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Trade Regimes and Gatt: Resource Intensive vs. Knowledge Intensive Growth

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Abstract

Trading blocks can help or hinder the liberalization of world trade. A determining factor is whether trade within the block is organized around traditional comparative advantages, or around economies of scale.

Regional free trade agreements such as NAFTA can be a *substitutes* for global free trade when they are based on traditional comparative advantages; then each regional market develops market power and incentives to impose tariffs on the rest of the world. Alternatively, regional trade agreements can be *complementary* to global free trade. This occurs when the blocks are organized around the exploitation of economies of scale and based on knowledge-intensive sectors.

I establish that external economies of scale produce incentives for expanded trade; they can defeat the standard arguments for "optimal tariffs" and mitigate another negative feature of trading blocks: their tendency to divert trade from efficient to inefficient sources. The emergence of regional blocks organized around economies of scale can therefore lead to increasingly open international markets. I discuss policy implications for the EU and for free trade in the Americas.

1 The EU, NAFTA and the Gatt

Regional free trade zones have been unexpectedly successful in the last decade. Since 1980 the European Union enlarged significantly its membership and its

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scope. Today the EU includes southern European countries, and it allows goods, people, services and capital to flow freely around an area accounting for about one fourth of world economic output.

In what appears to be a strategic response, the US has been activated to enter into similar agreements with its neighbors. The arithmetic is simple. The US accounted for about 40% of the world's output after the Second World War,[2] a figure that decreased steadily until today, when it represents about 25%. The recent completion of the European Union faced the US for the first time since 1945 with a unified group of countries that matches its own economic prowess. This changed matters: shortly afterwards a trade and investment agreement was signed with Canada followed almost immediately by the adoption of NAFTA. The agreement could expand to the rest of the Americas.

The same trend is observed in other regions. The six members of the Association of South East Asian Nations – Singapore, Malaysia, Thailand, Indonesia, the Philippines, and Brunei – have began in 1992 to build their Asean free trade area AFTA as a future counterweight to other international trading blocks. The Japanese have increasingly focused their economic attention in their own region, leading to more investment in and imports from the new East Asian manufacturing exporters. Even the Andean Pact seems to be progressing in Latin America after several decades of aimless discussions, with Mercosur following suit. Of the fourteen trading blocks in existence today[3] seven have been formed since 1992.

While regional free trade agreements prosper, the negotiations towards the liberalization of global trade have floundered for many years. The last round of Gatt negotiations, the Uruguay Round, was ratified recently by the US and also by the EU. All along the agricultural markets have been a key negotiating problem: this will be discussed later as an excellent example of the issues involved.

While the Gatt negotiations are political, it is reasonable to seek explanations for the situation from an economic viewpoint. The contrast between the lackluster performance of the Gatt and the success of the regional trade pacts raise disparate reactions. One view is that the emergence of regional trade pacts is a step in the right direction. "Custom unions", as regional free trade pacts are usually called, are in this view stepping stones towards world free trade. Another, quite distinct, reaction, is to fear that "customs unions" are inherently opposed to global free trade. Do custom unions increase free trade with insiders at the cost of diverting trade with outsiders?

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[2] Before the Second World War the US represented about 25% of the world economy. This increased to 40% after the War due to the destruction of the German and Japanese economies.

[3] EU inaugurated in 1958, SEMAC in 1964, ASEAN in 1967, ANDEAN in 1969, CACM in 1974, ECOWAS in 1975, PTA in 1981, SADC in 1992, UEMOA in 1994, NAFTA in 1994, MERCOSUR in 1994/95, G3 in 1994/95, APEC in 1994 and VISEGRAD in 1994.

Since the classic works of Meade [21] and Viner [26], who classified the issues into trade creation and trade diversion, there has been little conceptual advance on this issue. But the issue is very alive today, and requires our attention.

This paper will re-examine the positive and negative aspects of trading blocks as they relate to gains from free trade. It is primarily a discussion of conceptual issues, although it is based on facts and on particular cases which are of interest to the trade liberalization in the Americas. I take a somewhat different approach to a familiar issue. Rather than asking the standard question of whether regional blocks help or hinder global free trade, I ask: *what type of trading block* is likely to lead to a trade war between the blocks, and what type is, instead, likely to expand global trade? In practical terms: what type of trade regimes within the blocks will provide economic incentives for expanding free trade?

I shall compare the impact on the world economy of trading blocks which are organized around two alternative principles, or trade regimes. One is *traditional comparative advantages*, the other is external *economies of scale*.[4] These represent two patterns of growth: resource-intensive vs. knowledge-intensive. The aim is to determine how the patterns of trade *inside* the blocks determine the trade relations *among* the blocks.

The paper has four parts. The first part reviews the existing economics of trading blocks, and uses this to explain the current situation in the EU and NAFTA. The second part presents a new conceptual approach focusing on the internal organization of the trading blocks and the economic incentives that this generates with respect to the rest of the world. The third part is a conclusion which pulls the arguments together for an evaluation of NAFTA, EU, and global free trade. The fourth part is an Appendix which provides a formal general equilibrium model of trading blocks, an extension of my model of North-South trade [4–6] which incorporates goods which are produced with external economies of scale. I establish rigorously in the Appendix the results which underlie the discussion in the text.

2 The Economics of Trading Blocks

International trade in the last ten years focussed on economic dynamics and on market imperfections. However the central tenet of the theory of international trade remains the same: the classic results on the efficiency of competitive markets.

In competitive markets, free trade leads to Pareto efficient allocations. There is no way to make a someone better off without making someone else worse off.

[4] I benefitted from the ideas of Jane Jacobs in "Cities and the Wealth of Nations", Random House, 1985.

Called the first theorem of welfare economics, the general result that competitive markets lead to efficient allocations seems to loom the larger, the more special cases of market imperfections are pointed out.

In view of the efficiency of competitive markets, the difficulties faced by Gatt in bringing an agreement about a world of free trade seems, at a first sight, irrational. It would appear that countries act as if they could, but prefer not to, achieve an efficient allocation. Indeed, some believe that the failure of Gatt is simply a version of the well-known prisoners' dilemma.[5]

Are countries irrational in evading free trade? Such a view would be incorrect. The Gatt's problems derive not from irrational behavior, not from a lack of coordination. There is a simple, rational explanation: while free trade in competitive markets leads to efficient solutions, when countries are large and have market power, this is no longer true. Free trade may not lead to Pareto efficient allocations when the countries are large and have market power. Indeed, large countries may choose the quantities they export in order to manipulate to their advantage world market prices, much the same way that a monopolist chooses to supply a quantity that maximizes its profits considering its impact on prices. Such strategies are rational for large countries. The only case where free trade leads surely to Pareto efficient allocations is when markets are competitive, when no country has market power.

Do all countries stand to gain from a move to free trade? The answer is negative. Under classical assumptions, a move from tariffs to free trade will typically make some countries better off but other countries worse off. It is true that if a competitive allocation were reached, it would be Pareto efficient. But in a world with tariffs, as we have today, under traditional assumptions some country will loose if free trade is adopted. There is therefore no reason for all countries to agree to free trade.

Indeed when countries are sufficiently large to have an impact on market prices, then they have an incentive to impose tariffs on each other. One may ask: precisely how do large countries benefit from protectionism? How do tariffs work?

Large countries can improve their position by improving their *terms of trade:* the prices of exports relative to those of imports. Better terms of trade means that the country pays less for what it buys, and receives more for what sells. A country is typically better off with better terms of trade.

Of course, in competitive markets countries do not manipulate terms of trade to their advantage: this is practically the definition of competitive markets. But international trade theory proves that, under traditional assumptions, a large country does have an economic incentive to impose tariffs on others. This is the

[5] The words "prisoners' dilemma" are used to describe a generically inefficient situation, one which, with appropriate coordination between the players, can be altered so as to improve the welfare of all.

standard theorem on *optimal tariffs,* which is discussed in more detail below. The theorem says that, under traditional assumptions, there is always an *optimal tariff,* one at which the gains from increasing its terms of trade through tariffs exceeds the losses due to the attendant distortions. This theorem is widely accepted, understood and applied.

The argument in favor of optimal tariffs is of course not true for small countries. For this argument it is essential that the country should be large enough to have an impact on prices. Furthermore the larger the country, the more market power it has, and the more it can gain from imposing tariffs on others.

The importance of all this today is that if a world of small competitive economics merges into a few large trading blocks traditional, under traditonal assumptions, after the blocks are formed, there are more incentives for imposing tariffs than before. In other words, under traditional conditions, regional trade blocks, lead to protectionism.

