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Trilogy On Trade Policy: Safeguards; Mfn; Multiproduct Firms

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TRILOGY ON TRADE POLICY:

SAFEGUARDS; MFN; MULTIPRODUCT FIRMS

by

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Abstract

This thesis examines the effects of the imposition of trade restriction and promotion policies in a variety of frameworks. The first chapter provides an introduction. The second chapter is theoretical in nature and uses a general equilibrium model to compare the welfare effects of global trade restrictive measures to those of selective measures applied against particular countries. It is the thesis of Chapter 2 that on the grounds of economic efficiency, there is no blanket theoretical support for the MFN application of safeguards. Whether or not a safeguard action undertaken on an MFN basis is better for the world as a whole than that undertaken on a selective basis depends on two overriding factors: the notion of equivalence between the MFN and the selective trade measures, and the distribution of the rents produced by the trade measures.

Chapter 3 tackles the MFN vs. selectivity issue in an empirical framework. Using a Computable General Equilibrium (CGE) model, this chapter examines the effects on world welfare of the conversion to their global counterparts of selective trade measures which were present in the United States (US) and European Community (EC) in the textiles and clothing, steel, and auto industries in 1986. The effects of the presence of labour adjustment costs on the results are also considered, but they do not appear to dominate the model. This analysis suggests that the simultaneous conversion of all existing safeguards from selective measures to their global counterparts would yield non-negative world welfare changes. However, the conversion of only some to their global counterparts, while others remain as selective

measures, may produce negative welfare changes.

Chapter 4 uses a simple three-good, two-country general equilibrium framework to analyze the effects of trade policy on welfare and firm profits when multiproduct firms may be present in one or both countries. Various cases are examined in which both goods are produced by multi- or single product firms at home and/or abroad, and it can be shown that the presence of joint production can have definite effects on the trade policies advocated by home and foreign producers. In particular, domestic firms may not want tariffs on all imports when multiproduct firms are located in the foreign country.

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1. INTRODUCTION

The nature of trade policy has changed a great deal over the course of the GATT's 45-year history. As tariff barriers have been substantially reduced during successive rounds of GATT negotiations, a host of nontariff barriers (NTBs) have come to supplant them. Frequently used by the developed countries to target particular trading partners, these NTBs are implemented to safeguard politically sensitive domestic industries. The means used to accomplish this end, however, are often outside the scope of GATT Article XIX, which deals with safeguards. In particular, the NTBs employed typically take the form of 'voluntary' export restraints (VERs), which conveniently sidestep the traditional most-favoured-nation (MFN) interpretation of GATT Article XIX.

It is the selective nature of these NTBs which comes under the scrutiny of Chapters 2 and 3. It is the thesis of Chapter 2 that on the grounds of economic efficiency, there is no blanket theoretical support for the MFN application of safeguards. Whether or not a safeguard action undertaken on an MFN basis is better for the world as a whole than that undertaken on a selective basis depends on two overriding factors: the notion of equivalence between the MFN and the selective trade measures, and the distribution of the rents produced by the trade measures.

Using a 2-good, m-factor, 3-country framework, Chapter 2 compares the changes in world welfare when the instigating country increases its import tariff on either a selective or a global (i.e., MFN) basis. When the equivalence notion is the maintenance of the instigating country's import level, we show that for small tariff changes

the world welfare changes are identical in the global and selective cases, regardless of the distribution of tariff revenues. We also note that world welfare changes are monotonic in tariff changes. Thus, for other equivalence notions, whether or not world welfare is higher in the global case than in the selective case depends only on the relationship of the given selective tariff change to the selective tariff change which maintains the instigating country's imports at their global case level. Given, then, that there is no definitive equivalence notion, one cannot argue that MFN safeguard measures are to be preferred to selective ones on the grounds of economic efficiency.

More specifically, suppose that the instigating country retains the differential tariff revenues. Then, when the equivalence notion involves increasing global and selective tariffs by the same amounts, we show that a selective tariff increase would yield a smaller decline in world welfare than the corresponding global tariff increase. Also, when the equivalence notion is the maintenance of the instigating country's protected industry production level, we find that a selective tariff increase against the exporter with the smaller export supply elasticity yields higher world welfare than a global tariff increase (which in turn yields higher world welfare than a selective tariff increase against the exporter with the greater export supply elasticity). In contrast, when the exporting countries retain the differential tariff revenues, we find for this last equivalence notion that a global tariff increase produces higher world welfare than does either of the two corresponding selective tariff increases. Thus, if this equivalence notion is the relevant one, then one could argue that a small

global quota is preferable to a small VER, lending support to the use of GATT-legal safeguard measures. In addition, we note that for this equivalence notion, the instigating country's ranking of the global and the two potential selective measures is consistent with that of the world as a whole; hence, the world's support for global quotas over VERs does not go against the interests of the instigating country.

We also recast our model to take a brief look at tariff reductions. From this analysis, we note that when the equivalence notion requires the same reduction in the global and selective tariffs, the world is definitely better off with the global tariff reduction than the selective one.

Chapter 3 tackles the MFN vs. selectivity issue in an empirical framework. Using a Computable General Equilibrium (CGE) model, this chapter examines the effects on world welfare of the conversion to their global counterparts of selective trade measures which were present in the United States (US) and European Community (EC) in the textiles and clothing, steel, and auto industries in 1986. The effects of the presence of labour adjustment costs on the results are also considered.

As in Chapter 1, more than one notion of equivalence between the selective and global measures is considered: one notion requires the maintenance of the same level of imports in the home country; a second notion requires the maintenance of the same level of production in the import-competing industry. Two separate models are used in this chapter: one for textiles and clothing and one for steel and autos. The Textiles and Clothing Model is a final goods model with four regions: the European Community (EC), Japan, the Newly Industrialized Countries (NICs,

which we take to encompass Hong Kong, South Korea, and Taiwan), and the United States (US). The Steel and Autos Model incorporates the intermediate use of goods to better reflect the interactions between the steel and auto industries, and the focus of this model is only on the EC, Japan, and the US.

In both models, we find that the coversion of VERs to global quotas always produces non-negative gains for world welfare when all VERs in the model are simultaneously converted to their global counterparts. This is consistent with the results of Chapter 2 when the revenue distribution scheme has the exporters retaining the differential tariff revenues. Positive world welfare gains are also achieved in the Textiles and Clothing Model when the US converts its VERs on restricted textiles and clothing to a global quota. In the Steel and Autos Model, the conversion to a global quota of the Japanese VER on autos exported to the US, whether by itself, or in conjunction with the conversion of the American system of bilateral steel restraints to a global quota, also always produces positive changes in world welfare. However, in some instances, when the bilateral steel quotas are converted to a global quota and the autos VER is still in place, we find that world welfare declines, presumably because of the income effect of the the transfer of quota rents from Japan to the US. Thus, while our analysis seems to suggest that the simultaneous conversion of all existing safeguards from selective measures to their global counterparts would yield non-negative changes for world welfare (and, consequently, support the economic efficiency argument), it does not seem to be generally true that conversion of selective safeguards to global ones yields world welfare gains when undertaken on a

piecemeal basis.

And, while the presence of adjustment costs does tend to dampen welfare gains, or even lead to welfare losses, when VERs are converted to global quotas, their presence does not appear to dominate the model.

The frameworks of Chapters 2 and 3 are reminiscent of the customs union literature: we have multicountry models and we have selective trade policies which discriminate between export suppliers. There is, however, one major difference between our analysis and the customs union literature: our welfare comparisons are not between one discriminatory policy and the nondiscriminatory status quo, but rather between discriminatory and nondiscriminatory policies which are equivalent in some sense. Also, in Chapter 2, we have only a single country adjusting its trade policy, and not several nations in a potential union; and we do not allow for the elimination of any existing trade patterns, although this is possible in the empirical framework of Chapter 3.

In establishing a trade policy, however, a nation not only selects the countries to be targeted, it also selects the products which will be directly affected. The final chapter of this thesis uses a simple three-good, two-country general equilibrium framework to analyze the effects of trade policy on welfare and firm profits when multiproduct firms may be present in one or both countries. All three goods are produced in each country, but demand for two of the goods, X and Y, is generated only by the home country. These two goods are produced by firms which play a Cournot quantity game. The third good, Z, is a competitively-produced numeraire

good, and is exported by the home country to pay for its imports of X and Y. Various cases are examined in which X and Y are produced by multi- or single product firms at home and/or abroad.

In this chapter, it is found that when X and Y are produced separately in each country, each domestic firm will have higher profits with tariffs on all imports than with a single tariff on its own product; but that when X and Y are jointly produced in each country, a tariff on imports of one product may actually make the home firm better off than tariffs on both X and Y. Also, if technologies are different across countries, with separate production of X and Y at home and joint production of X and Y abroad, the home producer of a particular product may no longer be better off with tariffs on all imports than with a single tariff on his own product.

Changes in welfare are also examined. With separate production of X and Y in each country, it can be shown that there exists a product on which the imposition of a tariff will increase domestic welfare. However, with joint production of X and Y in each country, there is no parallel welfare result, although sufficient conditions are determined for there to exist such a tariff.

The effects of export subsidies on both foreign producer profits and foreign country welfare are also found to be sensitive to the presence of multiproduct firms.

2. SAFEGUARDS: A CHALLENGE TO MFN

2.1 Introduction

Since its inception in 1947, the cornerstone of the General Agreement on Tariffs and Trade (GATT) has been the principle of Most-Favoured-Nation status (MFN). Enshrined in Article I of the GATT, MFN requires each signatory of the GATT to treat all other signatories on the same basis in border transactions of international trade.[1] More specifically, under GATT Article XIX, if a GATT contracting party is caused or threatened serious injury as the consequence of enactment of a particular GATT obligation, and wants to impose a temporary safeguard measure, it may only do so on an MFN basis (i.e., against all GATT members).[2]

But is there any economic justification for the application of safeguard measures on an MFN basis as opposed to on a selective, discriminatory basis? Petersmann (1986) presents a strong case for the use of MFN safeguard measures: "The economic functions of the principle of non-discrimination for the administration of safeguard measures are not only to minimise trade distortions among countries, and to minimise the economic costs of a given level of trade protection, but also to

[1] Explicit exceptions to MFN are found in the text of the General Agreement itself (e.g., GATT Article XXIV permits the formation of customs unions and free-trade areas).

[2] In actual fact, Article XIX does not explicitly state that safeguard measures to be applied on an MFN basis. This has led to some debate as to whether or not discriminatory safeguard measures are GATT-legal (cf. Jackson (1987)). However, as Hart (1985, p. 85) points out, "the drafting history of Article XIX makes it clear that measures are meant to be non-discriminatory. Indeed, efforts to provide for discrimination by limiting action to the products of the supplying country or countries causing injury were specifically rejected".

promote undistorted competition among private economic agents within countries by ensuring that import needs can be satisfied from the most efficient sources of supply and exports can be sold in the best markets."[3] And Hart (1985) also says that there is a convincing economic argument in favour of MFN over selectivity: "Selectivity allows a country to bar the most efficient, most competitive producers from its market, subjecting domestic producers only to competition from less efficient producers."[4]

It is, however, the thesis of this chapter that on the grounds of economic efficiency there is, in fact, no general theoretical support for MFN over selectivity in the application of safeguard measures. In particular, we find that whether or not a safeguard action undertaken on an MFN basis is better for the world as a whole than that undertaken on a selective basis depends crucially on two factors: 1) the notion of equivalence between an MFN and a selective safeguard measure; and 2) the distribution of tariff revenues (or quota rents) across countries.

Now, whether or not one is arguing in favour of, or against, the use of MFN safeguard measures as opposed to selective safeguard measures, one must implicitly have in mind some notion of equivalence between the two. Ultimately, of course, safeguard measures are instituted to provide temporary relief to a domestic industry from import competition. To achieve this end, however, a given country could focus on a multitude of specific policy objectives, and consequently there is no definitive notion of equivalence between an MFN and a selective safeguard measure.

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[3] Petersmann (1986, p. 117).

[4] Hart (1985, p. 151).

Thus, while our analysis will present world welfare comparisons of MFN safeguard measures to arbitrary selective safeguard measures, we will also focus attention on world welfare comparisons involving three particular equivalence notions: 1) the maintenance of the same import level in the instigating country; 2) the maintenance of the same protected industry production level in the instigating country; and 3) the same increase in the MFN and selective tariff rates.[5]

Currently, selective safeguard measures often take place outside of Article XIX in the form of voluntary export restraints (VERs), from which the exporters receive the associated quota rents. But it's possible that in some future incarnation of Article XIX that selective trade measures could become explicitly GATT-legal, meaning in particular that tariffs could be selectively increased, in which case the associated tariff revenues would accrue to the importing country. Hence, to allow for these two possiblities, we will also conduct our analysis for two different revenue distribution schemes: one which allows an exporter to retain any tariff revenues (or quota rents) associated with the selective safeguard measure, and one which has the importer retain the revenues associated with the selective safeguard measure. We note that the importer will always be assumed to retain the revenues from the associated global trade measure.[6]

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[5] The first equivalence notion has peen previously used by Dinopoulos and Kreinin (1989); the second equivalence notion seems quite natural, in the sense that industries lobbying for protection are apt to be concerned with maintaining their own production levels; and the third notion is relevant since MFN treatment requires that any selective tariff reductions are to be extended to all trading partners.

[6] That the importer would retain any revenues arising from a global tariff increase is clear. There is, however, some debate as to what in fact constitutes a global quota, and this, in turn, will affect the distribution of quota rents. If a global quota means

The organization of the rest of the chapter is as follows. Section 2.2 defines the parameters of the model and provides the basic framework for the dual approach to the problem. Section 2.3 compares the changes in world welfare brought about by marginal changes in a country's tariffs on a global and selective basis when the exporters are allowed to retain any tariff revenues associated with selective tariff increases. In this section, some global and selective case welfare comparisons are also made for the instigating country and for the rest of the world. In particular, it is of interest if the instigating country's policy rankings coincide with those of the world as a whole. Section 2.4 repeats the analysis conducted in section 2.3, this time allowing the importer to retain the tariff revenues associated with the selective case. In addition, this section also takes a slight detour to recast some of its analysis in terms of tariff reductions. Section 2.5 discusses the generalization of our results beyond the 2-good case. It presents some analysis of a 3-good, 3-country model with more than one good subject to a tariff to illustrate that the presence of other trade distortions can prevent the generalization of our earlier results. Section 2.6 presents some summary comments.

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that quotas are allocated to all foreign suppliers based on their historic market shares, then the exporters would retain the quota rents; if a global quota means that quotas are allocated to domestic importers based on past import performances, then the importing country would retain the quota rents; and if a global quota means that quota rights are auctioned off, then the importing country would again retain the quota rents. This last definition of a global quota is the one used in this chapter. While each of the three potential definitions of a global quota may be GATT-legal, the last one has more currency as a non-discriminatory measure from an economic perspective.

2.2 Preliminaries

We have a 2-good, m-factor, 3-country model. The two goods are numbered 1 and 2; the three countries are labelled a, b, and c. We assume that each country has a convex technology and one consumer with a strictly quasi-concave utility function. In addition, both goods are assumed to be normal in demand in each country. Country a trades with both countries b and c, but b and c do not trade with each other.[7] In the initial equilibrium, it is assumed that country a exports good 1 to b and c in exchange for imports of good 2.

In the successive analysis, good 1 will be taken to be the numeraire, while the price of good 2 in country j will be given by p^j, for $j = a, b, c$. In country j, the utility level is u^j and the vector of fixed factor supplies is v^j. Letting x_i^j be the consumption of good i in country j, and letting q_i^j be the production of good i in country j, we can now define the expenditure and revenue functions, respectively, for country j as follows:

$$e^j(1, p^j, u^j) = \min_{x_1^j, x_2^j} \{x_1^j + p^j x_2^j | u^j(x_1^j, x_2^j) \geq u^j\}, \tag{2.1}$$

$$r^j(1, p^j, v^j) = \max_{q_1^j, q_2^j} \{q_1^j + p^j q_2^j | (q_1^j, q_2^j, v^j) \quad \text{feasible}\}. \tag{2.2}$$

We also assume throughout that the expenditure and revenue functions are twice differentiable. The compensated demand function and the supply function for good i in country j can then be found by partially differentiating e^j and r^j, respectively, with respect to p^j. Thus, we can define the compensated demand for

[7] Dinopoulos and Kreinin (1989) use the same assumption when comparing the effects on individual countries of VERs and global quotas.

net imports of good 2 in country j to be

$$m^j = e_p^j - r_p^j. \tag{2.3}$$

We will also let m^{jk} be the net imports of good 2 by country j from country k. For simplicity, the only distortions in the model will be tariffs imposed on good 2 by country a. Letting t^{ab} and t^{ac} be the specific tariffs imposed on good 2 by a against b and c, respectively, in al. cases examined we will assume that country a initially applies the same positive tariff rate to good 2 imported from both b and c (i.e., initially $t^{ab} = t^{ac} > 0$). We will also assume that country a is considering either marginally increasing the tariff rate uniformly against both countries, or changing it selectively against one of the other countries (which will typically be country c for the purpose of derivation). And, while all succeeding analysis is conducted with respect to tariffs, these tariffs could also be viewed as the tariff equivalents of quotas, and the associated tariff revenues could be viewed as quota rents.

2.3 The Basic Model

Often when safeguard actions are taken, they appear in the form of quotas. For this chapter, we will assume that when a global quota is introduced which is strictly compatible with GATT Article XIX, that the instigating country sets a single global quota on all imports of the good in question, regardless of their origins, and that the quota rights are auctioned off by the importing country.[8] Frequently, however, the instigating country will technically adhere to GATT Article XIX, while

[8] See footnote 6 above.

violating the omnipresent spirit of MFN, by arranging VERs, or export quotas, with individual countries;[9] and, by the very nature of export quotas, the exporting countries necessarily retain any associated quota rents. Now, in our model, country a initially has in place a positive uniform tariff on good 2 imports from countries b and c (i.e., $t^{ab} = t^{ac} > 0$). To mimic the additional imposition by country a of a global quota, we will marginally increase the tariffs against b and c by the same amounts, retaining the additional tariff revenues in country a; and, to mimic the additional imposition by country a of a VER against country c, we will marginally increase the tariff against c, and allow country c to retain any differential tariff revenues (i.e., $(t^{ac} - t^{ab})m^{ac}$). Thus, since the expenditures of each country should equal its revenues from production and tariff collections, we have that in equilibrium

$$e^a(1, p^a, u^a) = r^a(1, p^a, v^a) + t^{ab}m^a, \tag{2.4}$$

$$e^b(1, p^b, u^b) = r^b(1, p^b, v^b), \tag{2.5}$$

$$e^c(1, p^c, u^c) = r^c(1, p^c, v^c) + (t^{ac} - t^{ab})m^{ac}. \tag{2.6}$$

In equilibrium, we must also have that the world excess demand for each good is zero. In particular, for good 2, we must have that

$$e^a_p + e^b_p + e^c_p - r^a_p - r^b_p - r^c_p = 0, \tag{2.7}$$

$$\text{i.e.,} \quad m^a + m^b + m^c = 0. \tag{2.8}$$

[9] e.g., the bilateral arrangements between Canada and Japan, and between the United States and Japan, that restricted auto exports to North America in the early 1980s.

Thus, equations (2.4) to (2.7) specify the equilibrium of our model.[10]

We also note that prices p^a, p^b, and p^c are related as follows:

$$p^a = p^b + t^{ab} = p^c + t^{ac}, \tag{2.9}$$

or alternatively,

$$p^a - t^{ac} = p^b - (t^{ac} - t^{ab}) = p^c. \tag{2.10}$$

Now, we would like to compare the changes in world welfare for cases in which country a marginally increases its tariff rate against both countries b and c, and in which it marginally increases its tariff rate against only country c. Towards this end, we totatlly differentiate the equilibrium conditions (2.4) to (2.7), and then use the fact that $t^{ab} = t^{ac}$ at the initial equilibrium in order to obtain the following:

$$\begin{aligned}
&e^a_p dp^a + e^a_u du^a = r^a_p dp^a + t^{ab} dm^a + m^a dt^{ab},\\
&e^b_p dp^b + e^b_u du^b = r^b_p dp^b,\\
&e^c_p dp^c + e^c_u du^c = r^c_p dp^c + m^{ac}(dt^{ac} - dt^{ab}),\\
&e^a_{pp} dp^a + e^a_{pu} du^a + e^b_{pp} dp^b + e^b_{pu} du^b + e^c_{pp} dp^c + e^c_{pu} du^c\\
&- r^a_{pp} dp^a - r^b_{pp} dp^b - r^c_{pp} dp^c = 0.
\end{aligned} \tag{2.11}$$

We define the price derivative of country j's compensated net import demand for good 2 to be

$$s^j = e^j_{pp} - r^j_{pp}. \tag{2.12}$$

[10] We note that Walras Law has allowed us to ignore the requirement that the excess demand for the numeraire good is zero.

Substituting (2.3) and (2.12) in (2.11), we have that

$$\begin{aligned} & m^a dp^a + e_u^a du^a = m^a dt^{ab} + t^{ab} dm^a, \\ & m^b dp^b + e_u^b du^b = 0, \\ & m^c dp^c + e_u^c du^c = m^{ac}(dt^{ac} - dt^{ab}), \\ & s^a dp^a + s^b dp^b + s^c dp^c + e_{pu}^a du^a + e_{pu}^b du^b + e_{pu}^c du^c = 0. \end{aligned} \tag{2.13}$$

Then, noting that (2.10) $\Longrightarrow$

$$dp^a - dt^{ac} = dp^b - (dt^{ac} - dt^{ab}) = dp^c, \tag{2.14}$$

and substituting (2.14) in (2.13), we obtain

$$e_u^a du^a = -m^a(dp^c + (dt^{ac} - dt^{ab})) + t^{ab} dm^a, \tag{2.15}$$

$$e_u^b du^b = -m^b(dp^c + (dt^{ac} - dt^{ab})), \tag{2.16}$$

$$e_u^c du^c = -m^c(dp^c + (dt^{ac} - dt^{ab})), \tag{2.17}$$

$$\begin{aligned} & s^a(dp^c + dt^{ac}) + s^b(dp^c + (dt^{ac} - dt^{ab})) + s^c dp^c \\ & + e_{pu}^a du^a + e_{pu}^b du^b + e_{pu}^c du^c = 0. \end{aligned} \tag{2.18}$$

Then, noting that $m^{aj} = -m^j$ for $j = b, c$, and adding across equations (2.15) to (2.17), we define the change in world welfare to be[11]

$$\Delta W \equiv e_u^a du^a + e_u^b du^b + e_u^c du^c = t^{ab} dm^a, \tag{2.19}$$

which is essentially a volume of trade effect.[12]

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[11] See Dixit and Norman (1980, p. 155), for use of this measure of change in world welfare.

[12] See Wooton (1986) for a similar 3-country result obtained in analyzing the formation of preferential trading areas.

