

De Santis, Roberto A.

**Working Paper — Digitized Version**

## Why exporting countries agree voluntary export restraints: The oligopolistic power of the foreign supplier

Kiel Working Paper, No. 841

**Provided in Cooperation with:**

Kiel Institute for the World Economy – Leibniz Center for Research on Global Economic Challenges

*Suggested Citation:* De Santis, Roberto A. (1997) : Why exporting countries agree voluntary export restraints: The oligopolistic power of the foreign supplier, Kiel Working Paper, No. 841, Kiel Institute of World Economics (IfW), Kiel

This Version is available at:

<https://hdl.handle.net/10419/46697>

**Standard-Nutzungsbedingungen:**

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

**Terms of use:**

*Documents in EconStor may be saved and copied for your personal and scholarly purposes.*

*You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.*

*If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.*

# Kieler Arbeitspapiere

# Kiel Working Papers

Kiel Working Paper No. 841

**WHY EXPORTING COUNTRIES AGREE VOLUNTARY  
EXPORT RESTRAINTS: THE OLIGOPOLISTIC  
POWER OF THE FOREIGN SUPPLIER**

by Roberto A. De Santis

November 1997



Institut für Weltwirtschaft an der Universität Kiel  
The Kiel Institute of World Economics

The Kiel Institute of World Economics  
Düsternbrooker Weg 120  
D-24105 Kiel, FRG

Kiel Working Paper No. 841

**WHY EXPORTING COUNTRIES AGREE VOLUNTARY  
EXPORT RESTRAINTS: THE OLIGOPOLISTIC  
POWER OF THE FOREIGN SUPPLIER**

by Roberto A. De Santis

November 1997

796230

The authors are solely responsible for the contents and distribution of each Kiel Working Paper. Since the series involves manuscripts in a preliminary form, interested readers are requested to direct criticism and suggestions directly to the authors and to clear any quotations with them.

**WHY EXPORTING COUNTRIES AGREE VOLUNTARY  
EXPORT RESTRAINTS: THE OLIGOPOLISTIC  
POWER OF THE FOREIGN SUPPLIER**

by

**Roberto A. De Santis\***

**The Kiel Institute of World Economics**

Research Department 2

Düsternbrooker Weg 120

D-24105 Kiel

E-mail: r.desantis@ifw.uni-kiel.de

---

\* This paper arises from author's Ph.D. dissertation in the Department of Economics at Warwick University. I am indebted to my thesis advisor John Whalley for valuable suggestions. Moreover I have benefited from comments and discussions with David Collie, Norman Ireland, Gernot Klepper, Rolf Langhammer, Mathias Lücke, Carlo Perroni, Jeffrey Reed, Jeffery Round and Alasdair Smith. I would also like to thank for their comments the seminar participants at the Kiel Institute of World Economics, at the Universities of Nottingham and Warwick, and at the Econometric Society European Meeting and the European Economic Association Congress in Toulouse, 1997. Financial support from the Economic Social Research Council is gratefully acknowledged. All errors are my responsibility.

## ABSTRACT

This study analytically shows that a VER serves as an institution to protect incumbent firms of an exporting country. A VER is an entry barrier in the export market. It favours the concentration of industry, and allows established firms to better exploit economies of scale by producing output at lower average cost. Since the break-even price for potential firms is the average cost, entry in the domestic market is also inhibited, regardless of the form of competition. A VER also allows the raising of the price cost margin in the export market. However, the smaller the country, the greater the possibility also of a larger monopoly power in the domestic market. The impact on firm size is ambiguous. From the social point of view, three conventional effects from the elimination of a VER are usually considered: the rent loss effect, the efficiency effect and the export producer price effect. In this study, two further effects on welfare are examined: the increased intermediate inputs cost effect and the variety effect. The global effect on welfare on an exporting country is analytically indeterminate. A general equilibrium model applied to Turkey supports the conjecture that with the elimination of a VER, under Bertrand or Cournot conjectures, the loss in social welfare, the higher average cost, the fall of the concentration of the industry, and the fall of monopoly power of incumbent firms, are the key elements in understanding the rationale beyond VERs.

KEYWORDS: VERs, Strategic Trade, AGE Analysis.

JEL classification: D58, F12.

## TABLE OF CONTENTS

1. Introduction .....	4
2. A model with imperfect competition and symmetric firms .....	9
3. Analytical results .....	20
4. An AGE model for Turkey .....	29
5. Conclusions .....	48
References .....	50
Appendix A Price elasticities in Bertrand and Cournot .....	54
Appendix B Numerical model: the case of VERs .....	60

## 1. Introduction

The economic literature on VERs was developed in the eighties, when such agreements started to be used internationally as an instrument to protect the domestic economy from international competition, without breaking the GATT rules. The standard analysis of a VER, in the context of perfectly competitive markets, identifies three effects: the higher price paid by consumers of the importing country, the transfer of rents associated with artificially high prices from the importing to the exporting country, and the lower supply price for exports, as the marginal revenue product decreases.<sup>1</sup> It can be shown that the global welfare loss for a two-country economy as a whole is represented by the loss in the consumer surplus faced by the importing country, plus the loss in the producer surplus faced by the exporting country. In an imperfectly competitive market Harris (1985), Krishna (1989) and Rosendorff (1996) show that a further effect arises since quantitative restrictions may increase the market power of some firms. However, their models examine the VER effects on an importing economy and limit the analysis of the exporting country simply to the firm's profits. Harris (1985) and Krishna (1989) use a duopoly model with Bertrand competition and differentiated products in a partial equilibrium setting to show that a VER induces the domestic firm of the importing country to become an industry price leader, and therefore obtain the profits of a Stackelberg leader, as

---

<sup>1</sup> de Melo and Winters (1990) estimate a 9% fall of the marginal revenue product of factors employed in the Korean footwear industry leading the industry to contract, as a consequence of a VER agreement with the US in the period 1977-81. This econometric finding supports the view that a VER decreases the supply price of exports. The economic effects of VERs are surveyed by Hamilton (1985) and Pomfret (1989).

the foreign firm makes the credible commitment that it will not increase the level of exports when the domestic firm increases its price. Hence, the imposition of a VER at or close to the free trade level increases prices and profits to both the domestic and the foreign firms.<sup>2</sup> Rosendorff claims that an exporting country agrees a VER for fear of antidumping actions or other forms of administered protection by the importing country.<sup>3</sup>

Most of the literature on VERs focuses upon the effect of a VER on an importing economy. The implication for an exporting country have been mainly analysed with empirical models. de Melo and Winters (1993), for example, argue that with a VER the contraction in the restrained industry is associated with spillovers of exports to unrestricted markets.<sup>4</sup> Applying a partial equilibrium

---

<sup>2</sup> Harris (1985) argues that the introduction of a VER serves as a collusive focal point for domestic pricing. Hence, a VER may be an instrument to hold and reinforce the oligopolistic power of established domestic firms of the importing country, rather than an instrument for import substitution. The main conclusions of Harris and Krishna's analysis are that firstly, the imposition of a VER at or close to the free trade level increases prices and profits to both the domestic and the foreign firms; and secondly, a VER is a welfare reducing trade policy instrument for the importing country, if the loss in consumer surplus outweighs the profit gain accruing to the domestic firms of the importing country. It is important to emphasise that one would expect a loss in national welfare since domestic consumers also pay for the increase in the foreign firm's profits of the exporting country.

<sup>3</sup> Rosendorff shows that the government of the importing country prefers a VER to an optimal tariff if the domestic firm's profits, multiplied by a factor indicating the lobbying pressure on the government, are greater than the losses in tariff revenues.

<sup>4</sup> However, in a previous study, by investigating the effects of VERs on resource allocation in the Korean leather footwear industry, de Melo and Winters (1990) estimate



econometric model to the Taiwan footwear industry, they also found that this country suffered a welfare loss as a consequence of a VER. Trela and Whalley (1990) report estimates of national and global welfare costs of both developed country tariffs and bilateral quotas on textiles and apparel using an Applied General Equilibrium (AGE) model with constant returns to scale. When bilateral quotas alone are removed, results clearly show that the developed countries and the vast majority of developing countries gain. Based on 1986 data, the total gain has been estimated to be of around \$ 22 billion. On aggregate, developing countries gain around \$ 3 billion.<sup>5</sup> Similar results for developing countries are found by Yang (1994) and Yang, *et al.* (1997).

Francois, *et al.* (1995), by using various types of multiregional AGE models characterised by perfect competition, or imperfect competition, or endogenous capital stock, found that the elimination of the MFA would result in welfare gains for most of developing countries, and for developing countries as a whole.<sup>6</sup> In contrast, Harrison, *et al.* (1997), by using a similar modelling approach, found that the elimination of the MFA would result in welfare gains for

---

that the reduction of the industry size is mainly due to the difficulty of switching sales towards markets which are not constrained by VERs.

<sup>5</sup> In a subsequent study, Trela and Whalley (1995) focus their attention upon the extra costs on exporting countries of their own internal quota-allocation procedures. Since quotas are typically allocated to established rather than new and more efficient firms, the cost of quota restriction in their model is estimated to be \$ 23 billion per year compared to the \$ 3 billion without internal quota-allocation schemes.

<sup>6</sup> The main feature of the MFA is the use of bilateral agreements on export quotas to regulate textiles and apparel trade. VERs are typically agreed so as to limit textiles and apparel exports from developing countries. Under the MFA, in addition to bilateral quotas, importing countries also levy non-discriminatory tariffs (Yang, *et al.* 1997).

few countries, and in losses for developing countries as a whole. They argue that this aggregate welfare loss is due to the transfer of MFA quota rents from developing to industrialised countries. Only in the long run, after capital stock has optimally adjusted, do they estimate an aggregate welfare gain for developing countries as a whole. Similar results have been also obtained by Hertel, *et al.* (1995).

These empirical findings support the dominant view that several exporting countries, especially small countries, are forced, rather than agree voluntarily, to export restraints.

This paper explores the economic effects of a VER on a foreign supplier when the VER also modifies the degree of competition in the exporting country's domestic market, under both Bertrand and Cournot conjectures. I show that the elimination of a VER certainly leads to a more efficient allocation of resources, favouring the expansion of the previously restrained industry. However, the elimination of an export quota causes an increase in the producer price of exports, which brings about a rise in the composite producer price. The export expansion and the higher average cost allow less efficient firms to break even. As the number of the competing symmetric firms within the industry increases, the firms' perceived elasticity of export demand becomes more elastic. As a result, the power of incumbent firms declines regardless of the firms' conjectures. However, the smaller the country, the larger the possibility that the monopoly power in the domestic market declines more than in the export market. With regard to the impact on firm size, it positively depends upon the size of export growth for the industry as a whole, and on the impact on firms' domestic production, and negatively on the extent of new entry.

From the social point of view, I show that the elimination of a VER has three positive and two negative effects on the welfare of the exporting country. The positive effects are due to the conventional gains from trade (*efficiency effect*); the increase in the producer price of exports, as foreign consumers are more sensitive to price changes, rather than to quota premium variation (*export producer price effect*);<sup>7</sup> and to increased product diversity, as domestic brands enter in pursuit of positive profits (*variety effect*). The negative effects on welfare are due to the loss of the economic rent (*rent loss effect*), and the greater cost of purchasing intermediate inputs (*increased intermediate inputs cost effect*). In fact, I show that the impact on the costs of intermediate inputs might be substantial and might be larger than the rise in the producer price of exports. The impact on the consumer price index, although negligible, cannot be classified (*consumer price effect*). Thus, the welfare implications of VERs on an exporting economy are analytically indeterminate.

In order to comprehend the significance of the analytical results, to understand better the uncertain outcome on welfare and firm size, and to examine how sensitive the results are to alternative equilibrium concepts, an AGE model with the restrained sectors facing increasing returns to scale, identical firms, and free entry/exit has been built. This model studies the main effects of the elimination of VERs on welfare, output, resource allocation, average cost, firm size, concentration of the industry and price cost margin, under both Bertrand and Cournot conjectures. The model has been applied to the Turkish textiles and apparel industries, which have been subject to VERs in relation to the European

---

<sup>7</sup> In models with perfect competition and constant returns to scale, with the elimination of a VER, the rise in the supply price of exports is due to the fact that the marginal revenue product rises (de Melo and Winters, 1990).

market since 1982 for textiles and 1986 for apparel, and since then periodically renewed and now broken as a consequence of the recent customs union agreement (GATT, 1994). The numerical results clearly indicate that regardless of market conjectures, as a consequence of the elimination of VERs, the contraction of industry concentration is substantial, whilst it is modest regarding the negative impact on price cost margins. In addition, it supports the conjecture that the negative welfare effects dominate the positive effects with trade, thus decreasing the aggregate welfare of a nation, although by a small amount. It also confirms the analytical result that the smaller the country the larger the negative economic implications of the abrogation of VERs for incumbent firms. Similarly, there is a larger welfare loss for the nation as a whole. The quantitative results are less sensitive to equilibrium concepts. However, incumbent firms would be worse off in terms of new entry, size and average cost under Bertrand conjectures, as they are inherently more competitive. Hence, it seems that industry associations, with the consent of policy-makers of exporting countries, reach agreements about VERs for rational economic reasons.