The *optimal tariff* which we have just discussed is imposed by one country on others unilaterally. The classic theorem does not consider the possibility of retaliation by other countries. But what if they retaliate? What if other countries also impose tariffs in response?

We now move to a world of strategic considerations, a world with tariff wars. Each country imposes tariffs on each other, and does so strategically so as to maximize its welfare given the actions of others. The outcome of this tariff game was studied in Kennan and Riezman [15, 16]. If each country chooses as its tariff the best response to the others', a market equilibrium with tariffs is reached. We call this an *optimal tariff equilibrium* to distinguish it from the free trade equilibrium.[6]

In an optimal tariff equilibrium some countries are better of than they would be at a free trade equilibrium, [15, 16] and [25]. Furthermore, these works show that the larger the country, the more it can improve its welfare at the optimal tariff equilibrium.

To a certain extent the current situation in the world economy can be described as an optimal tariff equilibrium. Each country imposes tariffs on others strategically. In this light the difficulties of the Gatt have a reasonable explanation. The unwillingness of countries to agree to multilateral free trade is neither irrational nor a coordination problem. It is a rational response to economic incentives of countries with market power.

One immediate implication is that regional trade blocks will increase the market power of the market participants and therefore can lead to tariff wars. Under traditional conditions, the larger is the market power of a trade block, the larger is its incentive to impose tariffs on others. Even after retaliatory moves are

[6] It is not a competitive trade situation because the traders act strategically, manipulating prices. In a world with free and competitive trade, no-one has an impact on prices, nor does anyone act according to price strategies.

taken into account the same proposition holds: the larger the market power of the block, the greater its gains from a tariff war.

Since these results predict that regional free trade zones create incentives against global free trade under traditional assumptions, it is crucial to examine these assumptions closely. For whenever these conditions are satisfied, regional free trade inevitably leads to trade wars. And the larger the free trade zones, the more likely is that they will lead to trade wars.

I examine these conditions in the next section. This examination will be conceptual, but focused on particular cases of immediate interest. Recalling classical results on tariffs of A. Lerner [18] and of L. Metzler[23],[7] and based on new results on trading blocks with economies of scale of Chichilnisky [8] reported in the Appendix, I show that if the blocks are organized internally around the principle of economies of scale, the optimal tariff theorem can be defeated. *With increasing returns, a country may be better off with free trade than with tariffs.* Before I turn to the new results, I will explore the implications of the classic optimal tariff theorem on the European Union and on NAFTA.

NAFTA – and any further extension to a larger free trade zone in the Americas – emerged as a strategic response by the US to the creation of the European Union. The European Union is a free trade zone with a quarter of world output. In seeking to form a trading block with its natural trading partners in the Americas, the US appears to respond to the creation of market power, with an attempt to create more market power itself. This is a rational response if the US expects a united Europe to impose tariffs on the rest of the world. As discussed above, the emergence of a region with increased market power generally provides an incentive to other regions to seek similar status.

More explanatory power still can be extracted from the results of Kennan and Riezman [15, 16] and Riezman [25] on who wins trade wars. Following the creation of a custom union, the incentives are not just to create or join another free trade zone. The economic incentive is to join another free trade zone with the largest possible market power. This result allows us to predict that the US will seek a free trade deal with as many countries in the Americas as possible. The aim is to reach market power which exceeds that of a unified Europe.

The final result on world trade will however depend on the trade patterns adopted within the blocks. Trade patterns within the EU and NAFTA can be based either on traditional comparative advantages or on economies of scale. These are two different patterns of development, which can be broadly illustrated by Asian-type development strategies, which focus on knowlege-intensive products such as consumer electronics, communications and financial markets, and African and Latinamerican-style type development strategies, which focus instead on resources

[7] Lerner and Metzler do not refer to economies of scale: their results on the impact of tariffs on terms of trade are due to income effects.

and labor intensive products. The former emphasize products which rely on an educated labor force and human capital. The latter emphasizes resources and cheap, mostly uneducated, labor intensive products. It is to a certain extent a matter of policy choice which pattern of development is adopted. The choice is either products and technologies which are associated to *external* economies of scale, or those associated to traditional comparative advantages. In sum: trade policies within a trade block determine the extent to which the trade block will aid or hinder global free trade. The argument for this result, and its implications for trade policy, will occupy the rest of this paper.

3 Trade Creation and Diversion

3.1 The Traditional Case

How do we measure the gains and the losses of creating a free trade zone?

A naive view on this is that since free trade in competitive markets is Pareto efficient, any move towards free trade is positive. As we saw, this argument is not correct. Regional trade blocks, being larger than their components, will have more market power and therefore under traditional conditions will impose tariffs against outsiders. Therefore trading blocks hurt the countries outside these areas.

Are free trade zones only damaging to outsiders? The answer to this question is: generally no. There is a second source of potential damage. The trading block can lead to *trade diversion.* This means that a trade block may lead to the wrong specialization within the block. The classical argument about trade diversion is found in Viner [26], whose work remains a benchmark of analysis for preferential trade agreements. I summarize his argument here in order to show that, if trading within the blocks is organized around economies of scale, then Viner's argument can break down. With economies of scale, the negative effect of trade diversion can be mitigated. The empirical evidence discussed below suggests that this is what has happened in the European Common Market since 1958.

Viner's argument can be captured from the textbook table presented below:

There are three countries, Germany, Portugal and the USA. They trade a commodity, vegetable oil. Initially Germany has a tariff that applies equally to all imported oil, no matter what its source. If it imports oil despite the tariff, it will buy initially from the USA, which offers the best price. The example appears in the second column, showing a low initial tariff. However if the tariff is high enough, then Germany will produce its own oil, as in column 3. What happens if now Germany enters into a free trade agreement with Portugal?

If the tariff was initially the level indicated in column 2 of Figure 1, the welfare of Germany increases after the regional block is created, since it replaces its domestic oil with a less expensive oil and uses its domestic resources in

Cost of Veg. Oil	Tariffs		
	0	8	12
Germany	20	20	20
Portugal before EEC	16	24	28
Portugal after EEC	16	16	16
USA	10	18	22

Fig. 1. The effects of Trading Blocks: Trade Diversion.

more productive sectors. However, if the tariff was initially higher, as in column 3 of Figure 1, then after the free trade agreement Germany shifts from American to Portuguese oil, i.e. from a low cost to a higher cost producer. In this case, the free trade zone lowers welfare in the participating region. It has diverted trade.

Viner's point is that there are "trade creating" free trade zones, which increase imports by members from one another. These imports replace less efficient domestic production, and are therefore desirable. On the other hand, free trade blocks can "divert trade": imports can be diverted from a lower cost source outside the block to a less efficient source inside the block. The insider source could be less productive but may offer more attractive prices after the tariffs were selectively dropped. The latter trading is undesirable.

Extra trade among the members of the trading block can improve welfare. The trade which is a diversion from efficient outsiders to less efficient insiders, lowers welfare. For example if northern Europe is induced by the entry of southern Europe to buy oil from Portugal rather than an equivalent from the US, and the US source is more efficient but less competitive after the tariffs are dropped, there has been a welfare loss. Generally speaking Viner's approach evaluates free trade zones by the extent to which more trade is created, rather than existing trade diverted from one source to another.

3.2 Economies of Scale Mitigate Trade Diversion

Viner's original insight remains central to the analysis of preferential free trade zones. But, in practice, it misses an important aspect. The increased size of the market can sometimes lead to more efficiency and competitiveness. Even in the cases where Viner's analysis predicts welfare losses, namely when the trade block diverts trade to inside sources which are initially less competitive, welfare can still increase with economies of scale. This can be explained simply in our numerical example.

Cost of Veg. Oil	Tariffs		
	0	8	12
Germany	20	20	20
Portugal before EEC	16	24	28
Portugal after EEC	9	9	9
USA	10	18	22

Fig. 2. Trade is not Diverted with Economies of Scale.

As Portugal expands its oil production due to its new trade with Germany, it can become more efficient due to economies of scale. This situation is illustrated in Figure 2, column 1. After the tariffs are removed Portugal produces and exports more oil and in the process it becomes more competitive and its costs drop, reaching or improving upon the US level. In sum: with economies of scale, Viner's analysis is reversed.

Economies of scale can have a major impact on trade policies. They can check the negative effects of trade diversion. I shall argue in what follows that they can also limit another negative effect: the incentives for large blocks with market power to impose tariffs on outsiders. These are the two major drawbacks of trading blocks: tariff wars and trade diversion. Both drawbacks are reduced and could be eliminated in trade regimes based on economies of scale.

