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Three Essays on Imperfect Competition Welfare and Growth

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Three Essays on Imperfect Competition Welfare and Growth

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0.1 Summary

Developments in the theory of imperfectly competitive markets provide interesting insights in modern economic phenomena, often offering answers where traditional perfect competitive assumptions seem ineffective. What explains intra-industry trade? Why Japan experienced high growth rates notwithstanding its highly protected economy at the same period? Applications of imperfect competition in all areas of economic theory give interesting theoretical and empirical results. Applied in trade theory, imperfect competition explains intra-industry trade. Applied in growth theory predictions may give grounds for interventionist policies. In applied general equilibrium models of trade liberalization predicted welfare effects are larger when increasing returns to scale and imperfect competition are accounted for than is the case with perfect competition. This thesis consists of three applications of imperfect competition in general equilibrium models of trade, growth and welfare. In particular, I am concerned with applications to issues of trade liberalization and economic integration; a major trend in todays market economies.

Therefore, in the first part (Chapter 1) of this thesis, I attempt to provide a quantitative assessment of the importance of various alternative assumptions concerning the organization of imperfectly competitive markets using an applied general equilibrium model of the Greek economy. Four different assumptions on competitive behavior are explored. My results confirm the presumption that models of imperfect competition generate larger effects than

the more traditional competitive versions.

In the second chapter, I use a a static multicountry, multisector general equilibrium model with increasing returns to scale, imperfect competition and product differentiation at the firm level to evaluate the effects of the Completion of the Single European Market on the Greek economy. By completion of the Single Market I will refer to the elimination of nontariff trade barriers (NTB) within the European Union. My results suggest modest welfare gains but rather significant industry and resource reallocation effects. When compared with the other countries of the European Union I find that the industry reallocation effects and welfare effects are of greater magnitude in Greece. I also demonstrate that had Greece not participated in the "1992" program, it would have experienced, if anything, a deterioration of it's welfare.

In the third and final chapter I built a two-country, two representative consumers "endogenous growth model" where monopolistic competitive firms, producing differentiated capital goods, perform R&D to introduce new varieties of capital goods. I argue here that when welfare effects to the individual countries are taken into consideration, a policy that leads to a higher global growth rate in the steady state may be detrimental to the welfare (in present value) of one of the countries involved. I demonstrate this result by performing numerical experiments in a North American-North European context.

KEY WORDS: Applied General Equilibrium; Imperfect Competiton; Product Differentiation; European Union; Greece; Endogenous Growth; R&D;

0.2 Résumé

Les recherches dans le cadre de la théorie des marchés non parfaitement concurrentiels nous fournissent des indices intéressants sur les phénomènes de l' économie contemporaine, et nous offrent souvent des réponses là où les postulats traditionnels de concurrence parfaite semblent inopérants. Comment expliquer le commerce intra-industriel ? Pourquoi le Japon a-t-il connu une forte croissance élevée malgré d'importantes mesures simultanées de protectionnisme politique ? Dans tous les domaines de la theorie économique, l'application de la théorie des marchés non parfaitement concurrentiels fournit d'intéressants résultats théoriques et empiriques. Appliquée au commerce, la théorie des marchés non parfaitement concurrentiels permet d'expliquer le commerce intra-industriel. Appliquée à la croissance, les prédictions qu'elle permet de dégager peuvent servir de base aux politiques interventionnistes. Une fois appliqués, les modèles d'équilibre général de la libéralisation du commerce ont prédit un plus grand impact bénéfique lorsque l'on tient compte des retours croissants à l'échelle ? et de la concurrence imparfaite que cela n'est le cas avec la concurrence parfaite.

Cette thèse porte sur trois applications de concurrence imparfaite dans les modèles d'équilibre général du commerce, de la croissance et du bien-être. Je m'intéresse tout particulièrement à la libéralisation commerciale et à l'intégration économique, qui constituent une tendance majeure des économies de marché actuelles.