## **2. A model with imperfect competition and symmetric firms**

A VER is an entry barrier in the market for exports. It favours the concentration of the industry, and allows established firms, especially those which receive the export licence, to better exploit economies of scale by producing at lower average cost. Since the break-even price for potential entrants is the average cost, a VER can also be regarded as an effective entry barrier in the domestic market. Thus, the voluntary acceptance of export restraints not only generates forms of

oligopoly in the market for exports, but also modifies the degree of competition in the foreign supplier's domestic market. I model the oligopolistic behaviour of firms as a noncooperative game, where the stable solution is represented by a Nash equilibrium in prices or quantities. To justify that, it can be argued that a VER may facilitate the learning process of each established firm with regard to the reaction functions of other competing firms, such that each incumbent firm chooses the amount of output (exported and sold in the domestic market) in order to maximise its own profit, given the output or the price choice of other competing firms. So a VER may serve as an institution to protect an established domestic oligopoly of an exporting country, which behaves in a Cournot or Bertrand fashion.

The model presented in this section is an intraindustry general equilibrium model with increasing returns to scale, segmented markets and symmetric firms used to study the impact of the elimination of a VER on the average cost, the number of firms, firm size, industrial output, price cost margin and welfare, under both Bertrand and Cournot conjectures. I also assume the existence of sectors not subject to VERs, which face perfect competition and constant returns to scale. The latter sectors are indexed with  $crs$ , whilst the sectors subject to VERs are indexed with  $i$ . To represent all sectors of the economy, I use  $j = i \cup crs$ .

To model domestic and foreign trade, I assume that each firm in sector  $i$  and each industry  $crs$  employ factors and intermediate inputs to produce two imperfect substitute goods, one sold in the domestic market and the other exported. The representative consumer gains utility from the consumption of domestic goods produced by the industry  $crs$  and their imperfect substitute imports, and from the consumption of a variety of domestic goods produced by the sectors of differentiated products and a variety of imperfect substitute

imports. Also the sectoral intermediate demand, which is defined as a Leontief specification of sectoral output, is satisfied with the supply of domestic goods and imports.

[2.1] *Technology and cost function*

The production function of a single representative firm,  $\Theta\{\dots\}$ , is additively separable in  $\Phi_1[\dots]$  and  $\Phi_2[\dots]$ , and such that  $\partial^2\Theta/(\partial\Phi_1\partial\Phi_2) > 0$ :

$$(1) \quad y_i = \Theta\left[\Phi_1(x_{ji}), \Phi_2(l_i, k_i)\right]$$

$$= 0 \text{ if } l_i < l_i^f \text{ or } k_i < k_i^f$$

where  $y_i$  represents composite production of domestic goods and exports;  $x_{ji}$  denote intermediate inputs, assumed to be net complements;  $l_i$  and  $k_i$  represent labour and capital inputs; and  $l_i^f$  and  $k_i^f$  the fixed factor inputs needed to start the production process. Due to the presence of fixed setup costs, the production sets are not-convex.  $\Phi_2$  is locally assumed to be twice differentiable, so that  $\Phi_2' > 0$  and  $\Phi_2'' < 0$ .

The production possibility frontier of each firm is represented by

$$(2) \quad y_i = \Omega(d_i, e_i), \quad \Omega_d > 0, \Omega_e > 0, \partial^2\Omega/(\partial d_i \partial e_i) < 0,$$

which locally is a separable, differentiable transformation curve of domestic goods ( $d_i$ ) and exports ( $e_i$ ). The transformation curve is locally assumed twice differentiable with respect to  $d_i$  and  $e_i$ , such that  $\Omega''(d_i) < 0$  and  $\Omega''(e_i) < 0$ .

The fixed factor inputs,  $l_i^f$  and  $k_i^f$ , multiplied by their respective returns, determine the firm's fixed cost. It is important to emphasise the benefits for each

firm of raising production, as each firm would bear a reduced fixed cost element per unit of output. The total cost faced by each firm is the sum of variable and fixed costs, hence the average cost ( $ac_i$ ) to produce one unit of output is

$$(3) \quad ac_i = \left( wl_i + rk_i + \sum_j p_j x_{ji} \right) / y_i,$$

where  $p_j$  denote the price vector of final and intermediate goods. The factor demands of each firm and the marginal cost equation can be derived by solving a standard dual problem. The marginal cost is independent of output, and is a function of factor prices and sector specific parameters.

The production function and the transformation curve for sectors facing perfect competition and constant returns to scale take respectively the following form:

$$(4) \quad Y_{crs} = \Theta^{crs} \left[ \Phi_1^{crs}(x_{jcrs}), \Phi_2^{crs}(L_{crs}, K_{crs}) \right]$$

$$(5) \quad Y_{crs} = \Omega^{crs}(D_{crs}, E_{crs}),$$

where  $Y_{crs}$  denotes composite output,  $D_{crs}$  domestic output,  $E_{crs}$  exports,  $L_{crs}$  labour, and  $K_{crs}$  capital for the industry as a whole.  $\Theta^{crs}$  is globally linear homogenous, additively separable in  $\Phi_1^{crs}$  and  $\Phi_2^{crs}$ , and such that  $\partial^2 \Theta^{crs} / (\partial \Phi_1^{crs} \partial \Phi_2^{crs}) > 0$ .  $\Phi_2^{crs}$  is twice differentiable.  $\Omega^{crs}$  is globally linear homogenous, separable, differentiable and concave.

## [2.2] Number of firms

The model is characterised by free entry/exit. One key feature of the model is the definition of the profit function:

$$(6) \quad \pi_i = pd_i d_i + pe_i e_i - c_i(d_i + e_i) - f_i,$$

where  $\pi_i$  denotes pure profits net of rents from VERs,  $pd_i$  the domestic price,  $pe_i$  the producer price of exports,  $c_i$  the marginal cost and  $f_i$  fixed costs. It does not include rents from VERs, because entry in the export market is restricted to those owning the licence to export. So economic rents can be still made by firms with the licence to export. In summary, the number of firms is endogenously determined by the zero profit condition:  $\pi_i = 0$ .

### [2.3] Domestic and foreign demand functions

Armington (1969) argues that goods produced by industries located in different countries, but which compete in the same market, are imperfect substitute. The Armington specification is typically a CES function of domestically produced goods and imports. This approach is very useful to derive the demand for domestic goods ( $D_i$ ) and the demand for imports ( $M_i$ ) by solving the Armington-dual problem:

$$(7) \quad D_i = \varphi_i^{\varepsilon_i} pd_i^{-\varepsilon_i} p_i^{\varepsilon_i} Q_i$$

$$(8) \quad M_i = (1 - \varphi_i)^{\varepsilon_i} \overline{pwm}_i^{-\varepsilon_i} p_i^{\varepsilon_i} Q_i,$$

$$(9) \quad Q_i = f(HR, p_i) + X_i$$

where  $Q_i$  is the sum in quantities of final demand ( $f$ ) and intermediate demand ( $X_i$ ),  $HR$  denotes the representative consumer income,  $\overline{pwm}_i$  the fixed world price of imports,  $\varphi_i$  a share parameter of the Armington function and  $\varepsilon_i$  the elasticity of substitution between imports and domestic goods,

$$p_i = \left[ \varphi_i^{\varepsilon_i} pd_i^{1-\varepsilon_i} + (1 - \varphi_i)^{\varepsilon_i} \overline{pwm}_i^{1-\varepsilon_i} \right]^{1/(1-\varepsilon_i)} \quad \text{and} \quad X_i = \sum_j a_{ji} Y_j. \quad (9) \quad \text{is the}$$



equilibrium condition in the goods market. The Marshallian demand functions,  $f$ , are derived by solving a three stages utility maximisation problem, with the representative consumer facing a convex indifference curve *a la* Dixit-Stiglitz (Dixit and Stiglitz, 1977). In the first stage, consumers allocate income between goods which are produced by the differentiated industries; in the second stage, they allocate income between imports and domestic competing goods; and, in the third stage, they allocate income between the differentiated domestic products and the differentiated imports.

An oligopolistic profit maximising firm is characterised by a decreasing marginal revenue curve in the domestic market as well as in the market for exports. This implies that domestic demand and export demand ought to be downward sloping. The solution of the Armington-dual problem leads to the desired downward sloping domestic demand curve [see (7)], whilst the industry export demand function ( $E_i$ ) is assumed negative and isoelastic:

$$(10) \quad E_i = A_i p w e_i^{-\eta_i},$$

where  $p w e_i$  is the price paid by foreign consumers for goods under VER,  $\eta_i$  the absolute value of the foreign price elasticity and  $A_i$  a positive constant.<sup>8</sup>

The Armington specification and an infinitely elastic export demand function are postulated for sectors facing perfect competition and constant returns to scale.

---

<sup>8</sup> Note that the criticism by Whalley and Young (1984), about the external sector closure rules in AGE models, does not hold in this modelling framework for two reasons: firstly, the exchange rate does not appear in the model; secondly, the foreign import-supply function is assumed to be infinitely elastic.

[2.4] Price mark-ups and firms' perceived elasticities

The fact that the domestic market and the export market are segmented implies that firms maximise (6) with respect to both  $d_i$  and  $e_i$ . The profit maximising conditions result in the Lerner mark-ups formula:

$$(11) \quad pd_i \left( 1 - \frac{1}{|\tau_i|} \right) = c_i,$$

$$(12) \quad pe_i \left( 1 - \frac{1}{|\delta_i|} \right) = c_i,$$

where  $\tau_i$  and  $\delta_i$  represent the firm's perceived price elasticities of domestic demand and export demand, respectively.

$\tau_i$  can be derived by considering the consumer three-stage budgeting procedure. To derive  $\delta_i$ , I also assume that a hypothetical foreign consumer purchases different brands of the industry under VER.

In the third stage of the budgeting procedure, the representative domestic consumer maximises the following subutility function subject to the budget devoted to the purchase of domestic goods:

$$\max_{\tilde{d}_{is}} \left\{ D_i = \left[ \sum_{s=1}^n \tilde{\beta}_{is} \tilde{d}_{is}^{(\zeta_i-1)/\zeta_i} \right]^{\zeta_i/(\zeta_i-1)} \right\} \quad \text{s.t.} \quad \sum_{s=1}^n p \tilde{d}_{is} \tilde{d}_{is} = p d_i D_i,$$

$$\zeta_i > 1, \quad \sum_{s=1}^n \tilde{\beta}_{is} = 1,$$

where  $\tilde{\beta}_{is}$  are demand parameters describing the consumer preferences for a brand  $s$  produced by a sector  $i$ ,  $\tilde{d}_{is}$ , which is priced at  $p \tilde{d}_{is}$ ; and

$pd_i = \left[ \sum_{s=1}^n \tilde{\beta}_{is} \tilde{p}_{is}^{s_i} \right]^{1/(1-s_i)}$  represents the price index (or unit expenditure function).

Similarly, the foreign consumer in the purchase of brands subject to a VER faces the following problem

$$\max_{e_{is}} \left\{ E_i = \left[ \sum_{s=1}^n \tilde{\gamma}_{is} \tilde{e}_{is}^{\xi_i} \right]^{\xi_i/(\xi_i-1)} \right\} \quad \text{s.t.} \quad \sum_{s=1}^n pwe_{is} \tilde{e}_{is} = pwe_i E_i,$$

$$\xi_i > 1, \quad \sum_{s=1}^n \tilde{\gamma}_{is} = 1.$$

where  $\tilde{\gamma}_{is}$  are demand parameters describing the preferences of the foreign consumer for a brand  $s$  exported by sector  $i$ ,  $\tilde{e}_{is}$ ;  $\tilde{pwe}_{is}$  denote their price, and

$$pwe_i = \left[ \sum_{s=1}^n \tilde{\gamma}_{is} \tilde{pwe}_{is}^{\xi_i} \right]^{1/(1-\xi_i)}$$

is the price of the aggregate,  $E_i$ .

Utility maximisation implies that the demand for product varieties is a negative function of the price of the varieties and a positive function of the aggregate price index. In fact, the first order conditions yield:

$$(13) \quad \tilde{d}_{is} = \tilde{\beta}_{is}^{s_i} D_i pd_i^{s_i} \tilde{p}_{is}^{-s_i},$$

$$(14) \quad \tilde{e}_{is} = \tilde{\gamma}_{is}^{\xi_i} E_i pwe_i^{\xi_i} \tilde{pwe}_{is}^{-\xi_i}.$$

As a result, (10) and (14) imply that  $\xi_i > \eta_i$ .

As already described in section [2.3], domestic demand and export demand have different characteristics. Domestic demand is derived by solving a dual problem, whilst export demand is assumed to be isoelastic. So two different approaches have been employed to derive  $\tau_i$  and  $\delta_i$  under both Cournot and

Bertrand competition.  $\tau_i$  has been obtained following Harrison, *et al.* (1994), who in their model employ the Armington specification;<sup>9</sup> whereas  $\delta_i$  has been obtained following Smith and Venables (1988), where a isoelastic demand function is postulated. Under both Bertrand and Cournot conjectures, the profit maximising conditions take the form of (11) and (12). However, if firms maximise profits given rivals' prices (i.e. Bertrand competition), then  $\tau_i$  and  $\delta_i$  take the form,

$$(15) \quad \tau_i = -\frac{1}{n_i} \left[ (1 - \Psi_i) \varepsilon_i + \Psi_i \chi_i \right] - \left( 1 - \frac{1}{n_i} \right) \zeta_i,$$

$$(16) \quad \delta_i = -\xi_i \left( 1 - \frac{1}{n_i} \right) - \frac{\eta_i}{n_i},$$

where  $\Psi_i = pd_i D_i / (pd_i D_i + \overline{pwm}_i M_i)$  denotes the consumption share for domestic goods and  $\chi_i$  the absolute value of the price elasticity of aggregate demand.<sup>10</sup> If, in contrast, firms maximise profits given rivals' output (i.e. Cournot competition), then  $\tau_i$  and  $\delta_i$  take the form,

$$(17) \quad \frac{1}{\tau_i} = -\frac{1}{\zeta_i} - \frac{1}{n_i} \left[ \frac{(\zeta_i - \varepsilon_i)}{\zeta_i \varepsilon_i} + \Psi_i \left( \frac{\varepsilon_i - \chi_i}{\chi_i \varepsilon_i} \right) \right],$$

$$(18) \quad \frac{1}{\delta_i} = -\frac{1}{\xi_i} - \frac{1}{n_i} \frac{(\xi_i - \eta_i)}{\xi_i \eta_i}.$$

---

<sup>9</sup> Harrison, *et al.* (1994) derive the price elasticity of demand under Cournot conjectures and under the assumption that the price elasticity of aggregate demand ( $\chi_i$ ) is unity, whilst I assume that  $\chi_i$  is endogenously specified. The Bertrand formula is my derivation.