3.3 Empirical Evidence for Economies of Scale: Knowledge-intensive Growth

What does the empirical evidence show?[8] It is widely believed that economies of scale were an important factor in the Treaty of Rome. Economies of scale were central to the success of the European Common Market which was formed in 1958. While a strong possibility for trade diversion existed *a priori* in the EU, in reality

[8] Although the central body of international trade theory is based on the assumption of constant returns to scale, the belief is widespread that increasing returns are important in reality, and there is a large body of literature specifically addressing the issues that emerge. Classical references are Graham [12] and Viner [27]; modern references include Mathews [19] Meade [20] and more recently Chichilnisky and Heal [9] Chapter 3, Ethier [11], and Krugman and Obstfeld [17]. However the literature has neglected the issue of trading blocks with economies of scale as studied here. In fact, while the results of Graham and Viner argue that increasing returns to scale are a motive for protection, my results argue that, to the contrary, increasing returns provide a reason against tariffs, and for free trade.

huge inter-industry trade emerged in manufactures. The increase in market size and the associated rationalization in production led to efficiency gains which took precedence over possible trade diversion.

A discussion of the empirical evidence for economies of scale in the US and in Europe is in Chichilnisky and Heal [9], and the reader is referred to that source. Of particular interest are all sectors which require large scale production for efficiency such as automobile industry and aerospace. These were traditonally the most important sectors in the US economy. More recently, economies of scale became prominent in sectors where knowledge is an important input, such as computer processing, hardware and software, telecommunications, financial markets and genetic engineering. Chichilnisky and Heal [9] developed a rigorous foundations of international trade with increasing returns in a neoclassical model of trade with two countries and two goods, and discussed the policy implications of economies of scale for North-South trade.[9]

An interesting discussion on the matter of returns to scale is also in a recent paper which does not draw the connection between economies of scale, optimal tariffs and trade diversion, but provides evidence for the US-Canada case and for the EU[10]: "Indeed, hopes for large benefits from both the US-Canada free trade agreement and Europe 1992 rest largely on an increase in competition and rationalization. In the North American case, the estimate of Harris and Cox, which attempt to take account of competitive/industrial organization effects, suggest a gain for Canada from free trade that is about 4 time larger than those of standard models. In Europe the widely cited and somewhat controversial figure of 7 percent gain due to 1992 presented in the Cechini report of the Commission of the European Communities 1988 rests primarily on estimates by Alisdair Smith and Anthony Venables of gains from increased competition and rationalization."

A standard textbook analysis of economies of scale is in Nicholson [24], "Costs", pages 252–255, who documents that most studies of long-run cost curves have found that average costs are decreasing up to a point and then constant. Examples provided are agriculture, electricity generation, railroads, and commercial banking, all activites which are broadly associated with economic development. The same textbook analysis explains how competitive markets can lead to a negative association of quantities and prices across equilibria which is typical of economies of scale. This was the content of the famous debate in the 1920's between J. H. Clapham, A. C. Pigou and D. H. Robertson, which was resolved positively, and which appeared in the Economic Journal between 1922 and 1924,

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[9] They show that when the North exports goods with economies of scale and the South exports goods without, the North benefits from trade expansion, but the South's term of trade typically drop, Chapter 3.

[10] See P. Krugman "The Move to Free Trade Zones" Working Paper, Economics Department, MIT, 1991, presented at the UN-ECLA June 1992 Conference on Trade Liberalization in the Americas, Washington D.C.

see Nicholson [24], "Perfectly Competitive Pricing in the Long Run" page 332. These authors agree that competitive markets *can* show a negative association between prices and quantities in the long run. A typical example of this phenomenon is the computer industry. Chichilnisky and Heal [9] have discussed in some detail the policy implications of international trade in economies with increasing returns to scale in a report on trade policies in the 1980's to the Secretary General of UNCTAD. They arrive at similar conclusions.

I have argued that economies of scale can defeat trade diversion, and transform the attendant potential losses into gains. I will also argue below that increasing returns can defeat the incentives for tariff wars between blocks. Trade diversion and tariffs are the main forces which oppose the simultaneous development of trading blocks and free world trade. Therefore the formation of trading blocks with increasing returns can become a parallel, complementary effort towards the liberalization of world trade.

4 Trading Blocks With Economies of Scale

4.1 Trade Inside and Between the Blocks

Although predictions are inherently dangerous in an area so circumscribed by political action, my conclusion is that trade blocks can have different effects on global markets depending on their structure. It is the choice of well informed and reasonable economic agents which structure will prevail.

Regional trading blocks based on traditional comparative advantages will generally divert trade. They will also typically hinder the propects of global negotiations. In this case, as the block has more market power then its parts, it has the incentive to impose tariffs on the rest of the world. Regional blocks develop incentives for trade wars. This type of regional free trade zone works against global free trade.

However, if trade blocks are oriented to the expansion of trade based on increased size and on the productive efficiency and competitiveness that comes with economies of scale, matters are different. In this latter case, the regional free trade zones could unleash an appetite for further expansion of trade. In this case the incentive for blocks to impose tariffs is reduced, and can be defeated by the incentive in favor of trade expansion which accompanies economies of scale. The incentives are now for further expansion of trade. The creation of trading blocks which are organized around economies of scale is therefore part of a broader trend towards increasingly open world markets.

5 The Americas: Traditional Comparative Advantage or Economies of Scale

The pattern of trade inside the blocks is of particular importance for an American free trade zone. Trade within NAFTA is mosty based on traditional comparative advantage and on the diversity between the traders' economic development rather than on economies of scale. Exports from Mexico to the US are mostly petroleum or resource based products, a pattern which holds also for the rest of Latin America. Therefore NAFTA's characteristics are unfavourable to global free trade.

The matter is not only one of economic reality: it is also one of perceived economic reality. Both the European and the East Asian countries perceive gains from trade as a matter of exploiting economies of scale. The newly industrialized countries in Asia, and the Japanese, have a dynamic vision of comparative advantages. Moving up the ladder of comparative advantages in the production and trade of skilled-labor manufactures, of consumer electronics, and of products based on specialized knowledge and on technological skill, are widespread priorities.

By contrast, within the sphere of influence of the US, the vision of trade based on traditional comparative advantages still prevails. It permeates to a great extent the thinking about international trade at the government level, at the international organization level, at the academic, and even at the journalistic level.

The European free trade zone is, to a certain extent, a zone of equals. To encourage this equality, the free mobility of labor has been one of the first steps in the European integration of 1992.

The Americas, on the other hand, have the US as a hegemon, a "hub" which concentrates on exporting manufactures and skill intensive goods to the "spokes" in exchange for their resources. The free mobility of labor between the hub and the spokes is an unspoken issue. It has not even been contemplated in the American negotiations for free trade. It has not been mentioned by any of the governments concerned that labor could move freely between the NAFTA trade partners, as it is in the EU. In some cases, quite to the contrary, the free trade agreement has been mentioned as a way to limit the mobility of labor between the concerned countries, such as Mexico and the US.

To the extent that labor remains a fixed input of production within the countries of the Americas, traditional comparative advantages based on labor will be invoked as a foundation for policy. The concern is that an American free trade zone, if it emerges, may reflect the historical patterns of trade between industrial and developing regions, which is usually called North-South trade. These patterns would not be conducive to the overall liberalization of world trade.

6 Traditional Comparative Advantage and the Global Environment

The global environment provides another argument against traditional comparative advantages. Traditional comparative advantages emphasize the South's concentration in the production and export of goods which deplete environmental resources, such as wood pulp and cash crops which overuse rain forests, and fossil fuels and minerals whose combustion leads to the emission of greenhouse gases. Recent work in the area of North-South trade with environmental inputs to production (Chichilnisky [6, 7]) shows that poorly defined patterns of property rights on forests, fisheries, and arable land in developing countries may lead to a market-induced oversupply of products which are intensive in the use of these resources, and to Pareto inefficient patterns of international trade. Indeed, it is shown in Chichilnisky [6, 7] that differences in property rights can by themselves explain the patterns of trade between nations. What appears as comparative advantages may simply be a reflection of a market failure which through the magnifying glass of international trade leads to an inefficient overuse of resources in the entire world economy. Social and private comparative advantages differ, and social and private gains from trade may also differ in these circumstances [6, 7].

The global environment is therefore another argument against traditional comparative advantages as a foundation for trade.[11] Since two thirds of the current exports from Latin America are resources, and the main trade of Ecuador, Venezuela and Mexico with the US is petroleum, this problem is very real. It is also very real with respect to the trading in wood products which lead to the deforestations of the remaining tropical forests in Central and South America [1–3, 13]. Petroleum extraction in Ecuador destroys its Amazonian resources. Replacing traditional comparative advantages with economies of scale could be a necessary feature of a program of sustainable development.

