negative result was confirmed by other authors. Researchers then began to examine which parts of the theory were causing the problems.<sup>21</sup> Building on this work, Davis and Weinstein (2001) show that with a few simple modifications, the Heckscher-Ohlin-Vanek model is consistent with data from ten OECD countries and a rest-of-the-world aggregate. These modifications include, in particular, the introduction of cross-country differences in technology, a breakdown of factor price equalization, the existence of non-traded goods, and costs of trade.

A number of issues have been left unresolved by Davis and Weinstein (2001). First, researchers are currently looking into extending the range of countries used for the tests (Feenstra, 2004). Second, trade in intermediate products needs to be adequately distinguished from trade in final goods. Third, technological differences have been shown to be a major determinant of trade patterns and their underlying causes should be identified. Fourth, researchers are investigating the role of the

integrated equilibrium assumption and factor price equalization (Davis and Weinstein, 2000).<sup>22</sup>

In summary, most of the empirical work that attempted to test or estimate Heckscher-Ohlin models used inappropriate methods and is therefore largely irrelevant. Complete tests failed under the conventional assumptions of identical tastes and identical technologies with factor price equalization across countries. In recent years, however, studies using appropriate methods have shown that if technological differences and home bias are included in the model and if the assumption of an integrated world is relaxed, there appears to be a substantial effect of relative factor abundance on the commodity composition of trade. As pointed out by Feenstra (2004), recent work has been more about accounting for global trade flows than about testing hypotheses related to trade but it certainly has the merit to highlight the fact that there are multiple causes for trade. As the next sub-sections will show, economies of scale, product differentiation, or imperfect competition all play important roles.

#### **(d) Intermediate inputs, services, tasks and fragmentation**

As discussed in more detail later in this section, the most important development in world trade in the last few years has been the acceleration of the fragmentation of production of both goods and services and the associated development of foreign outsourcing and offshoring. Because the fragmentation of production involves trade in intermediate products and services, their role in international trade is viewed as increasingly important. This sub-section considers whether the principal results of the traditional theory of trade still hold in the presence of fragmentation, outsourcing and offshoring involving intermediate inputs and services.

##### *i) Intermediate inputs*

Deardorff (2005c) examines the role of comparative advantage in a Ricardian trade model with intermediate inputs. He finds that only an average relationship between comparative advantage and trade seems to be at all robust. The gains from trade, however, are unambiguous in these Ricardian models, with imported inputs actually providing an additional source of gain from trade. Deardorff (1979) shows that similar results hold in the

Heckscher-Ohlin case. With intermediate inputs, a trade barrier on an input that raises its price can make production of the corresponding final good too costly to survive, even though the country might otherwise be a relatively low-cost producer of the final good. Kemp (1964) shows that the Stolper-Samuelson and the Rybczynski theorems still hold in the presence of traded intermediate products. In a model where each final good can be used as intermediate input in the production of the other final good, Schweinberger (1975) shows the conditions under which the Heckscher-Ohlin theorem holds.

### *ii) Services*

Hindley and Smith (1984) consider the question of the applicability of the normative theory of comparative cost to the services sector. They discuss two potential difficulties in applying this theory to trade in services: the pervasiveness of regulations and licensing in services industries and the fact that services can be traded in different modes. They argue that none of these potential difficulties appears to yield any prior reason to suppose that the theory does not apply. In their words, “services are different from goods in ways that are significant and that deserve careful attention, but the powerful logic of the theory of comparative advantage transcends these differences”. In other words, there is no reason to have any doubt on the potential for countries to gain from free trade in services.