Jusqu'ici, le "meilleur" modèle et le modèle le plus "avancé" de ce phénomène dans les économies de marchés occidentales est sans conteste celui de l'Union Européenne. Il constitue donc une sorte de paradigme pour de nombreux autres pays qui suivent son exemple. En fait, ce qui rend l'expérience européenne si intéressante, c'est qu'elle porte sur l'unification de pays où l'on constate des grands différences, au niveau de leur structure industrielle et des revenus, notamment. Bien que l'on se soit attendu à ce que l'élargissement du marché commun européen ait un effet positif pour les pays européens les plus industrialisés (ce que plusieurs études empiriques ont confirmé), on n'a moins étudié les effets sur les plus petits pays moins développés, mais cela n'en constitue pas moins un important sujet de préoccupation. Qu'il s'agisse de l'Accord de libre-échange entre le Canada et les États-Unis, ou de l'Accord de libre-échange nord-américain qui englobe le Mexique, un pays moins industrialisé, l'expérience européenne constitue un point de référence de premier ordre. Un autre effet intéressant quant aux effets des politiques de libéralisation commerciale et de la participation à des marchés intégrés est mis en évidence lorsqu'on tient compte des paramètres de croissance.

Voilà la problématique générale à laquelle je m'attaque bien humblement dans cette thèse, dans le cadre méthodologique des modèles d'équilibre général et des postulats alternatifs relatifs à l'organisation des marchés non concurrentiels.

Dans la première partie de cette thèse (Chapitre 1), je fournis une évaluation quantitative de l'importance de divers postulats alternatifs concernant l'organisation

des marchés non parfaitement concurrentiels en appliquant un modèle d'équilibre général à un plus petit membre de l'Union européenne, soit la Grèce.

La politique adoptée a eu un impact positif sur les dépenses publiques consacrées aux biens et aux services. L'expérience s'inspire des transferts de fonds du Cadre intergouvernemental d'entraide de la Communauté européenne aux pays méditerranéens. On y analyse l'impact de quatre postulats différents sur les comportements concurrentiels : la concurrence parfaite où les produits domestiques et étrangers sont des substituts imparfaits (le postulat d'Armington), la concurrence monopolistique dans un contexte de produits homogènes, la concurrence monopolistique dans le contexte d'une différenciation des produits, et l'oligopole général avec discrimination des prix. Dans chacun de cas, on explore également deux postulats alternatifs quant aux structures de marché : un contexte de non-entrée /sortie des firmes par rapport au libre accès aux concurrents. Mes résultats confirment la présomption selon laquelle les modèles de concurrence non parfaite engendrent de plus grands effets que les modèles de marchés concurrentiels plus traditionnels. Mes résultats indiquent également que le contraste entre les prédictions des modèles de concurrence et de non-concurrence est encore plus marqué lorsqu'on ouvre l'accès aux entrées et sorties des concurrents.

Dans le deuxième chapitre, j'utilise un modèle d' équilibre général statique multinational et multisectoriel avec avec rendements á l'échelle croissants, concurrence non parfaite et différenciation des produits au niveau des entreprises, afin d'évaluer les impacts de la réalisation du Marché Européen Unique sur

l'économie de la Grèce.

Les évaluations antérieures de l'équilibre général appliqué du programme de l'Europe de 1992 mis en oeuvre par l'Union Européenne (U.E.), ont généralement regroupés les petits pays membres de l'Union en une seule région, le "reste de l'U.E.". Cette stratégie permet certes de saisir les impacts majeurs de l'intégration européenne sur l'économie mondiale, mais en contrepartie, elle risque d'engendrer de fausses perceptions quant aux effets sur les économies des petits pays comme les pays méditerranéens, en se basant sur ce qui se passe dans les plus grands pays industrialisés comme la France et l'Allemagne. L'analyse onctuelle d'un plus petit pays, comme la Grèce, peut donc s'avérer utile.

Une fois le Marché Unique réalisé, je vais référer à l'élimination des barrières économiques non tarifaires (BNT) au sein de l'Union européenne modelée sur la répression de l'établissement de prix discriminatoires entre les divers marchés nationaux au sein de l'U.E. L'expérience est menée en examinant, en alternance, divers postulats de comportements non-currentiels et de structures industriels (non-entrée vs accès libre des firmes). Mes résultats laissent entrevoir des gains modestes au chapitre du bien-être, et des impacts de réallocation plutôt significatifs des industries et des ressources; on constate un transfert de ressources des secteurs concurrentiels à forte main d'oeuvre vers les secteurs non-concurrentiels qui misent plutôt sur les capitaux.