7 External Economies of Scale are Labor and Knowledge Intensive

It seems desirable at this point to distinguish between two types of economies of scale: internal to the firm, or external to it. The former occur when each firm is more efficient in the use of its inputs to production as the level of its output increases. Such economies of scale are typical of traditional industries which require large fixed costs, such as aerospace, airlines, and automobiles. This type of increasing returns, called internal, can lead to monopolistic competition or other

[11] Tradional tax policies, levying duties on the use of such inputs in the South, may not work if they lead to lower income levels, and may indeed lead to more extraction of the resource and more exports of the resource intensive commodity. Property rights policies may be more effective in this case.

forms of limitations to market entry. There is a loss to the consumer because free market outcomes are typically not Pareto efficient when firms have market power and can influence prices.

There is a different type: external economies of scale. These also lead to a decrease in per unit costs as the ouput expands, but they do so at the level of the industry or of the country as a whole. Each firm's production function faces increasing cost per unit of output, i.e. decreasing returns to scale, which assures competitive behavior. However, as the industry expands, externalities are created which lead to increased productivity for all the firms. A good example is provided by the electronics industry. Each computer manufacturer faces a competitive market. On the other hand, as the overall level of output of the industry expands, knowledge about new technologies develops and is rapidly diffused across the industry leading to lower costs for all. Any industry which depends heavily on knowledge has this characteristic. Increasing returns originate in the skill of labor, which embodies knowledge. Knowledge is typically diffused and can be captured and imitated sooner or later. There are abundant examples in the software and hardware industry to prove this point[12]. Knowledge creates skilled labor, and this in turn leads to increasing returns to scale, which are often external to the firm. This can lead simultaneously to economies of scale and to competitive markets. The successful development experiences of Japan, Korea, Taiwan, and more generally the Asian Tigers, shows that export-led policies based on skilled labor intensive goods, for example in consumer electronics, is more successful than those based on inexpensive and uneducated labor. This point was developed formally in Chichilnisky [5], [4], and more recently of Dadzie [10].

In this paper I concentrate on external economies of scale, which are closely connected with production system based on skilled labor. It should be noted that the areas most favorable to external economies of scale, such as software production, are labor intensive rather than capital intensive. Therefore they are particularly well suited for developing countries with abundant and skilled labor.[13]

8 Optimal Tariffs

8.1 Traditional Theory With Decreasing Returns

A second traditional concern about trade blocks is that they generate incentives to levy tariffs on outsiders. I mentioned above that, under traditional assumptions, a large country will typically impose tariffs so as to improve its terms of

[12] Microsoft's Windows excellent imitation of the Apple operating system was tested in the US courts and found without fault.

[13] India is a good example; it exports software news succesfully. So is Mexico, which produces chips. Barbados is planning a shift to an information-age society in one generation.

trade. In doing so it typically introduces distortions in its production and consumption. Here I will show in a simple example how under traditional assumptions there is a tariff that improves welfare, in the sense that the gains from improved terms of trade exceed the losses from distortions. The analysis is completely standard, but it is included in order to highlight the differences which arise in economies with increasing returns to scale. This section discusses economies with decreasing returns: the next section discusses economies with increasing returns.

The analysis in this section relies on one assumption and one simplification. Both are lifted in the Appendix, which considers the general case. The assumption here is that the supply and demand curves of the economy are linear and, as already mentioned, supply exhibits decreasing returns to scale.[14] The simplification is to neglect the impact of the tariff revenues on income; this is typically done in textbooks, and will also be done in this section. It is however explicitly analyzed in the Appendix.

Assume that the home country H has a demand curve with equation

$$D = a - b\tilde{p}, \tag{1}$$

where $\tilde{p}$ is the domestic price of the good, and a supply curve

$$Q = e + f\tilde{p}. \tag{2}$$

Contry H's demand for imports is the difference

$$D - Q = (a - e) - (b + f)\tilde{p}. \tag{3}$$

Foreign export supply is also a straight line

$$(Q^* - D^*) = g + hp_w, \tag{4}$$

where p_w is the world price. The internal price in country H exceeds the world price by the tariff:

$$\tilde{p} = p_w + t. \tag{5}$$

In a world equilibrium imports must equal exports:

$$(a - e) - (b + f)(p_w + t) = g + hp_w. \tag{6}$$

[14] See e.g. [17], Appendix to Chapter 9.

Solving equation (6) for $t=0$ gives p_f, the world price that would prevail without tariffs. Then a tariff t alters the internal price to:

$$\tilde{p} = p_f + th/(b + f + h), \tag{7}$$

and the world price to

$$p_w = p_f - t(b + f)/(b + f + h). \tag{8}$$

Note that if the parameters a, e, b, h and f are all positive, then

$$p_f < \tilde{p} \quad \text{and} \quad p_w < p_f, \tag{9}$$

implying that *the tariff raises the internal price $\tilde{p}$ and lowers the world price p_w.*

It is immediate to show that, under these conditions, it is always possible to find a tariff t that increases the country's welfare. Let q_1 and d_1 be the free trade levels of consumption and production. Since the internal prive is higher after the tariff, domestic supply rises from q_1 to q_2 and demand falls from d_1 to d_2:

$$q_2 - q_1 + tfh/(b + f + h) \tag{10}$$

and

$$d_2 = d_1 - tbh/(b + f + h). \tag{11}$$

The gain in welfare from a lower world price is the area of the rectangle in Figure 3, the fall in the price multiplied by the level of imports after the tariff:

$$\begin{aligned}\text{gain in welfare} &= (d_2 - q_2) \times t(b+f)/(b-f+h) \\ &- t \times (d_1 - q_1) \times (b - f)/(b + f + h) - (t)^2 \times h(b+f)^2/(b+f-h)^2.\end{aligned} \tag{12}$$

The loss from distorted consumption is the sum of the areas of the two triangles in Figure 3:

$$\begin{aligned}\text{loss in welfare} &= (1/2) \times (q_2 - q_1) \times (\tilde{p} - p_f) - (1/2) \times (d_1 - d_2) \times (\tilde{p} - p_f) \\ &= (t)^2 \times (b+f) \times h^2/2(b + f + h)^2.\end{aligned} \tag{13}$$

Therefore the net effect on welfare is

$$\text{gain} - \text{loss} = t \times U - (t)^2 \times V. \tag{14}$$

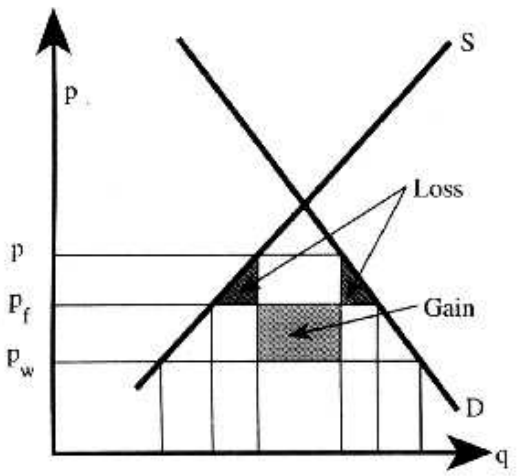

Fig. 3. Gains and Losses from Tariffs: Traditional Case.

where U and V are constants. The net effect is the sum of a positive number times the tariff rate and a negative number times the square of the tariff rate. It follows that when the tariff is sufficiently small the net effect must be positive, since t^2 is smaller than t, for t near zero. This establishes that, when supply and demand are linear, income effects of the tariff income are neglected and tariffs are small, there exists a positive tariff which increases the welfare of the country beyond that which can be obtained in free trade. Therefore there is a positive *optimal tariff*.

Of course, the size of the country matters. If the importing country is small, then foreign supply is highly elastic i.e. h is very large, so from (8) one verifies that the tariff has little or no effect on world prices p_w while raising domestic prices $\tilde{p}$ almost one-to-one.

8.2 Optimal Tariffs With Economies of Scale

The argument in the previous section shows that under traditional assumptions a large country is better off by imposing tariffs than it is under free trade. This proposition holds when the supply of goods increases with prices. In our example, this is formalized by the parameters in the supply function in equation (2), which is upward sloping. However, this assumption ceases to be valid when the economy has economies of scale. In such economies the larger is the output the lower are the costs, and therefore, in principle, the lower are the prices. Then $f<0$ in equation (8) or $h<0$ in equation (4) which in turn can lead to a negative welfare gain from the tariff from equation (12).