Deardorff (1985) focuses on the positive issue of whether trade in services conforms to a pattern that is explainable by comparative advantage. He looks at three different characteristics of trade in services and considers in each case what they suggest for the validity of the principle of comparative advantage. The first of these characteristics is that traded services often arise as a by-product of trade in goods. The second is that trade in services frequently requires or is accompanied by international direct investment. The third is that while goods can be produced elsewhere from where they are consumed, services cannot. He argues that while the first two of those characteristics do not undermine the usefulness of the law of comparative advantage in explaining trade, the third raises a number of issues.<sup>23</sup> In the third case, he uses a model that is like the standard Heckscher-Ohlin model except that one of the two goods is a service that must be produced where it is consumed and one of the factors

is "management" which can contribute to services production "in absentia". In this case, no version of the principle of comparative advantage is generally valid. Depending on the specific assumptions, weak versions of the law may apply.

Melvin (1989) includes capital services as a tradable in a Heckscher-Ohlin framework and shows that, contrary to the view of Hindley and Smith (1984), the introduction of services does require a different approach, which necessitates the reinterpretation of the law of comparative advantage.<sup>24</sup> If the tradable commodity uses the mobile factor service intensively, the country well endowed with capital will import the capital-intensive good, even though the relative price of this good was lower in this than in the other country in autarky. This result, at first glance, seems to contradict the law of comparative advantage and the Heckscher-Ohlin theorem. However it conforms with comparative advantage, as interpreted by Deardorff (1980), in the sense that it predicts that the country well endowed with capital exports capital services and imports the labour-intensive commodity. The Heckscher-Ohlin theorem also holds, for while the country which is well endowed with capital imports the capital-intensive commodity Y, it exports capital services, which are more capital-intensive than any good. One important implication of this model is that a service-exporting country will be observed to have a merchandise trade deficit. Such deficits, the author argues, would just reflect the country's comparative advantage in the service sector.<sup>25</sup>

Deardorff (2001) argues that for many services, the benefits from liberalization extend beyond the traditional gains from trade liberalization. Many services play a critical role of facilitating international trade in goods and other services. Trade liberalization for those services can yield benefits by facilitating trade in goods that are larger than might be expected from analysis of the services trade alone. Deardorff's paper explores this idea using simple theoretical models to specify the relationships between services trade and goods trade. Services industries, such as transportation, insurance and finance, provide inputs needed to complete and facilitate international transactions in goods. Measures that restrict trade in those services create costs that limit the international flow of trade in goods. By reducing these costs, liberalization can stimulate international trade of goods.

Supportive evidence is provided by Blyde and Sinyavskaya (2007). They match goods data from the United Nations Commodity Trade Statistics Database (COMTRADE) with International Monetary Fund (IMF) Balance of Payments services data to investigate empirically the relationship between trade in services and trade in goods. They find that trade in services is important to facilitate trade in goods in all the 2-digit SITC goods categories. Investigating which types of trade in services are more important for international trade in goods, they find that trade in transportation and communication services generate the largest impact on trade in goods. Insurance, business and travel services are found to generate positive impact on the international trade of only certain types of goods. Lennon (2006) finds some evidence of complementarity between trade in goods and trade in services. Bilateral trade in goods explains bilateral trade in services: the resulting estimated elasticity is close to unity.<sup>26</sup> Likewise, bilateral trade in services has a positive effect on bilateral trade in goods: a 10 per cent increase in trade in services raises traded goods by 4.58 per cent.

### *iii) Trade in tasks and fragmentation*

Revolutionary advances in transportation and (especially) communications technology have enabled an historic break-up of the production process by making it increasingly viable and profitable for firms to undertake different production stages in disparate locations.<sup>27</sup> This has resulted in offshoring of both services and manufacturing sector jobs and rapidly growing trade in intermediate products or tasks (see Box 3). This phenomenon has variously been called fragmentation, unbundling, offshoring,

vertical specialization, slicing-up of the value-added chain or trade in tasks. It will be considered in more detail in Section D. This sub-section only discusses how fragmentation has been integrated in traditional trade models and how it affects the main results of those models.