Now, if we let c^j be country j's demand for good 2, and if we let y^j be country j's money income, then we have that

$$e^j_p = c^j \Longrightarrow e^j_{pu} = c^j_u = c^j_y y^j_u = c^j_y e^j_u. \tag{2.20}$$

Hence, from (2.3), we see that

$$dm^j = s^j dp^j + c^j_y e^j_u du^j. \tag{2.21}$$

Then, using the fact that $t^{ab} = t^{ac}$ at the initial equilibrium, and substituting (2.20) and (2.21) in (2.15) to (2.18), we obtain

$$\begin{aligned}
&e^a_u du^a = -m^a(dp^c + (dt^{ac} - dt^{ab})) + t^{ac}s^a dp^c + t^{ac}s^a dt^{ac} + t^{ac}c^a_y e^a_u du^a,\\
&e^b_u du^b = -m^b(dp^c + (dt^{ac} - dt^{ab})),\\
&e^c_u du^c = -m^c(dp^c + (dt^{ac} - dt^{ab})),\\
&s^a(dp^c + dt^{ac}) + s^b(dp^c + (dt^{ac} - dt^{ab})) + s^c dp^c\\
&+ c^a_y e^a_u du^a + c^b_y e^b_u du^b + c^c_y e^c_u du^c = 0,
\end{aligned} \tag{2.22}$$

$\Longrightarrow$

$$(1 - t^{ac}c^a_y)e^a_u du^a = (t^{ac}s^a - m^a)dp^c + (t^{ac}s^a - m^a)dt^{ac} + m^a dt^{ab}, \tag{2.23}$$

$$e^b_u du^b = -m^b dp^c - m^b dt^{ac} + m^b dt^{ab}, \tag{2.24}$$

$$e^c_u du^c = -m^c dp^c - m^c dt^{ac} + m^c dt^{ab}, \tag{2.25}$$

$$\begin{aligned}
(s^a + s^b + s^c)dp^c = &-(c^a_y e^a_u du^a + c^b_y e^b_u du^b + c^c_y e^c_u du^c\\
&+ (s^a + s^b)dt^{ac} - s^b dt^{ab}).
\end{aligned} \tag{2.26}$$

We now let $S = s^a + s^b + s^c$, and note that s^a, s^b, s^c, and S are all strictly negative (which is true because the strict quasi-concavity of each country's utility

function implies that there is substitutability in consumption between goods 1 and 2 in each country[13]). Then (2.26) can be rewritten as

$$dp^c = -S^{-1}(c_y^a e_u^a du^a + c_y^b e_u^b du^b + c_y^c e_u^c du^c + (s^a + s^b)dt^{ac} - s^b dt^{ab}). \tag{2.27}$$

Substituting (2.27) in (2.23) to (2.25), we get

$$\begin{aligned}
(1 - t^{ac}c_y^a)e_u^a du^a =&(m^a - t^{ac}s^a)S^{-1}(c_y^a e_u^a du^a + c_y^b e_u^b du^b + c_y^c e_u^c du^c \\
&+ (s^a + s^b)dt^{ac} - s^b dt^{ab}) + (t^{ac}s^a - m^a)dt^{ac} + m^a dt^{ab} \\
e_u^b du^b =&m^b S^{-1}(c_y^a e_u^a du^a + c_y^b e_u^b du^b + c_y^c e_u^c du^c + (s^a + s^b)dt^{ac} - s^b dt^{ab}) \\
&- m^b dt^{ac} + m^b dt^{ab}, \\
e_u^c du^c =&m^c S^{-1}(c_y^a e_u^a du^a + c_y^b e_u^b du^b + c_y^c e_u^c du^c + (s^a + s^b)dt^{ac} - s^b dt^{ab}) \\
&- m^c dt^{ac} + m^c dt^{ab}.
\end{aligned} \tag{2.28}$$

Now we define the following variables:

$$\begin{aligned}
&A^a = 1 - t^{ac}c_y^a + B^a c_y^a, \quad \text{where} \quad B^a = (t^{ac}s^a - m^a)S^{-1}, \\
&A^b = 1 + B^b c_y^b, \quad \text{where} \quad B^b = -m^b S^{-1}, \\
&A^c = 1 + B^c c_y^c, \quad \text{where} \quad B^c = -m^c S^{-1}.
\end{aligned} \tag{2.29}$$

Then, if we let

$$D = \begin{pmatrix} A^a & B^a c_y^b & B^a c_y^c \\ B^b c_y^a & A^b & B^b c_y^c \\ B^c c_y^a & B^c c_y^b & A^c \end{pmatrix}, \tag{2.30}$$

we can rewrite (2.28) as

$$\begin{pmatrix} e_u^a du^a \\ e_u^b du^b \\ e_u^c du^c \end{pmatrix} = D^{-1} \begin{pmatrix} -B^a(s^a + s^b) + t^{ac}s^a - m^a \\ -B^b(s^a + s^b) - m^b \\ -B^c(s^a + s^b) - m^c \end{pmatrix} dt^{ac} + D^{-1} \begin{pmatrix} B^a s^b + m^a \\ B^b s^b + m^b \\ B^c s^b + m^c \end{pmatrix} dt^{ab}. \tag{2.31}$$

[13] cf. Dixit and Norman (1980, p. 130).

The determinant of D, $|D|$, is given by

$$|D| = A^a(A^bA^c - B^cc_y^bB^bc_y^c) - B^ac_y^b(B^bc_y^aA^c - B^cc_y^aB^bc_y^c) + B^ac_y^c(B^bc_y^aB^cc_y^b - B^cc_y^aA^b), \tag{2.32}$$

from which it can be shown that[14]

$$|D| = (1 - t^{ac}c_y^a)(1 - c_y^bm^bS^{-1} - c_y^cm^cS^{-1}) + (t^{ac}s^a - m^a)c_y^aS^{-1} > 0. \tag{2.33}$$

Using (2.33), we can then show that

$$D^{-1} = \frac{1}{|D|}\begin{pmatrix} A^bA^c - B^cc_y^bB^bc_y^c & -(B^ac_y^bA^c - B^cc_y^bB^ac_y^c) & B^ac_y^bB^bc_y^c - A^bB^ac_y^c \\ -(B^bc_y^aA^c - B^cc_y^aB^bc_y^c) & A^aA^c - B^cc_y^aB^ac_y^c & -(A^aB^bc_y^c - B^bc_y^aB^ac_y^c) \\ B^bc_y^aB^cc_y^b - B^cc_y^aA^b & -(A^aB^cc_y^b - B^cc_y^aB^ac_y^b) & A^aA^b - B^bc_y^aB^ac_y^b \end{pmatrix}, \tag{2.34}$$

$\Longrightarrow$

$$D^{-1} = \frac{1}{|D|}\begin{pmatrix} 1 + B^bc_y^b + B^cc_y^c & -B^ac_y^b & -B^ac_y^c \\ -B^bc_y^a & (1 - t^{ac}c_y^a)(1 + B^cc_y^c) + B^ac_y^a & -(1 - t^{ac}c_y^a)B^bc_y^c \\ -B^cc_y^a & -(1 - t^{ac}c_y^a)B^cc_y^b & (1 - t^{ac}c_y^a)(1 + B^bc_y^b) + B^ac_y^a \end{pmatrix}. \tag{2.35}$$

As stated earlier, we would like to compare the changes in world welfare for the cases in which country a marginally increases its tariff rate against both countries b and c, and in which it marginally increases its tariff rate against only country c. In the former case, which we will henceforth refer to as the global case, we have a situation where $dt^{ab} = dt^{ac}$; while in the latter case, which we will henceforth refer to as a selective case, we have a situation where $dt^{ab} = 0$. We will use the subscript g to refer to the global case and the subscript sji to refer to the selective case in

[14] We note that $t^{ac}c_y^a$ is the change in country a's tariff revenues which occurs when its income rises by one unit. Hence, we must have that $t^{ac}c_y^a < 1$ (cf. Wooton (1986, p. 90)). Also note that $s^j - c_y^jm^j$ is the uncompensated price derivative of the net import demand function for good 2 in country j, and is negative if good 2 is normal in demand in country j (cf. Dixit and Norman (1980, pp. 134–135)).

which the tariff is marginally increased against country j using equivalence notion i. We thus have that in the global case

$$\begin{pmatrix} e_u^a du_g^a \\ e_u^b du_g^b \\ e_u^c du_g^c \end{pmatrix} = D^{-1} \begin{pmatrix} -B^a s^a + t^{ac} s^a \\ -B^b s^a \\ -B^c s^a \end{pmatrix} dt_g^{ac}, \tag{2.36}$$

while in the selective case where country c is subject to a tariff increase, we have that

$$\begin{pmatrix} e_u^a du_{sci}^a \\ e_u^b du_{sci}^b \\ e_u^c du_{sci}^c \end{pmatrix} = D^{-1} \begin{pmatrix} -B^a(s^a + s^b) + t^{ac} s^a - m^a \\ -B^b(s^a + s^b) - m^b \\ -B^c(s^a + s^b) - m^c \end{pmatrix} dt_{sci}^{ac}. \tag{2.37}$$

We measure changes in world welfare in the global and selective cases, respectively, by

$$\Delta W_g \equiv e_u^a du_g^a + e_u^b du_g^b + e_u^c du_g^c, \quad \text{and} \tag{2.38}$$

$$\Delta W_{sci} \equiv e_u^a du_{sci}^a + e_u^b du_{sci}^b + e_u^c du_{sci}^c. \tag{2.39}$$

Now, the first equivalence notion which we will examine is the maintenance of the same level of imports of good 2 into country a in both the global and selective cases. We will refer to this equivalence notion with the subscript $i = 1$. Thus, to perform our first welfare comparison, we require that

$$dm_{sc1}^a = dm_g^a. \tag{2.40}$$

Then, using (2.19) and substituting (2.40) into (2.39), we obtain that

$$\Delta W_g - \Delta W_{sc1} = 0, \tag{2.41}$$

which, by symmetry, also gives us that

$$\Delta W_g - \Delta W_{sb1} = 0. \tag{2.42}$$

Thus, from (2.41) and (2.42), we have our first proposition.

Proposition 2.1: *Suppose that in the selective case the country subject to a selective increase in the tariff on its exports is the recipient of the differential tariff revenues. Also suppose that the equivalence notion is the maintenance of the same level of country a's imports in both the global and selective cases. Then, the change in world welfare is the same in the global case as it is in the selective case.*

Now, from equation (2.19), we noted earlier that the change in world welfare was simply a volume of trade effect. And, in particular, the world welfare change depended only on the change in imports of good 2 into country a. Hence, if our equivalence notion is one where we maintain the same level of imports of good 2 into country a, it is clear that the world welfare changes in the global and selective cases must be the same.

Now, it can be shown that

$$dt^{ac}_{sc1} = \frac{s^a(s^b - c^b_y m^b + s^c - c^c_y m^c)}{s^c(s^a - c^a_y m^a)} dt^{ac}_g. \tag{2.43}$$

Suppose that we also have an equivalence notion i, for which

$$dt^{ac}_{sci} = K dt^{ac}_g, \quad \text{where} \quad K \in \Re. \tag{2.44}$$

Then, using (2.36), (2.37), and (2.44), it can be shown that

$$\Delta W_g - \Delta W_{sci} = \frac{t^{ac} S^{-1}}{|D|}(s^a(s^b - c^b_y m^b + s^c - c^c_y m^c) - (s^a - c^a_y m^a)s^c K) dt^{ac}_g. \tag{2.45}$$

Therefore,

$$\Delta W_g - \Delta W_{sci} \underset{<}{\overset{>}{=}} 0 \iff s^a(s^b - c^b_y m^b + s^c - c^c_y m^c) - (s^a - c^a_y m^a)s^c K \underset{>}{\overset{<}{=}} 0. \tag{2.46}$$

Therefore,

$$\Delta W_g - \Delta W_{sci} \gtreqless 0 \quad \Longleftrightarrow \quad K \gtreqless \frac{s^a(s^b - c_y^b m^b + s^c - c_y^c m^c)}{s^c(s^a - c_y^a m^a)}. \tag{2.47}$$

But, from (2.43) and (2.44), we have that

$$dt_{sci}^{ac} - dt_{sc1}^{ac} = \left(K - \frac{s^a(s^b - c_y^b m^b + s^c - c_y^c m^c)}{s^c(s^a - c_y^a m^a)} \right) dt_g^{ac}. \tag{2.48}$$

Therefore,

$$dt_{sci}^{ac} - dt_{sc1}^{ac} \gtreqless 0 \quad \Longleftrightarrow \quad K \gtreqless \frac{s^a(s^b - c_y^b m^b + s^c - c_y^c m^c)}{s^c(s^a - c_y^a m^a)}. \tag{2.49}$$

Thus, (2.47) and (2.49) give us that

$$\Delta W_g - \Delta W_{sci} \gtreqless 0 \quad \Longleftrightarrow \quad dt_{sci}^{ac} - dt_{sc1}^{ac} \gtreqless 0, \tag{2.50}$$

and we have our second proposition.

Proposition 2.2: *Suppose that in the given selective case country c is subject to a selective increase in the tariff on its exports and is the recipient of the differential tariff revenues. Then, the change in world welfare in the global case is greater than, equal to, or less than it is in the given selective case iff the given change in the selective tariff against country c is greater than, equal to, or less than the corresponding change in the selective tariff against country c which maintains the same level of country a's imports that exist in the global case.*

Alternatively, we could have noted that

$$\Delta W_{sci} = \frac{t^{ac} s^c S^{-1}(s^a - c_y^a m^a)}{|D|} dt_{sci}^{ac}, \tag{2.51}$$

which is a strictly decreasing function of dt^{ac}_{sci}.

But, we also know from (2.14) that $dp^a_{sci} = dp^c_{sci} + dt^{ac}_{sci}$. Thus, dt^{ac}_{sci} is simply the change in the price distortion between countries a and c when a selective tariff change is made. Therefore, from (2.51), we see that the greater is this selective price distortion change, the smaller (more negative for $dt^{ac}_{sci} > 0$) is the world welfare change. Hence, we see that for a given change in the global tariff of dt^{ac}_g (and hence a corresponding given change in world welfare of ΔW_g), we have that the larger is dt^{ac}_{sci}, the smaller is ΔW_{sci}, and hence the larger is $\Delta W_g - \Delta W_{sci}$ (i.e., the greater the likelihood that the world welfare change will be greater in the global case than in the selective case). In particular, though, from Proposition 2.2, we have that whether or not the change in world welfare is higher or lower with the global measure than it is with the selective trade measure depends on the relationship between the given selective price distortion change dt^{ac}_{sci} and dt^{ac}_{sc1}, the price distortion change for which $\Delta W_{sc1} = \Delta W_g$ (i.e., for which $dm^a_{sc1} = dm^a_g$). Thus, Proposition 2.2 tells us that there is no general theoretical support, on grounds of economic efficiency, for the use of MFN over selectivity in the application of safeguard measures. Figure 2.1 below helps to illustrate this point.

Suppose now that we examine the equivalence notion which requires the same level of protected industry production in country a in both the global and selective cases. We will refer to this equivalence notion with the subscript $i = 2$. Then, it can be shown that this equivalence notion implies that

$$dt^{ac}_{sc2} = \frac{(1 - t^{ac}c^a_y)(s^b - c^b_y m^b + s^c - c^c_y m^c) - c^a_y m^a}{(1 - t^{ac}c^a_y)s^c} dt^{ac}_g > 0. \qquad (2.52)$$

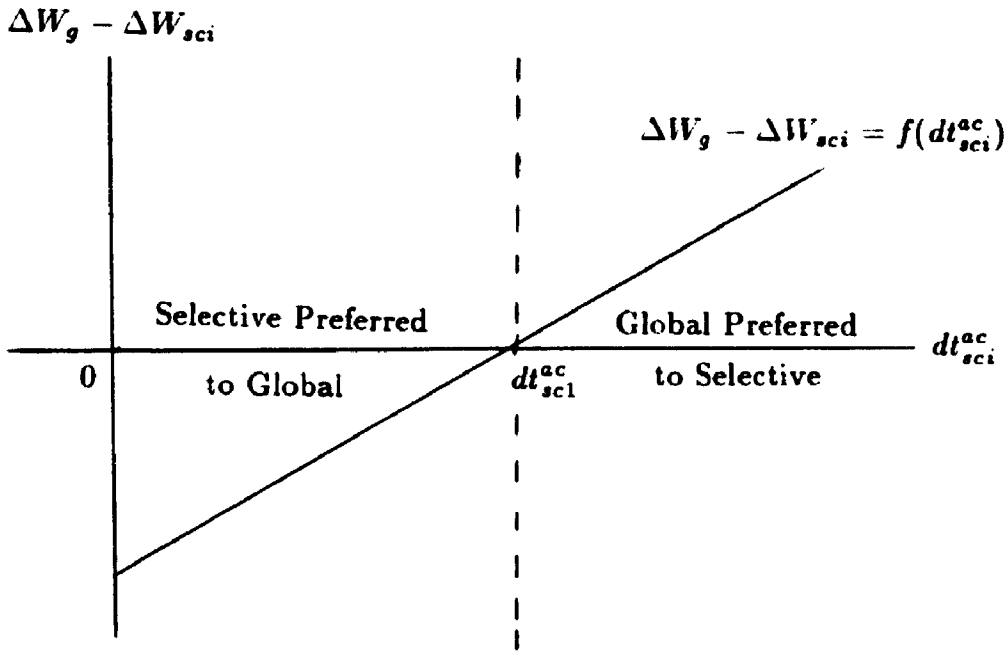

Figure 2.1

Then, from (2.43) and (2.52), we have that

$$dt^{ac}_{sc2} - dt^{ac}_{sc1} = \frac{-c^a_y m^a((1 - t^{ac}c^a_y)(s^b - c^b_y m^b + s^c - c^c_y m^c) + s^a - c^a_y m^a)}{(1 - t^{ac}c^a_y)(s^a - c^a_y m^a)s^c} dt^{ac}_g > 0. \tag{2.53}$$

Thus, from Proposition 2.2, we must have that

$$\Delta W_g - \Delta W_{sc2} > 0. \tag{2.54}$$

And, by symmetry, we must also have that

$$\Delta W_g - \Delta W_{sb2} > 0. \tag{2.55}$$

Then, taken together, (2.54) and (2.55) give us our first corollary to Proposition 2.2.

Corollary 2.1: *Suppose that in the selective case the country subject to a selective increase in the tariff on its exports is the recipient of the differential tariff revenues. Also suppose that the equivalence notion is the maintenance of the same protected industry production level in country a in both the global and selective cases. Then, the change in world welfare is greater in the global case than it is in the selective case.*

Thus, while Proposition 2.1 neither detracted from, nor provided support for, the use of MFN when imposing safeguard measures, Corollary 2.1 provides clear support for the MFN principle as applied to GATT Article XIX. Taken together, Proposition 2.1 and Corollary 2.1 also show the importance of specifying what notion of equivalence one has in mind when one makes statements about the desirability or undesirability of the use of MFN safeguard measures.

The third equivalence notion which we will examine will be referred to by the subscript $i = 3$. This notion requires that we increase the global tariff and the selective tariff by the same amount, i.e., when the selective tariff against country c is increased, it requires that we impose the condition

$$dt^{ac}_{sc3} = dt^{ac}_{g} > 0. \tag{2.56}$$

Then, from (2.43) and (2.56), we have that

$$dt^{ac}_{sc3} - dt^{ac}_{sc1} = \frac{s^c(s^a - c^a_y m^a) - s^a(s^b - c^b_y m^b + s^c - c^c_y m^c)}{s^c(s^a - c^a_y m^a)} dt^{ac}_{g}. \tag{2.57}$$

Therefore,

$$dt^{ac}_{sc3} - dt^{ac}_{sc1} \gtreqless 0 \iff s^c(s^a - c^a_y m^a) - s^a(s^b - c^b_y m^b + s^c - c^c_y m^c) \gtreqless 0. \tag{2.58}$$

Thus, from Proposition 2.2, we must have that

$$\Delta W_g - \Delta W_{sc3} \gtreqless 0 \quad \Longleftrightarrow$$

$$s^c(s^a - c_y^a m^a) - s^a(s^b - c_y^b m^b + s^c - c_y^c m^c) \gtreqless 0, \tag{2.59}$$

and we have our second corollary to Proposition 2.2.

Corollary 2.2: *Suppose that in the selective case, country c is subject to a selective increase in the tariff on its exports and is the recipient of the differential tariff revenues. Also suppose that the equivalence notion is the requirement that we increase both the global and the selective tariff against country c by the same amount. Then, the change in world welfare in the global case is greater than, equal to, or less than that in the selective case as condition (2.59) is satisfied with* $>$, $=$, *or* $<$.

Thus, because different model parameterizations could cause the inequality in (2.59) to go in different directions, with our third notion of equivalence between global and selective trade measures, Corollary 2.2 provides no uniform support for, nor detraction from, the use of MFN with respect to GATT Article XIX.

In this chapter, we have chosen to focus on three possible notions of equivalence between global and selective trade measures which we consider to be plausible. Presumably, though, one could construct a multitude of such equivalence measures, some bearing more credence than others.[15] In the end, however, regardless of what

[15] Two other equivalence notions which might have some validity are as follows: first, that which would require the maintenance of a given price level in the tariff-

notion of equivalence lies behind our selective tariff, Proposition 2.2 tells us that the choice between the global and the selective measures depends solely on the size of the given selective tariff change relative to the selective tariff change which would occur if the equivalence notion were that which required the maintenance of country a's import levels.

The main thrust of this chapter is the comparison of world welfare changes when global and selective trade measures are instituted. It is also of interest, however, to study the ranking of the global and selective measures by the instigating country (i.e., country a) and the rest of the world (i.e., the aggregation of countries b and c).

We first note that from Proposition 2.1, when the selective tariff maintains the same level of country a imports as the global tariff, because the change in world welfare is the same in the global case as it is in the selective case, country a's choice between the global and selective measures is irrelevant from the world perspective.

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imposing country (cf. Dinopoulos and Kreinin (1989)); and second, that which would require the maintenance of the employment level of a particular production factor (e.g., labour) in the protected industry in the tariff-imposing country. We note that in the 2-factor, 2-good case, these two equivalence notions are, in fact, 'equivalent' to our second equivalence notion, which requires that the same level of production be maintained in the protected industry in the tariff-imposing country.

It is still of interest to note, however, that it can be shown that

$$e_u^a du_g^a - e_u^a du_{sc1}^a = \frac{s^a S^{-1} m^a}{|D|(s^a - c_y^a m^a)} \cdot (s^a - c_y^a m^a + (1 - t^{ac} c_y^a)(s^b - c_y^b m^b + s^c - c_y^c m^c)) dt_g^{ac} > 0$$

and

$$(e_u^b du_g^b + e_u^c du_g^c) - (e_u^b du_{sc1}^b + e_u^c du_{sc1}^c) = -(e_u^a du_g^a - e_u^a du_{sc1}^a) < 0. \tag{2.60}$$

By symmetry, then, we must also have that

$$e_u^a du_g^a - e_u^a du_{sb1}^a > 0$$

and (2.61)

$$(e_u^b du_g^b + e_u^c du_g^c) - (e_u^b du_{sb1}^b + e_u^c du_{sb1}^c) < 0.$$

Thus, (2.60) and (2.61) give us Proposition 2.3.