A good example of this phenomenon is provided by the electronics industry, for example, computer hardware. The last fifteen years have seen a dramatic decrease in prices together with a dramatic expansion of output of computer

hardware. This occurs because the expansion in output leads to rationalization and the corresponding increased efficiency in production. In the hardware industry this takes the form of technological change which improves productive efficiency and lowers the costs of the industry as a whole. Even though a technological breakthrough may in principle be patented, and therefore could be captured by one firm with the corresponding increase in its market power and deviation from competitive behavior, in practice the computer industry is very competitive. This is because the knowledge which drives the technological innovation in this industry is easily diffused.

I shall now show how the analysis of optimal tariffs in the last section breaks down when there are increasing returns to scale. In such economies there may be no gains from imposing tariffs, even if the country is large and has substantial market power. The optimal tariff theorem no longer holds. I will explain how this happens in a concrete case.

It is useful to recall first how tariffs increase welfare in the economy of the previous section. Tariffs increase welfare by lowering the world prices p_w: this was seen in equation (7). The country's terms of trade thus improve after the tariff: It imports fewer lower cost goods from the rest of the world. The welfare gains were computed in equation (12): these depend crucially on the fact that, after the tariff, the consumers pay lower prices for the goods they import.

However, this argument no longer hold with economies of scale. With economies of scale the world price may *increase* rather than decrease after the tariff. The welfare gains from tariffs are measured by the drop in world prices times the quantity imported. But if the world price increases, the gains become losses.

After a tariff the terms of trade can deteriorate for the country; this was studied in A. Lerner [18] and in L. Metzler [23]. They argue mostly in terms of income effects, not in terms of increasing returns. A similar phenomenon occurs in economies with increasing returns, but due to different causes. With increasing returns, in constrast with the economy of the previous section, the parameters f and h in equations (8) and (4) are negative rather than positive. This means that across equilibria the prices drop as quantities increase, or otherwise, price increase when quantities drop. If the tariff decreases the quantitiy produced and traded, this lowers the efficiency of the economy. Costs increase and therefore prices increase too. The tariff defeats the gains from rationalization in production produced by the larger market size. This is represented in Figure 4 above. It shows a negative correlation between market clearing prices and the quantity of goods sold at an equilibrium, and how this can lead to an increase in the world prices after the tariff, corresponding with the decrease in output.

With increasing returns, after the tariff, the world price p_w can be higher with rather than lower as it is in the traditional case.[15] The terms of trade for the country

[15] A formal proof is in the Appendix.

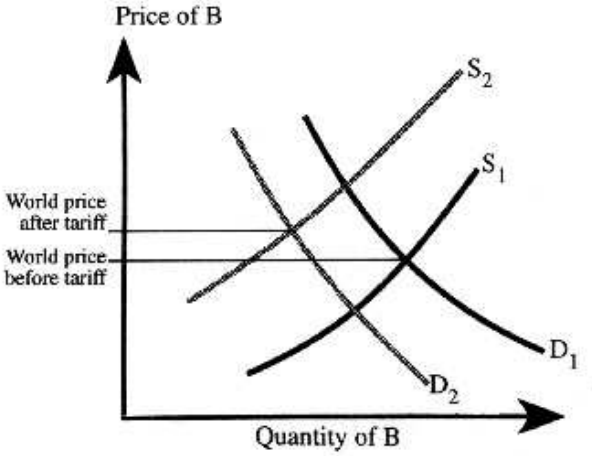

Fig. 4. Losses from Tariffs with Increasing Returns. International Market equilibrium: S_1 and D_1 are the supply and demand for exports and imports of B, respectively, at the first equilibrium without tariffs. The tariff shifts downward the demand schedule to D_2. The lower quantity exported (x) is associated to less efficiency and therefore to higher prices, due to increasing returns to scale. For a mathematical analysis, see the Appendix.

are therefore worse after the tariff. Consumers in the country are worse off: the price of their imports have increased. All of this is established rigorously in the appendix.

A economies of scale, the optimal tariff theorem is no longer true. The region's terms of trade can decrease with the imposition of tariffs, so that the importing region has no incentive to impose tariffs on others: it looses by restricting trade.

Consumer electronics, semiconductors, software production, banking and financial services, and any sector whose productivity depends mostly on knowledge and information have these characteristics. Software production is today actively developed in India as an export business. It is a sector which is simultaneously labor and knowledge intensive and subject to economies of scale. As already discussed the remarkable economic development of the Asian Tigers over the last fifteen years profited from the expansion of their international trade of skilled-labor intensive products such as consumer electronics. This sector is simultaneously labor intensive and subject to economies of scale.

All the arguments just presented hold equally for countries or for trading blocks. To the extent that sectors with economies of scale expand within the free trade zone, the zone itself loses its economic incentives to use its market power to restrict trade and to wage tariff wars.

9 Conclusions

I have argued that the formation of trading blocks harms the liberalization of markets when the blocks are organized around traditional comparative advantages. Under these conditions, the larger is the market power of the block, the larger are its incentives to impose tariffs. Protectionism emerges from the increased market power of the traders.

Retaliation can lead to a tariff war between the blocks. Furthermore under traditional assumptions, the larger country wins the tariff war. Therefore the larger is the trading block, the more likely it is to impose tariffs and to win a trade war.

Trading blocks of this nature have no economic incentive to favor world's free trade. They are better of with tariffs than with free trade. I argued that, to a certain extent, this explains the difficulties of the Gatt negotiations.

I discussed the example of the EU block in contrast with NAFTA. The evidence suggests that the EU benefited from increasing returns to scale.

NAFTA, and any eventual America free trading block, emerged as a strategic response to the increased market power of the European trading block. By contrast with the EU, the emerging NAFTA appears to be organizing under the traditional theory of comparative advantage.

The lack of any provision for the mobility of labor between the countries of the region reinforces this trend. NAFTA does not contemplate the mobility of labor between Mexico and the US. The lack of labor mobility tends to lock-in the traditonal comparative advantages between the countries within the area. Their trading of the basis of comparative advantages *within* the block will create incentives for trade wars *between* the blocks.

But NAFTA could be organized around economies of scale. Examples for such scenarios include Indian software trade, and the Asian Tigers' specialization in consumer electronics. Typically, electronic-based industries have increasing returns derived from the creation and diffusion of knowledge as output expands. This leads to rationalization in production and to increased efficiency and thus lower costs. The expansion of output is accompanied by lower rather than higher prices. From the point of view of the exporter, these markets are less likely to be protected because the importer, having increasing returns to scale in this industry, has less incentives to rely on tariffs than it does in other industries with decreasing returns. With increasing returns, tariffs decrease trade and can increase world prices, thus decreasing the welfare of the importing country. Economies of scale produce incentives to expand trade.

Economies of scale can defeat the standard result on optimal tariffs. While under traditional conditions, a trading block is always better of with tariffs than it is with free trade, with increasing returns to scale this is no longer true. Tariffs decrease the size of the market, and therefore decrease productive efficiency in economies with increasing returns. This decrease in efficiency leads to larger rather

than lower world prices, and the main purpose of the tariff, which is to improve the countries' terms of trade defeat. Under these conditions trading blocks are better of with free trade and with the corresponding expanded market, than they are with tariffs.

To the extent that NAFTA organizes itself around economies of scale the incentives for a trade wars between NAFTA and the EC are mitigated.

It seems useful to remind ourselves that the choice of products and of technology are, to a certain extent, open to policy. Countries with good educational systems, developed or not, can choose to follow development patterns with a concentration of knowledge-intensive products, avoiding the over exploitation of natural resources and exports of uneducated labor-intensive products. Those countries with poor educational systems can do better by investing in human capital and thus opening knowlege-intensive patterns of development for their future.

In any case, a choice of product, need not interfere with market efficiency. The first welfare theorem about the efficiency of competitive markets applies to a market with given technologies and with given products. The theorem does not explain how different technologies or products arise: it proves that once technologies and products are given, competive markets lead to Pareto efficiency. Once the product mix and the technologies are chosen the market can operate efficiently. This implies that the organizing principles within the blocks – traditional comparative advantages or economies of scale – are, to a certain extent, a policy choice. Technologies and a different product mix can be achieved without market distortions or loss of market efficiency. This point was already made by James Meade several years ago [22].

The emergence of an American trading block which reinforces the current tendency toward the exploitation of traditonal comparative advantages is a source of concern. It has been argued Chichilnisky [4, 5, 9] that export led policies based on (unskilled) labor intensive products can defeat the goals of development and trade by depressing the country's terms of trade and overall consumption. Trade between the countries of the Americas is organized today around traditonal comparative advantages: labor and resource intensive exports from the South and capital and skill-intensive exports from the North. If the emergence of an America free trade zone is based on similar principles, then not only may this continue a depressing growth trend in Latin America, but in addition it could create or reinforce incentives against the global liberalization of free trade.