En faisant la comparaison avec les autres pays membres de l'U.E., je constate que les impacts de réallocation industrielle sont plus marqués en Grèce

que dans les autres pays, à l'exception de l'Italie. Finalement, je démontre aussi que si la Grèce n'avait pas participé au Programme de 1992, elle aurait subi, a tout le moins, une détérioration de bien-être.

Dans le troisième et dernier chapitre de cette thèse, les firmes en concurrence monopolistique produisent des biens intermediaires différenciés et effectuent de la recherche et du développement afin de lancer de nouveaux moyens de production. Lorsque la fonction de production des produits finis engendre des rendements constants pour la totalité des variétés mises au point dans la laboratoires de recherche, les conditions nécessaires à une croissance endogène sont satisfaites, c'est-à-dire que la croissance est soutenue par la production de nouvelles variétés à un taux asymptotiquement positif. Dans un système à deux pays et un consommateur représentatif, où l'un des pays jouit d'un avantage comparatif en R&D, les politiques de libéralisation commerciale de même que de restrictions commerciales peuvent s'avérer propices au maintien de taux de croissance globale à long terme tant et aussi longtemps que la R&D est encouragée/découragée dans le pays qui a un avantage/désavantage comparatif dans ce genre d'activité (Helpman et Grossman, 1989). Je soutiens ici que lorsque l'on tient compte des effets sur le bien-être de chacun des pays, une politique qui mène à un taux de croissance globale dans l'état stationaire peut avoir un impact négatif et nuire au bien-être (en valeur actuelle) de l'un des pays en cause. Je démontre ce point à l'aide d'expériences numériques utilisant un modèle où le bien-êde chaque pays est considérée de manière isolée : je démontre que, dans un contexte raisonnable, le coût des ajustements struc-

turels transitoires peut nuire aux les gains à long terme de l'un des deux pays. Je démontre également ces résultats à l'aide d'une simulation qui s'apparente au contexte commercial de l'Amérique du Nord et de l'Union Européenne.

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0.7 Dédicace

á mes parents

Chapter 1

Applied General Equilibrium Modeling Under Alternative Assumptions on Competition and Market Structure: Review and Implications for Policy.

1.1 Introduction

In recent years, Leon Walras theory of general equilibrium has been widely exploited in computable general equilibrium models applied to a variety of developed and developing countries. Following this tradition, producers maximize profits facing constant returns to scale and consumers maximize their utility subject to their budgets constraints. According to this theory, only relative prices matter and all markets clear. One wide application of CGE models has been exploring theoretical issues of trade and policy. In the tradition of perfectly competitive markets, changes in trade flows and inter- industry production patterns are explained by changes in relative costs, i.e., through changes in comparative advantage.

Though perfect competition and the classical theory of trade was able to explain inter-industry trade flows, the "new" theory of trade, was set to explain the appearance of intra-industry trade among modern economies. As could well be expected, computable general equilibrium modeling followed by incorporating elements of the new theory in its basic framework.

The "new theory" essentially gives two explanations for intra- industry trade which have been derived from oligopoly theory. These explanations are product differentiation (Krugman, 1979), (Dixit and Norman,1980) and "reciprocal" dumping between segmented markets (Brander and Krugman, 1983).

In a general equilibrium framework, product differentiation and imperfect

competition reduces the sensitivity of inter-industry production patterns and trade flows to changes in relative costs and, therefore, leaves some comparative advantage unexploited. Nevertheless, under extreme conditions of free entry and product symmetry, comparative advantage and product differentiation become complementary explanations of trade (Helpman and Krugman, 1985). Product differentiation explain intra-industry trade patterns, with no intersectoral effects and comparative advantage explains intersectoral specialization and trade, but sheds no light on intra-industry patterns.

In what follows, I will describe in section 1.2 the structure of general equilibrium models under different assumptions concerning competition and market structure and identify the qualitative implications of these various assumptions on trade and policy issues. I then provide a quantitative assessment of these implications, using an applied model for Greece for a fictitious though reasonable policy experiment (sections 1.3-1.5). The results and concluding remarks are provided in sections 1.6 and 1.7 respectively.

1.2 The General Structure of G.E. models of trade and production with increasing returns to scale and imperfect competition.

1.2.1 The Demand Side

The Demand for Final Goods

The characteristics of the simplest neoclassical model is that all tradables goods are perfect substitutes independent of origin. A small country is a price

taker both as an importer and as an exporter and net exports are determined residually.