Propostion 2.3: *Suppose that in the selective case the country subject to a selective increase in the tariff on its exports is the recipient of the differential tariff revenues. Also suppose that the equivalence notion is the maintenance of the same level of country a's imports in both the global and selective cases. Then, country a is better off and the rest of the world is worse off with the global measure than with an equivalent selective measure.*

It can also be shown that

$$e_u^a du_g^a - e_u^a du_{sc2}^a = \frac{S^{-1} m^a}{|D|(1 - t^{ac} c_y^a)} \cdot (s^a - c_y^a m^a + (1 - t^{ac} c_y^a)(s^b - c_y^b m^b + s^c - c_y^c m^c)) dt_g^{ac} > 0$$

and

$$(e_u^b du_g^b + e_u^c du_g^c) - (e_u^b du_{sc2}^b + e_u^c du_{sc2}^c) = -(1 - t^{ac} c_y^a)(e_u^a du_g^a - e_u^a du_{sc2}^a) < 0. \tag{2.62}$$

And, again by symmetry, we also have that

$$e_u^a du_g^a - e_u^a du_{sb2}^a > 0$$

and (2.63)

$$(e_u^b du_g^b + e_u^c du_g^c) - (e_u^b du_{sb2}^b + e_u^c du_{sb2}^c) < 0.$$

Then, recalling from Corollary 2.1 that $\Delta W_g - \Delta W_{sc2} > 0$ and $\Delta W_g - \Delta W_{sb2} > 0$, we have Proposition 2.4.

Proposition 2.4: *Suppose that in the selective case the country subject to a selective increase in the tariff on its exports is the recipient of the differential tariff revenues. Also suppose that the equivalence notion is the maintenance of the same protected industry production level in country a. Then,*

(i) country a is better off and the rest of the world is worse off with the global measure in place than an equivalent selective measure against either country b or country c;[16] and

(ii) country *a*'s choice of trade measure coincides with that of the world as a whole.

If, in fact, the equivalence notions espoused in Propositions 2.3 and 2.4 have any validity, then these propositions tell us that for the given equivalence notions

[16] With respect to the instigating country, the results of Proposition 2.3 and Proposition 2.4(i) reinforce those found via offer curve analysis by Dinopoulos and Kreinin (1989) in a three-country framework. And, while not reported above, we found that both exporting countries were better off with a selective measure in place than with an equivalent global one. For the country not targeted by the selective measure, this result coincided with that of Dinopoulos and Kreinin. However, their work contrasted with ours in that they found it was ambiguous as to whether or not the selectively-targeted country was better or worse off with the selective measure in place as opposed to the global one. This difference in results likely arises because we are looking at only small tariff changes using differential analysis, while they were examining discrete changes.

the GATT requirement that MFN measures be used for safeguard purposes does not go against the interests of the instigating country.

Why then, one might wonder, do we in fact observe the presence of VERs on such products as automobiles, and textiles and clothing. Well, if our simple three-country paradigm were an accurate reflection of reality, it would have to be because country a's notion of equivalence was different from that used in either of Propositions 2.3 or 2.4. For example, for our third equivalence notion, maintenance of the same tariff increase against the selectively-hit country, it can be shown that

$$e_u^a du_g^a - e_u^a du_{sc3}^a = \frac{S^{-1}}{|D|}((s^a + s^c)m^a + t^{ac}s^a(s^b - c_y^b m^b - c_y^c m^c))dt_g^{ac} \gtreqless 0 \quad (2.64)$$

and

$$e_u^a du_g^a - e_u^a du_{sb3}^a = \frac{S^{-1}}{|D|}((s^a + s^b)m^a + t^{ac}s^a(s^c - c_y^b m^b - c_y^c m^c))dt_g^{ac} \gtreqless 0, \quad (2.65)$$

and that for some parameterizations both (2.64) and (2.65) will be negative, meaning that a selective measure would in fact be preferred to a global measure by country a.

It is more likely, however, that our model does not accurately reflect the world of trade. Not only have we restricted our attention to a model with only two goods and a distortion in only one market, but we have ignored the roles of uncertainty, adjustment costs, tariff retaliation, and political reality, all of which are important factors in the examination of the safeguards issue. It is possible that consideration of any one of these factors could make the choice of a selective trade measure rational from the instigating country's perspective.

From the perspective of the rest of the world, we have that

$$(e_u^b du_g^b + e_u^c du_g^c) - (e_u^b du_{sc3}^b + e_u^c du_{sc3}^c) = \frac{-m^a S^{-1}}{|D|}(s^a + (1 - t^{ac}c_y^a)s^c)dt_g^{ac} < 0 \quad (2.66)$$

and

$$(e_u^b du_g^b + e_u^c du_g^c) - (e_u^b du_{sb3}^b + e_u^c du_{sb3}^c) = \frac{-m^a S^{-1}}{|D|}(s^a + (1 - t^{ac}c_y^a)s^b)dt_g^{ac} < 0, \quad (2.67)$$

yielding Proposition 2.5.

Proposition 2.5: *Suppose that in the selective case the country subject to the selective tariff increase on its exports is the recipient of the differential tariff revenues. Also suppose that the equivalence notion is the requirement that we increase both the global and the selective tariffs by the same amount. Then the rest of the world is better off with the selective tariff increase than the global one.*

2.4 A Different Tariff Revenue Distribution Scheme

It is currently the case that selective safeguard actions are not explicitly permitted under GATT Article XIX. Hence, over the years, we have seen the proliferation of the so-called 'voluntary' export restraints. In the previous section we used tariffs to mimic the presence of both VERs and global quotas, and compared the world welfare changes resulting from the introduction of the two trade measures.

One might wonder, though, how world welfare changes would compare for equivalent global and selective trade measures if selectivity were permitted under GATT Article XIX. If selective safeguard actions were allowed under Article XIX, then the analysis of the previous section would not be pertinent if the instigating

country retained any differential tariff or quota rents resulting from a selective safeguard action. And, it is these such situations which will be modelled in this section.

Since country a is the tariff-imposing country in our 3-country framework, the only difference in the equilibrium conditions between this and the previous section is that instead of country c, country a now retains the differential tariff revenues $(t^{ac}-t^{ab})m^{ac}$ resulting from a selective trade measure taken against country c. Thus, consistent with our earlier notation, we now have a situation where the following conditions hold true in equilibrium:

$$e^a(1,p^a,u^a) = r^a(1,p^a,v^a) + t^{ab}m^{ab} + t^{ac}m^{ac}, \tag{2.68}$$

$$e^b(1,p^b,u^b) = r^b(1,p^b,v^b), \tag{2.69}$$

$$e^c(1,p^c,u^c) = r^c(1,p^c,v^c), \tag{2.70}$$

$$e^a_p + e^b_p + e^c_p - r^a_p - r^b_p - r^c_p = 0. \tag{2.71}$$

The price relations in (2.9) and (2.10) again hold true.

Then, after taking total differentials of the equilibrium conditions (2.68) to (2.71), and using (2.14), via a substitution process analogous to that undertaken

above, we can obtain that

$$\begin{aligned}(1 - t^{ac}c_y^a)e_u^a du^a =&(m^a - t^{ac}s^a)S^{-1} \\ &\cdot (c_y^a e_u^a du^a + c_y^b e_u^b du^b + c_y^c e_u^c du^c + (s^a + s^b)dt^{ac} - s^b dt^{ab}) \\ &+ (t^{ac}s^a - m^{ab})dt^{ac} + m^{ab}dt^{ab}, \\ e_u^b du^b =&m^b S^{-1}(c_y^a e_u^a du^a + c_y^b e_u^b du^b + c_y^c e_u^c du^c + (s^a + s^b)dt^{ac} - s^b dt^{ab}) \\ &- m^b dt^{ac} + m^b dt^{ab}, \\ e_u^c du^c =&m^c S^{-1}(c_y^a e_u^a du^a + c_y^b e_u^b du^b + c_y^c e_u^c du^c + (s^a + s^b)dt^{ac} - s^b dt^{ab}).\end{aligned} \tag{2.72}$$

Then, using (2.29) and (2.30), we can rewrite (2.72) as

$$\begin{pmatrix} e_u^a du^a \\ e_u^b du^b \\ e_u^c du^c \end{pmatrix} = D^{-1} \begin{pmatrix} -B^a(s^a + s^b) + t^{ac}s^a - m^{ab} \\ -B^b(s^a + s^b) - m^b \\ -B^c(s^a + s^b) \end{pmatrix} dt^{ac} + D^{-1} \begin{pmatrix} B^a s^b + m^{ab} \\ B^b s^b + m^b \\ B^c s^b \end{pmatrix} dt^{ab}. \tag{2.73}$$

Then, as in section 2.3 above, we again have that in the global case (2.36) holds true, while this time, in the selective case, we have that

$$\begin{pmatrix} e_u^a du_{sci}^a \\ e_u^b du_{sci}^b \\ e_u^c du_{sci}^c \end{pmatrix} = D^{-1} \begin{pmatrix} -B^a(s^a + s^b) + t^{ac}s^a - m^{ab} \\ -B^b(s^a + s^b) - m^b \\ -B^c(s^a + s^b) \end{pmatrix} dt_{sci}^{ac}. \tag{2.74}$$

Recalling that $t^{ab} = t^{ac}$ in the initial situation, we also find that, similar to section 2.3, we can show that the change in world welfare is

$$\Delta W \equiv e_u^a du^a + e_u^b du^b + e_u^c du^c = t^{ac} dm^a. \tag{2.75}$$

Then, if we perform the welfare comparison for our first equivalence notion, where we have

$$dm_g^a = dm_{sc1}^a, \tag{2.76}$$

by substituting (2.76) in (2.75), we again obtain

$$\Delta W_g - \Delta W_{sc1} = 0, \tag{2.77}$$

and symmetrically that

$$\Delta W_g - \Delta W_{sb1} = 0. \tag{2.78}$$

Then, from (2.77) and (2.78), we have our sixth proposition.

Proposition 2.6: *Suppose that country a retains all tariff revenues in both the global and selective cases. Also suppose that the equivalence notion is the maintenance of the same level of country a's imports in both the global and selective cases. Then, the change in world welfare is the same in the global case as it is in the selective case.*

Thus, once again, because equation (2.75) tells us that world welfare changes are simply volume of trade effects, it is not surprising that world welfare changes in the global and selective cases are identical for this equivalence notion.

In all of our propositions and corollaries presented in this chapter, we have implicitly been assuming that selective tariff changes equivalent to our global tariff changes always existed. There may, however, be some global tariff changes for which there do not exist corresponding selective tariff changes. For example, we note that in this section of the chapter we have that

$$dm_g^a = \frac{s^a S^{-1}}{|D|}(s^b - c_y^b m^b + s^c - c_y^c m^c) dt_g^{ac}, \tag{2.79}$$

while

$$dm^a_{sci} = \frac{S^{-1}}{|D|}((s^c - c^c_y m^c)(s^a + c^a_y m^b) - (s^b - c^b_y m^b)c^a_y m^c)dt^{ac}_{sci}. \tag{2.80}$$

From (2.79), we see that for $dt^{ac}_g > 0$, we have $dm^a_g \leq 0$, and, in particular, for $s^b - c^b_y m^b + s^c - c^c_y m^c < 0$, we have $dm^a_g < 0$. If we let

$$J^c = (s^c - c^c_y m^c)(s^a + c^a_y m^b) - (s^b - c^b_y m^b)c^a_y m^c, \tag{2.81}$$

it is possible that we could have $J^c \leq 0$, so that $dm^a_{sci} \geq 0 \quad \forall dt^{ac}_{sci} > 0, \quad dt^{ac}_{sci} \in \Re$. Hence, in order to ensure that selective tariff changes produce a decline in country a's imports (i.e., $dm^a_{sci} < 0$), in this section we impose the condition that

$$J^c > 0. \tag{2.82}$$

Also, defining

$$J^b = (s^b - c^b_y m^b)(s^a + c^a_y m^c) - (s^c - c^c_y m^c)c^a_y m^b, \tag{2.83}$$

we impose the condition that

$$J^b > 0. \tag{2.84}$$

Thus, for our first notion of equivalence, we have that

$$dt^{ac}_{sc1} = \frac{s^a(s^b - c^b_y m^b + s^c - c^c_y m^c)}{J^c} dt^{ac}_g. \tag{2.85}$$

If we also have an equivalence notion i for which

$$dt^{ac}_{sci} = K dt^{ac}_g, \quad \text{where} \quad K \in \Re, \tag{2.86}$$

then, using (2.36), (2.74), and (2.86), it can be shown that

$$\Delta W_g - \Delta W_{sci} = \frac{t^{ac}S^{-1}}{|D|}(s^a(s^b - c_y^b m^b + s^c - c_y^c m^c) - KJ^c)dt_g^{ac}. \qquad (2.87)$$

Therefore,

$$\Delta W_g - \Delta W_{sci} \gtreqless 0 \iff KJ^c \gtreqless s^a(s^b - c_y^b m^b + s^c - c_y^c m^c). \qquad (2.88)$$

But, from (2.85) and (2.86), we have that

$$dt_{sci}^{ac} - dt_{scl}^{ac} = \left(K - \frac{s^a(s^b - c_y^b m^b + s^c - c_y^c m^c)}{J^c}\right) dt_g^{ac}. \qquad (2.89)$$

Therefore, we have that

$$dt_{sci}^{ac} - dt_{scl}^{ac} \gtreqless 0 \iff KJ^c \gtreqless s^a(s^b - c_y^b m^b + s^c - c_y^c m^c). \qquad (2.90)$$

Thus, from (2.88) and (2.90), we have that

$$\Delta W_g - \Delta W_{sci} \gtreqless 0 \iff dt_{sci}^{ac} - dt_{scl}^{ac} \gtreqless 0, \qquad (2.91)$$

giving us Proposition 2.7.

Proposition 2.7: *Suppose that in the given selective case country c is subject to a selective increase in the tariff on its exports and that country a retains all tariff revenues in both the global and selective cases. Then, the change in world welfare in the global case is greater than, equal to, or less than it is in the given selective case iff the change in the selective tariff against country c is greater than, equal to, or less than the corresponding change in the selective tariff against country c which maintains the same level of country a's imports that exist in the global case.*

Thus, we find that Proposition 2.7 corresponds directly to Proposition 2.2 in section 2.3, where we had a different tariff revenue distribution scheme.

If we now employ our second equivalence notion, which requires the maintenance of the same protected industry production level in country a, then it can be shown that this implies that

$$dt^{ac}_{sc2} = \frac{(1 - t^{ac}c^a_y)(s^b - c^b_y m^b + s^c - c^c_y m^c) - c^a_y m^a}{(1 - t^{ac}c^a_y)(s^c - c^c_y m^c) + c^a_y m^c} dt^{ac}_g. \tag{2.92}$$

Then, from (2.36), (2.74), and (2.92), we have that

$$\begin{aligned} \Delta W_g - \Delta W_{sc2} = & \frac{t^{ac} S^{-1} c^a_y ((s^b - c^b_y m^b)m^c - (s^c - c^c_y m^c)m^b)}{|D|((1 - t^{ac}c^a_y)(s^c - c^c_y m^c) + c^a_y m^c)} \\ & \cdot ((1 - t^{ac}c^a_y)(s^b - c^b_y m^b + s^c - c^c_y m^c) + s^a - c^a_y m^a) dt^{ac}_g \end{aligned} \tag{2.93}$$

$$\Longrightarrow \quad \Delta W_g - \Delta W_{sc2} \gtreqless 0 \quad \Longleftrightarrow \quad (s^c - c^c_y m^c)m^b \gtreqless (s^b - c^b_y m^b)m^c. \tag{2.94}$$

Therefore,

$$\Delta W_g - \Delta W_{sc2} \gtreqless 0 \quad \Longleftrightarrow \quad \frac{s^c - c^c_y m^c}{m^c} \gtreqless \frac{s^b - c^b_y m^b}{m^b}. \tag{2.95}$$

Then, recalling that at the initial equilibrium we have $p^b = p^c$ (since initially $t^{ab} = t^{ac}$), it follows that

$$\Delta W_g - \Delta W_{sc2} \gtreqless 0 \quad \Longleftrightarrow \quad \frac{(s^c - c^c_y m^c)p^c}{m^c} \gtreqless \frac{(s^b - c^b_y m^b)p^b}{m^b}. \tag{2.96}$$

Now, by symmetry, we also have that

$$\Delta W_g - \Delta W_{sb2} \gtreqless 0 \quad \Longleftrightarrow \quad \frac{(s^b - c^b_y m^b)p^b}{m^b} \gtreqless \frac{(s^c - c^c_y m^c)p^c}{m^c}, \tag{2.97}$$

and we note that from (2.96) and (2.97), we also have that

$$\Delta W_g - \Delta W_{sc2} \gtreqless 0 \quad \Longleftrightarrow \quad \Delta W_g - \Delta W_{sb2} \lesseqgtr 0. \tag{2.98}$$

Finally, noting that countries b and c are net exporters of good 2 and that $\frac{(s^j - c_y^j m^j)p^j}{m^j}$ is simply the price elasticity of the uncompensated demand for net imports of good 2 in country j, we arrive at our next proposition.

Proposition 2.8: *Suppose that country a retains all tariff revenues in both the global and selective cases. Also suppose that the equivalence notion is the maintenance of the same protected industry production level in country a in both the global and selective cases.*

(i) Then, the global trade measure provides a larger change in world welfare than does the selective trade measure iff the selective trade measure is applied against the exporting country with the more price elastic uncompensated export supply.

(ii) From the world's perspective, a selective measure against the more inelastic export supplier would be preferred to either the global measure or a selective measure against the more elastic export supplier.[17]

Thus, in contrast to Corollary 2.1 in section 2.3, where use of this equivalence notion meant that a global trade measure was preferred to a selective trade measure, from Proposition 2.8, we see that when country a keeps all tariff revenues, there exists a selective measure which does at least as well as the global trade measure. Consequently, for this equivalence notion, the distribution of selective tariff revenues is a crucial factor in discerning between the desirability of global and selective trade measures. This very point, in turn, contrasts with the implication of Propositions

[17] A related public finance result is noted in Ramsey (1927): the optimal way to raise a small amount of tax revenue is to tax the more inelastic supplier at a higher tax rate.

2.1 and 2.6, which is that for our first equivalence notion (maintenance of the same level of country a imports in the global and selective cases), the distribution of tariff revenues does not affect our world welfare comparisons.

Now, at first glance, it might not seem obvious that the distribution of tariff revenues should affect our results, especially when the welfare changes we are discussing are for the world as a whole. But recall that at the initial equilibrium country a has a uniform tariff in place against countries b and c, meaning that country a initially faces a relatively higher domestic price for good 2 than do b and c. Thus, even if we had identical preferences across countries, there will be a proportionally greater demand for good 2 when b or c receives the differential tariff revenues than when a does, and consequently we should not expect world welfare changes to be the same for different revenue distributions.

Let us now examine our third equivalence notion, for which we impose the condition

$$dt^{ac}_{ac3} = dt^{ac}_{g} > 0. \tag{2.99}$$

We then find that

$$\Delta W_g - \Delta W_{ac3} = \frac{t^{ac}S^{-1}}{|D|} J^b dt^{ac}_g < 0. \tag{2.100}$$

By symmetry, we also find that

$$\Delta W_g - \Delta W_{ab3} = \frac{t^{ac}S^{-1}}{|D|} J^c dt^{ac}_g < 0. \tag{2.101}$$

Then, from (2.100) and (2.101), we have our ninth proposition.

Proposition 2.9: *Suppose that country a retains all tariff revenues in both the*

global and selective cases. Also suppose that the equivalence notion is the requirement that we increase both the global and the selective tariff by the same amount. Then, the change in world welfare is greater with the selective trade measure than it is with corresponding global one.

Thus, Proposition 2.9 contrasts with Corollary 2.2 in section 2.3, which found that for this equivalence notion, depending on the model parameterization, either the global measure or a selective measure against a particular country could yield higher world welfare. Hence, as with Proposition 2.8, we have again shown that the distribution of tariff revenues is important when comparing the changes in world welfare for a given equivalence notion. In particular, the results of this section deal a blow to the use of MFN safeguard measures for the three equivalence notions we have examined.

As in the previous section, it is also desirable to know if the instigating country's interests coincide with those of the world as a whole, and how the rest of the world ranks the global and selective measures. Now, from Proposition 2.6, we know that when the selective tariff maintains the same level of country a's imports as the global tariff, the change in world welfare is the same with a global tariff increase as it is with a selective tariff increase against any exporting country. Hence, country a's choice between the global and selective measures is irrelevant from the world perspective. It is still of interest to note, however, that

$$e_u^a du_g^a - e_u^a du_{sc1}^a = \frac{s^a S^{-1}}{|D|J^c}((1 - t^{ac}c_y^a)(s^b - c_y^b m^b + s^c - c_y^c m^c) + s^a - c_y^a m^a) \cdot ((s^b - c_y^b m^b)m^c - (s^c - c_y^c m^c)m^b)dt_g^{ac} \tag{2.102}$$

$$\Longrightarrow \quad e_u^a du_g^a - e_u^a du_{sc1}^a \gtreqless 0 \quad \Longleftrightarrow \quad (s^c - c_y^c m^c)m^b \gtreqless (s^b - c_y^b m^b)m^c. \tag{2.103}$$

By symmetry,

$$e_u^a du_g^a - e_u^a du_{sb1}^a \gtreqless 0 \quad \Longleftrightarrow \quad (s^b - c_y^b m^b)m^c \gtreqless (s^c - c_y^c m^c)m^b. \tag{2.104}$$

And, we have that

$$(e_u^b du_g^b + e_u^c du_g^c) - (e_u^b du_{sc1}^b + e_u^c du_{sc1}^c) = -(e_u^a du_g^a - e_u^a du_{sc1}^a) \tag{2.105}$$

and

$$(e_u^b du_g^b + e_u^c du_g^c) - (e_u^b du_{sb1}^b + e_u^c du_{sb1}^c) = -(e_u^a du_g^a - e_u^a du_{sb1}^a). \tag{2.106}$$

We also note that for our second equivalence notion, where we maintain the same protected industry production level in country a, it can be shown that

$$\begin{aligned} e_u^a du_g^a - e_u^a du_{sc2}^a = & \frac{S^{-1}((1 - t^{ac}c_y^a)(s^b - c_y^b m^b + s^c - c_y^c m^c) + s^a - c_y^a m^a)}{|D|((1 - t^{ac}c_y^a)(s^c - c_y^c m^c) + c_y^a m^c)} \\ & \cdot ((s^b - c_y^b m^b)m^c - (s^c - c_y^c m^c)m^b)dt_g^{ac}. \end{aligned} \tag{2.107}$$

Therefore,

$$e_u^a du_g^a - e_u^a du_{sc2}^a \gtreqless 0 \Longleftrightarrow (s^c - c_y^c m^c)m^b \gtreqless (s^b - c_y^b m^b)m^c. \tag{2.108}$$

Therefore, from (2.94) and (2.108), we have that

$$e_u^a du_g^a - e_u^a du_{sc2}^a \gtreqless 0 \quad \Longleftrightarrow \quad \Delta W_g - \Delta W_{sc2} \gtreqless 0, \tag{2.109}$$

and, by symmetry, that

$$e_u^a du_g^a - e_u^a du_{sb2}^a \gtreqless 0 \quad \Longleftrightarrow \quad \Delta W_g - \Delta W_{sb2} \gtreqless 0. \tag{2.110}$$

It can also be shown that

$$(e_u^b du_g^b + e_u^c du_g^c) - (e_u^b du_{sc2}^b + e_u^c du_{sc2}^c) \gtreqless 0 \quad \Longleftrightarrow \quad \Delta W_g - \Delta W_{sc2} \lesseqgtr 0 \quad (2.111)$$

and that

$$(e_u^b du_g^b + e_u^c du_g^c) - (e_u^b du_{sb2}^b + e_u^c du_{sb2}^c) \gtreqless 0 \quad \Longleftrightarrow \quad \Delta W_g - \Delta W_{sb2} \lesseqgtr 0 \quad (2.112)$$

Then, with reference to Proposition 2.8, (2.103) to (2.112) give us our next proposition.