<sup>10</sup> See Appendix A for derivation of equations (15)-(18)

(15)-(18) show that the larger the absolute value of the price elasticities of domestic (foreign) demand, or the larger the elasticities of substitution among domestic (export) varieties, the larger the absolute value of the price elasticity perceived by firms in the domestic (export) market and, as a result, the lower the price cost margin in the domestic (export) market. In addition, (15) and (17), and (16) and (18) provide a formal demonstration that the individual producer faces a more elastic demand curves with entry, if  $\zeta_i > \varepsilon_i > \chi_i$  and  $\xi_i > \eta_i$ , respectively. It is also interesting to note that as the number of firms rises, the absolute value of both price elasticities converges towards the elasticity of substitution among brands under both Cournot and Bertrand competition. This implies that the impact of trade policies on the main variables would vary under Cournot and Bertrand conjectures only with respect to the magnitude of the change. Whereas the direction of the change of the variables would remain substantially similar.<sup>11</sup>

### *[2.5] Rents and the supply price of exports*

The policy experiment performed in this study is the evaluation of the impact of the elimination of a VER, when rents accrue to firms. So I assume that the industry associations of an exporting country already agreed with an importing country to restrain their level of exports. This implies that the government does

---

<sup>11</sup> It is important to stress that a similar conclusion has been drawn by Venables (1994). By using a multiregional computable partial equilibrium model of trade under imperfect competition, Venables finds that the gains from an import tariff and an export subsidy are not significantly sensitive to the change of the equilibrium concept. The equilibrium types used in his study are the cases of price and quantity competition, segmented markets, and oligopoly and monopolistic competition.

not intervene in allocating export licenses and is not the recipient of the rents. The rents accrue to the private sector, and each firm receives a rent ( $ver_i$ ) which is equal to the *ad valorem* quota premium parameter ( $qr_i$ ) times exports, evaluated at  $pe_i$ :

$$(19) \quad ver_i = qr_i pe_i e_i$$

The producer price of exports ( $pe_i$ ) is equal to the agreed price adjusted by  $qr_i$ :

$$(20) \quad pe_i = \frac{pwe_i}{1 + qr_i}$$

As I am interested in examining the economic implications of the elimination of VERs,  $qr_i$  is assumed to be exogenous. When  $qr_i$  is zero, the rent disappears and  $pe_i = pwe_i$ .

### [2.6] Representative household income

The sources of household income are value added, pure profits, plus the economic rents which originate from sales on foreign markets:

$$(21) \quad HR = \sum_j (pd_j D_j + pe_j E_j - p_j X_j) + \sum_i n_i \pi_i + \sum_i n_i ver_i,$$

where the first term represents the value added, that is the value of production minus the cost of intermediate inputs. In order to study the impact of VERs alone, it is assumed free entry/exit, so that the number of firms adjusts until pure profits are zero.

### 3. Analytical results

[3.1] *The impact on the export producer price and the average cost*

If the VER agreement is broken and the country can have an impact on its terms of trade, the immediate effect is a lower level of  $pwe_i$  and an increase of the demand for exports (10). However, the producer price of exports rises if foreign consumers are more sensitive to price changes, rather than to *ad valorem* quota premium variation. In fact, by using (10) and (20),  $pe_i$  can be written as

$$(22) \quad pe_i = A_i^{1/\eta_i} E_i^{-1/\eta_i} (1 + qr_i)^{-1}.$$

By differentiating the latter expression with respect to  $qr_i$ , then

$$(23) \quad \frac{dpe_i}{dqr_i} = -A_i^{1/\eta_i} E_i^{-1/\eta_i} (1 + qr_i)^{-2} \left( 1 - \frac{\Psi_i}{\eta_i} \right),$$

where  $\Psi_i = -[(1 + qr_i)/E_i] dE_i/dqr_i$ . Then,  $dpe_i/dqr_i < 0$  if, and only if,  $\eta_i > \Psi_i$ .

Since consumers are more sensitive to changes of prices gross of equivalent taxes, rather than to the variation of the equivalent tax rate itself, I argue that the elimination of a VER raises the producer price of exports. Obviously, the smaller the country (that is the larger  $\eta_i$ ), the greater the negative impact on  $pe_i$ . In summary,  $pe_i$  under free trade is greater than its value under VER, but smaller than  $pwe_i$  under VER.

The composite producer price ( $py_i$ ) is equal to

$$(24) \quad py_i = \frac{D_i}{Y_i} pd_i + \frac{E_i}{Y_i} pe_i.$$

Since  $qr_i$  has a secondary impact on  $pd_i$  and  $D_i$ , then also  $py_i$  rises as a consequence of the VER abrogation. Given the zero profit condition, then,  $dac_i/dqr_i < 0$ . In summary:

**PROPOSITION 1:** *The elimination of a VER increases the producer price of exports. The liberalisation process is thus associated with a rise in the average cost, which is larger, the smaller the country.*

### [3.2] The impact on the number of firms

The zero profit conditions can be also written as:

$$(25) \quad pd_i \left[ 1 - (1 + \lambda_i)(n_i \omega_i)^{-1} \right] = c_i,$$

$$(26) \quad pe_i \left[ 1 - (1 + \lambda_i)(n_i \eta_i)^{-1} \right] = c_i,$$

where  $\omega_i$  is the absolute value of the price elasticity of domestic demand and  $\lambda_i$  the firms' conjectural variation parameter, which for simplicity is assumed to be equal in both markets.<sup>12</sup> By multiplying (25) by  $D_i$  and (26) by  $E_i$ , and rearranging, the zero profit condition and the assumption that the marginal cost is independent of output yield

$$(27) \quad n_i = \left\{ \frac{1 + \lambda_i}{f_i} \left[ \frac{pd_i D_i}{\omega_i} + \frac{pe_i E_i}{\eta_i} \right] \right\}^{1/2}.$$

---

<sup>12</sup> Appendix A shows that under Bertrand conjectures  $\omega_i = \varepsilon_i - (\varepsilon_i - \chi_i)\Psi_i$ , whilst under Cournot conjectures  $\omega_i = [1/\varepsilon_i - (1/\varepsilon_i - 1/\chi_i)\Psi_i]^{-1}$ .



The reduced form for  $n_i$  is very simple to interpret. Firstly, an expansion of domestic sales or export sales invites entry; secondly, markets, which are characterised by a greater price elasticity, fear more competition, than those characterised by a smaller price elasticity; thirdly, the larger the fixed cost to produce one unit of output, the smaller the number of firms in equilibrium; finally, markets, which are characterised by a lower degree of competition (i.e. a larger  $\lambda_i$ ), allow a larger number of firms in equilibrium, which cooperate to a certain extent.

The total differential of (27) with respect to  $qr_i$  yields

$$(28) \quad \frac{dn_i}{dqr_i} = \frac{1}{2} \left\{ \frac{f_i}{1 + \lambda_i} \left[ \frac{pd_i D_i}{\omega_i} + \frac{pe_i E_i}{\eta_i} \right] \right\}^{-1/2} \left[ \frac{1}{\omega_i} \frac{d(pd_i D_i)}{dqr_i} - \frac{pd_i D_i}{\omega_i^2} \frac{d\omega_i}{dqr_i} + \frac{1}{\eta_i} \frac{d(pe_i E_i)}{dqr_i} \right]$$

Given the secondary impact of  $qr_i$  on the variables related to domestic production and domestic consumption, the elimination of a VER, by raising export sales, determines the entry of new firms:  $dn_i/dqr_i < 0$ . So,

**PROPOSITION 2:** *The elimination of a VER raises the number of firms in equilibrium.*

It is important to stress that markets characterised by an infinite demand elasticity do not determine the number of firms in equilibrium. This feature is important to explain the empirical finding in section [4.2.1], where a third unrestricted export market is introduced.

[3.3] *The impact on the price-cost margin*

(16) and (18) clearly show that, with the elimination of a VER, as the number of firms rises, each producer faces a more elastic export demand curve, under both Cournot and Bertrand competition. This implies that with the elimination of a VER, the price cost margin in the export market declines. In contrast, the impact on  $\tau_i$  also depends upon the impact on  $\Psi_i$  and  $\chi_i$ . However, by differentiating (15)-(18) by  $qr_i$ , the incumbent firms' power in the domestic market would also fall, and at a larger rate than the drop in the export market, if

$$(29) \quad \left[ \zeta_i - (1 - \Psi_i)\varepsilon_i - \Psi_i\chi_i \right] \frac{dn_i}{dqr_i} + n_i \left[ (\chi_i - \varepsilon_i) \frac{d\Psi_i}{dqr_i} + \Psi_i \frac{d\chi_i}{dqr_i} \right] > (\xi_i - \eta_i) \frac{dn_i}{dqr_i}$$

under Bertrand conjectures, and if

$$(30) \quad \left[ \frac{(\zeta_i - \varepsilon_i)}{\zeta_i \varepsilon_i} + \Psi_i \left( \frac{1}{\chi_i} - \frac{1}{\varepsilon_i} \right) \right] \frac{dn_i}{dqr_i} - n_i \left[ \left( \frac{1}{\chi_i} - \frac{1}{\varepsilon_i} \right) \frac{d\Psi_i}{dqr_i} - \frac{\Psi_i}{\chi_i^2} \frac{d\chi_i}{dqr_i} \right] > \frac{(\xi_i - \eta_i)}{\xi_i \eta_i} \frac{dn_i}{dqr_i}$$

under Cournot conjectures. It is clear that, given the curvature of the foreign consumer's preferences ( $\xi_i$ ), the smaller the country (that is, the larger  $\eta_i$ ) the greater the possibility that the price cost margin would fall more in the domestic market as a result of a VER abrogation.

**PROPOSITION 3:** *The elimination of a VER leads to a fall of incumbent firms' monopoly power in the export market. The impact on the monopoly power in the domestic market is ambiguous. However, the smaller the country, the greater the possibility that the price cost margin would decline more in the domestic market than in the export market.*

[3.4] *The impact on firm size*

The impact on firm size is ambiguous. Since  $dy_i/dqr_i = y_i(dn_i/dqr_i) + n_i(dy_i/dqr_i)$ , and since, by aggregating firms' domestic output and exports, the total derivative of output for the industry as a whole with respect to  $qr_i$  is  $dY_i/dqr_i = \Omega_D(dD_i/dqr_i) + \Omega_E(dE_i/dqr_i)$ , where  $\Omega_D$  and  $\Omega_E$  respectively denote the partial derivative of composite production with respect to domestic output and exports for the industry as a whole, the latter two expressions can be rearranged as

$$(31) \quad \frac{dy_i}{dqr_i} = \frac{\Omega_E}{n_i} \frac{dE_i}{dqr_i} - \frac{1}{n_i} (y_i - \Omega_D d_i) \frac{dn_i}{dqr_i} + \Omega_D \frac{dd_i}{dqr_i}.$$

With the elimination of the quota premium, the first term represents the positive impact of an export expansion for the industry as a whole. The second term denotes the negative impact of returns to scale, as a larger number of firms results in the less efficient exploitation of fixed inputs (note that  $\Omega_D d_i < y_i$ , if  $\phi_{yd} < 1$ , where  $\phi_{yd}$  denotes the elasticity of composite production with respect to domestic output).<sup>13</sup> Finally, the third term denotes the capability of firms to sell in the domestic market after new entry is occurred. We expect it to be negative, since given the domestic demand, a larger number of firms implies a fall in per firm domestic production. Hence, despite the benefits from export expansion, the size of incumbent firms might not expand.

---

<sup>13</sup> Note that  $\Omega_D d_i < y_i$  implies  $\Omega_d/(y_i/d_i) < 1$ .

**PROPOSITION 4:** *The elimination of a VER raises the size of incumbent firms if, and only if, export expansion outweighs the negative effects of both inefficiently exploiting economies of scale and of trading in the domestic market.*

On the basis of the results on average cost, number of firms, price cost margin and firm size, which are summarised by the first four propositions, incumbent firms will lobby the government or industry associations to keep signing VERs agreements.<sup>14</sup>

### *[3.5] The impact on the cost of primary and intermediate inputs*

The lower price cost margin in the export market is obtainable only if the marginal cost increase is larger than the rise in the producer price of exports (12). Since the model assumes the factor inputs to be homogenous among sectors, the impact on factor returns should not be large. This implies that the rise in the marginal cost is mainly due to the substantial rise in the intermediate inputs costs. This finding is very important when I will analyse the VER implication on welfare in section [3.7].

**PROPOSITION 5:** *The elimination of a VER raises slightly the cost of primary factor inputs, and substantially the cost of intermediate inputs. The intermediate inputs cost rise might be larger than the rise in the export producer price.*

---

<sup>14</sup> One might ask why incumbent firms would accept VERs in the first place, if some of them would exit the market. It could be argued that if export quotas in the first place are at, or close to, the free market equilibrium, incumbent firms would rationally welcome them.