With this assumption comparative advantage is the sole explanation of trade flows and model predictions are extremely sensitive to relative price changes. To get around this problem, Armington (1969) introduced the assumption that tradable goods of different origin are imperfect substitutes in demand: changes in the relative demand for goods of different origin will respond to changes in relative prices with a finite substitution elasticity. This type of imperfect substitution can be modeled in an analogous manner for both final and intermediate goods, by defining a composite good that is a CES aggregate of domestic and imported goods. To see this, I introduce the following utility function which combines consumption of the sectors' s domestic good and of sectors' s imported good (C_{m_s}):

$$C_{.s} = \left(\delta_s C_s^{\frac{(\sigma_s - 1)}{\sigma_s}} + \delta_{m_s} C_{m_s}^{\frac{(\sigma_s - 1)}{\sigma_s}} \right)^{\frac{\sigma_s}{(\sigma_s - 1)}} \tag{1.1}$$

$C_{.s}$ is interpreted as the amount of sectors' s composite good demanded for consumption purposes and $\sigma_s \geq 1$ is the elasticity of substitution between goods of the two different origins. It is conventional to assume that global consumer preferences are separable so that the households choice problem can be decomposed into separate maximization subproblems (a procedure that is known as "two stage budgeting" . In the case of a Cobb-Douglas utility function such as:

$$U(.) = \sum_{s \in S} \rho_s log C_{.s} \qquad with \sum_{s \in S} \rho_s = 1 \tag{1.2}$$

then the first stage problem, which consists of choosing the optimal amount of the composite good $C_{.s}$ subject to the budget constraint

$$\sum_{s \in S} P_{.s} C_{.s} = E \tag{1.3}$$

will yield constant expenditure shares equal to ρ_s.

$$\sum_{s \in S} P_{.s} C_{.s} = E \tag{1.4}$$

E is global expenditure and $P_{.s}$ is the unit price of the composite good which is given for the consumer.

The first order condition to this optimization problem is

$$\frac{\rho_s}{C_{.s}} = \lambda P_{.s} \tag{1.5}$$

where λ is the Langrangian multiplier of the budget constraint. By substitution I obtain the following demand function for the composite good

$$C_{.s} = \frac{(\rho_s E)}{P_{.s}} = \frac{E_s}{P_{.s}} \tag{1.6}$$

The second stage problem consists of choosing the optimal composition of the composite good; i.e, the optimal mix between goods of different geographical origin (domestic or imported). This is achieved by minimizing the total cost of achieving a given level of aggregate consumption $C_{.s}$, for given prices. Formally, minimize

$$P_s C_s + P_{w_s} C_{w_s} \tag{1.7}$$

so that (1.1) is satisfied with $C_{.s}$, P_s and P_{w_s} given.

The solution to this problem yields the following demand functions for domestic and imported goods:

$$C_s = \delta_s^{\sigma_s} \left(\frac{P_s}{P_{.s}} \right)^{-\sigma_s} C_{.s} \tag{1.8}$$

$$C_{w_s} = \delta_{w_s}^{\sigma_s} \left(\frac{\overline{P}_{w_s}}{P_{.s}} \right)^{-\sigma_s} C_{.s} \tag{1.9}$$

where $P_{.s}$ is the shadow price associated with the constraint. Substituting (1.8) and (1.9) into (1.1) I obtain the expression for the composite price $P_{.s}$ in terms of the given market prices P_s:

$$P_{.s}^{\,1-\sigma_s} = \delta_s{}^{\sigma_s} P_s^{\,1-\sigma_s} + \delta_{w_s}{}^{\sigma_s} P_{w_s}{}^{1-\sigma_s} \tag{1.10}$$

It is clear that if $\sigma_s \to \infty$, we are back in the traditional Hecksner-Ohlin world of small economies[1]

Until now I have assumed that products of the same sector with identical geographical origin are homogeneous. Such an assumption may be questioned. It is indeed possible that there is product differentiation within a sector, in which case welfare will depend on the number of varieties available. Since Spence (1976) and Dixit and Stiglitz (1977), (S.D.S), it has become customary to specify preferences for varieties with a concave symmetrical constant

[1] In the study I have undertaken, I consider the rest of the world as exogenous, so that prices P_{w_s} are set equal to one and the second term in equation (1.10) is therefore a constant to be determined by calibration.