Proposition 2.10: *Suppose that country a retains all tariff revenues in both the global and selective cases. Suppose that the equivalence notion is either the maintenance of the same level of country a's imports or the maintenance of the same level of country a's protected industry production in both the global and selective cases.*

(i) Then, country a is better off and the rest of the world is worse off with a global tariff increase than with a selective tariff increase iff the selective trade measure is applied against the exporting country with the more price elastic uncompensated export supply.

(ii) Country a is better off and the rest of the world is worse off with a selective measure against the more inelastic uncompensated export supplier than with either the global measure or a selective measure against the more elastic supplier.

(iii) When the equivalence notion is the maintenance of the same level of country a's protected industry production, country a's preferred policy coincides with that preferred by the world as a whole.

Thus, as in Proposition 2.4, with our second equivalence notion in mind, we see that country a's policy choice reflects that of the entire world.

We also note, as in section 2.3, that for our third equivalence notion (imposition of the same tariff increase in both the global and selective cases) there is no unambiguous relationship between country a's and the world's rankings of the global and selective trade measures. However, for the rest of the world, we have that

$$(e_u^b du_g^b + e_u^c du_g^c) - (e_u^b du_{sc3}^b + e_u^c du_{sc3}^c) = R_{c3},$$

where (2.113)

$$R_{c3} = \frac{S^{-1}}{|D|}(m^b s^a - (1 - t^{ac}c_y^a)((s^b - c_y^b m^b)m^c - (s^c - c_y^c m^c)m^b))dt_g^{ac} \underset{>}{\leq} 0$$

and

$$(e_u^b du_g^b + e_u^c du_g^c) - (e_u^b du_{sb3}^b + e_u^c du_{sb3}^c) = R_{b3},$$

where

$$R_{b3} = \frac{S^{-1}}{|D|}(m^c s^a - (1 - t^{ac}c_y^a)((s^c - c_y^c m^c)m^b - (s^b - c_y^b m^b)m^c))dt_g^{ac} \underset{>}{\leq} 0. \quad (2.114)$$

Then, together, (2.113) and (2.114) $\Longrightarrow$

$$\begin{aligned}&(e_u^b du_g^b + e_u^c du_g^c) - (e_u^b du_{sc3}^b + e_u^c du_{sc3}^c)\\ &+(e_u^b du_g^b + e_u^c du_g^c) - (e_u^b du_{sb3}^b + e_u^c du_{sb3}^c) \qquad (2.115)\\ &=\frac{s^a S^{-1}(m^b + m^c)}{|D|}dt_g^{ac} < 0,\end{aligned}$$

and, in particular, we note that if country c is the more elastic uncompensated export supplier, then the inequality in (2.113) will be satisfied with ($<$), while if country b is the more elastic uncompensated export supplier, then the inequality in (2.114) will be satisfied with ($<$). This gives us our final proposition.

Proposition 2.11: *Suppose that country a retains all tariff revenues in both the global and selective cases. Also suppose that the equivalence notion is the requirement that we increase both the global and the selective tariff by the same amount. Then a selective tariff increase against the most elastic supplier makes the rest of the world better off than the corresponding global tariff increase.*

Thus, Proposition 2.11 is similar to Proposition 2.5 in that for our third equivalence notion there always exists a selective trade measure which is preferred to the global one by the rest of the world. The propositions differ in that when the importer retains all the revenues, the selective measure against the more inelastic export supplier may make the rest of the world worse off compared to the global measure.

Now, the main focus of this chapter has been the comparison of world welfare changes when global and selective safeguard actions have been invoked. In this section, however, because country a retains all tariff revenues, the results of our analysis can readily be reinterpreted from the perspective of tariff reductions (i.e, $dt_g^{ac} < 0$) as opposed to tariff increases (i.e., $dt_g^{ac} > 0$).

Under Article I of the GATT, whenever a country reduces its tariffs against one GATT member, it must also extend those tariff reductions to all other GATT members. A natural question that arises is whether or not this invocation of MFN is in the best interests of the world as a whole.

Referring back to (2.87) and (2.89), we see that by imposing $dt_g^{ac} < 0$ we still

obtain that

$$\Delta W_g - \Delta W_{sci} \gtreqless 0 \iff dt^{ac}_{sci} - dt^{ac}_{sc1} \gtreqless 0. \tag{2.116}$$

Thus, from (2.116), we see that for tariff reductions, as for tariff increases by country a, either the global or a given selective measure could yield higher world welfare, depending on the equivalence notion employed.

Consequently, the very sanctity of MFN with respect to simple tariff reductions can be called into question. And, it is clear that the promotion of this most basic GATT principle cannot be made solely on the grounds of economic efficiency. Traditional supporters of MFN tariff reductions may, however, draw some solace from the fact that if we impose our third equivalence notion, whereby we decrease both the global and selective tariffs by the same amount, we have that

$$\Delta W_g - \Delta W_{sc3} = \frac{t^{ac} S^{-1} J^b}{|D|} dt^{ac}_g > 0, \tag{2.117}$$

and

$$\Delta W_g - \Delta W_{sb3} = \frac{t^{ac} S^{-1} J^c}{|D|} dt^{ac}_g > 0, \tag{2.118}$$

meaning that world welfare is higher with a global tariff reduction than a selective one taken against either of the other two countries. Hence, if this third equivalence notion is the one which GATT negotiators have in mind with respect to tariff reductions, then MFN may still wield some clout on the grounds of economic efficiency.

2.5 Beyond the Basic Model

The chapter thus far has employed a 2-good, m-factor, 3-country model to study the issue at hand. One might wonder, though, how robust the results of our propositions are when the model is made more general. In particular, it is of interest to know if our earlier results carry over when we introduce more products and more trade distortions in a 3-country framework.

It is not too difficult to show for our first equivalence notion (maintenance of the same level of country a imports in the global and selective cases), regardless of the distribution of tariff revenues, that world welfare changes by the same amount in the global and selective cases when we generalize to an n-good, m-factor, 3-country model with no additional trade distortions. Thus, both Propositions 2.1 and 2.6 are generalizable beyond the 2-good case. And, while some types of generalizations may be possible for our other propositions, the algebraic complexity of the requisite analysis is not very tractable.

We would like to emphasize, however, that our results are not robust when more than one country has import tariffs in place. And, to at least provide some indication that this is, in fact, the case, we conduct some analysis in this section to illustrate that Proposition 2.6 in section 2.4 does not generalize to models in which more than one good is subject to a trade distortion.

More specifically, we postulate a 3-good, 3-country model, where good 1 is the numeraire good, good 2 is imported by country a from both countries b and c, and good 3 is exported by country a to both countries b and c.[18] We will let p^{ij} be

[18] We note that with good 3 now being exported from a to b and c, we need not

the price of good i in country j, m^{ijk} be the imports of good i in country j from country k, m^{ij} be the aggregate imports of good i into country j, t^{ijk} be the tariff on imports of good i in country j from country k, and t^{ij} be the tariff on aggregate imports of good i into country j. We will also let $p^j = \begin{pmatrix} p^{2j} \\ p^{3j} \end{pmatrix}$ be the vector of non-numeraire prices for country j. Similar to section 2.4, we assume that each country retains all tariff revenues on its imports. Finally, we will assume that country a is considering either globally increasing its tariff on good 2 against countries b and c, or selectively increasing its tariff on good 2 against country b or c.

Then, consistent with our earlier notation, we now have a situation where the following conditions hold true in equilibrium:

$$e^a(1, p^{2a}, p^{3a}, u^a) = r^a(1, p^{2a}, p^{3a}) + t^{2ab}m^{2ab} + t^{2ac}m^{2ac}, \tag{2.119}$$

$$e^b(1, p^{2b}, p^{3b}, u^b) = r^b(1, p^{2b}, p^{3b}) + t^{3b}m^{3b}, \tag{2.120}$$

$$e^c(1, p^{2c}, p^{3c}, u^c) = r^c(1, p^{2c}, p^{3c}) + t^{3c}m^{3c}, \tag{2.121}$$

$$e^a_p + e^b_p + e^c_p - r^a_p - r^b_p - r^c_p = 0, \tag{2.122}$$

where (2.122) consists of vector price derivatives. In addition, we also have the price relationships

$$p^{2a} = p^{2b} + t^{2ab} = p^{2c} + t^{2ac} \tag{2.123}$$

and

$$p^{3a} = p^{3b} - t^{3b} = p^{3c} - t^{3c}. \tag{2.124}$$

We note that at the initial equilibrium, we impose that $t^{2ab} = t^{2ac}$. Then, taking the total differentials of equations (2.119) to (2.124) and via a substitution process

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specify a trade pattern for the numeraire good.

analogous to that undertaken above, we can obtain that

$$e_u^a du^a = -m^{2a} dp^{2c} - m^{3a} dp^{3c} + m^{2ab}(dt^{2ab} - dt^{2ac}) + t^{2ac} dm^{2a}, \quad (2.125)$$

$$e_u^b du^b = -m^{2b} dp^{2c} - m^{3b} dp^{3c} + m^{2b}(dt^{2ab} - dt^{2ac}) + t^{3b} dm^{3b}, \quad (2.126)$$

$$e_u^c du^c = -m^{2c} dp^{2c} - m^{3c} dp^{3c} + t^{3c} dm^{3c}. \quad (2.127)$$

Then, aggregating across (2.125) to (2.127), we find that

$$\Delta W \equiv e_u^a du^a + e_u^b du^b + e_u^c du^c = t^{2ac} dm^{2a} + t^{3b} dm^{3b} + t^{3c} dm^{3c}, \quad (2.128)$$

which tells us that the change in world welfare, once again, is a function of volume of trade effects. Now, however, with the addition of good 3, which is imported by b and c from a at tariff-distorted prices, we have three volume of trade terms as opposed to the one term in (2.75) in section 2.4. Now, not only does the change in the volume of trade in the good subject to the actual tariff changes (good 2) affect the world welfare change, but so do country-specific volume of trade changes in the other non-numeraire good.

As we stated earlier, we want to show that Proposition 2.6 does not generalize when we have more than one good subject to a trade distortion. We will thus want to compare world welfare changes in the global and selective cases when the equivalence notion is the maintenance of the same level of country a's good 2 imports in both the global and selective cases (i.e., we want $dm_g^{2a} = dm_{sc1}^{2a}$ for a selective measure against country c). Therefore, from (2.127), we will have that

$$\Delta W_g - \Delta W_{sc1} = t^{3b}(dm_g^{3b} - dm_{sc1}^{3b}) + t^{3c}(dm_g^{3c} - dm_{sc1}^{3c}), \quad (2.129)$$

which need not be equal to zero. Hence, since $\Delta W_g - \Delta W_{sc1} = 0$ in Proposition 2.6, we have shown that Proposition 2.6 does not generalize to cases involving more than one good subject to a trade distortion.

We also note that if we had used the same equivalence notion and applied a selective measure against country b, we'd find that

$$\Delta W_g - \Delta W_{sb1} = t^{3b}(dm_g^{3b} - dm_{sb1}^{3b}) + t^{3c}(dm_g^{3c} - dm_{sb1}^{3c}), \tag{2.130}$$

which also need not equal zero.

2.6 Summary Comments

In this chapter, we have used a 2-good, m-factor, 3-country model to challenge the view that safeguard actions should be instituted on an MFN basis, as opposed to on a selective one, on the grounds of economic efficiency. We have shown, in fact, that whether or not world welfare is higher in the presence of an MFN safeguard measure than it is in the presence of a selective measure depends both on the notion of equivalence between the two measures and on the distribution of the differential tariff revenues.

In particular, when the equivalence notion is the maintenance of the instigating country's import level, we showed that for small tariff changes the world welfare changes are identical in the global and selective cases, regardless of the distribution of tariff revenues. But, we also noted that world welfare changes were monotonic in tariff changes. Thus, for other equivalence notions, whether or not world welfare was higher in the global case than in the selective case depended only on the relationship

of the given selective tariff change to the selective tariff change which maintained the instigating country's imports at their global case level. Given, then, that there is no definitive equivalence notion, one cannot argue that MFN safeguard measures are to be preferred to selective ones on the grounds of economic efficiency.

More specifically, suppose that the instigating country retains the differential tariff revenues. Then, when the equivalence notion involves increasing global and selective tariffs by the same amounts, we have shown that a selective tariff increase would yield a smaller decline in world welfare than the corresponding global tariff increase. Also, when the equivalence notion is the maintenance of the instigating country's protected industry production level, we found that a selective tariff increase against the exporter with the smaller export supply elasticity yielded higher world welfare than a global tariff increase (which in turn yielded higher world welfare than a selective tariff increase against the exporter with the greater export supply elasticity).

In contrast, when the exporting countries retain the differential tariff revenues, we found for this last equivalence notion that a global tariff increase produced higher world welfare than did either of the two corresponding selective tariff increases. Thus, if this equivalence notion is the relevant one, then one could argue that a small global quota is preferable to a small VER, lending support to the use of GATT-legal safeguard measures. In addition, we note that for this equivalence notion, the instigating country's ranking of the global and the two potential selective measures is consistent with that of the world as a whole; hence, the world's support for global

quotas over VERs does not go against the interests of the instigating country.

We were also able to recast our model to take a brief look at tariff reductions. Once again, whether or not a global or selective tariff decline was to be best for the world depended on our notion of equivalence, thus also challenging the application of tariff reductions on an MFN basis. If, however, we imposed our third equivalence notion, under which tariffs were reduced by the same amounts in the global and selective cases, then there was unqualified support for the MFN application of tariff reductions.

We noted, too, that it was not too difficult to generalize to the n-good case our claim that regardless of the revenue distribution scheme, that world welfare changed by the same amount in the global and selective cases when our equivalence notion was the maintenance of country a's import level. However, we pointed out that attempts to generalize our other results are hampered by the algebraic complexity of the model in the n-good case.

And, while our results were true for the two-good case where we had only one good subject to a trade measure, we emphasized that the presence of other trade distortions could affect our results.

Finally, we note that there are many paths for future research on this topic. It would be of particular interest to do some empirical analysis of existing trade measures: existing selective (or global) trade measures could be converted to their global (or selective) counterparts, and we could measure the discrete world welfare changes involved. Also, it would be interesting to expand our existing model to in-

corporate such features as uncertainty, adjustment costs, and strategic interactions of countries.[19] Each of these factors is as important to the discussion of safeguards as is the role of economic efficiency in a perfectly competitive world. And, it could well be that MFN has much stronger support when these additional factors are taken into consideration.

[19] cf. Takemori (1989).

3. MFN VERSUS SELECTIVITY: AN EXAMINATION OF THE TEXTILES AND CLOTHING, STEEL, AND AUTO INDUSTRIES

3.1 Introduction

As the result of successive rounds of GATT negotiations, tariff rates on manufactured goods have been substantially reduced by the developed countries. Parallel to these reductions in tariffs, however, there has also been a proliferation in the use of 'grey area' trade measures. These measures take the form of export quotas and assume a variety of seemingly innocuous names: Voluntary Export Restraints (VERs), Voluntary Restraint Arrangements (VRAs), and Orderly Marketing Arrangements (OMAs).[20]

Kostecki (1987) notes that "in the mid-1980s, not less than 10 per cent of world trade ... [was] covered by export-restraint arrangements." In particular, in 1984, "the import-weighted coverage of 'grey area' measures was about 38 per cent for the European Community's imports from Japan and not less than 33 per cent for the United States' imports from Japan."[21]

In most cases, such measures are introduced as safeguards to placate industries which are facing increased import competition from lower cost suppliers. And, while these 'voluntary' export quotas do not technically violate GATT Article XIX, which deals with safeguards, they do violate the general spirit of the article, which has been interpreted as requiring that safeguard measures be implemented on a

[20] Kostecki (1987, p. 425).
[21] Ibid, p. 429.

Most-Favoured Nation (MFN) basis (i.e., against all GATT members).[22]

Among the many arguments made in defence of GATT Article XIX is the traditional one for economic efficiency: applying a safeguard measure on a global basis against all suppliers, as opposed to on a selective basis against only the 'offending' suppliers, means that the demand for imports will be met by only the most efficient suppliers.[23] As Chapter 2 showed, however, in the application of safeguards, there is no blanket support for MFN over selectivity on the grounds of economic efficiency. But Chapter 2 examined only small tariff changes within a special three-country, two-good framework, with a fixed pattern of trade. The purpose of this chapter is to determine how well the economic efficiency argument holds up when real-world safeguard measures are examined within a more complex computable general equilibrium (CGE) framework.[24] This chapter will also address the isssue of labour adjustment costs: will the loss of real resources due to the labour adjustment involved in changing from a selective to a global measure dominate any real efficiency gains which result from such a conversion?

In particular, we have used 1986 data to examine the changes in global welfare that are effected as the result of converting existing American and European selective safeguard measures imposed on textiles and clothing, steel, and autos into global measures. As in Chapter 2, more than one notion of equivalence between

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[22] cf. Hart (1985,p. 85).

[23] see Hart (1985) and Petersmann (1986).

[24] Many authors have focused attention on the welfare changes effected by the implementation of real-world safeguards (e.g., Tarr and Morkre (1984); Hufbauer, Berliner, and Elliott (1986); Tarr (1987); de Melo and Tarr (1988); Trela and Whalley (1988); and Clarete, Trela, and Whalley (1991)), but only Tarr (1987) even attempted to compare a selective trade measure to a global equivalent.

the selective and global measures is considered: one requires the maintenance of the same level of imports in the home country; a second requires the maintenance of the same level of production in the import-competing industry. Two separate models are used in this chapter: one for textiles and clothing and one for steel and autos. The Textiles and Clothing Model is a final goods model with four regions: the European Community (EC), Japan, the Newly Industrialized Countries (NICs, which we take to encompass Hong Kong, South Korea, and Taiwan), and the United States (US). The Steel and Autos Model incorporates the intermediate use of goods to better reflect the interactions between the steel and auto industries, and the focus of this model is only on the EC, Japan, and the US.

The organization of the chapter is as follows: section 3.2 outlines the structure of the models; section 3.3 presents the functional forms used in this chapter; section 3.4 comments briefly on the data and parameterization of the model; section 3.5 presents the results; section 3.6 presents some summary comments on the chapter; and the appendix presents a detailed discussion of the data and parameterization of the model.

3.2 Structure of the Models

In the Textiles and Clothing Model, we have four trading regions: the European Community (EC), Japan, the Newly Industrialized Countries (NICs, which we take to encompass Hong Kong, South Korea, and Taiwan), and the United States (US). The three goods produced in this model are restricted textiles and clothing (i.e., restricted in trade between the importers, the EC and US, and the exporters, the

NICs and Japan, via a series of bilateral trade restrictions under the Multifibre Arrangement (MFA), although not restricted in trade between the EC and US), nonrestricted textiles and clothing (i.e., free to be traded between all countries), and a composite good. The three goods are homogeneous across countries and are produced in each country. All trade configurations are possible, although we do prohibit any direct trade between Japan and the NICs, so that any differential supply prices in restricted textiles and clothing would not be arbitraged away. We also note that, while the homogeneity assumption precludes the simultaneous import and export of nonrestricted textiles and clothing and of the composite good, it does not prevent the EC from being both an importer (from Japan and the NICs) and an exporter (to the US) of restricted textiles and clothing. This is true because of the segmentation of markets which is created by the series of bilateral quotas on this product.

All goods are produced using only labour and capital, where both factors of production are immobile between regions, capital is mobile between industries, and where labour will be taken to be either completely, or only partially, mobile between industries. Labour will be only partially mobile between industries in the labour adjustment costs version of the model, which has a transactions sector for the movement of labour between industries. Each region is taken to be populated by a representative consumer who owns all of the capital and labour used within the confines of her region.

Tariffs are applied by all regions to imports of all goods except the composite

good, which is freely traded between regions. In the benchmark situation, both the EC and the US have bilateral quotas in place on restricted textiles and clothing from Japan and the NICs. The rights to these voluntary export restraints are modelled as being auctioned off by the Japanese and NIC governments. All tariff revenues and quota rents collected by governments are assumed to be transferred back to home region consumers in a lump-sum fashion.

In the Steel and Autos Model, we have only three trading regions: the EC, Japan, and the US. A more elaborate model structure is used in the study of steel and autos so that we might better capture the relationships that exist between the two industries. Four goods are used in this model: steel, autos, other manufacturing, and a composite good. Similar to the Textiles and Clothing Model, all goods are homogeneous across regions and are produced in each region. Unlike in the Textiles and Clothing Model, all possible trade configurations are in fact allowed in the Steel and Autos Model. In this model, the homogeneity assumption precludes the simultaneous import and export of the other manufacturing and composite goods, but the existence of bilateral quotas on steel (by the US against the EC and Japan) and on autos (by both the US and EC against Japan) creates a system of segmented markets in which the EC is simultaneously an importer and exporter in both the steel and auto industries in the benchmark situation.

To more accurately reflect the interactions between the steel and auto industries, in addition to using the factors labour and capital, all goods in this model, except for the composite good, have intermediate input requirements for all four

goods. Steel is used only as an intermediate good, while the other three goods are both intermediate and consumer goods.