Two main approaches to the modelling of fragmentation can be distinguished. The first approach is to model fragmentation as trade in intermediates based on comparative advantage. The main insight is that offshoring is similar to technical progress in the production of final goods. Consider a world with two nations, Home (H) and Foreign (F), one final good (X) and one single production factor (labour). The production of X involves two tasks, 1 and 2, which are produced with labour.<sup>28</sup> Assume H has a comparative advantage in task 1 and F has a comparative advantage in task 2. With free trade in tasks, H specializes in the production of task 1, F specializes in the production of task 2. Specialization allows more of the final good to be produced (and consumed) in both countries (standard static gains from production and consumption efficiency). Since more of the final good can be produced with the same amount of primary factors, fragmentation is akin to technological progress in the final good. In other words, offshoring increases labour productivity, expressed as output of the final good per hour worked, in both nations.

Deardorff (2005a) examines in more detail the effect of fragmentation on traditional gains from trade in this first approach. He models fragmentation as the possibility to split a productive activity into parts that can be performed in different locations, much like a new technological possibility that becomes available

### Box 3

#### Tasks, services and intermediate goods

It is important to point out that trade in tasks is potentially encompassing both trade in services and/or trade in intermediate goods.

Tasks can be classified as follows:

1. analytical tasks;
2. interactive tasks;
3. routine cognitive tasks;
4. routine manual tasks;
5. non-routine manual tasks.

If there is trade in tasks 1-3, this will be classified as trade in services. If there is trade in tasks 4-5, this will be classified as trade in goods, because it implies the sourcing of physical inputs (intermediates) produced abroad. Hence, trade in tasks can involve both trade in services and trade in goods.

*Source:* Spitz-Oener (2006).

to a country or to the world. Fragmentation, as he understands it, involves offshoring and thus trade of services. His conclusions about the gains from fragmentation are similar to the conclusions of trade theory about the gains from trade. Cases can be identified where fragmentation lowers the welfare of particular countries. If, for instance, fragmentation causes a change in relative world prices, it is possible that one country's terms of trade worsen to such an extent that it is made worse off, despite the new technological ability that fragmentation represents. Similarly, if fragmentation interacts negatively with existing distortions, such as tariffs, it can lower the welfare of particular countries and even of the world as a whole. However, on average, fragmentation is likely to expand world welfare because it will systematically expand what the world is able to do potentially with its given resources.

The second approach to fragmentation has been introduced recently by Grossman and Rossi-Hansberg (2006b). They present a theory of offshoring, or trade in tasks, which they refer to as a "new paradigm". Because their main contribution relates to the effect of fragmentation/offshoring on wages and distribution, it will be discussed in more detail in Section E of this Report.<sup>29</sup> The discussion here focuses on the linkages between the "new paradigm" and traditional trade theory. The main result is that in addition to comparative advantage gains from trade, fragmentation has a welfare-enhancing productivity effect on wages in the offshoring country, according to Grossman and Rossi-Hansberg.<sup>30</sup> A main difference between their approach and the first approach of fragmentation is that they factor in that a firm with better technology can use this technology abroad. There are also task-specific offshoring costs that are best understood as the communication and organizational costs that a firm pays when it sources the performance of a task abroad. The advantage of offshoring a task is that the firm combines its superior technology with cheap foreign labour when the task is performed abroad.<sup>31</sup>

To understand the thinking behind the model, consider two countries, North and South. Firms in North have superior technology. Wages are higher in North than in South because they are tied to technologies. North firms are interested in combining their superior technology with cheap labour in South. They will offshore a task if the initial wage gap is larger than the offshoring costs. The wage in South is assumed to remain

constant. The reason for this is that South firms are assumed to continue producing the final good using South technology which keeps the wage at the low level. The wage in North will increase because productivity increases. Productivity increases because offshoring releases domestic workers who can focus on the tasks where they have a trade-cost-adjusted comparative advantage. This productivity effect is independent of comparative advantage based on tasks. For the offshoring country, it comes in addition to the Ricardian gains from trade that existed in the first approach.