To prove Proposition 5, it is necessary to subgroup the marginal cost into two components: the marginal cost related to the primary factor inputs ( $v_i$ ) and the marginal cost related to intermediate inputs ( $int_i$ ). Rearranging (12),

$$(32) \quad v_i + int_i = pe_i \{1 - 1/|\delta_i|\}.$$

From Proposition 6,  $dY_i/dqr_i < 0$ , which implies that  $dL_i/dqr_i < 0$  and  $dK_i/dqr_i < 0$ , where  $Y_i = n_i y_i$ ,  $L_i = n_i l_i$ , and  $K_i = n_i k_i$ . Consequently,  $dv_i/dqr_i < 0$ . By using the chain rule,  $d\delta_i/dqr_i < (d\delta_i/dn_i)(dn_i/dqr_i)$ . Since  $dn_i/dqr_i < 0$  (from Proposition 2) and  $d\delta_i/dn_i < 0$ , then  $d\delta_i/dqr_i > 0$ . The latter finding, plus the fact that  $dpe_i/dqr_i < 0$ , imply that  $dc_i/dqr_i < 0$ . Consequently, if primary factor inputs are homogenous among sectors and the reduction of  $qr_i$  just slightly varies  $v_i$ , then  $dint_i/dqr_i < 0$ . In addition, the total differential of (32) with respect to  $qr_i$  is

$$(33) \quad \frac{dv_i}{dqr_i} + \frac{dint_i}{dqr_i} = \{1 - 1/|\delta_i|\} \frac{dpe_i}{dqr_i} + \left\{ pe_i |\delta_i|^{-2} \right\} \frac{d|\delta_i|}{dqr_i}.$$

The latter expression can be rearranged as

$$(34) \quad \frac{dv_i}{dqr_i} + \frac{dint_i}{dqr_i} = \frac{(pe_i - c_i)}{qr_i} \left[ \frac{qr_i}{|\delta_i|} \frac{d|\delta_i|}{dqr_i} - \frac{qr_i}{pe_i} \frac{dpe_i}{dqr_i} \right] + \frac{dpe_i}{dqr_i}.$$

Since  $dpe_i/dqr_i < 0$  and  $d|\delta_i|/dqr_i < 0$ , then the first term on the right is positive, if the export producer price elasticity with respect to  $qr_i$  is in absolute value larger than the elasticity of the inverse of the price cost margin in the export market with respect to  $qr_i$ . If  $\frac{dv_i}{dqr_i} < \frac{(pe_i - c_i)}{qr_i} \left[ \frac{qr_i}{|\delta_i|} \frac{d|\delta_i|}{dqr_i} - \frac{qr_i}{pe_i} \frac{dpe_i}{dqr_i} \right]$ , then  $dint_i/dqr_i > dpe_i/dqr_i$ . In other words, if the cost of primary factor inputs is just slightly affected, and the fall in the price cost margin in the export market is

smaller than the rise in the producer price of exports, the rise in the intermediate inputs cost would be larger than the rise in the producer price of exports.

[3.6] *The impact on output and trade volume*

Given the characteristics of the transformation function (2), at industry level

$$(35) \quad \frac{dY_i}{dq_i} = \Omega_D \frac{dD_i}{dq_i} + \Omega_E \frac{dE_i}{dq_i}.$$

The first term represents the effect on domestic demand, and the second term the effect on exports. Given the secondary effect on  $D_i$ , and since  $dE_i/dq_i < 0$ , then  $dY_i/dq_i < 0$ .

The trade balance can be written as

$$(36) \quad \sum_i pwe_i E_i + \sum_{crs} \overline{pe}_{crs} E_{crs} = \sum_j \overline{pwm}_j M_j.$$

The derivative of (36) with respect to  $q_i$  yields

$$(37) \quad \sum_i pwe_i \frac{dE_i}{dq_i} + \sum_i E_i \frac{dpwe_i}{dq_i} + \sum_{crs} \overline{pe}_{crs} \frac{dE_{crs}}{dq_i} = \sum_j \overline{pwm}_j \frac{dM_j}{dq_i},$$

where, with the elimination of VERs, the first term denotes the positive quantity effect due to export expansion, the second term denotes the negative terms of trade effect, the third term represents the negative effect of other sectoral exports, as resources are reallocated, and the last term denotes the impact on imports.

**PROPOSITION 6:** *The elimination of a VER leads to the growth of a previously restrained industry. The impact on trade volume is positive if, and only if, the quantity effect dominates the negative terms of trade effect and the negative effects on other industrial exports.*

These latter two results, easily obtainable with models facing constant returns to scale, are consistent with the general thinking about the effects of the elimination of a VER on an exporting country.

### [3.7] The impact on welfare

The sign of the welfare change can be measured by the ratio between the change in indirect utility function and the marginal utility of income, which is equal to the difference between the change in income ( $dHR$ ) and the change in the consumer price index ( $\sum_j Q_j dp_j$ ).<sup>15</sup>

If the numeraire of the model is the Leysperes price index of domestic goods, the total differential of household income, under the zero profit condition, yields:

$$(38) \quad dHR = \sum_i n_i \left( pd_i dd_i + pe_i de_i - \sum_j p_j dx_{ji} \right) + \sum_{crs} \left( pd_{crs} dD_{crs} + \bar{p}e_{crs} dE_{crs} - \sum_j p_j dx_{jcrs} \right) + \sum_i dpe_i E_i - \sum_j dp_j X_j + \sum_i n_i dver_i + \sum_i dn_i \left( pd_i d_i + pe_i e_i - \sum_j p_j x_{ji} + ver_i \right)$$

The sum of the first two terms on the right-hand side represents the global efficiency gain, as resources are allocated towards a more competitive industry

---

<sup>15</sup>  $V[p_j, HR]$  is the household's indirect utility function, where  $p_j$  is the price vector of consumption goods. The total differential of  $V[p_j, HR]$  is  $dV[p_j, HR] = (\partial V / \partial HR) dHR + \sum_j (\partial V / \partial p_j) dp_j$ . Using the Roy's identity, the latter expression can be written as  $dV[p_j, HR] = (\partial V / \partial HR) \left[ dHR - \sum_j Q_j dp_j \right]$ , where  $Q_j$  is the quantity demanded.

(*efficiency effect*). The third term represents the gain from an increase in the producer price of exports, as described by Proposition 1 (*export producer price effect*). The fourth term represents the loss from an increase in the cost of intermediate inputs, as described by Proposition 5 (*increased intermediate inputs cost effect*). The fifth term represents the loss from the annulment of the economic rent (*rent loss effect*). The last term represents the gains from variety, as domestic firms enter in pursuit of positive profits, in accordance with Proposition 2 (*variety effect*). Hence, the net gain on aggregate welfare is analytically indeterminate. It is important to stress that the literature on VERs focuses only on the *efficiency effect*, the *rent loss effect* and, to a certain extent, to the *export producer price effect*. The *variety effect* and the *increased intermediate inputs cost effect* have been neglected. Since the *consumer price effect* is negligible, as the Leysperes price index of domestic goods is assumed constant and the world price of imports is not affected by the trade policy, then

**PROPOSITION 7:** *The elimination of a VER leads to a welfare gain if, and only if, the efficiency effect, the variety effect and the export producer price effect outweigh the increased intermediate inputs cost effect and the rent loss effect.*

#### **4. An AGE model for Turkey**

This section seeks to answer three main questions: Do the qualitative effects identified in the previous section [3] lead to quantitative aspects of significant magnitude? Can the analytical ambiguity of the policy effect on some of the variables, in particular welfare and firm size, be numerically resolved? Is the



impact of the elimination of a VER sensitive to the type of competition employed? To answer these fundamental questions, I use an AGE model with the same features of the analytical model applied to Turkey. This country is a good test case for two main reasons. Firstly, as a consequence of the recent customs union agreement with the EU, VERs on Turkish textiles and apparel have been abolished. Secondly, since the Turkish government does not officially recognise any quota restriction, VER agreements could only be made with Turkish industry associations (GATT, 1994). Thus, the rents from VERs accrued to the exporting firms which were able to obtain the export quota documents for deliveries to the EU.

The model contains two categories of industries: those where perfect competition and constant return to scale are assumed to prevail (18 sectors), and those which are characterised by increasing returns to scale (textiles and apparel).<sup>16</sup>

The production function has a two stage nested CES structure. At the first stage, I assume a Leontief function among primary factors of production and intermediate inputs, which are in turn assumed to be net complements. At the second stage, the value added is characterised by constant returns variable costs with nonsunk setup costs. The elasticity of substitution among the mobile labour and the mobile capital is assumed to be positive and to vary across industries. The production possibility frontier has a two stage constant elasticity of transformation (CET) specification. At the first stage, producers allocate their production in the domestic market and abroad.<sup>17</sup> At the second stage, exports are

---

<sup>16</sup> The structure of the AGE model is reported in Appendix B.

<sup>17</sup> One property of the CET specification is that the condition  $\Omega_{\rho} d_i < y_i$  [see footnote (13)] is valid for any value of the elasticity of transformation.

allocated in the restricted EU market and in the unrestricted rest of the world (RoW) market. On the demand side, at the first stage, the representative household's demand and the intermediate demand are satisfied by composite commodities.<sup>18</sup> At the second stage, buyers choose among imports and domestic goods. At the third and fourth stages, buyers first choose among a variety of domestically produced goods and a variety of composite imports, and then among imports from the EU and imports from the RoW, according to the Armington specification, which states that goods competing in the same market are imperfect substitutes. The *small country* assumption is postulated for all traded commodities, with the exception of textiles and apparel exports to the EU for which an isoelastic demand curve is supposed.

#### [4.1] *Benchmark and calibration*

The theoretical model outlined above and applied to Turkey requires a benchmark data set to calibrate unknown parameters, such that the observed value of endogenous variables constitutes an equilibrium of the numerical model. The main bulk of the data comes from a 1990 Social Accounting Matrix (SAM) for Turkey (De Santis and Ozhan, 1995 and 1997), which has been compiled by using the official 1990 Input-Output Table for Turkey (SIS, 1994). The SAM has been adjusted in order to extract the rents on exports subject to VERs accruing to the companies and, then, to households. The activities and commodities are disaggregated into 20 different types and classified according to the I-O table classification.

---

<sup>18</sup> At the first stage, the utility function is taken to be Cobb-Douglas. This assumption, plus (9) imply that  $\chi_i$  is equal to the ratio between final demand and aggregate demand.

**Table 1: Production and cost structure in Turkey, 1990**

<i>Sectors</i>	$D_j$	$E_j$	$M_j$	$\frac{L_j}{D_j + E_j}$	$\frac{K_j}{D_j + E_j}$	$\frac{X_j}{D_j + M_j}$
<i>Agriculture</i>	93760	2513	3079	0.069	0.609	0.413
<i>Mining</i>	7005	510	11276	0.266	0.504	0.843
<i>Food processed products</i>	31663	4561	3264	0.073	0.142	0.358
<i>Beverages and tobacco</i>	8009	526	2068	0.223	0.328	0.110
<i>Textiles</i>	20798	6214	2414	0.071	0.240	0.547
<i>Wearing apparel</i>	5706	4814	587	0.062	0.225	0.028
<i>Leather and fur products</i>	1941	399	501	0.022	0.339	0.761
<i>Footwear</i>	1569	87	65	0.075	0.197	0.057
<i>Wood and wood products</i>	18060	295	1374	0.075	0.255	0.628
<i>Chemical products</i>	16658	1592	10524	0.100	0.262	0.599
<i>Petroleum and coal products</i>	16769	763	3652	0.021	0.263	0.895
<i>Non-metallic mineral products</i>	17117	1047	1960	0.127	0.294	0.761
<i>Metal products</i>	17221	3304	10313	0.096	0.124	0.907
<i>Machinery</i>	26146	1656	17850	0.107	0.272	0.285
<i>Transport equipment</i>	15660	939	9403	0.158	0.164	0.309
<i>Electricity, gas and waterworks</i>	11920	115	15	0.267	0.427	0.762
<i>Construction</i>	56015	0	0	0.229	0.187	0.000
<i>Trade, restaurants and hotels</i>	84208	8938	1220	0.175	0.544	0.320
<i>Transport and communication</i>	69366	12534	2205	0.079	0.548	0.396
<i>Other services</i>	76610	1255	662	0.500	0.336	0.325
<i>Total or Average</i>	596201	52062	82432	0.165	0.386	0.417

Source: Data elaboration from SIS (1994).

$D_j$ ,  $E_j$  and  $M_j$  are evaluated in billions of Turkish lira. So, in this Table, they indicate the volumes of domestic sales, exports and imports gross of tariffs, respectively.

Table 1 shows the official statistics related to Turkish production and cost structure. Table 2 shows the official statistics related to the composition of demand and trade flows with the EU. According to these official data, the value of production of Turkish textiles and apparel is 5.5% of total output value, whilst textiles and apparel export sales comprise 18.5% of total exports. These two sectors are relatively efficient in Turkey, as the average productivity of labour and capital is almost double than that recorded by the economy as a whole.

As far as the demand side is concerned, textiles and apparel intermediate demand comprises 4.6% of total intermediate demand, whilst the budget share of the representative consumer is equal to 5.6% of his disposable income.

The accounts for imports and exports are disaggregated to model the relations with the EU and the RoW. The share of imports and exports have been derived from a recent unpublished statistical source of the Turkish State Institute of Statistics.<sup>19</sup>

The export volume of textiles and apparel to the European market is estimated to be 16.4% of total exports. These summary statistics indicate that the elimination of VERs in textiles and apparel might have an important impact on the reallocation of resources within the economy.