Another reason to avoid trade policies based on traditional comparative advantages is that they tend to deplete environmental assets such as forests, fisheries or fertile land, and overuse minerals which are exported by the developing countries to the North. Some of these minerals are the source of potentially dangerous CO_2 emissions. Petroleum exported from Mexico, Ecuador and Venezuela to the USA fits this description. Indeed, any concept of *sustainable*

development requires a rethinking of trade policies away from those based on comparative advantages. This general premise is particularly well suited to the NAFTA, and to the Americas as a whole, since two thirds of Latin American exports today are resources.

The main point of this paper is that the characteristics of trading policies *within* the trading blocks can determine the extent to which the block will favor or harm global free trade. Trading policies based on comparative advantages are generally negative. Trading policies based on economies of scale can be positive. They can mitigate the economic incentive towards tariffs and favor instead the expansion of world's trade. The emergence of such trading blocks could advance in tandem with the global liberalization of trade.

10 Appendix: Trading Blocks with Endogenous Technology and Increasing Returns to Scale

10.1 A Two Region Two Good Model With Endogenous Technology and Economies of Scale

This appendix introduces and develops an international trade model, and proves rigorously the propositions stated in the body of the paper.

The model presented here extends the North-South model introduced in Chichilnisky [4, 5, 9] in several directions. One is to allow technologies given by Cobb-Douglas production functions;[16] a second aspect is that countries here trade in goods produced under conditions of increasing returns to scale, while previous work considered constant returns to scale.

At least one of the goods (B) is produced here under increasing returns to scale; the second good (I) could be produced either with constant returns or with increasing returns to scale. A novel aspect of this model is that the increasing returns are here *external* to the firm: each firm takes technology as given, a Cobb-Douglas production function with constant returns, multiplied by a coefficient γ. This parameter γ is treated as given by the firm. However γ varies with the production of the whole sector, making all those firms having increasing returns simultanously more productive at an equilibrium in which more is produced. Therefore technologies are *endogenous:* the returns to scale of each sector are endogenously determined along with all other variables, at the equilibrium. Competitive markets are assumed throughout: firms maximize profits and the classic marginal conditions prevail.

The material is presented as follows: first I formulate the model for one region; then I extend this to two trading regions. I then find one explicit equation, a

[16] Chichilnisky [4, 5] considered fixed coefficients technologies.

"resolving equation", which solves the model analytically as a function of only one variable: the terms of trade. From this equation one calculates analytically a complete solution of the model from the values of its exogenous parameters, by solving for the equilibrium values of the terms of trade. Finally I establish formally that, with increasing returns to scale, large countries can achieve higher welfare levels with free trade than with tariffs. This means that increasing returns can defeat the optimal tariff theorem.

The model describes two regions, 1 and 2, producing and trading two goods B (basic goods) and I (industrial goods) with each other; these goods are produced using two inputs, labor L and capital, K. The economies of the two countries are competitive, so that in each region prices are taken as given by consumers and producers. Producers maximize profits, and consumers maximize utility subject to their budget constraints. Walras Law is satisfied, so that the value of the excess demand is equal to zero. At an equilibrium all markets, for goods and for factors, clear.

The *increasing returns to scale* considered here are "external" to the firm as in the examples discussed in the text. This means that in the production functions, formalized below, the parameter γ increases with the total level of output of the economy. As the output of the economy expands, the production function varies, formalizing the notion that factors are more productive at higher levels of aggregate output. To obtain the results presented here, all that is required is that the production function becomes more productive as the output of *one* of the good (B) increases. The firms take this parameters γ as given – this is the assumption that the increasing returns are external to the firm. For each given value of the parameter γ the firm has constant returns to scale. The firms are therefore competitive, and in particular zero profits are achieved at an equilibrium.

10.2 One Region Model

Consider the model of one region first. The production fuctions are[17]

$$\begin{aligned} B^s &= \gamma L_1^{\alpha} K_1^{1-\alpha} \\ I^s &= \gamma L_2^{\beta} K_2^{1-\beta} \end{aligned} \tag{16}$$

[17] Note that there is no specification of supply behaviour outside of equilibrium, because as far as the firm is concerned there are constant returns to scale in production so that profit maximizing supply functions are, as is standard with constant returns, undefined. As is standard, one derives supply and demand simultaneously at an equilibrium from the condition of full employment of factors and market clearing, and in this model this is done together with a condition which incorporates the simultaneous determination of the parameter giving the extent of economies of scale.

where $\alpha, \beta \in (0,1)$, γ is a positive parameter determining returns to scale which is determined endogenously at an equilibrium, L_1 and K_1 are the inputs of labor and capital in the B sector, and L_2 and K_2 the inputs of labor and capital in the I sector. The total amount of labor and capital in the economy are L^s and K^s respectively. Prices are p_B and p_I; we assume that I is the numeraire so that

$$p_I = 1. \tag{17}$$

Factor prices are denoted as usual: w for wages and r for rental on capital. I shall assume for simplicity that the demand for basic goods at an equilibrium is known:

$$B^d = \mu(wL) + (1-\mu)rK, \quad 0 \leq \mu \leq 1. \tag{18}$$

By Walras Law the demand for industrial goods in equilibrium is

$$I^d = (wL^s - rK^s - p_B B^d), \tag{19}$$

because there are zero profits derived from the firm's profit maximization under constant returns to scale. Demand functions other than (18) can be postulated without changing the results, see for example the various demand functions utilized in Chichilnisky [5]. Indicating the equilibrium level of exports by X_B^s* and the equilibrium level of imports by X_I^d*, the model of the world economy is formalized by the following equilibrium conditions:

$$\begin{aligned}
&p_B^* B^{s*} + I^* = w^* L^* + r^* K^* \quad \text{(zero profits)} \\
&K^* = K^s = K_1 + K_2 \quad \text{(capital market clears)} \\
&L^* = L^s = L_1 + L_2 \quad \text{(labor market clears)} \\
&B^{s*} = B^{d*} - X_B^{s*} \quad (B \text{ market clears}) \\
&I^{d*} = I^{s*} + X_I^{d*} \quad (I \text{ market clears}) \\
&\gamma = \gamma(B^*, I^*) \quad \text{(endogenous technology)}.
\end{aligned} \tag{20}$$

10.3 Two Region Model

The model for the world economy consists of two regions, indicated with the indices 1 and 2, each specified as above. To solve the model, there are therefore five prices to the determined: the "terms of trade" p_B, and two factor prices in each country: w an r. The quantities to be determined in an equilibrium are the use of factors in each sector of each region: K_1, K_2, L_1, L_2 and the outputs of the

two goods B^s and I^s. At the equilibrium one obtains endogenously the value of the parameter γ determining the external economies of scale in each sector of the economy $\gamma = \gamma(B^*, I^*)$. At an equilibrium one also determines the exports and imports of each of the two goods in each of the two regions, $X_B^s{}^*$ and $X_I^s{}^*$, and the demand for each good in each region: B^{d*} I^{d*}. There is therefore a total of *twenty seven* variables to be determined endogenously at an equilibrium, including all prices and quantities in all markets and in both regions.

The following Proposition 1 proves that all of these variables can be determined once the variable giving the terms of trade in equilibrium p_B is known. Furthermore I prove that there exists *one* "resolving equation" which determines the equilibrium value of the terms of trade as a function of all the exogenous parameters of the model.

The are *six* exogenous parameters in each region: $\alpha, \beta, \sigma, B^{d*}, L^s$ and K^s, and a total of *twelve* in the world economy. The impact of changes in each of these parameters on the equilibrium of the model can be traced analytically via the "resolving equation".

10.4 Solving the Model With a Single "Resolving" Equation in the Terms of Trade

Proposition 1

There exists one "resolving" equation depending only on the terms of trade, from which a complete solution of the two region model can be computed explicitly as a function of all the exogenous parameters of the model.

Proof

The proof consists of writing the market clearing conditions on the world market for B and substituting step by step until one finds one expression which depends on all the exogenous parameters of the model and only on one variable: the terms of trade. Then I show that all other endogenous variables can be found once the terms of trade are known, including of course the value of the returns to scale parameter γ which defines the technology. The proof proceeds in a number of steps. In step 1, I express the labor and capital ratios used in the two industries l_1 and l_2, as functions of the terms of trade, p_B. Step 2 express the level of capital and labor used a functions of p_B. Step 3 expresses output in the two sectors as functions of p_B and the technology parameter γ. Step 4 expresses the output levels in the two sectors as a function of p_B alone, by carrying out a simple "fixed point" argument on the technology parameter γ. Step 5 expresses the international market claring con-

dition in the B market as a function of p_B alone, thus producing the desired "resolving equation". Finally, Step 6 shows how all endogenous variables in the model are determined once p_B is known.