### (e) Factor mobility

So far, models have been considered where the factor(s) of production are assumed to be mobile between industries but not between countries. In this sub-section, these assumptions are relaxed and consideration is given to how the gains from trade and comparative advantage results are affected. The assumption that there is no movement of factors of production between countries is maintained but the assumption of perfect factor movement between industries is further qualified. This sub-section ends by considering how traditional trade models take account of international mobility.

#### *i) Internal mobility*

The specific factors model assumes that an economy produces two goods using three factors of production in a perfectly competitive market. Two of the three factors of production, typically land and capital, are assumed to be sector-specific, which means that they can be used only in the production of a particular good, while the third, typically labour, is common to both sectors. Since mobility of factors in response to any economic change is likely to rise over time, the specific factors model can be interpreted as capturing medium-term effects and the models with perfect movement between industries as representing the long-term effects.

A number of interesting results – in particular, regarding the distributional effects of trade – can be derived from the specific factors model, which was used extensively prior to the ascendancy of the Heckscher-Ohlin model. Because there is only one factor that is used in both sectors, the allocational problem in the specific factors model is relatively simple. The wage rate and the equilibrium allocation of labour can be found by setting the

sum of labour demand in each sector equal to the available supply of labour. The wage rate can then be used to determine the rental rate of the two specific factors.

While the gains from trade result remains valid in the specific factors model, there are some issues with the law of comparative advantage and the effect of changes in prices or endowments that are different here from what they are in the Heckscher-Ohlin model.

First, trade produces overall gains in the limited sense that those who gain could in principle compensate those who lose while still remaining better-off than before.<sup>32</sup> Second, as already mentioned, in a two-sector, multi-factor world, comparative advantage will not be an infallible predictor of a country's trade pattern. As demonstrated by Falvey (1981), however, while the statement that “a country will export those commodities in which it has a comparative advantage” is no longer a theorem, it appears to be a useful presumption, even in a multi-factor world. Third, the implications of the specific factors model are quite different from those of the Heckscher-Ohlin model. In the specific factors model, an increase in the price of a good raises the real return to the specific factor in that sector, lowers that to the other specific factor, and has an ambiguous effect on the real return to the mobile factor.<sup>33</sup> An increase in the endowment of a factor specific to a sector leads to a less than proportionate increase in the output of that sector and a decline in the output of the other sector. The return of the mobile factor rises, while those to sector-specific factors decline. An increase in the endowment of the mobile factor lowers the return to that factor and increases those to specific factors. Outputs of both sectors rise.

The specific factors model has been much neglected empirically (Leamer and Levinsohn, 1995). Grossman and Levinsohn (1989) provide some evidence suggesting that capital is sector-specific while Kohli (1993) finds that a sector-specific structure is broadly consistent with data for the US economy.

### *ii) International factor mobility*

From an economic point of view, trade in factors is much like trade in goods. It is driven by international differences in resources and is beneficial in the sense

that it increases world production. The focus here, however, is not on explaining factor movements but rather on the interactions between trade in goods and factor mobility. A major and strong assumption in the models discussed so far is that factors of production cannot move between countries. In this sub-section, this assumption is relaxed and consideration is given to how this affects the law of comparative advantage and the validity of some of the main trade theorems. Trade literature has focused on capital movements, probably because labour is considered less mobile at least in the short term. However, some of the results would in principle apply to any factor.

The idea that trade is a substitute for factor movements dates back to the early 20<sup>th</sup> century and has been expressed by a number of eminent economists. This idea is based on the factor endowment theory of international trade elaborated by Heckscher and Ohlin. According to this theory, trade in goods is caused by differences in factor endowments between countries. Thus, on the one hand, movements of factors between countries that tend to equalize resources reduce incentives to trade. On the other hand, as already mentioned, exports of goods can be viewed as indirect exports of factor services. Trade in goods tends to equalize factor prices and thus to reduce incentives for factors to move.