Most of the elasticity values have been selected from the existing literature: the factor substitution elasticities, the Armington trade elasticities, the elasticities of substitution between imports coming from different regions and the production possibility frontier's elasticities have been selected from Harrison, *et al.* (1992), and some of them in relation to the sectors facing constant returns to scale have been adjusted for differences in the aggregation of sectoral output (see Table 3).

---

<sup>19</sup> The EU is composed of 15 countries: 12 members existing in 1990, plus the new members Finland, Austria and Sweden.

**Table 2: Composition of demand in Turkey, 1990**

<i>Sectors</i>	$\frac{C_j}{D_j + M_j}$	$\frac{E_j}{D_j + E_j}$	$\frac{M_j}{D_j + M_j}$	$\frac{M_j^{EU}}{M_j^{EU} + M_j^{RoW}}$	$\frac{E_j^{EU}}{E_j^{EU} + E_j^{RoW}}$
<i>Agriculture,</i>	0.553	0.026	0.032	0.265	0.464
<i>Mining</i>	0.063	0.068	0.603	0.016	0.871
<i>Food processed products</i>	0.596	0.126	0.093	0.465	0.534
<i>Beverages and tobacco</i>	0.856	0.062	0.204	0.069	0.032
<i>Textiles</i>	0.401	0.230	0.100	0.401	0.963
<i>Wearing apparel</i>	0.809	0.458	0.090	0.033	0.831
<i>Leather and fur products</i>	0.130	0.171	0.200	0.524	0.243
<i>Footwear</i>	0.709	0.053	0.038	0.369	0.287
<i>Wood and wood products</i>	0.338	0.016	0.069	0.641	0.193
<i>Chemical products</i>	0.398	0.087	0.385	0.644	0.434
<i>Petroleum and coal products</i>	0.228	0.044	0.135	0.240	0.700
<i>Non-metallic mineral products</i>	0.252	0.058	0.101	0.642	0.792
<i>Metal products</i>	0.000	0.161	0.369	0.312	0.330
<i>Machinery</i>	0.282	0.060	0.400	0.688	0.758
<i>Transport equipment</i>	0.317	0.057	0.369	0.598	0.321
<i>Electricity, gas and waterworks</i>	0.175	0.010	0.001	0.467	0.017
<i>Construction</i>	0.000	0.000	0.000	0.000	0.000
<i>Trade, restaurants and hotels</i>	0.573	0.096	0.014	0.486	0.440
<i>Transport and communication</i>	0.522	0.153	0.030	0.487	0.440
<i>Other services</i>	0.271	0.016	0.008	0.486	0.440
<i>Average</i>	0.375	0.080	0.118	0.447	0.556

Source: Data elaboration from SIS (1994) and from an unpublished document of SIS.

**Table 3: Elasticities' values**

<i>Sectors</i>	$\sigma_j$	$\epsilon_j$	$\mu_j$	$\rho_j$	$\omega_j$
<i>Agriculture,</i>	0.945	2.000	5	2.9	5
<i>Mining</i>	0.426	0.500	5	2.9	5
<i>Food processed products</i>	0.945	1.050	5	2.9	5
<i>Beverages and tobacco</i>	0.886	1.840	5	2.9	5
<i>Textiles</i>	0.927	2.000	5	2.9	5
<i>Wearing apparel</i>	0.927	3.400	5	2.9	5
<i>Leather and fur products</i>	0.927	3.400	5	2.9	5
<i>Footwear</i>	0.927	3.400	5	2.9	5
<i>Wood and wood products</i>	0.899	2.000	5	2.9	5
<i>Chemical products</i>	1.009	1.762	5	2.9	5
<i>Petroleum and coal products</i>	0.374	0.400	5	2.9	5
<i>Non-metallic mineral products</i>	0.964	1.169	5	2.9	5
<i>Metal products</i>	0.911	0.762	5	2.9	5
<i>Machinery</i>	1.105	0.839	5	2.9	5
<i>Transport equipment</i>	1.670	1.511	5	2.9	5
<i>Electricity, gas and waterworks</i>	1.884	2.000	5	2.9	5
<i>Construction</i>	1.988	-	-	-	-
<i>Trade, restaurants and hotels</i>	1.557	2.000	5	2.9	5
<i>Transport and communication</i>	1.890	2.000	5	2.9	5
<i>Other services</i>	2.010	2.000	5	2.9	5

$\sigma_j$ : elasticity of substitution among primary factors of production;  $\epsilon_j$ : elasticity of substitution between imported and domestically produced goods;  $\mu_j$ : elasticity of substitution among imports from different regions;  $\rho_j$ : elasticity of transformation between production for exports and the domestic market;  $\omega_j$ : elasticity of transformation among exports to different regions.

The smaller export demand elasticities for the sectors facing increasing returns to scale (see Table 4) have been chosen from Dervis, *et al.* (1982). The elasticity of substitution between domestic brands and brands to be exported have been chosen exogenously, such that they are respectively larger than the elasticity of substitution between domestic goods and imports, and the export demand elasticity. The fact that the calibrated price elasticity of aggregate demand are less than one in both sectors implies that  $\zeta_i > \varepsilon_i > \chi_i$ . As a result, the individual producer will face a more elastic demand curve with entry. The *ad valorem* quota premium have been selected from Trela and Whalley (1990). The economic rents from VERs are equal to 0.5% of total household's revenues.

In order to calibrate the variables of sectors facing increasing returns to scale, the algebraic structure of the model required further information on price-cost margins, fixed costs and the number of symmetric firms at sectoral level. These data are not easily collectable. However, the 1990 SAM for Turkey classifies labour in 8 different labour categories. I assume that three categories, represented by "professional workers", "administrative and managerial workers", and "clerical workers" comprise the fixed amount of labour required to have the plant open. According to the SAM's estimates, the fixed labour cost in textiles and apparel is almost 20% of total labour force. With regard to the capital stock, the Istanbul Chamber of Industry (1991) published some statistical information on the largest 500 industries in Turkey. Using this statistical source, the fixed capital stock, represented by capital depreciation, interest payments and rents, has been estimated to be equal to 15% of total sales in both textiles and apparel. The number of firms has been chosen exogenously; whereas the price cost margins in both domestic and foreign markets have been calibrated within the model, with their value depending upon the adopted conjectures.

**Table 4** Data for the imperfectly competitive sectors

---

<i>SECTORS</i>	<i>Textiles</i>	<i>Apparel</i>
<i>Elasticity of substitutions among domestic brands</i>	8	8
<i>Elasticity of substitutions among exported brands</i>	8	8
<i>Export demand elasticity (small)</i>	2	2
<i>Export demand elasticity (high)</i>	5	5
<i>Price elasticity of aggregate demand</i>	0.401	0.809
<i>Number of firms</i>	20	20
<i>Ad valorem quota premium</i>	0.150	0.300
<i>Fixed labour cost (1)</i>	0.197	0.196
<i>Fixed capital cost (2)</i>	0.150	0.150
<i>Price cost margin for domestic goods (Bertrand)</i>	0.131	0.131
<i>Price cost margin for exports (Bertrand - <math>\eta_i = 2</math>)</i>	0.130	0.130
<i>Price cost margin for exports (Bertrand - <math>\eta_i = 5</math>)</i>	0.127	0.127
<i>Price cost margin for domestic goods (Cournot)</i>	0.230	0.175
<i>Price cost margin for exports (Cournot - <math>\eta_i = 2</math>)</i>	0.144	0.144
<i>Price cost margin for exports (Cournot - <math>\eta_i = 5</math>)</i>	0.129	0.129

---

(1) The fixed labour cost is a share of the total labour cost.

(2) The fixed capital cost is a share of total sales.



The price cost margin in the Bertrand case is smaller, because Bertrand conjectures are inherently more competitive (see Table 4).

Table 4 shows that the additional data needed to calibrate equations with imperfect competitive features are assumed to be similar in both sectors. This assumption is not a fallacy of the numerical model. On the contrary, since the *ad valorem* quota premium in apparel is double that in textiles, the empirical findings will help us in understanding the relation between the impact on sectoral variables and the size of the binding quota.

As the analytical model, the AGE model assumes free entry/exit. Hence, the benchmark generates a long run reference equilibrium by setting pure profits to zero. This reference equilibrium is then the basis for comparison in counterfactual trade policy analysis.

#### *[4.2] The elimination of VERs scenarios*

##### *[4.2.1] The impact on Turkish industry and incumbent firms' variables*

The equilibrium concepts employed in this paper are Nash equilibria in prices (i.e. Bertrand competition) or quantities (i.e. Cournot competition). Tables 5-8 report the numerical results of the elimination of VERs on Turkish textiles and apparel respectively under Cournot and Bertrand conjectures in two different cases, assuming the price elasticity of the export demand in these two sectors to be equal to 2 and 5. In this way, the sectoral results of the policy scenarios can be compared under alternative Nash equilibria, and under different hypothesis regarding the size of the country and the size of the quota premium.

**Table 5: The impact of the elimination of VERs on aggregate variables**  
(Cournot - Base year = 100)

	$\eta_i = 2$	$\eta_i = 5$
<i>Turkey's social welfare</i>	99.4	98.9
<i>Aggregate output in real terms</i>	100.7	101.4
<i>Trade volume</i>	100.5	100.6
<i>Consumer price index</i>	100.0	100.0
<i>Intermediate inputs cost index</i>	101.0	103.1

It is clear that the numerical results are fully consistent with the analytical findings, which are unambiguous. The elimination of VERs brings about a large increase of sectoral exports to the EU, both in terms of total exports and exports per firm. The large impact on textiles and apparel exports to the EU raises output in both industries quite remarkably in accordance with Proposition 6, and expands trade volume under both forms of competition. The producer price of exports to the EU is also positively affected in accordance with Proposition 1. The possibility of making profits allows less efficient firms to break even in accordance with Proposition 2 (see Tables 6 and 8). The number of firms increases by 7.3% (12.9%) in textiles and 6.1% (4%) in apparel in the Cournot case, and by 8.3% (13.7%) in textiles and 7.3% (5.9%) in apparel in the Bertrand case.

**Table 6: The impact of the elimination of VERs at sectoral and firm level**  
(Cournot - Base year = 100)

	<i>Textiles</i>	<i>Apparel</i>	<i>Textiles</i>	<i>Apparel</i>
<b>- At sectoral level</b>				
<i>Exports to the EU</i>	124.6	148.8	133.8	192.1
<i>Output</i>	107.3	112.5	110.9	124.0
<i>Number of firms</i>	107.3	106.1	112.9	104.0
<i>Domestic sales</i>	106.5	99.7	111.7	99.0
<i>Export sales to the EU</i>	128.4	158.6	145.2	219.2
<i>Export sales to the RoW</i>	92.6	96.6	58.9	91.6
<i>Price elasticity of domestic demand</i>	97.0	102.2	95.0	105.1
<b>- At firm level</b>				
<i>Output</i>	100.0	106.0	96.5	119.9
<i>Domestic output</i>	96.0	88.3	91.3	83.7
<i>Exports to the EU</i>	116.1	140.2	118.5	186.5
<i>Exports to the RoW</i>	85.9	91.0	52.1	88.1
<b>- Prices and costs</b>				
<i>Producer price of exports to the EU</i>	103.0	106.6	108.5	114.1
<i>Average cost</i>	102.6	104.7	107.6	109.3
<i>Marginal cost</i>	103.2	106.7	108.5	114.1
<i>Primary factor inputs cost</i>	100.5	100.4	100.5	100.7
<i>Intermediate inputs cost</i>	103.6	107.1	109.8	114.9
<i>Price cost margin in the domestic market (1)</i>	99.6	98.4	99.7	98.9
<i>Price cost margin in the EU market (2)</i>	99.1	99.2	99.7	99.9
<i>Price cost margin ratio: (1) / (2)</i>	100.5	99.1	100.0	99.0

The zero profit condition is once again restored if the average cost rises in accordance with Proposition 1. In the Cournot case, the average cost rises by 2.6% (7.6%) in textiles and 4.7% (9.3%) in apparel. Whereas in the Bertrand case, it rises by 3.3% (9%) in textiles and 5.3% (10.4%) in apparel.

It is interesting to note that although, in accordance with Proposition 1, there is a unique positive relation between size of quota premium, or size of the country, and average cost, a similar relation between size of quota premium, or size of the country, and number of firms does not occur. This is because the impact on the number of firms is also a function of domestic sales and of the price elasticity of domestic demand [(see (28))]. In fact, Tables 6 and 8 show that although the quota premium in textiles is half that in apparel, new entry is larger in textiles, because the VERs abrogation reduces the price elasticity of domestic demand and has a positive impact on domestic sales. I should stress that the impact on the export sales to the RoW does not affect the number of firms, because the RoW faces an infinitely elastic demand function. A similar conclusion can be drawn with respect to the size of the country.

As far as the form of competition is concerned, the impact on both average cost and new entry is larger under Bertrand conjectures, as they are inherently more competitive. Similarly, the ex-post size of firms is smaller under Bertrand competition. This implies that incumbent firms will prefer the *status quo* especially under a price setting oligopoly. However, it must be stressed that the difference between the numerical results obtained under Bertrand and Cournot conjectures is small.

**Table 7: The impact of the elimination of VERs on aggregate variables  
(Bertrand - Base year = 100)**

	$\eta_i = 2$	$\eta_i = 5$
<i>Turkey's social welfare</i>	99.4	98.9
<i>Aggregate output in real terms</i>	100.6	101.2
<i>Trade volume</i>	100.7	100.6
<i>Consumer price index</i>	100.0	100.0
<i>Intermediate inputs cost index</i>	100.8	103.6

So despite the significance of the quantitative results, they are less sensitive to equilibrium concepts, as already described by Venables (1994) for the case of an import tariff and an export tax. This is because as the number of firms rises, the price cost margins in the domestic and export markets converge towards the same value (that is, the inverse of the elasticity of substitution among brands) under both conjectures.