As in the Textiles and Clothing Model, labour and capital are immobile between regions, capital is mobile between industries, and labour will be taken to be either completely, or only partially, mobile between industries. Again, each region has a representative consumer who owns all of the capital and labour used within the confines of the region. Tariffs are applied by all regions to imports of all goods, except for the composite good. All benchmark bilateral quotas are assumed to be VERs, the rights to which have been auctioned off by the appropriate government. And, as above, all tariff revenues and quota rents collected by governments are assumed to be transferred to home region consumers in a lump-sum fashion.

Because the two models are used to analyze the effects of conversion of selective trade measures to global ones, both with and without labour adjustment costs, and because the Steel and Autos Model involves an intermediate good structure, while the Textiles and Clothing Model does not, in what follows, we provide an outline of a general model which incorporates both labour adjustment costs and intermediate input requirements. To obtain the no adjustment costs form of the model, one need only remove the transactions sector from the succeeding presentation; to obtain a version of the model in which some or all goods use only basic factor inputs, one need only assume that the appropriate intermediate input requirements are zero.

This general model is based on that of Clarete and Whalley (1988), and the succeeding presentation of the model draws heavily on this work. In their model,

labour requires real resources, in the form of transactions services, to move between industries when an exogenous shock hits the economy. Their transactions sector is a function of labour and capital; but, for our purposes, we will specify a very simple transactions services industry, as used by Clarete, Trela, and Whalley (1991), in which only labour is used in the transactions process. The rationale behind this approach is that we veiw the transactions services as a proxy for the real labour resources lost in an economy due to the unemployment involved in relocating workers between industries.

The general model has R regions, and each region r has N goods-producing industries with production functions specified as follows:

$$Y_i^r = \min\left(\frac{V_i^r}{a_{Vi}^r}, \frac{Y_{1i}^r}{a_{1i}^r}, \frac{Y_{2i}^r}{a_{2i}^r}, ..., \frac{Y_{Ni}^r}{a_{Ni}^r}\right) \quad i = 1, 2, ..., N, \tag{3.1}$$

where Y_i^r is the output of good i in region r, V_i^r is the value-added in output i in region r, Y_{ji}^r is the quantity of good j used to produce good i in region r, a_{Vi}^r is the fixed value-added requirement per unit of output of good i in region r, and a_{ji}^r is the fixed requirement of good j per unit of output of good i in region r.

The value-added functions nested within the production functions, are given by

$$V_i^r = V_i^r(K_i^r, L_i^r), \tag{3.2}$$

where K_i^r and L_i^r are the capital and labour used to produce the value-added in industry i in region r.

Each region r has a transactions services sector, too, for which the production

function is of the form

$$T^r = T^r(L_T^r), \tag{3.3}$$

where T^r and L_T^r are the quantities of transactions services and of labour, respectively, used to produce transactions services in region r. We note that the production functions in (3.2) and (3.3) are assumed to be both continuous linearly homogenous and increasing in each factor of production. The value-added functions in (3.2) are also assumed to be strictly quasi-concave.

To model the presence of labour adjustment costs in our model, we assume that for labour to move out of an industry it requires the use of the transactions services sector to convert the existing labour into mobile labour. Similarly, for labour to enter an industry, it must come from the pool of mobile labour. Thus, we define sectors to move labour out of an industry and into the pool of mobile labour:

$$\overline{LM}_i^r = \overline{LM}_i^r(LO_i^r, T_i^r) = \min(LO_i^r, T_i^r), \tag{3.4}$$

where LO_i^r is the amount of benchmark labour in industry i in region r moving out of that industry, T_i^r is the quantity of transactions services used to move labour out of industry i in region r, and $\overline{LM}_i^r$ is the quantity of mobile labour which results when LO_i^r units of labour exit industry i in region r.

To then represent the movement of mobile labour into a goods-producing industry, we define

$$LI_i^r = LI_i^r(LM_i^r) = LM_i^r, \tag{3.5}$$

where LM_i^r is the amount of mobile labour moving into industry i and LI_i^r is the extra labour in industry i exceeding the benchmark allocation $\overline{L}_i^r$.

Because labour is no longer completely mobile between industries, a single wage rate will no longer prevail in each region; instead, there will be $N+1$ sector-specific wage rates. Bounds on these wage rates will be determined by the magnitude of the labour adjustment costs, which is reflected in the value of transactions services required to move a unit of labour between industries. In particular, if w^r and $\overline{w}^r$ are the wage rates in region r in the expanding and contracting sectors, respectively, then $\overline{w}^r = w^r - P_T^r$, where P_T^r is the price of transactions services in region r. Also, if w_i^r is the wage rate in industry i in region r when no labour moves in or out of that industry, then $w^r \geq w_i^r \geq \overline{w}^r$ because the price of transactions services is large enough that it dominates any increase in wages available to labour if it exited industry i.

On the consumption side, we assume that in each region we have a single representative consumer who is endowed with all of the labour, capital, and quota rights in the economy, and who also receives all government transfers which arise from the collection of tariff revenues. Thus, in region r, the representative consumer is maximizing his utility function subject to his budget constraint

$$\sum_{i=1}^{N} P_i^r X_i^r \leq I^r, \tag{3.6}$$

where, in region r,

$$I^r = \sum_{i=1}^{N} w_i^r \overline{L}_i^r + \tau^r \overline{K}^r + \sum_{i=1}^{N} \left(\sum_{q=1}^{R} P_i^{qr} \overline{Q}_i^{qr} \right) + \sum_{i=1}^{N} t_i^r \left(\sum_{q=1}^{R} (P_i^q E_i^{qr} + P_i^{rq} Q_i^{rq}) \right) \tag{3.7}$$

is the consumer's income, P_i^r is the price of good i, X_i^r is the consumption of good i, w_i^r is the wage rate in industry i, $\overline{L}_i^r$ is the original allocation of labour in industry

i, r^r is the rental rate of capital, and $\overline{K}^r$ is the endowment of capital; and where P_i^{qr} is the quota premium on imports of good i by region q from region r, $\overline{Q}_i^{qr}$ is region r's endowment of quota on imports of good i by region q, t_i^r is the tariff imposed by region r on imports of good i, P_i^q is the price of good i in region q, E_i^{qr} is the exports of good i by region q to region r, and Q_i^{rq} is the quantity of quota demanded by region r for imports of good i from region q.

Now, even though goods are homogeneous and traded across regions, because of the existence of tariffs and bilateral quotas, prices for any given good will generally be different across regions. To reflect this difference in prices, we thus also need to define a series of bilateral import functions:

$$M_i^{rq} = \min(E_i^{qr}, Q_i^{rq}), \tag{3.8}$$

where M_i^{rq} is the imports of region r from region q of good i.

Thus, a competitive general equilibrium is defined by a set of non-negative prices such that:

(a) No sector earns a positive profit, i.e ,

$$w^r \overline{LM}_i^r \le w_i^r LO_i^r - P_T^r T_i^r,$$

$$w_i^r LI_i^r \le w^r LM_i^r,$$

$$P_i^r Y_i^r \le r^r K_i^r + w_i^r L_i^r + \sum_{j=1}^{N} P_j^r Y_{ji}^r,$$

$$P_T^r T^r \le w_T LM_T^r, \quad \text{and}$$

$$P_i^r M_i^{rq} \le (1 + t_i^r)(P_i^q E_i^{qr} - P_i^{rq} Q_i^{rq}),$$

$$\text{for} \quad i = 1, ..., N, \quad q, r = 1, ..., R,$$

where w^r is the wage rate of mobile labour in region r.

(*b*) Excess demand for every commodity and factor is nonpositive, i.e.,

$$\sum_{r=1}^{R}\left(\sum_{j=1}^{N} Y_{ji}^{r}\right)+\sum_{r=1}^{R} X_{i}^{r} \leq \sum_{r=1}^{R} Y_{i}^{r},$$

$$\sum_{j=1}^{N} T_{j}^{r} \leq T^{r},$$

$$\sum_{j=1}^{N} K_{j}^{r} \leq \overline{K}^{r},$$

$$L_{i}^{r} \leq \overline{L}_{i}^{r}-LO_{i}^{r}+LI_{i}^{r},$$

$$\sum_{j=1}^{N} LM_{i}^{r}+LM_{T}^{r} \leq \sum_{i=1}^{N} \overline{LM}_{i}^{r}, \quad \text{and}$$

$$Q_{i}^{qr} \leq \overline{Q}_{i}^{qr},$$

for $i = 1, ..., N, \quad q, r = 1, ..., R.$

3.3 Functional Forms

Production

The value-added functions are taken to be constant elasticity of substitution (CES), so that for industry j we have that

$$VA_{j}^{r}=\gamma_{j}^{r}\left[\delta_{j}^{r} K_{j}^{r}{}^{\frac{\sigma_{j}^{r}-1}{\sigma_{j}^{r}}}+\left(1-\delta_{j}^{r}\right) L_{j}^{r}{}^{\frac{\sigma_{j}^{r}-1}{\sigma_{j}^{r}}}\right]^{\frac{\sigma_{j}^{r}}{\sigma_{j}^{r}-1}},$$

where γ_{j}^{r} is a units parameter, δ_{j}^{r} is a weighting parameter, and σ_{j}^{r} is the elasticity of substitution between capital and labour.

We note that in the Textiles and Clothing Model, because there is no intermediate use of goods, all of the production functions in that model collapse to these value-added functions. In the Steel and Autos Model, only the composite good is produced using only labour and capital.

Since we are assuming constant returnse to scale production functions and since transactions services are assumed to be a function of only labour, the transactions function is necessarily of the form

$$T^r = \frac{1}{\alpha^r} L_T^r,$$

where α^r is a parameter representing labour adjustment costs.

Consumption

The utility function for each country is also taken to be CES, so that in region r, utility is represented by

$$W^r = \left[\sum_{i=1}^{N} (b_i^r X_i^r)^{\frac{\sigma^r - 1}{\sigma^r}} \right]^{\frac{\sigma^r}{\sigma^r - 1}},$$

where the b_i^r's are weighting parameters and σ^r is the elasticity of substitution in consumption.

Because the Textiles and Clothing Model distinguishes between textiles and clothing produced in restricted and nonrestricted categories, we have a nested CES structure in that model. Thus, we have that for $i = \ell$, where ℓ represents a composite of both restricted and nonrestricted textiles and clothing,

$$X_\ell^r = \left[\sum_{i=1}^{2} (b_{i\ell}^r X_{i\ell}^r)^{\frac{\sigma_\ell^r - 1}{\sigma_\ell^r}} \right]^{\frac{\sigma_\ell^r}{\sigma_\ell^r - 1}},$$

where $X_{1\ell}^r$ is nonrestricted textiles and clothing and $X_{2\ell}^r$ is restricted textiles and clothing.

3.4 Data and Parameterization of the Models

A separate date set was used in each of the two models analyzed in this chapter. Both models are calibrated to 1986 data. A detailed discussion of the construction of the two data sets and the parameterization of the two models is provided in the appendix.

3.5 Results

In each model, we perform counterfactual analysis which involves the conversion of one or more selective trade measures to one or more global measures, using a particular notion of equivalence between the selective and global measures. Policies 1, 2, and 3 in each model involve the equivalence notion that requires the maintenance of the same level of imports of the quota-protected good by the region converting the selective quota to a global quota. Policies 4, 5, and 6 in each model involve the equivalence notion that requires the maintenance of the same level of production of the import-competing good in the region converting the selective quota to a global quota. Policy 0 is simply the original policy in place in the benchmark data set. A no adjustment costs case, and low and high adjustment costs cases are all calibrated and analyzed with respect to the various policy changes.

While the emphasis of this chapter is on global changes in welfare which are brought about as the result of policy changes, the reader may find the resulting regional welfare changes also of interest. Thus, in Tables 3.1 to 3.4, both regional and global welfare changes are presented, and we also provide some summary policy rankings for each region and the world as a whole. In order to calculate the

percentage change in world welfare that resulted from each policy change, we did a separate counterfactual calculation which involved the simultaneous implementation of the policy as well as a system of lump-sum transfers which were designed so that all countries would be either equally better or worse off (in percentage change in welfare) relative to the original situation. It is this percentage of increase (or decrease) in all countries' welfare that is recorded as a measure of the percentage change in world welfare.[25] Since our measure of world welfare change involves the actual carrying out of lump-sum transfers between regions, we avoid the many well-known problems associated with such ad hoc measures of global welfare change as the aggregated Hicksian Equivalent and Compensating Variations.

Results from the Textiles and Clothing Model

Policies 1 to 6 in the Textiles and Clothing Model are outlined at the bottom of Tables 3.1 and 3.2. From Table 3.1, we observe that without adjustment costs, we have that the World Policy Ranking is $3 = 1 > 2 = 0$. Thus, each of the policies 1, 2, and 3 yields non-negative benefits for the world as a whole, and amongst these policies, the greatest benefits to the world accrue when the US, either alone, or in concert with the EC, converts its system of bilateral quotas on restricted textiles and clothing to global quotas which maintain the same aggregate levels of imports of this product. That there are no losses to the world from instituting any one of these three policies does not seem surprising since in each case, through the conversion of a selective to a global trade measure, there is increased trade with a more efficient

[25] Harrison, Rutherford, and Wooton (1989) use a similar procedure with respect to policy changes in the EC.

supplier (i.e., the NICs).

When labour adjustment costs are incorporated into the model, the results are substantially the same. There are non-negative benefits from each of these policies and the ranking does not change. Thus, even though the presence of adjustment costs reduces the size of the available production possibilities in each region, and even though any policy change could result in the loss of real resources (in the form of labour), the benefits from increased trade with the most efficient restricted textiles and clothing supplier appears to dominate any negative impact due to the presence of labour adjustment costs. We note, however, that for Policies 1 and 3, the magnitude of the increase in world welfare is lower, the higher the adjustment costs, a result which seems to derive from the reduction in available production possibilities which occurs as labour adjustment costs rise.

It seems, however, to be the case that with or without adjustment costs, the reason for the ranking $3 = 1 > 2$ is that Policies 3 and 1 involve greater values of trade being coverted to global quotas, while Policy 2 involves the smallest value of trade being coverted to a global quota, with trade creation providing greater benefits with greater volumes of trade.

In contrast to the policy rankings of Table 3.1, in Table 3.2, we see that when the notion of equivalence is the maintenance of production levels, as opposed to the maintenance of import levels, the preferred policy is now one in which only the US converts its bilateral quotas to a global quota (Policy 4). The reason that this policy seems to be preferred to the simultaneous conversion of bilateral to global quotas

by the US and the EC (Policy 6) seems to be that for this equivalence notion, more restrictive global quotas are required in each region (especially in the EC) when the US and EC jointly implement global quotas than when only one region implements a global quota. In the initial situation, because of the presence of bilateral quotas by both the US and EC against both Japan and the NICs, the EC is initially both an importer (from Japan and the NICs) and an exporter (to the US) of restricted textiles and clothing. Thus, when the US replaces its bilateral quotas against Japan and the NICs with a global quota against Japan, the NICs, and the EC, the EC no longer exports to the US and so its own production of restricted textiles and clothing declines. Hence, when both the US and EC jointly implement global quotas, for the EC to maintain its original production level, it must impose a fairly restrictive quota because of the negative effect of the American policy on EC production levels of restricted textiles and clothing.

Again, because of the larger volume of trade involved in trade creation with the NICs under Policy 4 than under Policy 5, any increase in world welfare under Policy 4 will be higher than any increase (or decrease) in world welfare resulting from Policy 5.

Once again, the model produced very similar results when labour adjustment costs were used to examine the effects of Policies 4-6 on world welfare. While policy ranking did remain unchanged, it is notable that there was a slight decline in the change in world welfare under Policy 4 as labour adjustment costs increased.

Some sensitivity analysis with respect to elasticities of substitution was also

carried out. In one version of the model, all parameters were identical to those employed in the Central Case, with the exception that all elasticities of substitution in consumption were set equal to 2.0. A second version of the model had all parameters identical to those employed in the Central Case, with the exception that all elasticities of substitution between labour and capital in production were set equal to 2.0. None of this sensitivity analysis produced qualitatively different results from those found in the Central Case.

Results from the Steel and Autos Model

Policies 1 to 6 in the Steel and Autos Model are outlined at the bottom of Tables 3.3 and 3.4. From Table 3.3, we observe that without adjustment costs the World Policy Ranking is $3 > 2 > 0 > 1$. Thus, policies 3 and 2 yield positive benefits for the world, while Policy 1 produces a decline in world welfare. The implementation of Policy 1 involves the conversion of the US's bilateral quotas on steel to a global quota on steel which yields the same volume of imports of steel in the US. With this policy, there is clearly an efficiency gain for the world in steel production due to the diversion of US imports to the more efficient Japanese suppliers. Now, because the US is the recipient of the quota rents on steel products under this policy, there is an increased US demand for all goods, and for autos in particular. However, because the US still has its bilateral quota on Japanese autos in place under Policy 1, the US cannot obtain the increased demand for autos from the lowest cost supplier, Japan. Hence there is an increased efficiency loss in the production of autos, which would appear to dominate the increased efficiency gains in steel production, thus

producing the overall decline in world welfare as a result of Policy 1.

It is interesting, then, that Policy 2 should be beneficial for the world when it involves the US conversion of its bilateral auto quota to a global quota, while maintaining the US bilateral quotas on steel. Again, the conversion of a bilateral quota to a global quota implies the transfer of quota rents to the US, thus increasing American demand for final goods. Efficiency gains in production of autos under Policy 2 are much greater than the efficiency gains in production of steel under Policy 1 because of the much larger volume of trade involved in autos and because of the very restrictive effect of the initial bilateral quota on Japanese autos. Also, steel is not a final good. Thus, while increased US production of final goods which use steel as an input may increase demand for the less-efficiently produced domestic steel, any increase in imports of final goods involves importing goods which have access to more efficiently produced steel (in particular, from Japan). Consequently, as a result of Policy 2, the benefits from more efficient auto production dominate any additional efficiency losses in the steel industry. And, as is indicated by the policy ranking, the best policy is clearly one which simultaneously converts the bilateral quotas on both steel and autos to global quotas (Policy 3), since then all inefficiencies due to the bilateral quotas have been eliminated.

From Table 3.4, we see that the world policy ranking is $6 > 5 > 4 > 0$. Noting that the only difference between Policies 4, 5, and 6 and Policies 1, 2, and 3, respectively, is the notion of equivalence between the bilateral and global systems of quotas, the same reasoning behind the policy ranking $3 > 2 > 1$ can be applied to

the policy ranking 6 > 5 > 4. We note, however, that we have that Policy 4 yields a positive increase in world welfare, indicating that for this equivalence notion, when there are no labour adjustment costs, the increased efficiency in steel production due to conversion to a global quota dominates any losses in production efficiency associated with increased auto production from producers less efficient than the Japanese.

We also note that when adjustment costs are included in the steel and autos model, results are much the same as in the no adjustment costs case. However, it is worth noting that in contrast to the no adjustment costs case, the low adjustment costs case has Policy 4 yielding no world welfare change, while the high adjustment costs case has world welfare actually declining. Thus, the combined effects of adjustment costs and less efficient auto production appear to dominate the increased efficiency in the steel industry. World welfare gains also generally decrease and losses generally increase as adjustment costs increase.

Sensitivity analysis was conducted in the Steel and Autos Model similar to that done in the Textiles and Clothing Model. When the model employed is identical to that in the Central Case, with the exception that all elasticities of substitution in consumption are now set equal to 2.0, the welfare changes are qualitatively the same as those from the Central Case, with the exception that in the no adjustment costs case, Policy 4 now produces a loss in world welfare.

When the model used is identical to that in the Central Case, with the exception that all elasticities of substitution between labour and capital in production are now

set equal to 2.0, the only qualitative difference between these results and those in the Central Case is that Policy 1 now yields a positive change in world welfare in the no adjustment costs case, thus producing the world policy ranking $3 > 2 > 1 > 0$. It would seem that the higher elasticities of substitution in production, the greater the production possibilities available to the world after any policy change, so that there is a greater likelihood of welfare gain for this notion of equivalence.

An interesting result which emanates from both models is one which is not reported in the tables. When a given policy in either model is compared using the two different notions of equivalence, one finds that the change in world welfare is highly correlated with the size of the global quota. This result has echoes of Chapter 2, which showed in a theoretical framework that world welfare changes depended solely on changes in the volume of trade. Unlike in Chapter 2, however, we have shown in this chapter that policies which maintain the same level of imports with a global quota as they did with selective quotas do not always produce zero welfare changes (although they are often less than .03% in absolute value!).

The strength of this correlation is also striking: in only 2 out of 54 comparisons is the result invalidated! And, in those two instances, we were looking at the conversion of the American steel VERs to a global quota, which we already noted above had a deleterious effect on efficiency in the auto industry because of income effects, so that it may not in fact be surprising that an increased global steel quota could lead to a decline in world welfare.

Textiles and Clothing Model: Central Case*

Table 3.1

% Change in Welfare: No Adjustment Costs

Region	Policy 1	Policy 2	Policy 3	Policy Ranking
EC	.000	.021	.021	2 = 3 > 1 = 0
Japan	-.011	-.002	-.013	0 > 2 > 1 > 3
NICs	-1.055	-.337	-1.392	0 > 2 > 1 > 3
US	.070	.000	.070	3 = 1 > 2 = 0
World	.006	.000	.006	3 = 1 > 2 = 0

Policy 1 = US conversion of bilateral quotas on restricted textiles and clothing to a global quota which maintains the same level of aggregate US imports of restricted textiles and clothing.
Policy 2 = EC conversion of bilateral quotas on restricted textiles and clothing to a global quota which maintains the same level of aggregate EC imports of restricted textiles and clothing.
Policy 3 = Simultaneous US and EC conversion of their systems of bilateral quotas on restricted textiles and clothing to global quotas which maintain the same levels of aggregate US and EC imports, respectively, of restricted textiles and clothing.

A .001% change in EC welfare corresponds to an annual per capita income change of $.10 and an annual aggregate income change of $31,979,098.
A .001% change in Japanese welfare corresponds to an annual per capita income change of $.15 and an annual aggregate income change of $18,331,787.
A .001% change in NIC welfare correpsonds to an annual per capita income change of $.03 and an annual aggregate income change of $1,869,660.
A .001% change in US welfare corresponds to an annual per capita income change of $.16 and an annual aggregate income change of $38,707,769.
A .001% change in World welfare corresponds to an annual per capita income change of $.12 and an annual aggregate income change of $90,888,314.

* Central Case uses a forty-year time horizon with a 5% discount rate. Labour is unemployed in the US for 31 weeks in the Low Adjustment Costs Case and 50 weeks in the High Adjustment Costs Case.