Consider a world economy with two regions defined as in equations (16–20). I now solve the model by finding an explicit expression for the equilibrium terms of trade p_B^* in the world economy. I shall use the indices 1 and 2 to distinguish the parameters of the two countries. It is important to observe that since I have given no specification of demand or supply behaviour outside of an equilibrium, there is no information for carrying out stability analysis. Since the model has constant returns to scale, profit maximizing supply functions are, as is standard, undefined. In fact, there are many possible and equally good specifications of disequilibrium behaviour in this model, each leading to different stability properties (which are not analyzed here). For stability analysis, see Chichilnisky [4] and [5]. As is standard in models with constant returns to scale, derive the equilibrium relations between supplies and prices from the condition of full employment of factors together with an equilibrium condition which incorporates the external economies of scale.

Step 1: express the labor and capital ratios used in the two industries as a function of the term of trade. The strategy is to used logarithmic expressions and then convert these. Denote:

$$l_1 = L_1/K_1$$

$$l_2 = L_2/K_2$$

Since by assumption each firm takes the parameter γ as given, from the production functions (16), marginal conditions and zero profits imply:

$$w = \gamma\alpha(L_1/K_1)^{\alpha\ \ -1} p_B = \gamma\alpha l_1^{q-1} p_B$$

$$r - \gamma(1-\alpha) l_1^q p_B \tag{21}$$

and

$$w = \gamma\beta l_2^{\beta-1}$$

$$r = \gamma(1-\beta) l_2^{\beta} \tag{22}$$

so that

$$\frac{r}{w} = \left[\frac{(1-\alpha)}{\alpha}\right] l_1 \quad \text{and} \quad \frac{r}{w} = \left[\frac{(1\ \ \beta)}{\beta}\right] l_2 \tag{23}$$

and in particular

$$l_1 = \frac{[(1-\beta)\alpha]}{[\beta(1 \quad \alpha)]}\, l_2. \tag{24}$$

Indicating natural logarithms with the symbol "~" the four equations in (21) and (22) can be rewritten as:

$$\begin{aligned}
\tilde{w} &= (\alpha - 1)\tilde{l}_1 + \tilde{\alpha} + \tilde{p}_B + \tilde{\gamma} \\
\tilde{r} &= \alpha\tilde{l}_1 + (1\tilde{-}\alpha) + \tilde{p}_B + \tilde{\gamma} \\
\tilde{w} &= (\beta \quad 1)\tilde{l}_2 - \tilde{\beta} - \tilde{\gamma} \\
\tilde{r} &= \beta\tilde{l}_2 + (1 \quad \beta) + \tilde{\gamma}.
\end{aligned} \tag{25}$$

so that

$$(\alpha \quad 1)\tilde{l}_1 + \tilde{\alpha} + \tilde{p}_B = (\beta \quad 1)\tilde{l}_2 + \tilde{\beta} \tag{26}$$

and

$$\alpha\tilde{l}_1 + (1\tilde{-}\alpha) + \tilde{p}_B = \beta\tilde{l}_2 - (1\tilde{-}\beta), \tag{27}$$

or equivalently

$$\begin{aligned}
(\alpha \quad 1)\tilde{l}_1 + (1-\beta)\tilde{l}_2 &= \tilde{\beta} \quad \tilde{p}_B \quad \tilde{\alpha} \\
\alpha\tilde{l}_1 - \beta\tilde{l}_2 &= (1\tilde{-}\beta) - \tilde{p}_B - (1\tilde{-}\alpha).
\end{aligned} \tag{28}$$

Solving the system (28) of two linear equations in $\tilde{l}_1, \tilde{l}_2$ one obtains:

$$\tilde{l}_1 = \frac{[(\tilde{\beta} - \tilde{p}_B - \tilde{\alpha})(-\beta) - (1 \quad \beta)[(1\tilde{-}\beta) - \tilde{p}_B - (1\tilde{-}\alpha)]}{[\beta - \alpha]} \tag{29}$$

and

$$\tilde{l}_2 = \frac{[(\alpha \quad 1)[(1\tilde{-}\beta) - \tilde{p}_B - (1\tilde{-}\alpha)] - [(\tilde{\beta} \quad \tilde{p}_B - \tilde{\alpha})\alpha]]}{[\beta - \alpha]} \tag{30}$$

From (29) and (30) one obtains:

$$\tilde{l}_1 = \frac{\tilde{p}_B}{(\beta - \alpha)} + A \tag{31}$$

and

$$\tilde{l}_2 = \frac{\tilde{p}_B}{(\beta - \alpha)} + B$$

where

$$A = \frac{[(\tilde{\beta} - \tilde{\alpha})(-\beta) - (1 - \beta)[(1\tilde{-}\beta) - (1\tilde{-}\alpha)]]}{(\beta - \alpha)}$$

and

$$B = \frac{[(\alpha - 1)[(1\tilde{-}\beta) - (1\tilde{-}\alpha)] - \alpha(\tilde{\beta} - \tilde{\alpha})}{(\beta - \alpha)},$$

with $A > 0$ and $B < 0$ if $\beta < \alpha$. Therefore

$$l_1 = e^A p_B^{1/(\beta - \alpha)} \tag{32}$$

and

$$l_2 = e^B p_B^{1/(\beta - \alpha)}.$$

Step 1 is therefore completed: l_1 and l_2 are expressed as functions of terms of trade p_B.

Step 2: Express labor and capital used as function of p_B. Since

$$l_2 = \frac{(L^s - L_1)}{K^s - K_1} \rightarrow L^s - L_1 = l_2(K^s - K_1) \text{ or } L_1 = L^s - l_2(K^s - K_1) \tag{33}$$

and

$$l_1 = L_1/K_1 \rightarrow L_1 = l_1 K_1 \text{ so that by (33) } L^s - l_2(K^s - K_1) = l_1 K_1 \tag{34}$$

$$\rightarrow K_1(l_1 - l_2) = L^s - l_2 K^s \text{ and } K_1 = (L^s - l_2 K^s)/(l_1 - l_2). \tag{35}$$

From (33)–(35) one obtains:

$$K_1 = \frac{(L^s - l_2 K^s)}{(l_1 - l_2)} \tag{36}$$

and

$$L_1 = \frac{(l_1)}{(l_1 - l_2)}(L^s - l_2 K^s) \tag{37}$$

from which together with (32) one obtains the levels of supply of labor and capital used in each sector at an equilibrium, as a function of the equilibrium level of the relative price of B:

$$L_1 = \frac{e^A L^s}{(e^A - e^B)} - \frac{e^A e^B}{(e^A - e^B)} K^s p_B^{1/(\beta \quad \alpha)} \tag{38}$$

and

$$K_1 = \frac{L^s}{e^A - e^B} \mathrm{p}_B^{1/\alpha - \beta} - e^B(e^A - e^B)K^s \tag{39}$$

thus completing Step 2 of the proof. *Step 3* is to express output levels as a function of the terms of trade. From (16), (38) and (39) one obtains the quantity of B and I produced at each level of relative prices, p_B. Since these relations hold for every level of γ, taking $\gamma = 1$, I denote these as $\phi(p_B)$ and $\psi(p_B)$ respectively. Therefore from (16) one obtains the equilibrium level of outputs as a function of equilibrium prices:

$$B^s = \gamma\phi(p_B). \tag{40}$$

In the case that the sector I has also external economies of scale – which is not a necessary assumption for the results, one obtains similarly:

$$I^s = \gamma'\psi(p_B),$$

where γ' could be in principle different from γ. Equation (40) is almost what is needed for *Step 4* but not quite: observe that (40) does not fully express outputs as an explicit function of equilibrium prices because $\gamma = \gamma(B)$. In order to obtain outputs as functions of equilibrium prices alone, one must also find out simultaneously the equilibrium value of $\gamma = \gamma^*(B)$. This is "fixed point" problem, since for each given p_B, γ depends on B while for each p_B, B depends

on γ. This is solved in Step 4, which follows, by a simple "fixed point" argument.