Entry leads to a modest decline of the price cost margin in both markets. Another important empirical result is in relation to the ratio between the price cost margins in the domestic and export markets. Given the elasticity of substitution among exported brands, the smaller the country, the greater the loss of monopoly power in the domestic market with respect to the export market [see (29) and (30)] in accordance with Proposition 3.

**Table 8: The impact of the elimination of VERs at sectoral and firm level**  
**(Bertrand - Base year = 100)**

	<i>Textiles</i>	<i>Apparel</i>	<i>Textiles</i>	<i>Apparel</i>
<b>- At sectoral level</b>				
<i>Exports to the EU</i>	123.5	148.6	128.7	193.0
<i>Output</i>	106.7	112.3	107.2	123.9
<i>Number of firms</i>	108.3	107.3	113.7	105.9
<i>Domestic sales</i>	106.1	99.6	111.4	99.1
<i>Export sales to the EU</i>	127.8	158.5	140.8	220.0
<i>Export sales to the RoW</i>	94.9	96.8	67.3	87.5
<i>Price elasticity of domestic demand</i>	97.2	102.3	95.2	105.0
<b>- At firm level</b>				
<i>Output</i>	98.5	104.6	94.2	117.1
<i>Domestic output</i>	94.7	87.1	89.7	82.2
<i>Exports to the EU</i>	114.0	138.4	113.2	182.3
<i>Exports to the RoW</i>	87.6	90.2	50.2	82.6
<b>- Prices and costs</b>				
<i>Producer price of exports to the EU</i>	103.5	106.6	109.3	114.0
<i>Average cost</i>	103.3	105.3	109.0	110.4
<i>Marginal cost</i>	103.5	106.7	109.4	114.0
<i>Primary factor inputs cost</i>	100.4	100.3	100.4	100.1
<i>Intermediate inputs cost</i>	104.0	107.1	110.7	114.8
<i>Price cost margin in the domestic market (1)</i>	99.6	99.6	99.4	99.6
<i>Price cost margin in the EU market (2)</i>	99.7	99.7	99.8	99.9
<i>Price cost margin ratio: (1)/(2)</i>	99.9	99.8	99.6	99.7

The full employment assumption of factor inputs implies a reallocation of resources among sectors. Thus, despite the increase of factor inputs demand in textiles and apparel, wage and rental rates characterising the whole of the economy are only slightly affected in accordance with Proposition 5. Hence, if the cost of primary factor inputs rises slightly, and the fall in the price cost margin in the export market is smaller than the rise in the producer price of exports, then the cost of intermediate inputs has to increase substantially, and at a higher rate than the rise in the producer price of exports to the EU, for the price cost margin in the export market to decline in accordance with Proposition 5.

Despite output growth, output per firm might expand or decline in accordance with Proposition 4, depending positively on the size of export expansion, which is obviously larger in apparel, and negatively on both the number of new entrants, which is larger in textiles, and the domestic output fall, which is larger in apparel.

A further important empirical result is in relation to the impact on firms' domestic output. All scenarios show that despite the large spillovers of exports from the RoW, firms record a domestic output contraction, which is larger, the smaller the country.

These numerical results support the conjecture that a VER is a good instrument to prevent entry and to protect the monopoly power of incumbent firms in both the domestic and the export markets, either in a quantity-setting or in a price-setting oligopoly.

#### [4.2.2] The impact on Turkey's social welfare

The measure of the welfare change in AGE literature is the Hicksian equivalent variation. To be consistent with the analytical model, the representative household faces a convex indifference curve *a la* Dixit-Stiglitz, which is taken to be Cobb-Douglas at the first stage, and CES form at the second, third and fourth stages. Income distribution issues are neglected, hence the representative consumer's utility function can be regarded as representing the Samuelsonian social indifference curves, which takes the following form:

$$(39) \quad W = \prod_{crs} [C_{crs}^{\vartheta_{crs}}] \prod_i [I_i^{\vartheta_i}], \quad \sum_{crs} \vartheta_{crs} + \sum_i \vartheta_i = 1,$$

where  $\vartheta_j$  represents the household's consumption shares,  $C_{crs}$  denotes the individual's consumption of commodities produced by industries facing constant returns to scale, and  $I_i$  can be regarded as the Dixit-Stiglitz quantity index of aggregate consumption of the industry output of differentiated products.  $C_{crs}$  is derived by maximising the subutility function subject to the money income spent on commodities produced by the industries facing constant returns to scale.

Given the assumption that domestic production and imports satisfies both household consumption and the intermediate demand of the industry [see (9)],  $I_i$  takes the form,

$$(40) \quad I_i = \chi_i \left[ \varphi_i D_i^{(\varepsilon_i - 1)/\varepsilon_i} + (1 - \varphi_i) M_i^{(\varepsilon_i - 1)/\varepsilon_i} \right]^{\varepsilon_i / (\varepsilon_i - 1)},$$

where  $\chi_i$ , the price elasticity of aggregate demand, is equal to the share of household consumption in the total demand of goods produced by industries facing increasing returns to scale.

Given the symmetry assumption among firms, the utility gained from the consumption of domestic goods and imported products can be written as:



$$(41) \quad D_i = n_i \zeta_i / (\zeta_i - 1) d_i,$$

$$(42) \quad M_i = \bar{n}_i \bar{\zeta}_i / (\bar{\zeta}_i - 1) \left[ \nu_i m_i^{EU(\mu_i - 1)/\mu_i} + (1 - \nu_i) m_i^{RoW(\mu_i - 1)/\mu_i} \right]^{\mu_i / (\mu_i - 1)},$$

where  $\bar{n}_i^m$  represents the fixed number of competing foreign brands,  $m_i^{EU}$  and  $m_i^{RoW}$  denote respectively the EU and the RoW representative firms' sale to the market of the exporting country,  $\bar{\zeta}_i$  is the elasticity of substitution among imported varieties,  $\mu_i$  is the elasticity of substitution among imports from different regions, and  $\nu_i$  is a share parameter of the import aggregation function.  $\bar{n}_i^m$  should properly be treated as an endogenous variable. However, the model presented in this study is a single country open economy model. It is therefore difficult to model the product selection process in foreign industries.<sup>20</sup>

---

<sup>20</sup> In examining the economic implications for Canada of the North-America free trade agreement, Harris (1984) assumes that the number of imported variety of a product is in a constant ratio to the number of domestically produced varieties. However, this assumption implies that as the number of domestic firms decreases with the elimination of tariffs, the number of competing foreign varieties is also reduced. In contrast, it is generally accepted that product variety rises with trade. Thus, the welfare gains of tariff liberalisation in the presence of product differentiation would be underestimated. As far as the effect of a VER on  $\bar{n}_i^m$  is concerned, it can be argued that the *ad valorem* quota premium is equivalent to an *ad valorem* tariff rate for the importing country. Its elimination might produce the same results discussed in Harris (1984), where the elimination of tariffs imposes a downward pressure on price mark-ups in manufacturing industries and forces the less efficient firms to exit in response to losses. Thus, fixing  $\bar{n}_i^m$  exogenously might overestimate the welfare effect of the elimination of a VER. It is likely that only a multiregional model might attempt to explicitly model both domestic and foreign brands, and in this way examine the welfare effect of trade policies in the

Tables 5 and 7 show that, as a consequence of the elimination of VERs, the impact on welfare, though small, is negative. Social welfare decreases by a factor of 0.6 (1.1) as a percentage of consumer income in 1990 in both forms of competition. Given the fact that the consumer price index is not affected, the social welfare loss indicates that the *rent loss* effect and the *increased intermediates input cost* effect dominate the positive effects from trade. It also seems that the smaller the country, the larger the welfare loss of the elimination of VERs, although the efficiency gains (represented by the rise of aggregate output in real terms), the gains from variety, and from the rise in the export producer price, are much larger. Thus, since the loss of the economic rent and the consumer price index are equal in all scenarios, it is reasonable to suggest that the *increased intermediate inputs cost* effect is an important negative effect, which might determine the size of the welfare loss in the exporting country. In fact, the computed estimates show that the intermediate inputs cost index rises quite remarkably, when the country faces a more elastic foreign demand curve.

In summary, if policy-makers of exporting countries might accept VERs agreements in order to improve the welfare of their nations, industry associations voluntarily agree to restrain their level of exports in order to limit entry of other potential firms. This allows incumbent firms to better exploit economies of scale, capture rents and protect their monopoly power in both domestic and export market.

---

presence of product differentiation. In this study,  $\bar{n}_i^m$  is assumed to be equal to the benchmark value of  $n_i$ , and  $\bar{\zeta}_i$  is assumed to be equal to  $\zeta_i$ .

## 5. Conclusions

This paper analyses the possible consequences of VERs on an exporting country when firms facing increasing returns to scale behave either in a Cournot fashion or with Bertrand conjectures. I show that the elimination of a VER raises the average cost to produce one unit of output, and this effect is larger, the smaller the country. It decreases the concentration of the industry and the price cost margins in the export market. The impact on firm size is ambiguous. In addition, I show that the smaller the country, the greater the possibility of a relative lower price cost margin in the domestic market, as a result of a VER abrogation. This implies that incumbent firms have interest in renewing VERs in order also to protect their monopoly power in the domestic market. The analytical effect on social welfare is indeterminate: the positive effect comes from the positive impact of trade liberalisation upon exports (*efficiency effect*); the increased product diversity, as the number of symmetric firms rises (*variety effect*); and from the increase of the producer price of exports, as foreign consumers are more sensitive to price changes rather than to *ad valorem* quota premium variation (*export producer price effect*); whilst the negative effect comes from the loss of the economic rent (*rent loss effect*), and from the rise in the intermediate inputs cost (*increasing intermediate inputs cost effect*). The latter effect is very important, as a fall in the price cost margin in the export market can be achieved only if the cost of purchasing intermediate inputs rises substantially.

An AGE model with increasing returns to scale, segmented markets and free entry/exit, applied to the Turkish textiles and apparel industries, indicates that the analytical results are quantitatively interesting, under both Bertrand and Cournot competition, and seems to support the conjecture that an exporting

country is better off under a VER, as the *rent loss* effect and the *intermediate inputs cost* effect dominate the positive effects from trade. The numerical model indicates that the smaller the exporting country, the larger the welfare loss. Given the facts that the consumer price index is not affected, and the loss of economic rents is equal in all three scenarios, and since the *export producer price* effect, the *variety* effect and the *efficiency* effect are negatively related to the size of the exporting country, it is reasonable to suggest that the *increased intermediate inputs cost* effect explains much of the welfare loss in an exporting country.

The numerical results also indicate that the contraction of firms' domestic output is large, whilst the impact on price cost margins is modest. In addition, they show that the rise in both the average cost and the number of new entrants is larger under Bertrand conjectures, as they are inherently more competitive. Similarly, the size of the firms is smaller. This implies that especially industries characterised by more competitive conjectures will lobby government or industry associations to keep renewing VERs agreements. However, the quantitative difference of the impact of the elimination of VERs under Bertrand and Cournot conjectures is small, which implies that the impact of this policy is less sensitive to equilibrium concepts.

A possible loss in social welfare and the fall of monopoly power of incumbent firms in both domestic and export markets are the key elements to understanding why exporting countries voluntarily agree to restrain their level of exports.

## REFERENCES

- Armington, P. (1969), "A theory of demand for products distinguished by place of production", *IMF Staff Papers*, vol. 16, pp. 261-78.
- Dervis K., de Melo J. & Robinson S., (1982) *General equilibrium Models for Development Policy*, Cambridge, Cambridge University Press.
- De Santis, R. A. and Ozhan, H. G. (1997), "A note on a SAM for Turkey 1990", *Economic System Research*, vol. 9, n. 3, forthcoming.
- De Santis, R. A. and Ozhan, H. G. (1995), "A social accounting matrix for Turkey 1990", Department of Economics, University of Maryland at College Park, *INFORUM Working Papers*, n. 1.
- Dixit, A. K. and Stiglitz, J. E. (1977), "Monopolistic competition and optimum product diversity", *American Economic Review*, vol. 67, pp. 297-308.
- Francois, J. F., McDonald, B. and Nordstrom, H. (1995), "Assessing the Uruguay Round", in Martin, W. and Winters L. A. (eds.), *The Uruguay Round and the Developing Countries*, Discussion Paper n. 307, Washington, The World Bank.
- GATT (1994), *Trade Policy Review. The Republic of Turkey 1994*, Geneva.

Harris, R. (1984), "Applied general equilibrium analysis of small open economies with scale economies and imperfect competition", *American Economic Review*, vol. 74, pp. 1016-1032.

Hamilton, C. (1985), "Economic aspects of voluntary export restraints". In Greenaway D. (eds.), *Current Issues in International Trade: Theory and Policy*, London, Macmillan.

Harris, R. (1985), "Why voluntary export restraints are 'voluntary'", *Canadian Journal of Economics*, vol. 18, pp. 799-809.

Harrison, G. W., Rutherford, T. F. and Tarr, D. G. (1992), "Piecemeal trade reform in partially liberalised economies: an evaluation for Turkey", *World Bank Working Papers*, Country Economics Department, n. 951.

Harrison, G. W., Rutherford, T. F. and Tarr, D. G. (1994), "Product standard, imperfect competition, and completion of the market in the European Union", *World Bank Policy Research Working Papers*, International Economics Department, n. 1293.