Textiles and Clothing Model: Central Case*

Table 3.2

% Change in Welfare: No Adjustment Costs

Region	Policy 4	Policy 5	Policy 6	Policy Ranking
EC	.000	.021	.006	5 > 6 > 4 = 0
Japan	-.011	-.002	-.014	0 > 5 > 4 > 6
NICs	-1.055	-.337	-1.392	0 > 5 > 4 > 6
US	.071	.000	.070	4 > 6 > 5 = 0
World	.006	.000	.000	4 > 5 = 6 = 0

Policy 4 = US conversion of bilateral quotas on restricted textiles and clothing to a global quota which maintains the same level of US production of restricted textiles and clothing.
Policy 5 = EC conversion of bilateral quotas on restricted textiles and clothing to a global quota which maintains the same level of EC production of restricted textiles and clothing.
Policy 6 = Simultaneous US and EC conversion of their systems of bilateral quotas on restricted textiles and clothing to global quotas which maintain the same levels of US and EC production, respectively, of restricted textiles and clothing.

A .001% change in EC welfare corresponds to an annual per capita income change of $.10 and an annual aggregate income change of $31,979,098.
A .001% change in Japanese welfare corresponds to an annual per capita income change of $.15 and an annual aggregate income change of $18,331,787.
A .001% change in NIC welfare correpsonds to an annual per capita income change of $.03 and an annual aggregate income change of $1,869,660.
A .001% change in US welfare corresponds to an annual per capita income change of $.16 and an annual aggregate income change of $38,707,769.
A .001% change in World welfare corresponds to an annual per capita income change of $.12 and an annual aggregate income change of $90,888,314.

* Central Case uses a forty-year time horizon with a 5% discount rate. Labour is unemployed in the US for 31 weeks in the Low Adjustment Costs Case and 50 weeks in the High Adjustment Costs Case.

Steel and Autos Model: Central Case*

Table 3.3

% Change in Welfare: No Adjustment Costs

Region	Policy 1	Policy 2	Policy 3	Policy Ranking
EC	-.001	-.007	-.009	0 > 1 > 2 > 3
Japan	-.009	-.274	-.283	0 > 1 > 2 > 3
US	.009	.193	.203	3 > 2 > 1 > 0
World	-.001	.024	.026	3 > 2 > 0 > 1

Policy 1 = US conversion of its bilateral quotas on steel to a global quota on steel which maintains the same aggregate level of US imports of steel.
Policy 2 = US conversion of its bilateral quota on Japanese autos to a global quota on autos which maintains the same aggregate level of US imports of autos.
Policy 3 = Simultaneous US conversion of its bilateral quotas on steel and autos to global quotas which maintain the same aggregate level of US imports of steel and autos.

A .001% change in EC welfare corresponds to an annual per capita income change of $.10 and an annual aggregate income change of $31,032,879.
A .001% change in Japanese welfare corresponds to an annual per capita income change of $.15 and an annual aggregate income change of $18,332,721.
A .001% change in US welfare corresponds to an annual per capita income change of $.16 and an annual aggregate income change of $38,635,026.
A .001% change in World welfare corresponds to an annual per capita income change of $.12 and an annual aggregate income change of $87,990,626.

* Central Case uses a forty-year time horizon with a 5% discount rate. Labour is unemployed in the US for 31 weeks in the Low Adjustment Costs Case and 50 weeks in the High Adjustment Costs Case.

Steel and Autos Model: Central Case*

Table 3.4

% Change in Welfare: No Adjustment Costs

Region	Policy 4	Policy 5	Policy 6	Policy Ranking
EC	-.004	-.007	-.009	$0 > 4 > 5 > 6$
Japan	-.009	-.274	-.283	$0 > 4 > 5 > 6$
US	.009	.194	.204	$6 > 5 > 4 > 0$
World	.001	.024	.026	$6 > 5 > 4 > 0$

Policy 4 = US conversion of its bilateral quotas on steel to a global quota on steel which maintains the same level of US production of steel.
Policy 5 = US conversion of its bilateral quota on Japanese autos to a global quota on autos which maintains the same level of US production of autos.
Policy 6 = Simultaneous US conversion of its bilateral quotas on steel and autos to global quotas which maintain the same level of US production of steel and autos.

A .001% change in EC welfare corresponds to an annual per capita income change of $.10 and an annual aggregate income change of $31,032.879.
A .001% change in Japanese welfare corresponds to an annual per capita income change of $.15 and an annual aggregate income change of $18,332,721.
A .001% change in US welfare corresponds to an annual per capita income change of $.16 and an annual aggregate income change of $38,635,026.
A .001% change in World welfare corresponds to an annual per capita income change of $.12 and an annual aggregate income change of $87,990,626.

* Central Case uses a forty-year time horizon with a 5% discount rate. Labour is unemployed in the US for 31 weeks in the Low Adjustment Costs Case and 50 weeks in the High Adjustment Costs Case.

3.6 Summary Comments

Using a CGE framework, we have used two separate models to examine how well the traditional economic efficiency argument holds up when comparing existing selective trade measures on textiles and clothing, steel, and autos to various global counterparts.

In both models, we found that the coversion of VERs to global quotas always produced non-negative gains for world welfare when all VERs in the model were simultaneously converted to their global counterparts. This is consistent with the results of Chapter 2 when the revenue distribution scheme had the exporters retaining the differential tariff revenues. Positive world welfare gains were also achieved in the Textiles and Clothing Model when the US converted its VERs on restricted textiles and clothing to a global quota. In the Steel and Autos Model, the conversion to a global quota of the Japanese VER on autos exported to the US, whether by itself, or in conjunction with the conversion of the American system of bilateral steel restraints to a global quota, also always produced positive changes in world welfare. However, in some instances, when the bilateral steel quotas were converted to a global quota and the autos VER was still in place, we found that world welfare declined, presumably because of the income effect of the the transfer of quota rents from Japan to the US. Thus, while our analysis seems to suggest that the simultaneous conversion of all existing safeguards from selective measures to their global counterparts would yield non-negative changes for world welfare (and, consequently, support the economic efficiency argument), it does not seem to be generally

true that conversion of selective safeguards to global ones yields world welfare gains when undertaken on a piecemeal basis.

And, while the presence of adjustment costs did tend to dampen welfare gains, or even lead to welfare losses, when VERs were converted to global quotas, their presence did not appear to dominate the model.

Thus, with or without adjustment costs, the only instances in which there appeared to be any support for selectivity was when there still existed other selective trade measures in place. Hence, for those countries which now advent the inclusion of selectivity in GATT Article XIX, there appears to be a challenge against them, from this chapter, on the grounds of economic efficiency.

But while global measures do seem to dominate selective measures, here, the overall gains or losses in world welfare are either nonexistant or extremely small in absolute value. This is not unreminiscent of Proposition 2.1 in Chapter 2, which stated that world welfare changes were identical for global and selective measures when import volumes were identical. Thus, this chapter's tentative support for the MFN application of Article XIX must be tempered.

The analysis of two separate models has also emphasized the importance of analyzing the effects of policies for particular industries in the presence of other existing distortions. If the textiles and clothing sector had been incorporated into the Steel and Autos Model, it may very well have been the case that conversion of American VERs on restricted textiles and clothing to global quotas would not have resulted in world welfare gains unless instituted in conjuntion with the conve. ion

of the other existing selective measures (as was the case for steel in that model).

The results of this chapter also suggest that further theoretical analysis needs to ' : done. A natural extension of Chapter 2 would be to do some simulations within that framework, but using discrete quota changes instead of marginal ones. Further applied work is also obviously needed. The competitive framework used in this model is not an accurate reflection of the steel or automobile sectors: it would be interesting to conduct some further analysis incorporating imperfect competition for these particular sectors.

Appendix

A1. Data and Parameterization of the Textiles and Clothing Model

Import Data

The import data is based on that used by Trela and Whalley (1988). What they labelled as categories 1 to 7 have been aggregated to form our restricted textiles and clothing; and their categories 8 to 14 have been aggregated to form our nonrestricted textiles and clothing. The Trela and Whalley import data is at c.i.f. prices.

In the restricted textiles and clothing category, quota rents were aggregated across categories 1 to 7. The values of restricted textiles and clothing and of the associated quota rents were also aggregated across Hong Kong, South Korea, and Taiwan to produce values of restricted textiles and clothing and of quota rents for the NICs.

Given our units convention that the quantity of a good is that amount which sells for US $1 in the US, we can use our values of rents and of imports by the US to determine quantities imported by t' : US, quota premia on restricted textiles and clothing exported by Japan and the NICs to the US, and the restricted textiles and clothing supply prices of Japan and the NICs.

Now, because the EC simultaneously exports restricted textiles and clothing to the US and imports restricted textiles and clothing from the NICs and Japan, both the EC supply price and quota premia on EC imports of restricted textiles and clothing from Japan and the NICs are residually determined so as to support this pattern of trade.

Since there are no restrictions on US-EC trade in textiles and clothing, net imports of textiles and clothing by the US from the EC are divided into imports of restricted textiles and clothing and nonrestricted textiles and clothing according to the proportions imported from Japan and the NICs, in aggregate, in those categories.

Because the Trela and Whalley data set did not have imports of the NICs and Japan from other countries, import data for these countries was obtained from the United Nations (1987) and from GATT (1988).

Imports or exports of the composite good are calculated residually for each region such that each region's value of imports equals its value of exports.

Production Data

Data on the value of production for both restricted and nonrestricted textiles and clothing is taken from Trela and Whalley (1988). Data on GDP and on payments to labour is obtained from Europa (1989) and OECD (1989). Each good in this model is produced using only labour and capital. For the US, GDP is divided into the values of labour and capital by setting the value of labour equal to wages and salaries (including any additional remunerations to labour), and by then setting the value of capital equal to GDP minus the value of labour. The 1986 share of wages in value-added for textiles for the US is then used to divide the values of production for each of restricted and nonrestricted textiles and clothing into payments to labour and capital. The values of production, labour, and capital for the composite good are then residually determined as the difference between the corre-

sponding values for all goods in aggregate and the sum of those values for restricted and nonrestricted textiles and clothing.

For the EC, GDP data is also divided into values of labour and capital in the same way as it was for the US. The share of labour in textiles and clothing production was not available for the EC for 1986, nor was it available for all EC member countries for previous years. Thus, the 1984 share of labour in aggregate textiles and clothing production in Belgium, France, Germany, the Netherlands, and Spain is applied to the 1986 EC production of restricted and nonrestricted textiles and clothing to obtain labour and capital value allocations for these two goods. Values of labour, capital, and output for the composite good are residually determined.

For Hong Kong, South Korea, and Taiwan, the shares of wages and salaries in both GDP and in the textiles and clothing industry were taken from 1986 or the year closest to 1986 for which data was available, and were used to allocate values to labour and capital in GDP, in restricted texitles and clothing, and in nonrestricted textiles and clothing for each country. The values of labour, capital, and production for the composite good were residually determined. The values of labour, capital, and of production for each industry were then aggregated across the three countries to form the corresponding data for the NICs.

Consumption Data

Consumption data for each good in each region was residually determined as production minus net exports.

Elasticities

In consumption, the elasticity of demand in the United States for textiles and clothing, $\epsilon = -.6$, taken from Cline (1987), is used to derive the elasticity of substitution between aggregate textiles and clothing and the composite good, $\sigma = .587595723$. At the lower level of our nested utility function, an elasticity of substitution of $\mu = 5.0$ is used as in Trela and Whalley (1988), to reflect a high degree of substitution between restricted and nonrestricted textiles and clothing in consumption. These elasticies are assumed to be the same for all countries.

In production, an elasticity of substitution between labour and capital in both the restricted and nonrestricted textiles and clothing industries is taken from Caddy (1976) to be 1.0. An elasticiy of substitution of 1.0 is also used in the composite good industry.

Tariff Rates

The tariff rates for the US, EC, and Japan for both restricted and non-restricted textiles and clothing are set at the weighted averages of tariffs on textiles and clothing listed in Table 3.2 of GATT (1984). The NICs are net exporters of both these products and so their tariffs for them are set to zero. The composite good is modelled as a freely traded good for all regions.

Quota Premia

The quota premia and supply prices for each region were taken from the Trela and Whalley data set and used to determine the quota rents and quantities of quota-restricted goods imported by the US from each of Japan and each of the

three countries comprising the NICs. These quota rents and quantities for the three NIC members were then aggregated and a quota premium on the imports of restricted textiles and clothing from the NICs into the US is calculated by dividing the aggregate rents by the aggregated quantities. A supply price for the restricted textiles and clothing produced by the NICs can then be calculated based on the difference between the pre-tariff US price and the quota premium.

The EC supply price and the quota premia on EC imports of restricted textiles and clothing from the NICs and Japan are then calculated so as to be consistent with EC exports of the restricted textiles and clothing to the US.

Adjustment Costs

When labour adjustment costs are incorporated into the model, they are assumed to be proportional to the unemployment rates across countries. Unemployment rates for Hong Kong, South Korea, Japan, and the US are taken from the United Nations (1989). Unemployment rates for Taiwan and the EC are taken from the Statistical Office of the European Communities (1988). An unemployment rate for the NICs is derived by weighting each member country's unemployment rate by its proportion of the total NIC labour force.

As in Clarete, Trela, and Whalley (1991), the adjustment costs for the US are calculated by taking the value of wages lost due to unemployment divided by the discounted value of wages which could be earned over the rest of the worker's perceived work life (which is taken to be 40 years, based on the assumption that it is the youngest workers in an industry who will be most likely to switch jobs). A

discount rate of $d = .05$ is used, while unemployment periods of 31 weeks (obtained from Bale (1976)) and 50 weeks (based on a 50-week work year) are assumed in the low and high adjustment cost cases, respectively. We also note that because we consider labour adjustment costs in some of the analysis, the entire data set is discounted over the 40-year time horizon at the discount rate $d = .05$.

A2. Data and Parameterization of the Steel and Autos Model

Import Data

Trade data for the US, EC, and Japan in steel, autos, and other manufactures was obtained from the United Nations (1987) and GATT (1988). Since we have only homogeneous goods in our model, only net exports between regions were required for the quota-restricted steel and auto industries (thus allowing the EC to be simultaneously a net steel and autos exporter to the US and a net steel and autos importer from Japan), while only aggregate net exports between regions were required for other manufactures (thus prohibiting any region from simultaneously being both an importer and exporter of other manufactures). Imports or exports of the composite good were calculated residually for each region such that each region's value of imports equaled its value of exports.

Production Data

Production data for the EC was aggregated from that available for each individual member country. Data for EC-member countries, Japan, and the US on the values of labour, capital, and total production in the steel industry was taken from the United Nations (1990). The value of production of automobiles (i.e., pas-

senger vehicles) in the US was taken from the United States International Trade Commission (1988).

An indirect method was used to obtain the value of Japanese auto production. First, the value of Japanese exports (f.o.b.) to the United States (obtained from the United Nations (1987)) was divided by the actual quantity of automobiles exported to the US (obtained from the Motor Vehicle Manufacturers Association of the United States (1990)), yielding the value of an auto exported from Japan to the US. To then obtain the actual supply price of a Japanese auto, this figure was then reduced to take into consideration the quota premium included in its value. The resulting supply price of a Japanese car was then multiplied by the number of Japanese autos actually produced in 1986 (also obtained from the Motor Vehicle Manufacturers Association of the United States (1990)), thus producing a proxy for the value of Japanese auto production.

An indirect method was then also used to obtain the value of EC auto production. Since EC autos faced no quantitative restrictions on entry into the US, it was assumed that the supply price of a European auto was the same as the quota premium-inclusive supply price of a Japanese auto exported to the US. This price was then multiplied by the number of autos produced in the EC (excluding Denmark, since quantity production data was unavailable for this country) in 1986 (once again, obtained from the Motor Vehicle Manufacturers Association of the United States (1990)) to obtain a proxy for the value of EC auto production.

The values of labour and capital in the auto industry for the US, Japan, and

EC were all approximated by applying the weights of these variables in the value of production of motor vehicles (obtained from the United Nations (1990)) to the value of production of autos.

The values of labour, capital, and production in other manufactures are found by subtracting the values of these variables in the steel and auto industries from their corresponding values for all manufacturing industries (obtained from the United Nations (1990) and the United Nations (1991)).

Using data from the United Nations (1991), the value of labour in the composite good industry for each region is obtained by subtracting the payments to labour in all manufacturing from the payments to labour in all economic sectors. The value of capital used in this industry is then found by subtracting the value of labour in this industry and total value added in manufacturing from GDP. Because the composite good is assumed to be produced using only labour and capital, summing these derived values of labour and capital yields the value of production in this industry.

The auto industry and other manufactures use all four goods as intermediate inputs, while the steel industry uses all goods except autos as intermediate inputs. For the US, the intermediate input requirements in the steel and auto industries are taken from the United States Department of Commerce (1984a and 1984b). The intermediate input requirements of other manufactures for autos and other manufactures are also taken from these sources. The quantity of steel required in this industry is taken to be the sum of steel produced in the US plus American

imports of steel minus the steel used in the production of steel and autos. The composite good requirement in this industry is then residually determined.

For Japan, the intermediate input requirements in the steel industry come from the Statistics Bureau, Prime Minister's Office (1982). Since the intermediate input requirements for the Japanese auto industry were not known, we applied the American requirements to the Japanese data for this industry. The American intermediate input requirement for autos in other manufactures is also applied to the Japanese data. The intermediate input requirement for other manufactures in this industry is obtained by taking the Japanese intermediate input requirement for both autos and other manufactures and then subtracting off the requirement for autos that was calculated on the basis of the American data. The intermediate use of steel in this industry is calculated by taking the total value of Japanese steel production and subtracting from it the intermediate use of steel in the other two industries and the exports of steel to other regions. The intermediate composite good requirement in this industry is then residually determined.

The US intermediate input requirements in the steel and auto industries and the other manufactures' intermediate input requirement for autos and other manufactures were all applied to the EC data. Then, as for Japan and the US, the intermediate input requirement of steel in other manufactures in the EC is obtained by taking the value of steel production and subtracting from it the intermediate use of steel in the other two industries and the net exports of steel to other regions. And, also as for the US and Japan, the intermediate composite good requirement

in this industry is then residually determined.

As a general comment on data for the values of labour, capital, and production, it should be noted that for the EC members, data was sometimes unavailable for particular categories for 1986, thus necessitating the use of various weighting schemes (either obtained from a previous year for the given country, from the next-largest category available for the given country, or from the same category for other EC countries for which the data was available) to obtain proxies for these data components.

Consumption Data

Each region is taken to have a single representative consumer. Steel is not consumed as a final good. Consumption of autos and other manufactures in each of the three regions is calculated as the value of production of that good minus both the domestic intermediate uses of the good and the net exports of the good. The value of consumption of the composite good by each region is then residually calculated so as to satisfy the given region's budget constraint.

Elasticities

The elasticity of substitution in consumption is the same in each region and is the same as that used in the Textiles and Clothing Model.

In production, the steel, autos, and other manufacturing industries all have fixed coefficient technology. The capital-labour substitution elasticities are 1.0 for steel (from Heckman (1978), as reported in de Melo and Tarr (1988)), .8 for autos (from Caddy (1976)), and .8 for other manufactures (also from Caddy (1976)). The

composite good only uses labour and capital and has an elasticity of substitution of .76, which is the simple arithmetic average of the five non-manufacturing categories from de Melo and Tarr (1988).

Tariff Rates

A wide range of sources was used for the tariff rates. For steel, the tariff rate of 4.7% for the US is taken from Tarr and Morkre (1984); for Japan, it is derived from Deardorff and Stern (1986); and for the EC, it is residually determined so as to be consistent with the observed trade pattern. In autos, the US tariff rate again comes from Tarr and Morkre (1984), while those for Japan and the EC are taken from the US Government Printing Office (1984). For other manufactures, the tariff rate for the US comes from Schott (1989), while for Japan and the EC it is taken from Whalley (1985). The composite good is taken to be a freely traded good between all regions.

Quota Premia

The quota premium on autos imported by the US from Japan was taken from Tarr and de Melo (1988). A quota premium on autos imported by the EC from Japan was residually determined such that it was consistent with the existing trade pattern in autos.

In steel products, the quota premia for steel imported by the US from Japan and the EC were taken from Clarette Trela, and Whalley (1991).

Exchange Rates

Most EC data had to be aggregated from that available for each of the twelve

member countries, which was often denominated in own-country currency. Data for Japan was also often denominated in yen. Thus, since we used the US dollar as the standard unit of value, we had to convert a great deal of data into this currency using exchange rates taken from Federal Reserve (1988).

Population Estimates

Population estimates in both models came from UN (1988) and Highlight International (1988).

Adjustment Costs

The calculation of adjustment costs in this model was the same as in the Textiles and Clothing Model.

4. THE EFFECTS OF TRADE POLICY IN A MODEL WITH MULTIPRODUCT FIRMS

4.1 Introduction

During the last fifteen years, international trade theory has made use of oligopoly models to study a wide range of issues, such as the profit-shifting motives for tariffs (e.g., Brander and Spencer (1984)), import protection as export promotion (e.g., Krugman (1984)), and the increase of foreign market profitability through export subsidization (e.g., Dixit and Grossman (1984), Brander and Spencer (1985)). With the exception of Dixit and Grossman (1984), however, there appears to have been little examination of the effects of trade policy in the presence of more than one oligopolistic industry. And, in particular, there has been a noticeable absence of study of the effects of trade policy in the presence of multiproduct firms.

To rectify this gap in the literature, this chapter uses a simple three-good, two-country general equilibrium model to examine the effects of domestic and foreign trade policy on welfare and firm profits when multiproduct firms may be present in one or both countries. All three goods are produced in each country, but demand for two of the goods, X and Y, is generated only by the home country. These two goods are produced by firms which play a Cournot quantity game. The third good, Z, is a competitively-produced numeraire good, and is exported by the home country to pay for its imports of X and Y. Various cases are examined in which X and Y are produced by multi- or single product firms at home and/or abroad, and it can be shown that the presence of joint production can have definite effects on

the trade policies advocated by home and foreign producers.

The model is similar to Krugman (1984) and Brander and Spencer (1984) in that the domestic and foreign versions of each good produced in oligopoly are perfect substitutes in consumption. However, with the presence of multiproduct firms, there may be substitution in production as well. This presence of joint production can mean that the introduction of new trade measures can have adverse effects on one country's profits, depending in part on the cost structure of the multi-product firm and in part on the strategic reaction of the other country's producer(s) (see Bulow et al (1985)).

As stated earlier, the focus of this chapter will be on the effects of different trade policies on the two countries' welfare and on their firms' profits. For simplicity, all tariffs (or export taxes) will be specific (per unit) in nature and will be applied solely on either X or Y (at rate T_X or T_Y, respectively), at the free trade equilibrium. It is interesting to note, as demonstrated later in the chapter, that when X and Y are produced separately in each country, each domestic firm will have higher profits with tariffs on all imports than with a single tariff on its own product; but that when X and Y are jointly produced in each country, a tariff on imports of one product may actually make the home firm better off than tariffs on both X and Y. Also, if technologies are different across countries, with separate production of X and Y at home and joint production of X and Y abroad, the home producer of a particular product may no longer be better off with tariffs on all imports than with a single tariff on his own product.