Recall that the economy has increasing returns which are external to the firm, and the parameter γ is assumed in (16) to increase with the level of output of B (and potentially also I). For example[18]:

$$\gamma = \gamma(B) = B^{\sigma}, \quad \sigma < 1. \tag{41}$$

At an equilibrium equations (40) and (41) must be satisfied simultaneously, i.e.

$$\begin{aligned} \gamma &= [\gamma \cdot \phi(p_B)]^{\sigma} \\ &= \gamma^{\sigma}\phi(p_B)^{\sigma}, \quad \text{or} \quad \gamma^{1-\sigma} = \phi(p_B)^{\sigma} \end{aligned} \tag{42}$$

so that

$$\gamma = \phi(p_B)^{\sigma/(1-\sigma)}.$$

Therefore at an equilibrium (40) and (41) imply a relation between the output of B and p_B. If one assumes that I has external economies as well (which is not necessary for the Results), then one could have a similar expression for I:

$$\begin{aligned} B^s &= \phi(p_B)^{1/(1-\sigma)} \\ I^s &= \psi(p_B)^{1/(1-\sigma)}. \end{aligned} \tag{43}$$

Note that

$$\text{when } \sigma > 1, \quad \theta = 1/1 \quad \sigma < 0 \tag{44}$$

so that:

Lemma 2

When $\sigma > 1$, the partial equilibrium supply function of each firm producing B is an increasing function of the price of B, p_B. However, due to the external economies of scale, as the total output of B increases within the region this leads to drops in the price p_B across equilibria, since $\phi(p_B)^{1/(1-\sigma)}$ is a decreasing function of the price p_B. Note that since $\sigma > 1$,

$$as \quad \sigma \to 1, \quad \theta \to -\infty. \tag{45}$$

[18] This is an example. In general $\gamma = \gamma(B^*, I^*)$. The general case admits a similar solution, at the cost of more notation.

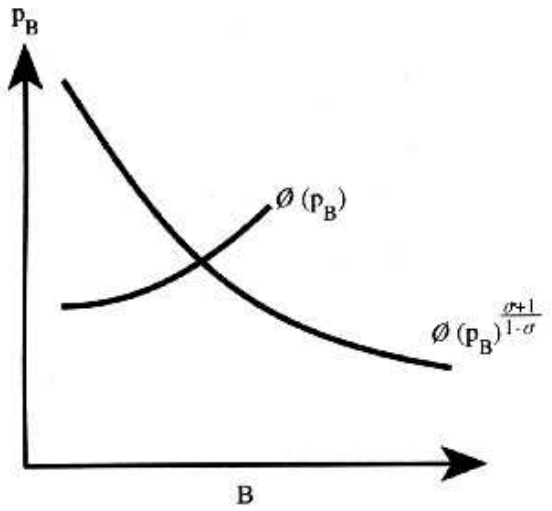

Fig. 5. Each firm faces an upward cost curve. However, the sector B as a whole faces a downward cost curve due to external economies of scale.

Proof

This follows directly: $\phi(p_B)$ is an increasing function of p_B for each fixed γ, but from (44), $\theta = 1/1-\sigma < 0$, so that increases in total output across equilibria leads to lower prices, see Figure 5. □

The next step is *Step 5:* to produce the "resolving equation" for the two region model. To solve the model we now consider the market clearing condition in B. At a world equilibrium, the B market must clear so that:

$$B^{d,1}(p_B+t)-B^{s,1}(p_B+t)=B^{s,2}(p_B)-B^{d,2}(p_B),$$

defining the implicit function

$$F(p_B,t)=B^{d,1}(p_B+t)-B^{s,1}(p_B+t)-B^{s,2}(p_B)+B^{d,2}(p_B)=0. \tag{46}$$

From (18), (19), (21), (32) and (43), equation (46) is a function of the variable p_B alone, which we call a "resolving" equation for this model. Solving the equation $F=0$ gives the equilibrium values of p_B. Finally Step 6 consists of showing that the equilibrium values of all other variables can be computed from that of p_B. From (32) one obtains l_1 and l_2; from this and (38), (39) one obtains L_1 and K_1; from (22) one obtains r and w in each region; B^s and I^s are obtained in each region from (43). Demand for B and I in each region is obtained from (18) and (19). The model is thus solved. This completes the proof of Proposition 1. □

The following result has two parts. The first part (i) shows that under the conditions, increasing returns to scale defeat the optimal tariff argument since a tariff on imports leads to lower terms of trade for the importing country. For the second part, assume that $\mu = 1$, so that $B^d = wL$, and that β is small, $\beta < \alpha$; these assumptions are *not* necessary and are *not* used to prove that the terms of trade of the importing region worsen after the tariff. They are only made to simplify the proof of the second part of the Proposition, (ii), namely that the importing regions' welfare decreases after the tariff – other assumptions could be made leading to the same results.

Proposition 3

Consider a world economy as formalized above, in which both regions produce B under condition of external economies of scale. The demand for imports of B by region 1 *decreases with world prices of B, and the exporting region,* 2, *has strong external economies of scale in B:*

$$\gamma = \gamma(B) = B^{\sigma}, \quad \text{with } \sigma > 1,$$

and $\partial X_B^{s2}/\partial p_B < 0$ *is relatively large in absolute value. Then (i) no tariff can improve the terms of trade of the importing region over and above those which the region achieves under free trade, and (ii) the welfare of the importing region is lower with a tariff than without.*

Proof

Part (i) first. It is useful to recall first the standard argument for optimal tariffs dicussed above in Section 8.1; this will be only used here as an illustration and to aid intuition. The formal proof is given after this example.

Example 4

Define simple linear functions for home supply and demand, respectively $D = a - b\tilde{p}$, *and* $Q = e + f\tilde{p}$, *so that the demand for imports in* $D - Q = (a - e) - (b + f)\tilde{p}$, *and define similarly a linear foreign export supply* $(Q^* - D^*) = g - hp_w$, *where* p_w *is the world price, and* $p_w + t = \tilde{p}$. *In a world equilibrium imports must equal exports:*

$$(a - e) - (b + f)(p_w + t) = g + hp_w. \tag{47}$$

Solving equation (47) for $t=0$ gives p_f the world price without tariffs. Then a tariff takes the world price to $p_w = p_f - t(b+f)/(b-f+h)$ and the internal price to $\tilde{p} = p_f + th/(b+f+h)$. Note that if all parameters are positive, then $p_f < \tilde{p}$, and $p_w < p_f$, implying that the tariff raises the internal price p_f and lowers the world price p_w. Unter this conditions it is easy to see that a positive tariff exists that makes the country better off, because the welfare gains from a tariff obtain from an increase of imports at lower prices, see Section 8.1. Matters change if the economies have increasing returns: in that case the parameters can change sign, for example, if $f<0$ and is sufficiently large in absolute value, then after the tariff the world price p_w can be higher *than p_f. Terms of trade therefore worsen for the country who imposes the tariff, and the gains from the tariff are lost, because world prices increase with respect to domestic prices, while the losses from distortions remain.*

I now formalize this example within the equilibrium model of trade defined in this Appendix. The intuition is the same, but it is carried out rigorously using the "resolving equation" and the implicit function theorem.

One studies first the changes in the terms of trade as a function of the tariff t, and shows that the tariff leads to higher rather than lower world prices so that the importing country has better terms of trade without tariffs. By the implicit function theorem from (46):

$$\partial p_B/\partial t = \frac{-\partial F/\partial t}{\partial F/\partial p_B} = -\frac{-\partial(B^{d,1} - B^{s,1})/\partial(p_B + t)}{[\partial(B^{d,1} - B^{s,1})/\partial(p_B + t)] + [\partial(B^{d,2} - B^{s,2})/\partial p_B]} \tag{48}$$

By the assumptions $\partial(B^{d,1} - B^{s,1})/\partial(p_B - t) < 0$ and therefore the numerator of (48) is positive. The denominator is positive by the assumptions on foreign supply, because due to economies of scale $(\partial X_B^{s,1}/\partial p_B) = \partial(B^{s,2} - B^{d,2})/\partial p_B$ is negative and relatively large (see Lemma 2 above). Therefore, by (48) $\partial p_B/\partial t > 0$: this means that, in a new equilibrium after the tariff t is imposed, the world price p_B increases, so that the importer's terms of trade worsen as stated in (i). The optimal tariff argument is therefore defeated.

Part (ii) next. One shows that lower terms of trade lead region 1 to a lower welfare level. Since in the world equilibrium with tariffs the world price p_B increases, so does the domestic price which is $p_B + t$. Since the importing economy has increasing returns in the B sector, this increase in p_B after the tariff could only be associated to a lower domestic output of the good B. Furthermore, since the exports of the exporting region decrease with prices, the imports of B by region 1 must have decreased as well. Therefore in the new equilibrium the domestic consumption of good B, B^d, is lower in region 1. Finally, consider region 1's

consumption of good I. By Walras' law (19), $I^d = rK$. Now by (32) when $\beta < \alpha$, as p_B increases I_2 decreases; by (22) this implies that r decreases as well implying that $I^d = rK$ decreases after the tariff as well. Since both the consumption of B and the consumption of I decrease at home after the tariff in the importing country, the welfare of the importing country decreases after the tariff, completing the proof of Proposition 3. □

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