Harrison, G. W., Rutherford, T. F. and Tarr, D. G. (1997), "Quantifying the Uruguay Round", *Economic Journal*, vol. 107, pp. 1405-1430.

Hertel, T. W., Martin, W., Yanagishima, K. and Dimaranan, B. (1995), "Liberalising manufactures trade in a changing world economy", in Martin, W.

and Winters L. A. (eds.), *The Uruguay Round and the Developing Countries*, Discussion Paper n. 307, Washington, The World Bank.

Krishna, K. (1989), "Trade restrictions as facilitating practices", *Journal of International Economics*, vol. 26, pp. 251-270.

de Melo, J. and Winters, L. A. (1990) "Voluntary export restraints and resource allocation in developing countries", *World Bank Economic Review*, vol. 4, pp. 209-233.

de Melo, J. and Winters, L. A. (1993) "Do exporters gain from VERs", *European Economic Review*, vol. 37, pp. 1331-1349.

Pomfret, R. (1989), "The economics of voluntary export restraint agreements", *Journal of Economic Survey*, vol. 3, pp. 199-211.

Rosendorff, B. P. (1996), "Voluntary export restraints, antidumping procedure, and domestic politics", *American Economic Review*, vol. 86, n. 3, pp. 544-561.

SIS (State Institute of Statistics Prime Ministry Republic of Turkey) (1994), *The Input-Output Structure of the Turkish Economy 1990*, Ankara.

Smith, A. and Venables, A. J. (1988), "Completing the internal market in the European Community. Some industry simulations", *European Economic Review*, vol. 32, pp. 1501-25.

The Istanbul Chamber of Industry (1991), *The 500 largest Industrial Establishments of Turkey* (in Turkish), Istanbul, vol. 26, n. 306.

Trela, I. and Whalley, J. (1990), "Global effects of developed country trade restrictions on textiles and apparel", *Economic Journal*, vol. 100, pp. 1190-1205.

Trela, I. and Whalley, J. (1995), "Internal quota-allocation schemes and the costs of the MFA", *Review of International Economics*, vol. 3, n. 3, pp. 284-306.

Venables, A. J (1994), "Trade policy under imperfect competition: a numerical assessment", in Krugman, P. and Smith, A. (eds.), *Empirical Studies of Strategic Trade Policy*, Chicago, University of Chicago Press.

Whalley, J and Young, B. (1984), "External sector closing rules in applied general equilibrium models", *Journal of International Economics*, vol. 16, pp. 123-138.

Yang, Y. (1994), "The phasing out of the Multifibre arrangement", *Journal of Development Studies*, vol. 30, pp. 892-915.

Yang, Y., Martin W. and Yanagishima, K. (1997), "Evaluating the benefits of abolishing the MFA in the Uruguay Round package", in Hertel, T. W. (eds.), *Global Trade Analysis. Modelling and Applications*, Cambridge, Cambridge University Press.



## Appendix A Price elasticities in Bertrand and Cournot

### [A.1] Derivation of firms' perceived elasticity of domestic demand

An industry  $i$  faces an aggregate demand function which is represented by (7). If domestic goods are produced by symmetric firms, they can be treated as imperfect substitutes. Thus, the aggregate domestic demand at the third stage of the demand tree can be written as

$$(A1) \quad D_i = \left[ \sum_{s=1}^n \tilde{\beta}_{is}^{\sim(\zeta_i-1)/\zeta_i} \tilde{d}_{is}^{\sim(\zeta_i-1)/\zeta_i} \right]^{\zeta_i/(\zeta_i-1)}, \quad \zeta_i > 1, \quad \sum_{s=1}^n \tilde{\beta}_{is} = 1,$$

where  $\zeta_i$ , is the elasticity of substitution among  $n$  domestic varieties,  $\tilde{d}_{is}$ ; and  $\tilde{\beta}_{is}$  are demand parameters describing the consumer preferences for a brand  $s$  produced by sector  $i$ .

The solution of the dual problem yields

$$(A2) \quad \tilde{d}_{is} = \tilde{\beta}_{is}^{\zeta_i} D_i p d_i^{\zeta_i} \tilde{p} d_{is}^{-\zeta_i},$$

$$\text{where } p d_i = \left[ \sum_{s=1}^n \tilde{\beta}_{is}^{\zeta_i} \tilde{p} d_{is}^{(1-\zeta_i)} \right]^{1/(1-\zeta_i)}.$$

#### [A.1.1] Derivation of (15)

(A2) can be log-linearised as

$$(A3) \quad \ln \tilde{d}_{is} = \zeta_i \ln \tilde{\beta}_{is} + \ln D_i + \zeta_i \ln p d_i - \zeta_i \ln \tilde{p} d_{is}.$$

By definition the derivative of (A3) with respect to  $\ln \tilde{pd}_{is}$  yields the firms' perceived price elasticity of domestic demand ( $\tau_i$ ):

$$(A4) \quad \tau_i = \frac{d \ln D_i}{d \ln \tilde{pd}_{is}} + \zeta_i \frac{d \ln pd_i}{d \ln \tilde{pd}_{is}} - \zeta_i.$$

Since under Bertrand conjectures  $\frac{\partial pd_i}{\partial \tilde{pd}_{is}} = \tilde{\beta}_{is}^{\zeta_i} pd_i^{\zeta_i} \tilde{pd}_{is}^{-\zeta_i}$ , and since from

$$(A2) \quad \tilde{\beta}_{is}^{\zeta_i} pd_i^{\zeta_i} \tilde{pd}_{is}^{-\zeta_i} = \tilde{d}_{is}/D_i, \text{ then}$$

$$(A5) \quad \frac{d \ln D_i}{d \ln \tilde{pd}_{is}} = \frac{\tilde{pd}_{is}}{D_i} \frac{\partial D_i}{\partial pd_i} \frac{\partial pd_i}{\partial \tilde{pd}_{is}} = \frac{\tilde{pd}_{is} \tilde{d}_{is}}{pd_i D_i} \frac{pd_i}{D_i} \frac{\partial D_i}{\partial pd_i},$$

and

$$(A6) \quad \frac{d \ln pd_i}{d \ln \tilde{pd}_{is}} = \frac{\tilde{pd}_{is} \tilde{d}_{is}}{pd_i D_i}$$

Given the symmetry assumption, (A6) and (A5) into (A4) yield

$$(A7) \quad \tau_i = \left[ \zeta_i + \frac{pd_i}{D_i} \frac{\partial D_i}{\partial pd_i} \right] \frac{1}{n_i} - \zeta_i.$$

By applying similar steps at the second stage of the demand tree, then

$$(A8) \quad \frac{pd_i}{D_i} \frac{\partial D_i}{\partial pd_i} = [\varepsilon_i - \chi_i] \Psi_i - \varepsilon_i,$$

where  $\Psi_i$  denotes the consumption share for domestic goods and  $\chi_i$  the absolute value of the price elasticity of aggregate demand.

(A8) into (A7) yields (15).

### [A.1.2] Derivation of (17)

The inverse demand function of (A2) is

$$(A9) \quad \ln \tilde{p}d_{is} = \ln \tilde{\beta}_{is} + \frac{1}{\varsigma_i} \ln D_i - \frac{1}{\varsigma_i} \ln \tilde{d}_{is} + \ln pd_i.$$

By definition the derivative of (A9) with respect to  $\ln \tilde{d}_{is}$  yields the inverse of  $\tau_i$ :

$$(A10) \quad \frac{1}{\tau_i} = \frac{1}{\varsigma_i} \frac{d \ln D_i}{d \ln \tilde{d}_{is}} - \frac{1}{\varsigma_i} + \frac{d \ln pd_i}{d \ln \tilde{d}_{is}}.$$

Since under Cournot conjectures  $\frac{\partial D_i}{\partial d_{is}} = \tilde{\beta}_{is} D_i^{1/\varsigma_i} \tilde{d}_{is}^{-1/\varsigma_i}$ , and since from

$$(A2) \quad \tilde{\beta}_{is} D_i^{1/\varsigma_i} \tilde{d}_{is}^{-1/\varsigma_i} = \tilde{p}d_{is} / pd_i, \text{ then}$$

$$(A11) \quad \frac{d \ln D_i}{d \ln \tilde{d}_{is}} = \frac{\tilde{p}d_{is} \tilde{d}_{is}}{pd_i D_i}.$$

Since, by using the chain rule,  $\frac{\partial pd_i}{\partial \tilde{d}_{is}} = \frac{\partial pd_i}{\partial D_i} \frac{\partial D_i}{\partial \tilde{d}_{is}}$ , then

$$(A12) \quad \frac{d \ln pd_i}{d \ln \tilde{d}_{is}} = \frac{\tilde{p}d_{is} \tilde{d}_{is}}{pd_i D_i} \frac{D_i}{pd_i} \frac{\partial pd_i}{\partial D_i}.$$

Given the symmetry assumption, (A12) and (A11) into (A10) yield

$$(A13) \quad \frac{1}{\tau_i} = -\frac{1}{\varsigma_i} + \frac{1}{n_i} \left( \frac{1}{\varsigma_i} + \frac{D_i}{pd_i} \frac{\partial pd_i}{\partial D_i} \right).$$

By applying similar steps at the second stage of the demand tree, then

$$(A14) \quad \frac{D_i}{pd_i} \frac{\partial pd_i}{\partial D_i} = -\frac{1}{\varepsilon_i} + \Psi_i \left( \frac{1}{\varepsilon_i} - \frac{1}{\chi_i} \right).$$

(A14) into (A13) yields (17).

[A.2] Derivation of firms' perceived elasticity of foreign demand

Assume that a representative foreign consumer gains utility by the following two stages utility function  $U^* = g^*(E_i)$ , where

$$(A15) \quad E_i = A_i pwe_i^{-\eta_i},$$

and

$$(A16) \quad E_i = \left[ \sum_{s=1}^n \tilde{\gamma}_{is} \tilde{e}_{is}^{-(\xi_i-1)/\xi_i} \right]^{\xi_i/(\xi_i-1)}, \quad \xi_i > 1, \quad \sum_{s=1}^n \tilde{\gamma}_{is} = 1.$$

$\xi_i$  is the elasticity of substitution among  $n$  exported brands,  $\tilde{e}_{is}$ ; and  $\tilde{\gamma}_{is}$  are demand parameters describing the preferences of the foreign consumer for a brand  $s$  exported by sector  $i$ .

The first order conditions yield the lower level demand:

$$(A17) \quad e_{is} = \tilde{\gamma}_{is}^{\xi_i} E_i pwe_i^{\xi_i} pwe_{is}^{-\xi_i},$$

$$\text{where } pwe_i = \left[ \sum_{s=1}^n \tilde{\gamma}_{is}^{\xi_i} pwe_{is}^{-(1-\xi_i)} \right]^{1/(1-\xi_i)}.$$

[A.2.1] Derivation of (16)

By using (A15), (A17) can be log-linearised as

$$(A18) \quad \ln \tilde{e}_{is} = \xi_i \ln \tilde{\gamma}_{is} + \ln A_i + (\xi_i - \eta_i) \ln pwe_i - \xi_i \ln pwe_{is}, \quad \xi_i > \eta_i.$$

By definition the derivative of (A18) with respect to  $\ln pwe_{is}$  yields the firms' perceived price elasticity of foreign demand ( $\delta_i$ ):

$$(A19) \quad \delta_i = (\xi_i - \eta_i) \frac{d \ln pwe_i}{d \ln pwe_{is}} - \xi_i.$$

Since under Bertrand conjectures  $\partial pwe_i / \partial \tilde{pwe}_{is} = \left( \tilde{\gamma}_{is} pwe_i / \tilde{pwe}_{is} \right)^{\xi_i}$ ,

then

$$(A20) \quad \frac{d \ln pwe_i}{d \ln \tilde{pwe}_{is}} = \tilde{\gamma}_{is}^{\xi_i} \left( \frac{\tilde{pwe}_{is}}{pwe_i} \right)^{1-\xi_i}.$$

In addition, by using (A15) and (A17), since  $\tilde{pwe}_{is} \tilde{e}_{is} = \tilde{\gamma}_{is}^{\xi_i} A_i pwe_i^{\xi_i - \eta_i} \tilde{pwe}_{is}^{1-\xi_i}$ , then

$$(A21) \quad \left( \frac{\tilde{pwe}_{is}}{pwe_i} \right)^{1-\xi_i} = \frac{\tilde{pwe}_{is} \tilde{e}_{is}}{\sum_s \tilde{pwe}_{is} \tilde{e}_{is}}.$$

Given the symmetry assumption (A21) into (A19) yields (16).

#### [A.2.2] Derivation of (18)

By using (A15), (A17) can be log-linearised as

$$(A22) \quad \ln \tilde{pwe}_{is} = \ln \tilde{\gamma}_{is} + \left( \frac{1}{\xi_i} - \frac{1}{\eta_i} \right) \ln E_i - \frac{1}{\xi_i} \ln \tilde{e}_{is}.$$

By definition, the derivative of (A22) with respect to  $\ln \tilde{e}_{is}$  yields the inverse of  $\delta_i$ :

$$(A23) \quad \frac{1}{\delta_i} = \left( \frac{1}{\xi_i} - \frac{1}{\eta_i} \right) \frac{d \ln E_i}{d \ln \tilde{e}_{is}} - \frac{1}{\xi_i}.$$

Since under Cournot conjectures  $\partial E_i / \partial \tilde{e}_{is} = \tilde{\gamma}_{is} \left( E_i / \tilde{e}_{is} \right)^{1/\xi_i}$ , then

$$(A24) \quad \frac{d \ln E_i}{d \ln \tilde{e}_{is}} = \tilde{\gamma}_{is} \left( \frac{\tilde{e}_{is}}{E_i} \right)^{1-1/\xi_i}.$$

In addition, by using (A15) and (A17), since

$\tilde{pwe}_{is} \tilde{e}_{is} = \tilde{\gamma}_{is} A_i^{1/\eta_i} E_i^{1/\xi_i - 1/\eta_i} \tilde{e}_{is}^{1-1/\xi_i}$ , then

$$(A25) \quad \tilde{\gamma}_{is} \left( \frac{\tilde{e}_{is}}{E_i} \right)^{1-1/\xi_i} = \frac{\tilde{pwe}_{is} \tilde{e}_{is}}{\sum_s \tilde{pwe}_{is} \tilde{e}_{is}}.$$

Given the symmetry assumption, (A25) into (A23) yields (18).