It is clear, then, that the presence of joint production could have an important effect on the type of protection for which import-competing industries would lobby their governments. An examination of the model from the perspective of the foreign country also highlights the importance of joint production when considering the effects of subsidization of exports on foreign industry profits.

The organization of the chapter is as follows: section 4.2 provides an outline of the basic model; section 4.3 discusses the effects of various tariff structures on the domestic economy in the presence of either separate or joint production of X and Y in both countries; section 4.4 discusses how the presence of different production structures across countries can affect profits and welfare in the home country; section 4.5 provides a look at the effects of different subsidization policies from the perspective of the foreign country; and section 4.6 provides a chapter summary.

4.2 The Basic Model

We will assume that we have a two-country world consisting of a home and foreign country, which will be referenced by subscripts $i = 1,2$, respectively. Demand for the two oligopolisticly produced goods, X and Y, is generated only by the home country, but both the home and the foreign countries will be assumed to produce some of each of X and Y in equilibrium. The imports of X and Y by the home country will be paid for through exports of a competitively produced numeraire good, Z.

Each country has an endowment of a single homogeneous factor, L (labour).

Letting productior of good j in country i be q_{ij}, $j = X,Y,Z$, and the amount of labour used 'o produce q_{ij} be L_{ij} (when q_{ij} is not jointly produced with another product), we choose units such that

$$L_{iZ} = q_{iZ}. \tag{4.1}$$

If X and Y are produced by distinct firms in country i, we will say that X and Y are produced separately in country i, and in that case the production functions for country i in implicit form are

$$\begin{aligned} &L_{ij} = F_{ij} + C_{ij}(q_{ij}) \text{ for } j = X,Y, \text{ where } F_{ij} > 0, \quad C_{ij}(q_{ij}) > 0, \\ &C'_{ij}(q_{ij}) = \frac{dC_{ij}(q_{ij})}{dq_{ij}} > 0, \text{ and } C''_{ij}(q_{ij}) = \frac{d^2C_{ij}(q_{ij})}{dq_{ij}^2} > 0 \quad \forall q_{ij} > 0. \end{aligned} \tag{4.2}$$

If, however, X and Y are produced by a multiproduct firm, then we will say that X and Y are produced jointly in country i, and in that case, if we let $L_{i,X,Y}$ be the amount of labour required to produce q_{iX} and q_{iY}, we have that the production function for country i in implicit form is

$$\begin{aligned} &L_{i,X,Y} = F_i + C_i(q_{iX}, q_{iY}), \text{where } F_i > 0, \quad C_i(q_{iX}, q_{iY}) > 0, \\ &C_i^j(q_{iX}, q_{iY}) = \frac{\partial C_i(q_{iX}, q_{iY})}{\partial q_{ij}} > 0, \quad C_i^{jj}(q_{iX}, q_{iY}) = \frac{\partial^2 C_i(q_{iX}, q_{iY})}{\partial q_{ij}^2} > 0, \\ &C_i^{XY}(q_{iX}, q_{iY}) = \frac{\partial^2 C_i(q_{iX}, q_{iY})}{\partial q_{iX} \partial q_{iY}} > 0, \quad \textit{and} \quad C_i^{jj} \geq C_i^{XY}, \\ &\textit{for} \quad j = X,Y, \quad \forall q_{iX}, q_{iY} > 0. \end{aligned} \tag{4.3}$$

Imposing 'he restriction $C_i^{jj} \geq C_i^{XY} > 0$ for $j = X,Y$ means that X and Y are substitutes in production. The propositions of this chapter also hold when X and Y are complements or unrelated (aside from fixed costs) in production ($C_i^{XY} \leq 0$), but the more interesting cases arise when we have that X and Y are substitutes in

production ($C_i^{XY} \geq 0$).[26] If the implicit production functions for country i are as in (4.1) and (4.2), then we have that

$$L_i = L_{i,X} + L_{iY} + L_{iZ}, \tag{4.4}$$

while if the implicit production functions for country i are as in (4.1) and (4.3), we have that

$$L_i = L_{i,X,Y} + L_{iZ}. \tag{4.5}$$

Since the value of the marginal product of labour is equal to one in the competitive sector, the implicit production functions in (4.2) and (4.3) also represent cost functions.

The utility function for the home country is

$$\begin{gathered} W_1 = a_X q_X + a_Y q_Y - \frac{1}{2}(b_X q_X^2 + b_Y q_Y^2) - c q_X q_Y + Z_1^c, \\ \text{where } a_j, b_j > 0, \text{ and } b_j > |c| \text{ for } j = X, Y, \end{gathered} \tag{4.6}$$

where q_j is the consumption of good j, and where Z_1^c is home consumption of the numeraire good, which will generally differ from home production, q_{1Z}, of the numeraire good.

With this utility function, if the price of good j is taken to be P_j, then the inverse demands for X and Y are

$$\begin{aligned} P_X &= a_X - b_X q_X - c q_Y, \\ P_Y &= a_Y - b_Y q_Y - c q_X, \end{aligned} \tag{4.7}$$

[26] In their competitive framework, MacDonald and Slivinski (1987) impose the weaker constraint that C_i be strictly convex. The additional restriction, $C_i^{jj} \geq C_i^{XY}$ is imposed here to facilitate the signing of many comparative results.

Solving (4.7) for the direct demands for X and Y, we have

$$q_X = \frac{a_X b_Y - a_Y c - b_Y P_X + c P_Y}{b_X b_Y - c^2}$$
$$\text{and } q_Y = \frac{a_Y b_X - a_X c - b_X P_Y + c P_X}{b_X b_Y - c^2}, \tag{4.8}$$

and we observe that X and Y are substitutes (complements) in demand iff $c > (<)0$. We also see that $b_X, b_Y > |c| \Rightarrow b_X b_Y - c^2 > 0$, thus ensuring that neither X nor Y is a Giffen good.[27] And, unless otherwise stated, it will be assumed from now on that we have $c > 0$.

Since we are assuming that the foreign country is producing X and Y only for export, and receives the numeraire good Z in return, we postulate a very simple utility function for the foreign country,

$$W_2 = Z_2^c, \tag{4.9}$$

where Z_2^c is foreign consumption of the numeraire good, which generally differs from foreign production, q_{2Z}, of the numeraire good.

Taken together, equations (4.1) to (4.9) constitute our simple general equilibrium framework.[28]

4.3 Separate versus Joint Production

We will first examine the effects of various tariffs imposed by the home country when X and Y are produced separately in both countries.

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[27] We also note that the conditions imposed on the utility function in (4.6) and on the cost functions in (4.2) and (4.3) will be sufficient to ensure local stability of equilibria in the cases discussed in later sections of the chapter.

[28] For similar general equilibrium constructions, see Brander and Spencer (1984) and Horstmann and Markusen (1988).

In that case, we have that the production costs for countries 1 and 2 are as specified in (4.2), and hence the profits of the firms producing goods X and Y in countries 1 and 2, respectively, are

$$\begin{aligned} \Pi_{1X} &= (a_X - b_X q_X - cq_Y)q_{1X} - F_{1X} - C_{1X}(q_{1X}), \\ \Pi_{1Y} &= (a_Y - b_Y q_Y - cq_X)q_{1Y} - F_{1Y} - C_{1Y}(q_{1Y}), \end{aligned} \tag{4.10}$$

and

$$\begin{aligned} \Pi_{2X} &= (a_X - b_X q_X - cq_Y - T_X)q_{2X} - F_{2X} - C_{2X}(q_{2X}) \\ \Pi_{2Y} &= (a_Y - b_Y q_Y - cq_X - T_Y)q_{2Y} - F_{2Y} - C_{2Y}(q_{2Y}) \end{aligned} \tag{4.11}$$

Then the first-order conditions from (4.10) and (4.11) are

$$\begin{aligned} \frac{\partial \Pi_{1X}}{\partial q_{1X}} = 0 \;\Rightarrow\; & a_X - 2b_X q_{1X} - b_X q_{2X} - cq_{1Y} - cq_{2Y} - C'_{1X} = 0, \\ \frac{\partial \Pi_{1Y}}{\partial q_{1Y}} = 0 \;\Rightarrow\; & a_Y - 2b_Y q_{1Y} - b_Y q_{2Y} - cq_{1X} - cq_{2X} - C'_{1Y} = 0, \end{aligned} \tag{4.12}$$

and

$$\begin{aligned} \frac{\partial \Pi_{2X}}{\partial q_{2X}} = 0 \;\Rightarrow\; & a_X - T_X - b_X q_{1X} - 2b_X q_{2X} - cq_{1Y} - cq_{2Y} - C'_{2X} = 0, \\ \frac{\partial \Pi_{2Y}}{\partial q_{2Y}} = 0 \;\Rightarrow\; & a_Y - T_Y - b_Y q_{1Y} - 2b_Y q_{2Y} - cq_{1X} - cq_{2X} - C'_{2Y} = 0, \end{aligned} \tag{4.13}$$

Taking the total differential of each equation in (4.12) and (4.13), and letting Π be the matrix of second-order partials, we can place the results in the form

$$\Pi \begin{pmatrix} dq_{1X} \\ dq_{1Y} \\ dq_{2X} \\ dq_{2Y} \end{pmatrix} = \begin{pmatrix} 0 \\ 0 \\ dT_X \\ dT_Y \end{pmatrix}, \tag{4.14}$$

where $\Pi = \begin{pmatrix} \frac{\partial^2 \Pi_{1X}}{\partial q_{1X}^2} & \frac{\partial^2 \Pi_{1X}}{\partial q_{1X}\partial q_{1Y}} & \frac{\partial^2 \Pi_{1X}}{\partial q_{1X}\partial q_{2X}} & \frac{\partial^2 \Pi_{1X}}{\partial q_{1X}\partial q_{2Y}} \\ \frac{\partial^2 \Pi_{1Y}}{\partial q_{1Y}\partial q_{1X}} & \frac{\partial^2 \Pi_{1Y}}{\partial q_{1Y}^2} & \frac{\partial^2 \Pi_{1Y}}{\partial q_{1Y}\partial q_{2X}} & \frac{\partial^2 \Pi_{1Y}}{\partial q_{1Y}\partial q_{2Y}} \\ \frac{\partial^2 \Pi_{2X}}{\partial q_{2X}\partial q_{1X}} & \frac{\partial^2 \Pi_{2X}}{\partial q_{2X}\partial q_{1Y}} & \frac{\partial^2 \Pi_{2X}}{\partial q_{2X}^2} & \frac{\partial^2 \Pi_{2X}}{\partial q_{2X}\partial q_{2Y}} \\ \frac{\partial^2 \Pi_{2Y}}{\partial q_{2Y}\partial q_{1X}} & \frac{\partial^2 \Pi_{2Y}}{\partial q_{2Y}\partial q_{1Y}} & \frac{\partial^2 \Pi_{2Y}}{\partial q_{2Y}\partial q_{2X}} & \frac{\partial^2 \Pi_{2Y}}{\partial q_{2Y}^2} \end{pmatrix}$. (4.15)

It can be shown that Π is negative definite, and hence that the equilibrium is locally strictly stable (see Bulow et al (1985)). In particular, the determinant of Π, $|\Pi|$, is strictly positive.

Now, (4.14) can be used to solve for $\frac{\partial q_{i,j}}{\partial T_k}$, $i = 1,2$, and $j,k = X,Y$, from which all other comparative static results may be derived. For the home producer of $q_{i,j}$, we then have that

$$\frac{\partial \Pi_{1,X}}{\partial T_X} = \frac{\partial \Pi_{1,X}}{\partial q_{2,X}}\frac{\partial q_{2,X}}{\partial T_X} + \frac{\partial \Pi_{1,X}}{\partial q_Y}\frac{\partial q_Y}{\partial T_X}$$
$$= q_{1,X}\left(-b_X\frac{\partial q_{2,X}}{\partial T_X} - c\frac{\partial q_Y}{\partial T_X}\right)$$

$\Longrightarrow$

$$\frac{\partial \Pi_{1,X}}{\partial T_X} = \frac{q_{1,X}}{|\Pi|}\begin{pmatrix} 2b_Xb_Y(3b_Xb_Y - 2c^2) + b_Y(3b_Xb_Y - 2c^2)C''_{1,X} \\ +2b_X(2b_Xb_Y - c^2)(C''_{1Y} + C''_{2Y}) \\ +(2b_Xb_Y - c^2)C''_{1,X}(C''_{1Y} + C''_{2Y}) \\ +2b_X^2C''_{1Y}C''_{2Y} + b_XC''_{1,X}C''_{1Y}C''_{2Y} \end{pmatrix} > 0, \quad (4.16)$$

and

$$\frac{\partial \Pi_{1,X}}{\partial T_Y} = \frac{\partial \Pi_{1,X}}{\partial q_{2,X}}\frac{\partial q_{2,X}}{\partial T_Y} + \frac{\partial \Pi_{1,X}}{\partial q_Y}\frac{\partial q_Y}{\partial T_Y}$$
$$= q_{1,X}\left(-b_X\frac{\partial q_{2,X}}{\partial T_Y} - c\frac{\partial q_Y}{\partial T_Y}\right)$$

$\Longrightarrow$

$$\frac{\partial \Pi_{1,X}}{\partial T_Y} = \frac{cq_{1,X}}{|\Pi|}\begin{pmatrix} 2b_X^2b_Y + b_Xb_YC''_{1,X} + 2b_X^2C''_{1Y} + 2b_Xb_YC''_{2,X} + b_XC''_{1,X}C''_{1Y} \\ + 2b_XC''_{1Y}C''_{2,X} + b_YC''_{1,X}C''_{2,X} + C''_{1,X}C''_{1Y}C''_{2,X} \end{pmatrix} > 0. \quad (4.17)$$

Similarly, we could also show that $\frac{\partial \Pi_{1,Y}}{\partial T_Y} > 0$ and $\frac{\partial \Pi_{1,Y}}{\partial T_X} > 0$, thus giving us our first proposition.

Proposition 4.1: *With separate production of X and Y in both the home and the*

foreign country, the profits of each firm in the home country increase when a tariff is placed on either X or Y.

Thus, with separate production of X and Y in both countries, if a home firm were lobbying for protection, it would prefer to have tariffs on all imports rather than a single tariff on imports of its own or another product.[29]

But how do these results compare with the case where X and Y are jointly produced both at home and abroad? In that case, with the production costs for countries 1 and 2 as specified in (4.3), we have that the profits of the firms in countries 1 and 2 are, respectively,

$$\Pi_1 = (a_X - b_X q_X - c q_Y) q_{1X} + (a_Y - b_Y q_Y - c q_X) q_{1Y} - F_1 - C_1(q_{1X}, q_{1Y}) \quad (4.18)$$

and

$$\Pi_2 = (a_X - b_X q_X - c q_Y - T_X) q_{2X} + (a_Y - b_Y q_Y - c q_X - T_Y) q_{2Y} - F_2 - C_2(q_{2X}, q_{2Y}). \quad (4.19)$$

The first-order conditions from (4.18) and (4.19) are

$$\begin{aligned} \frac{\partial \Pi_1}{\partial q_{1X}} = 0 \;\Rightarrow\; & a_X - 2b_X q_{1X} - b_X q_{2X} - 2c q_{1Y} - c q_{2Y} - C_1^X = 0, \\ \frac{\partial \Pi_1}{\partial q_{1Y}} = 0 \;\Rightarrow\; & a_Y - 2b_Y q_{1Y} - b_Y q_{2Y} - 2c q_{1X} - c q_{2X} - C_1^Y = 0, \end{aligned} \quad (4.20)$$

and

$$\begin{aligned} \frac{\partial \Pi_2}{\partial q_{2X}} = 0 \;\Rightarrow\; & a_X - T_X - 2b_X q_{2X} - b_X q_{1X} - 2c q_{2Y} - c q_{1Y} - C_2^X = 0, \\ \frac{\partial \Pi_2}{\partial q_{2Y}} = 0 \;\Rightarrow\; & a_Y - T_Y - 2b_Y q_{2Y} - b_Y q_{1Y} - 2c q_{2X} - c q_{1X} - C_2^Y = 0. \end{aligned} \quad (4.21)$$

[29] It can also be shown that for the case where there is separate production of X and Y in each country, but joint ownership of the production facilities, this result is robust insofar as the home firm always prefers a uniform tariff to a single tariff on X or Y.

Taking the total differential of each equation in (4.20) and (4.21), and letting Π be the new matrix of second-order partials, we can again place the results in the form of (4.14) above, and solve for $\frac{\partial q_{ij}}{\partial T_k}$, $i = 1,2$ and $j,k = X,Y$. We also note that the new matrix Π is also negative-definite, meaning that the equilibrium in this case is also locally strictly stable.

Then we have that for $j = X,Y$,

$$\frac{\partial \Pi_1}{\partial T_j} = \frac{\partial \Pi_1}{\partial q_{2X}} \frac{\partial q_{2X}}{\partial T_j} + \frac{\partial \Pi_1}{\partial q_{2Y}} \frac{\partial q_{2Y}}{\partial T_j}. \tag{4.22}$$

Therefore

$$\frac{\partial \Pi_1}{\partial T_j} > 0 \iff \frac{\partial \Pi_1}{\partial q_{2j}} \frac{\partial q_{2j}}{\partial T_j} > -\frac{\partial \Pi_1}{\partial q_{2k}} \frac{\partial q_{2k}}{\partial T_j}, \tag{4.23}$$

where $j,k = X,Y$ and $j \neq k$. Then, it can be shown that $\frac{\partial \Pi_1}{\partial q_{2j}} < 0$, $\frac{\partial q_{2j}}{\partial T_j} < 0$, $\frac{\partial \Pi_1}{\partial q_{2k}} < 0$, and $\frac{\partial q_{2k}}{\partial T_j} > 0$. Thus, $\frac{\partial \Pi_1}{\partial q_{2j}} \frac{\partial q_{2j}}{\partial T_j} > 0$ and $-\frac{\partial \Pi_1}{\partial q_{2k}} \frac{\partial q_{2k}}{\partial T_j} > 0$, and we see that (4.23) means that the home firm would want a tariff on good j if the resulting increase in profits in sector j dominates the resulting loss of profits in sector k.

We can rewrite (4.22) as

$$\begin{aligned} \frac{\partial \Pi_1}{\partial T_j} &= -(b_X q_{1X} + c q_{1Y}) \frac{\partial q_{2X}}{\partial T_j} - (c q_{1X} + b_Y q_{1Y}) \frac{\partial q_{2Y}}{\partial T_j} \\ &= -q_{1X} \left(b_Y \frac{\partial q_{2X}}{\partial T_j} + c \frac{\partial q_{2Y}}{\partial T_j} \right) - q_{1Y} \left(c \frac{\partial q_{2X}}{\partial T_j} + b_Y \frac{\partial q_{2Y}}{\partial T_j} \right) \\ \Rightarrow \quad & \frac{\partial \Pi_1}{\partial T_X} = \frac{1}{|\Pi|} (q_{1X} A1_X + q_{1Y} B1_Y) \gtrless 0 \\ & \text{and } \frac{\partial \Pi_1}{\partial T_Y} = \frac{1}{|\Pi|} (q_{1Y} A1_Y + q_{1X} B1_X) \gtrless 0, \end{aligned} \tag{4.24}$$

where $A1_X, A1_Y > 0$ and $B1_X, B1_Y \gtrless 0$.

But, it can be shown that

$$\frac{\partial \Pi_1}{\partial T_X} + \frac{\partial \Pi_1}{\partial T_Y} > 0 \tag{4.25}$$

$\Rightarrow$ at least one of $\frac{\partial \Pi_1}{\partial T_X} > 0$, $\frac{\partial \Pi_1}{\partial T_Y} > 0$ is true, which gives us our second proposition.

Proposition 4.2: *With joint production of X and Y in both the home and the foreign country, there exists a tariff on either X or Y which increases the home firm's profits.*

From (4.24), however, we see that, unlike in the case of separate production discussed above, the home firm may actually prefer a tariff on only X or Y to tariffs on both X and Y, i.e., the home firm may actually prefer to have both a subsidy for the imports of one product and a tariff on the imports of the other.

Also, if one is of the view that tariff structures are constructed predominantly on the basis of lobbying by industry, one can see from (4.24) that it is possible that two countries with the same import-competing industries may not necessarily apply tariffs to the same products.

In the case of joint production of X and Y, it is the interrelated costs ($C_i^{XY} > 0$, $i = 1,2$) that is the source of the possible decrease in profits for the home firm as the result of say an increase in T_X. With the imposition of a tariff on X, the home firm increases its production of X, while the foreign firm decreases its production of X. But, with interrelated production costs in each country, an increase (decrease) in the production of X by a firm increases (decreases) the marginal costs of producing both X and Y, ceteris paribus. Also, because X and Y are substitutes in consumption, there will be an increase in demand for Y at any given price, P_Y, since it can be shown that P_X increases when $T_X > 0$ is imposed. If the net result of these

interactions in demand and supply is a loss in revenue from the Y market for the home producer, this may dominate any increased revenue from the X market, resulting in an overall loss of profits for the home firm. In particular, we see from (4.25) that if $B1_Y < 0$ (which is true, for example, when X and Y are perfect substitutes in production) then if the home firm's initial production of q_{1X} were relatively large compared to its production of q_{1Y}, there is a smaller chance that $\frac{\partial \Pi_1}{\partial T_X} < 0$ will occur. Thus, as a rough rule of thumb, the larger is the market for X relative to that for Y, the more likely it is that a tariff on X will increase the home firm's profits.

One is also interested in the changes in welfare brought about by the introduction of new tariffs. In the model of separate production of X and Y, if we assume that the home country maximizes the utility function in (4.6) subject to the constraint

$$P_X q_X + P_Y q_Y + Z_1^c = \Pi_{1X} + \Pi_{1Y} + T_X q_{2X} + T_Y q_{2Y} + L_1, \tag{4.26}$$

then, substituting (4.26) in (4.6), we obtain

$$\begin{aligned} W_1 = a_X q_X + a_Y q_Y - \frac{1}{2}(b_X q_X^2 + b_Y q_Y^2) - c q_X q_Y - P_X q_X - P_Y q_Y \\ + \Pi_{1X} + \Pi_{1Y} + T_X q_{2X} + T_Y q_{2Y} + L_1. \end{aligned} \tag{4.27}$$

Using (4.7), we then have that

$$\begin{aligned} \frac{\partial W_1}{\partial T_j} = {} & a_X \frac{\partial q_X}{\partial T_j} + a_Y \frac{\partial q_Y}{\partial T_j} - b_X q_X \frac{\partial q_X}{\partial T_j} - b_Y q_Y \frac{\partial q_Y}{\partial T_j} \\ & - c q_X \frac{\partial q_Y}{\partial T_j} - c q_Y \frac{\partial q_X}{\partial T_j} - P_X \frac{\partial q_X}{\partial T_j} - q_X \frac{\partial P_X}{\partial T_j} \\ & - P_Y \frac{\partial q_Y}{\partial T_j} - q_Y \frac{\partial P_Y}{\partial T_j} + \frac{\partial \Pi_{1X}}{\partial T_j} + \frac{\partial \Pi_{1Y}}{\partial T_j} + q_{2j} \end{aligned}$$

$$\Rightarrow \quad \frac{\partial W_1}{\partial T_j} = -q_X \frac{\partial P_X}{\partial T_j} - q_Y \frac{\partial P_Y}{\partial T_j} + \frac{\partial \Pi_{1X}}{\partial T_j} + \frac{\partial \Pi_{1Y}}{\partial T_j} + q_{2j} \gtrless 0 \qquad for j = X, Y. \tag{4.28}$$

However, it can be shown that

$$\frac{\partial W_1}{\partial T_X} + \frac{\partial W_1}{\partial T_Y} > 0. \tag{4.29}$$

Thus, we have the next proposition.