Mundell (1957) laid out the argument that trade and factor movement can substitute for each other in a model where both trading countries share the same technology. When factor-price equalization holds, free trade implies commodity price equalization and a tendency towards factor price equalization even when factors are immobile while perfect factor mobility implies factor price equalization and a tendency towards commodity price equalization even when trade in goods is not allowed. When factor prices are not equalized, goods trade and factor movement are nevertheless substitutes but in a weaker sense (Wong, 1995).

Wong (1995) shows how the law of comparative advantage can be generalized to cover the movements of goods and capital. The general law of comparative advantage, however, is so general that it cannot be used to predict the direction of movement of a particular good or capital even if all the autarkic prices are known. Wong thus discusses the conditions under which patterns of trade and direction of international capital movements are

predictable. He shows that perfect capital mobility between countries preserves most of the core trade theorems in a Heckscher-Ohlin setting with two goods, two immobile factors and internationally mobile capital. He also shows that without the assumption of identical technologies, the analysis can become quite complicated. Comparative advantage and absolute advantage, defined in terms of price ratios in the countries, are no longer a fixed concept. In the presence of capital movement, they depend on the direction and level of capital movement. Reversal of comparative advantage and the transformation of absolute into comparative advantages are possible.

Norman and Venables (1995) investigate both the direction of trade and the question of which goods or factors are traded. They let goods be tradeable and factors of production be internationally mobile. Since goods trade alone does not equalize factor prices, there is an incentive for international factor mobility. From this general model, they are able to derive conditions on factor endowments and trade costs with the result that the equilibrium has no trade; has trade in goods only; has factor movements only; or has both trade in goods and factor movements.

The substitutability relationship between trade and factor movements is closely associated with the Heckscher-Ohlin endowments driven trade theory. Markusen (1983) demonstrates that factor movements and trade in goods can be complements in models where trade is driven by differences in technologies or by other factors.<sup>34</sup> To do this, he uses a simple model with two goods and two factors and assumes that both countries have the same factor endowments but that one of the countries is more efficient in the production of one of the goods. In this setting, the more efficient country exports the good that he produces more efficiently. In the initial trading equilibrium, factor prices are not equalized and if factors are allowed to move, there will be an inflow of the factor used intensively in the production of the export good. This will add a factor proportions basis for trade that will complement the differences in technology basis. Factor mobility will thus lead to an increase in the volume of trade.

Another interesting effect of international factor mobility is that it makes it important to distinguish between domestic and national welfare. Bhagwati and Brecher (1980) shows that in the traditional

Heckscher-Ohlin model of trade theory, a shift from autarky to free trade may reduce national welfare while it increases domestic welfare. Assume for instance that the importable good is labour intensive, labour is wholly national but capital is all foreign. A change from autarky to free trade will lead to exports of the capital-intensive good, which will reduce the real income of labour and increase the real income of capital. Free trade in this case would reduce national welfare.

## 2. “NEW” TRADE THEORY: GAINS FROM ECONOMIES OF SCALE, PRODUCT VARIETY AND INCREASED COMPETITION

This sub-section discusses the “new” trade theory, motivated to a large extent by the observed importance of intra-industry trade and of trade between similar countries (in terms of technology or resources) that traditional models had difficulties in explaining. Even in the absence of differences, countries gain from trade, since consumers have a wider choice of products at lower prices and firms can exploit economies of scale when having access to a larger market. Of course, the rationalization of production also implies that some firms go out of business. The size and relative importance of these effects have been subject to empirical investigation of pre- and post-liberalization episodes in a range of countries.

### (a) Intra-industry trade and the volume of trade between similar countries

Perhaps one of the earliest and best-known studies on the importance of intra-industry trade has been by Balassa (1966) on the formation of the European Economic Community (EEC). He made a number of observations that have triggered the search for an alternative explanation of international trade beyond country differences and comparative advantage. He showed that the trade share of the dominant suppliers in an industry during the implementation of the EEC decreased in practically all industries in the 1958-63 period. This contrasts with the predictions of traditional trade theory, according to which inter-industry specialization in line with comparative advantage would be expected, with the largest supplier within each industry taking the lion's share in the expansion of trade.