## Appendix B Numerical model: the case of VERs

This appendix reports the algebraic formulation of the numerical model employed to study the economic impact of the elimination of the VERs in Turkish textiles and apparel. The appendix has been split into six sections: (i) equations related to prices and costs; (ii) equations related to production and factor demand; (iii) equations related to domestic and foreign trade; (iv) equations related to income; (v) equations related to final demand and intermediate demand; (vi) equations related to the market clearing conditions.

### [B.1] Price and cost equations

$$(B1) \quad p_j = \Delta_j^{-1} \left[ \varphi_j^{\varepsilon_j} p m_j^{1-\varepsilon_j} + (1-\varphi_j)^{\varepsilon_j} p d_j^{1-\varepsilon_j} \right]^{1/(1-\varepsilon_j)}$$

$$(B2) \quad p y_i y_i = p d_i D_i / n_i + p e_i E_i / n_i$$

$$(B3) \quad p y_{crs} = \Omega_{crs}^{-1} \left[ \beta_{crs}^{\rho_{crs}} p d_{crs}^{1-\rho_{crs}} + (1-\beta_{crs})^{\rho_{crs}} p e_{crs}^{1-\rho_{crs}} \right]^{1/(1-\rho_{crs})}$$

$$(B4) \quad p m_j M_j = \overline{p w m}_j^{EU} M_j^{EU} + \overline{p w m}_j^{RoW} M_j^{RoW}$$

$$(B5) \quad p e_i E_i = p e_i^{EU} E_i^{EU} + \overline{p w e}_i^{RoW} E_i^{RoW}$$

$$(B6) \quad p e_{crs} E_{crs} = \overline{p w e}_{crs}^{EU} E_{crs}^{EU} + \overline{p w e}_{crs}^{RoW} E_{crs}^{RoW}$$

$$(B7) \quad p e_i^{EU} \left( 1 - \frac{1}{|\delta_i|} \right) = c_i$$

$$(B8) \quad \overline{p w e}_i^{EU} = p e_i^{EU} (1 + q r_i)$$

$$(B9) \quad pd_i \left( 1 - \frac{1}{|\tau_i|} \right) = c_i$$

$$(B10) \quad pv_j = \Theta_j^{-1} \left[ \gamma_j^{\sigma_j} w^{1-\sigma_j} + (1-\gamma_j)^{\sigma_j} r^{1-\sigma_j} \right]^{1/(1-\sigma_j)}$$

$$(B11) \quad c_i = pv_i + \sum_j a_{ji} p_j$$

$$(B12) \quad a\hat{c}_i = \left[ w(l_i + l'_i) + r(k_i + k'_i) + \sum_j p_j a_{ji} y_i \right] / y_i$$

$$(B13) \quad \tau_i = -\frac{1}{n_i} \left[ (1-\Psi_i)\varepsilon_i + \Psi_i\chi_i \right] - \left( 1 - \frac{1}{n_i} \right) \zeta_i \quad \text{under Bertrand}$$

$$(B13a) \quad \frac{1}{\tau_i} = -\frac{1}{\zeta_i} - \frac{1}{n_i} \left[ \frac{(\zeta_i - \varepsilon_i)}{\zeta_i \varepsilon_i} + \Psi_i \left( \frac{\varepsilon_i - \chi_i}{\chi_i \varepsilon_i} \right) \right] \quad \text{under Cournot}$$

$$(B14) \quad \delta_i = -\xi_i \left( 1 - \frac{1}{n_i} \right) - \frac{\eta_i}{n_i} \quad \text{under Bertrand}$$

$$(B14a) \quad \frac{1}{\delta_i} = -\frac{1}{\xi_i} - \frac{1}{n_i} \frac{(\xi_i - \eta_i)}{\xi_i \eta_i} \quad \text{under Cournot}$$

$$(B15) \quad \bar{\lambda} = \frac{\sum_j pd_j \bar{D}_j}{\sum_j \overline{pd_j \bar{D}_j}}$$

## [B.2] Production and factor demand equations

$$(B16) \quad Y_{crs} = \Theta_{crs} \left[ \gamma_{crs} AL_{crs}^{(\sigma_{crs}-1)/\sigma_{crs}} + (1-\gamma_{crs}) AK_{crs}^{(\sigma_{crs}-1)/\sigma_{crs}} \right]^{\sigma_{crs}/(\sigma_{crs}-1)}$$

$$(B17) \quad AL_{crs} = \Theta_{crs}^{(\sigma_{crs}-1)} \gamma_{crs}^{\sigma_{crs}} w^{-\sigma_{crs}} p v_{crs}^{\sigma_{crs}} Y_{crs}$$



$$(B18) \quad AK_{crs} = \Theta_{crs}^{(\sigma_{crs}-1)} (1 - \gamma_{crs})^{\sigma_{crs}} r^{-\sigma_{crs}} p v_{crs}^{\sigma_{crs}} Y_{crs}$$

$$(B19) \quad l_i = \Theta_i^{(\sigma_i-1)} \gamma_i^{\sigma_i} w^{-\sigma_i} p v_i^{\sigma_i} (y_i + l_i^f + k_i^f)$$

$$(B20) \quad k_i = \Theta_i^{(\sigma_i-1)} (1 - \gamma_i)^{\sigma_i} r^{-\sigma_i} p v_i^{\sigma_i} (y_i + l_i^f + k_i^f)$$

### [B.3] Trade equations

$$(B21) \quad Q_j = \Delta_j \left[ \varphi_j M_j^{(\epsilon_j-1)} + (1 - \varphi_j) D_j^{(\epsilon_j-1)} \right]^{\epsilon_j / (\epsilon_j - 1)}$$

$$(B22) \quad \frac{M_j}{D_j} = \left( \frac{1 - \varphi_j}{\varphi_j} \right)^{-\epsilon_j} \left( \frac{pd_j}{pwm_j} \right)^{\epsilon_j}$$

$$(B23) \quad M_j^{EU} = A_j^{\mu_j-1} \iota_j^{\mu_j} \left( \frac{\overline{pwm}_j^{EU}}{pm_j} \right)^{-\mu_j} M_j$$

$$(B24) \quad M_j^{RoW} = A_j^{\mu_j-1} (1 - \iota_j)^{\mu_j} \left( \frac{\overline{pwm}_j^{RoW}}{pm_j} \right)^{-\mu_j} M_j$$

$$(B25) \quad Y_{crs} = \Omega_{crs} \left[ \beta_{crs} D_{crs}^{(\rho_{crs}+1)/\rho_{crs}} + (1 - \beta_{crs}) E_{crs}^{(\rho_{crs}+1)/\rho_{crs}} \right]^{\rho_{crs} / (\rho_{crs} + 1)}$$

$$(B26) \quad y_i = \frac{\Omega_i}{n_i} \left[ \beta_i D_i^{(\rho_i+1)/\rho_i} + (1 - \beta_i) E_i^{(\rho_i+1)/\rho_i} \right]^{\rho_i / (\rho_i + 1)}$$

$$(B27) \quad \frac{D_{crs}}{E_{crs}} = \left( \frac{\beta_{crs}}{1 - \beta_{crs}} \right)^{-\rho_{crs}} \left( \frac{pd_{crs}}{pwe_{crs}} \right)^{\rho_{crs}}$$

$$(B28) \quad E_j = \Gamma_j \left[ \alpha_j E_j^{EU(\omega_{crs}+1)/\omega_{crs}} + (1 - \alpha_j) E_j^{RoW(\omega_{crs}+1)/\omega_{crs}} \right]^{\omega_{crs} / (\omega_{crs} + 1)}$$

$$(B29) \quad \frac{E_{crs}^{EU}}{E_{crs}^{RoW}} = \left( \frac{\alpha_{crs}}{1 - \alpha_{crs}} \right)^{-\bar{\alpha}_{crs}} \left( \frac{\overline{pwe}_{crs}^{EU}}{\overline{pwe}_{crs}^{RoW}} \right)^{\bar{\alpha}_{crs}}$$

$$(B30) \quad E_i^{EU} = \bar{E}_i^{EU} \left( \frac{\bar{\chi}_i}{pwe_i} \right)^{\eta_i}$$

#### [B.4] Income equations

$$(B31) \quad \pi_i = (py_i - ac_i)y_i$$

$$(B32) \quad ver_i^{EU} = qr_i pe_i^{EU} E_i^{EU}$$

$$(B33) \quad HR = w\overline{LAB} + r\overline{CAP} + \sum_i n_i \pi_i + \sum_i ver_i^{EU}$$

#### [B.5] Intermediate and final demand equations

$$(B34) \quad X_j = \sum_{crs} a_{jcrs} Y_{crs} + \sum_i a_{ji} n_i y_i$$

$$(B35) \quad C_j = \vartheta_j \frac{HR}{p_j}$$

#### [B.6] Market clearing conditions

$$(B36) \quad Q_j = C_j + X_j$$

$$(B37) \quad \sum_j \overline{pwe}_j^{RoW} E_j^{RoW} + \sum_j pwe_j^{EU} E_j^{EU} =$$

$$\sum_j \overline{pwm}_j^{EU} M_j^{EU} + \sum_j \overline{pwm}_j^{RoW} M_j^{RoW}$$

$$(B38) \quad \overline{LAB} = \sum_{crs} AL_{crs} + \sum_i n_i (l_i + l_i^f)$$

$$(B39) \quad \overline{CAP} = \sum_{crs} AK_{crs} + \sum_i n_i (k_i + k_i^f)$$

$$(B40) \quad py_i = ac_i$$

*Variables (\*):*

$ac_i$	Average cost
$AL_{crs}$	Labour
$AK_{crs}$	Capital
$c_i$	Marginal cost
$C_j$	Private demand of goods
$\overline{CAP}$	Aggregate capital stock
$D_j$	Demand for domestic commodity
$\overline{D}_j$	Domestic commodities demanded in the base year
$E_j$	Exports
$E_j^{EU}$	Exports to the EU
$\overline{E}_i^{EU}$	Exports to the EU in the base year
$E_j^{RoW}$	Exports to the RoW
$HR$	Household revenues
$k_i$	Capital per firm
$l_i$	Labour per firm

$\overline{LAB}$	Aggregate labour
$M_j$	Imports
$M_j^{EU}$	Imports from the EU
$M_j^{RoW}$	Imports from the RoW
$n_i$	Number of firms
$p_j$	Price of the final and the intermediate good
$\overline{pd}_j$	Price of the domestic good in the base year
$pd_j$	Price of domestically produced commodity
$pv_j$	Value added price
$py_j$	Aggregate producer price
$\overline{pwe}_i^{EU}$	Price of exports to the EU
$pwe_i^{EU}$	Price of exports to the EU
$\overline{pwe}_j^{RoW}$	Price of exports to the RoW
$\overline{pwm}_j^{EU}$	Price of imports from the EU
$\overline{pwm}_j^{RoW}$	Price of imports from the RoW
$Q_j$	Composite commodity
$r$	Return to capital
$X_j$	Intermediate demand
$y_i$	Output per domestic firm
$Y_{crs}$	Output by the industry
$w$	Wage
$\chi_i$	Price elasticity of aggregate demand

$\bar{\chi}_i$	World price of similar exported goods
$\pi_i$	Profit per firm
$\bar{\Lambda}$	Numeraire
$\Psi_i$	Share of consumption of domestic goods in total consumption

*Parameters (\*):*

$a_{jj}$	Leontief input-output coefficients.
$k_i^f$	Fixed amount of capital per firm
$l_i^f$	Fixed amount of labour per firm
$v_i$	Conjectural variation shift parameter
$\alpha_j$	Share parameter in the second nest CET function
$\beta_j$	Share parameter in the CET aggregation function
$\delta_i$	Firm perceived elasticity in the export market
$\varepsilon_j$	Elasticity of substitution between imported and domestic goods
$\varphi_j$	Share parameter in the Armington trade aggregation function
$\gamma_j$	Share parameter in the CES production function
$\iota_j$	Share parameter in the second nest Armington function
$\eta_i$	Price elasticity of export demand
$\varpi_j$	Elasticity in the second nest CET function
$\vartheta_j$	Household budget shares
$\rho_j$	Elasticity in the CET aggregation function
$\sigma_j$	Elasticity of substitution among primary factors of production

$\tau_i$	Firm perceived elasticity in the domestic market
$\xi_i$	Elasticity of substitution among exported brands
$\zeta_i$	Elasticity of substitution among domestic brands
$A_j$	Shift parameter in the second nest Armington function
$\Delta_j$	Shift parameter in the Armington trade aggregation function
$\Gamma_j$	Shift parameter in the second nest CET function
$\Theta_j$	Shift parameter in the CES production function
$\Omega_j$	Shift parameter in the CET aggregation function

(\*) Parameter and variables with a bar are set exogenously.  $crs$  and  $i$  denote sectors facing constant and increasing returns to scale, respectively ( $j = crs \cup i$ ).