Proposition 4.3: *With separate production of X and Y in both the home and the foreign country, there exists a tariff on either X or Y which increases the home country's welfare.*

This is significant because it tells us that there is always some product on which a tariff would benefit the home country. From (4.28), however, we see that the home country may, in fact, not want a tariff on both of X and Y.

Also, in the model of joint production, if we assume that the home country maximizes the utility function in (4.6) subject to the constraint

$$P_X q_X + P_Y q_Y + Z_1^c = \Pi_1 + T_X q_{2X} + T_Y q_{2Y} + L_1, \tag{4.30}$$

we can substitute (4.30) in (4.6) to obtain

$$\begin{aligned} W_1 = a_X q_X + a_Y q_Y - \frac{1}{2}(b_X q_X^2 + b_Y q_Y^2) - c q_X q_Y - P_X q_X - P_Y q_Y \\ + \Pi_1 + T_X q_{2X} + T_Y q_{2Y} + L_1. \end{aligned} \tag{4.31}$$

Using (4.7), we then have that

$$\begin{aligned} \frac{\partial W_1}{\partial T_j} = \; & a_X \frac{\partial q_X}{\partial T_j} + a_Y \frac{\partial q_Y}{\partial T_j} - b_X q_X \frac{\partial q_X}{\partial T_j} - b_Y q_Y \frac{\partial q_Y}{\partial T_j} \\ & - c q_X \frac{\partial q_Y}{\partial T_j} - c q_Y \frac{\partial q_X}{\partial T_j} - P_X \frac{\partial q_X}{\partial T_j} - q_X \frac{\partial P_X}{\partial T_j} \\ & - P_Y \frac{\partial q_Y}{\partial T_j} - q_Y \frac{\partial P_Y}{\partial T_j} + \frac{\partial \Pi_1}{\partial T_j} + q_{2j} \end{aligned}$$

$$\Rightarrow \quad \frac{\partial W_1}{\partial T_j} = -q_X \frac{\partial P_X}{\partial T_j} - q_Y \frac{\partial P_Y}{\partial T_j} + \frac{\partial \Pi_1}{\partial T_j} + q_{2j} \gtrless 0 \qquad for j = X, Y. \qquad (4.32)$$

However, the following proposition can be shown to be true.

Proposition 4.4: *With joint production of X and Y in both the home and the foreign country, there exists a tariff on either X or Y that increases home country welfare if one of the following conditions is satisfied:*

$$(i) \qquad cC_1^{XX} - b_X C_1^{XY} \geq 0 \quad \text{and} \quad cC_1^{YY} - b_Y C_1^{XY} \geq 0,$$

$$(ii) \qquad C_2^{XX} = C_2^{YY} = C_2^{XY}.$$

One could in some sense interpret condition (i) as saying that X and Y are closer substitutes in demand than they are in production. In examining the two expressions in (i), one observes that at either $c = 0$ (when X and Y are not related in demand) or $C_1^{XX} = C_1^{YY} = C_1^{XY}$ (when X and Y are perfect substitutes in production), the required conditions are not satisfied. However, as $c \rightarrow b_X, b_Y$ (i.e., as X and Y become closer substitutes), and as $C_i^{XY} \rightarrow 0$ (i.e., as X and Y become less related in production), these two expressions will tend to be satisfied. If condition (i) holds, then, if X and Y are relatively close substitutes, there will tend to be a smaller loss in consumer surplus when a tariff is imposed on one product. Also, if X and Y are not close substitutes in production, an increase in production of the tariffed product by the home firm will not have as adverse an effect on its costs of producing the other product. Hence, :n condition (i) holds, welfare of the home country will be more likely to increase when a tariff is imposed on either X or Y. Condition (ii) says that X and Y are perfect substitutes in production in the

foreign country. Thus, when a tariff is imposed on one product by the home country, a decrease in production of that good by the foreign country will, ceteris paribus, decrease the marginal cost of producing X and Y by the same amounts in the foreign country. This decrease in the marginal cost of producing the other product by the foreign producer will be larger than it would have been if X and Y were imperfect substitutes in production. Thus, there will tend to be a larger increase in production of the other product by the foreign producer, and consumers of that product in the home country will tend to lose less, or even gain, from that market, making it more likely that any given tariff will increase home welfare. Examining (4.32) more closely, we see that $\frac{\partial W_1}{\partial T_j}$ is composed of four distinct terms: changes in payments for initial X and Y consumption, changes in the home firm's profits, and new tariff revenues. We note, however, that a tariff on X which increases P_X and decreases profits may still increase the home country's welfare if, in addition to generating new tariff revenues, there is a relatively large Y market and a decrease in the price of Y. On the other hand, if Π_1 decreases, it may dominate any new revenues and increases in consumer surplus, resulting in a decrease in home welfare.

To highlight these last two points, and to illustrate Propositions 4.2 and 4.4, we will look at two specific examples where profits of the home firm decrease as the result of the imposition of a particular tariff. For the first example, we suppose that we have cost functions as in (4.3), with $C_i(q_{iX}, q_{iY}) = \frac{1}{2}(q_{iX} + q_{iY})^2$ for $i = 1,2$ (i.e., we have satisfied condition (ii) of Proposition 4.4), and a home utility function as in (4.6), with $a_X = 1$, $a_Y = 3$, $b_X = b_Y = 1$, and $c = 0$.[30] Then it can be shown that

[30] While we have assumed thus far that $c > 0$, the results of Propositions 4.2 and

at $T_X = T_Y = 0$, we have $q_{1X} = q_{2X} = \frac{3}{45}$, $q_{1Y} = q_{2Y} = \frac{33}{45}$, $\frac{\partial P_X}{\partial T_X} = \frac{\partial P_Y}{\partial T_Y} = \frac{12}{45}$, and $\frac{\partial P_Y}{\partial T_X} = \frac{\partial P_X}{\partial T_Y} = \frac{-3}{45}$. Then, (4.24) $\Rightarrow$ $\frac{\partial \Pi_1}{\partial T_X} = \frac{-234}{2025}$ and (4.28) $\Rightarrow$ $\frac{\partial W_1}{\partial T_X} = \frac{27}{2025}$, the tariff revenues and the benefit from the decreased price of Y outweighing the welfare loss arising from the increased price of X and the decreased profits of the home firm. We can also show that $\frac{\partial \Pi_1}{\partial T_Y} = \frac{666}{2025}$ and $\frac{\partial W_1}{\partial T_Y} = \frac{1337}{2025}$. Hence, as would be predicted by Propostion 2, there exists a tariff on one product, (in this example, Y) which makes the home firm better off. And, in this example, we also have that a single tariff on Y is preferred by the home firm to tariffs on both X and Y. However, in this example, since $\frac{\partial W_1}{\partial T_X} > 0$ and $\frac{\partial W_1}{\partial T_Y} > 0$, the home country as a whole would prefer to have tariffs on both X and Y to a single tariff on Y, emphasizing the point that producer interests do not always reflect interests of the country as a whole.

Now suppose that we have the same parameters as in the above example, except that we now set $a_Y = 3.5$. Then, at $T_X = T_Y = 0$, we have that $q_{1X} = q_{2X} = \frac{1.5}{45}$, $q_{1Y} = q_{2Y} = \frac{39}{45}$, $\frac{\partial P_X}{\partial T_X} = \frac{\partial P_Y}{\partial T_Y} = \frac{12}{45}$, and $\frac{\partial P_Y}{\partial T_X} = \frac{\partial P_X}{\partial T_Y} = \frac{-3}{45}$. Then, (4.24) $\Rightarrow$ $\frac{\partial \Pi_1}{\partial T_X} = \frac{-319.5}{2025}$ and (4.28) $\Rightarrow$ $\frac{\partial W_1}{\partial T_X} = \frac{-54}{2025}$, the welfare loss arising from the decreased profits of the home firm overwhelming any gains from the new tariff revenues and decreased price of Y. Also, $\frac{\partial \Pi_1}{\partial T_Y} = \frac{805.5}{2025}$, while $\frac{\partial W_1}{\partial T_Y} = \frac{1633.5}{2025}$. Thus, both the home producer of X and Y and the home country would prefer a single tariff on Y to tariffs on both X and Y. The fact that home country welfare increases in the first example, but decreases in the second when a tariff is imposed on imports of X also emphasizes the ambiguity of welfare changes as the result of

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4.4 do in fact extend to the case of $c = 0$. The imposition of $c = 0$ in these examples is for ease of computation.

particular policies.

4.4 Different Technologies Across Countries

In the previous section, we examined the cases where X and Y were either separately or jointly produced in both the home and the foreign country. One might wonder, though, how tariffs would affect the home country and its producer(s) of X and Y if the home and the foreign country were employing different technologies to produce the two goods. In this section, we will examine situations in which technologies do differ across countries, and we will conduct our analysis with reference to four basic cases for which the major points of interest have been summarized in Table 4.1. Cases 1 and 2 refer to the cases covered in section 4.3, where we had separate and joint production, respectively, of X and Y in both countries; Case 3 refers to the situation where the home country has joint production of X and Y, while the foreign country produces X and Y separately; and Case 4 refers to the situation where the foreign country jointly produces X and Y, while the home country produces them separately.

From Cases 2 and 3 in Table 4.1, we see that with joint production of X and Y at home, and joint (Case 2) or separate (Case 3) production of X and Y in the foreign country, a tariff on X may lower or raise the home firm's profits and the home country's welfare, while there exists a tariff on either X or Y which necessarily increases the home firm's profits in both cases. It can also be shown that, with separate production abroad, as when there is joint production abroad, a sufficient condition for there to exist a tariff on X or Y which increases home

	Case 1*	Case 2*	Case 3*	Case 4*
$\frac{\partial \Pi_{1X}}{\partial T_X}, \frac{\partial \Pi_{1Y}}{\partial T_Y}$	+			+
$\frac{\partial \Pi_{1X}}{\partial T_Y}, \frac{\partial \Pi_{1Y}}{\partial T_X}$	+			?
$\frac{\partial \Pi_{1j}}{\partial T_X} + \frac{\partial \Pi_{1j}}{\partial T_Y}$	+			+
$\frac{\partial \Pi_1}{\partial T_X}, \frac{\partial \Pi_1}{\partial T_Y}$		?	?	
$\frac{\partial \Pi_1}{\partial T_X} + \frac{\partial \Pi_1}{\partial T_Y}$		+	+	
$\frac{\partial W_1}{\partial T_X}, \frac{\partial W_1}{\partial T_Y}$	?	?	?	?
$\frac{\partial W_1}{\partial T_X} + \frac{\partial W_1}{\partial T_Y}$	+	?	?	+

*Case 1 = Separate Production of X and Y at Home, Separate Production of X and Y Abroad.

Case 2 = Joint Production of X and Y at Home, Joint Production of X and Y Abroad.

Case 3 = Joint Production of X and Y at Home, Separate Production of X and Y Abroad.

Case 4 = Separate Production of X and Y at Home, Joint Production of X and Y Abroad.

Table 4.1

welfare is that $cC_1^{jj} \geq b_j C_1^{XY} \geq 0$ for $j = X,Y$.

With separate production of X and Y at home, the production structure of the foreign economy may have an effect on the trade policies advocated by home country firms. We know from Proposition 1 that with separate production of X and Y abroad, as well as at home, the home producer of Y would prefer tariffs on both X and Y to a single tariff on Y. However, we see from Case 4 in Table 4.1, that with joint production of X and Y abroad, $\frac{\partial \Pi_{1X}}{\partial T_Y} > 0$ and $\frac{\partial \Pi_{1X}}{\partial T_X} \lessgtr 0$, so that the Y producer may prefer a single tariff on Y to tariffs on both X and Y. In the

latter case, with interrelated costs abroad, a tariff on X would decrease foreign X production, and hence the marginal cost of producing both X and Y would decrease in the foreign country, ceteris paribus. The domestic producer of Y has no such change in his cost structure, and this may allow the foreign producer to take some of the home producer's former market share, as well as meet any increased demand for Y resulting from any substitution away from X, meaning that the home firm's profits may actually decrease when a tariff on X is imposed. This contrast with Case 1 shows that the presence of multiproduct firms in the foreign market can substantially alter how individual firms in the home market will be affected by the tariff structure imposed on them.

4.5 Subsidization of Exports by the Foreign Country

So far, we have been concerned only with the perspectives of the home firms and the home country as a whole. The model which we have already described can also, of course, be readily interpreted from the point of view of the foreign country and its firms. Redefining T_X and T_Y to represent export taxes imposed by the foreign country on X and Y, respectively, we can now look at what happens when the foreign country subsidizes (negatively taxes) its exports.

In Case 1, with separate production of X and Y in both countries, we have that

$$\frac{\partial \Pi_{2X}}{\partial T_X} = \frac{\partial \Pi_{2X}}{\partial q_{1X}} \frac{\partial q_{1X}}{\partial T_X} + \frac{\partial \Pi_{2X}}{\partial q_Y} \frac{\partial q_Y}{\partial T_X} - q_{2X}$$

$$= -q_{2X} \left(b_2 \frac{\partial q_{1X}}{\partial T_X} + c \frac{\partial q_Y}{\partial T_X} + 1 \right)$$

from which it can be shown that

$$\frac{\partial \Pi_{2X}}{\partial T_X} < 0. \tag{4.33}$$

Also,

$$\begin{aligned}\frac{d\Pi_{2X}}{\partial T_Y} &= \frac{\partial \Pi_{2X}}{\partial q_{1X}} \frac{\partial q_{1X}}{\partial T_Y} + \frac{\partial \Pi_{2X}}{\partial q_Y} \frac{\partial q_Y}{\partial T_Y} \\ &= q_{2X} \left(-b_X \frac{\partial q_{1X}}{\partial T_Y} - c \frac{\partial q_Y}{\partial T_Y} \right),\end{aligned}$$

from which it can be shown that

$$\frac{\partial \Pi_{2X}}{\partial T_Y} > 0. \tag{4.34}$$

However, we also note that

$$\frac{\partial \Pi_{2X}}{\partial T_X} + \frac{\partial \Pi_{2X}}{\partial T_Y} < 0. \tag{4.35}$$

Similarly, it can be shown that $\frac{\partial \Pi_{2Y}}{\partial T_Y} < 0$, $\frac{\partial \Pi_{2Y}}{\partial T_X} > 0$, and $\frac{\partial \Pi_{2Y}}{\partial T_Y} + \frac{\partial \Pi_{2Y}}{\partial T_X} < 0$. Hence, we have shown our next proposition to be true.

Proposition 4.5: *With separate production of X and Y in both the home and the foreign country, the profits of the foreign producer of good j ($j = X,Y$) increase with a subsidy to the exports of his own product, decrease with a subsidy to the exports of the other firm's product, and can increase with subsidies on both X and Y.*

Also, for Case 1, we have that

$$W_2 = \Pi_{2X} + \Pi_{2Y} + T_X q_{2X} + T_Y q_{2Y} + L_2 \tag{4.36}$$

as a measure of country 2's welfare. As for changes in welfare in the foreign country, from (4.36) we have that for $j = X,Y$,

$$\frac{\partial W_2}{\partial T_j} = \frac{\partial \Pi_{2X}}{\partial T_j} + \frac{\partial \Pi_{2Y}}{\partial T_j} + q_{2j} \gtreqless 0 \tag{4.37}$$

Also,

$$\frac{\partial W_2}{\partial T_X} + \frac{\partial W_2}{\partial T_Y} \gtreqless 0. \tag{4.38}$$

Thus, in general, it is ambiguous as to which product should receive an export subsidy and which should receive an export tax in order to increase the foreign country's welfare. If, however, one sets $c = 0$ in (4.37), it can be shown that $\frac{dW_2}{dT_j} < 0$ for $j = X,Y$, which gives us Proposition 4.6.

Proposition 4.6: *With X and Y unrelated in demand, and with separate production of X and Y in both the home and the foreign country, the welfare of the foreign country increases with a single subsidy to either X or Y.*

Proposition 4.6 is essentially a one-producer result, since demands for X and Y are unrelated and each good is produced separately. When $c = 0$, it can be shown that we have that $\frac{\partial \Pi_{2X}}{\partial T_Y} = \frac{\partial \Pi_{2Y}}{\partial T_X} = 0$. Thus, when a subsidy is made to one industry, allowing it to reap increased profits, it has no effect whatsoever on the other foreign firm's profits, giving us a Brander and Spencer (1985)-type result, in which the home country is better off with a subsidy to the home exporter.

With joint production of X and Y at home and abroad, we have that for

$j = X,Y,$

$$\begin{aligned}\frac{\partial \Pi_2}{\partial T_j} &= \frac{\partial \Pi_2}{\partial q_{1X}}\frac{\partial q_{1X}}{\partial T_j} + \frac{\partial \Pi_2}{\partial q_{1Y}}\frac{\partial q_{1Y}}{\partial T_j} - q_{2j} \\ &= (-b_X q_{2X} - c q_{2Y})\frac{\partial q_{1X}}{\partial T_j} + (-c q_{2X} - b_Y q_{2Y})\frac{\partial q_{1Y}}{\partial T_j} - q_{2j} \\ &= -q_{2X}\left(b_X \frac{\partial q_{1X}}{\partial T_j} + c\frac{\partial q_{1Y}}{\partial T_j}\right) - q_{2Y}\left(c\frac{\partial q_{1X}}{\partial T_j} + b_Y \frac{\partial q_{1Y}}{\partial T_j}\right) - q_{2j}\end{aligned}$$

$$\Rightarrow \quad \begin{aligned}\frac{\partial \Pi_2}{\partial T_X} &= \frac{-1}{|\Pi|}(q_{2X} A2_X + q_{2Y} B2_Y) \gtrless 0 \\ \text{and } \frac{\partial \Pi_2}{\partial T_Y} &= \frac{-1}{|\Pi|}(q_{2Y} A2_Y + q_{2X} B2_X) \gtrless 0,\end{aligned} \tag{4.39}$$

where $A2_X, A2_Y > 0$ and $B2_X, B2_Y \gtrless 0$.

But, it can be shown that

$$\frac{\partial \Pi_2}{\partial T_X} + \frac{\partial \Pi_2}{\partial T_Y} < 0, \tag{4.40}$$

which leads us to Proposition 4.7.

Proposition 4.7: *With joint production of X and Y in both the home and the foreign country, there exists a subsidy on foreign exports of either X or Y which increases the foreign firm's profits.*

From (4.39), we also observe that the relative size of the X and Y markets will influence the views of the foreign firm on which product(s) it would like to have subsidized. In particular, just as the home country tends to be better off when a tarriff is imposed on the product with the relatively larger market, from (4.39) we see that the foreign firm will tend to be better off when a subsidy is provided for the product with the relatively larger market.

Finally, we note that for Case 2, with joint production of X and Y in both countries, we have that

$$W_2 = \Pi_2 + T_X q_{2X} + T_Y q_{2Y} + L_2 \tag{4.41}$$

as a measure of the foreign country's welfare. Thus, from (4.41), we have that for $j = X,Y$,

$$\frac{\partial W_2}{\partial T_j} = \frac{\partial \Pi_2}{\partial T_j} + q_{2j} \gtrless 0. \tag{4.42}$$

However, the following proposition can be shown to be true.

Proposition 4.8: *With joint production of X and Y in both the home and the foreign country, there exits a subsidy to either X or Y that increases foreign country welfare if one of the following conditions is satisfied:*

$$(i) \qquad cC_1^{XX} - b_X C_1^{XY} \geq 0 \quad \text{and } cC_1^{YY} - b_Y C_1^{XY} \geq 0,$$

$$(ii) \qquad C_2^{XX} = C_2^{YY} = C_2^{XY}.$$

If condition (i) is satisfied, then, with X and Y not relatively close substitutes in production in the home country, if the foreign firm introduces a subsidy on a particular product, the home firm will decrease production of that product, but this does not give it as big of a cost advantage in the other market as if the products had been closer substitutes in production. Hence, there is greater likelihood that a given subsidy will increase the foreign firm's profits and increase foreign welfare. The intuition behind condition (ii) in this case is less clear.

4.6 Summary Comments

The joint production of goods by firms is a stylized fact which has more often than not been ignored in recent trade literature. When, however, this type of market structure is posited, we have been able to demonstrate that it has definitive effects on the types of tariff (subsidy) structures which individual firms would prefer. While the derived results were clearly driven by the assumed substitution of X and Y in production, in the extreme case of perfect substitution of X and Y in production, this assumption is merely one which would yield a traditional U-shaped average cost curve for production of $X + Y$. It is of interest that technology differences across countries could determine whether or not a home firm would be better off with tariffs on all products, or a single product tariff on one particular product. The relative sizes of a joint producer's X and Y markets were also shown to affect his tariff preference. Thus, if one believes that observed tariff and subsidy structures are predominantly determined by producer interests, then our model illustrates how important the presence of joint production in one or both countries can be to the tariff structure that evolves.

And, it is significant that most results in this model were generalized to situations in which both products were substitutes in demand. Indeed, the degree of substitutability between goods in demand and production were both crucial in the determination of many welfare results when joint production was present in one or both countries. That the welfare effects of individual tariffs were ambiguous with or without the presence of joint production should not be surprising since,

for example, for the home country there is generally a tradeoff between increased (decreased) profits and decreased (increased) consumer surplus. We were able to emphasize this potential dichotomy of producer and consumer interests when we created two examples, one in which home country welfare decreased when the home country's profits decreased, and one in which the home country's welfare increased even though the home firm's profits decreased.

Perhaps the most important feature of this analysis is the fact that the presence of multiproduct firms means that firms will generally want a more fine-tuned trade policy, as opposed to the 'blunt instrument'-type of approach, whereby all imports (or even all imports within a certain product classification) are treated the same for trade policy purposes.

As a parting caveat, we note that this chapter did not address the issues of optimal tariffs or strategic interactions between countries. And while it would have been possible to assume more specific cost structures (e.g., quadratic) and determine such results for particular cases, the dimensionality of the model did not make this a pleasant prospect.

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