elasticity of substitution function which can be represented by

$$C_{.s} = \left(\sum_{\omega \in \Omega} \delta_{s_\omega} c_{s_\omega}^{\frac{\sigma_s^n - 1}{\sigma_s^n}} \right)^{\frac{\sigma_s^n}{\sigma_s^n - 1}} \tag{1.11}$$

where $\sigma_s^n \geq 1$ is now the elasticity of substitution between two pairs of varieties of the same product and c_{s_ω} is consumption of variety ω of sector s. [2]

The domestic consumer problem is now to choose c_{s_ω} so that (1.11) is maximized subject to

$$\sum_{\omega \in \Omega} p_{s_\omega} c_{s_\omega} = E_s \tag{1.12}$$

with given expenditure E_s and prices.

From the first order conditions of this problem I get

$$c_{s_\omega} = \left(\frac{\lambda}{C_{.s}} \right)^{-\sigma_s^n} {p_{s_\omega}}^{-\sigma_s^n}$$

where λ is the shadow price associated with the constraint. Substituting this expression into the budget constraint, solving for $(\frac{\lambda}{C_s})$ and substituting again this term into the first order condition I obtain the demand curve,

$$c_{s_\omega} = \frac{{\delta_{s_\omega}}^{\sigma_s^n} {p_{s_\omega}}^{-\sigma_s^n}}{\sum_{\omega \in \Omega} {p_{s_\omega}}^{1-\sigma_s^n}} E_s \tag{1.13}$$

Substituting the latest equation into the budget constraint gives us the equivalent form for the composite price in the case of the S.D.S preferences,

$$P_{.s} = \left(\sum_{\omega} {\delta_{s_\omega}}^{\sigma_s^n} {p_{s_\omega}}^{1-\sigma_s^n} \right)^{\frac{1}{1-\sigma_s^n}} \tag{1.14}$$

[2] We observe here that every pair of variety is equally well substitutable for each other and does not depend on either the consumption levels of the two varieties being considered or of any other variety;

If domestic (foreign) firms are symmetrical, then all domestic (foreign) varieties are equally priced and whatever the spending level allocated to sector s, it is optimal to purchase all domestic (foreign) varieties in equal quantities.

A composite price of domestic and foreign varieties, can be expressed by

$$P_{.s}^{1-\sigma_s^n} = \delta_s^{\sigma_s^n} n_s p_s^{1-\sigma_s} + \delta_{w_s}^{\sigma_s^n} n_{w_s} p_{w_s}^{1-\sigma_s^n} \tag{1.15}$$

where n_{s_w} and p_{w_s} are the foreign varieties and foreign price of an individual variety.[3].

Similarly I obtain the relevant expression for the domestic consumers demand for domestic varieties

$$c_s = \delta_s^{\sigma_s^n} \frac{p_s^{-\sigma_s^n}}{\delta_s^{\sigma_s^n} n_s p_s^{1-\sigma_s^n} + \delta_{w_s}^{\sigma_s^n} n_{w_s} p_{w_s}^{1-\sigma_s^n}} E_s \tag{1.16}$$

The foreign consumers demand for the domestic variety is symmetrical in this case where there is no product differentiation by geographic origin.[4]

By a similar procedure I obtain an expression for the demand for foreign varieties. I observe that all demands will be functions of relative prices, elasticities of substitution and the number of existing firms.

[3]As I will consider n_{s_w} and p_{w_s} exogenous, the second term of this equation also reduces to a constant determined by calibration

[4]In the general case where domestic and foreign varieties are also symmetric, I obtain the following simplified expressions:

$$P_{.s} = \delta_s^{\frac{\sigma_s^n}{1-\sigma_s^n}} n_s^{\frac{1}{1-\sigma_s^n}} p_s \tag{1.17}$$

and

$$C_{.s} = \frac{E_s}{P_{.s}} = \delta_s^{\frac{\sigma_s^n}{\sigma_s^n-1}} \frac{E_s}{P_s} \tag{1.18}$$

This last equation demonstrates that for a given level of expenditure and a given price for the available varieties welfare increases as the number of varieties becomes larger. Thus the subutility function demonstrates the property that variety is valued per se.

The Demand for Intermediate Goods

The demand for intermediate goods may be modeled in a similar way as the demand for final goods. I assume that there is a competitive sector with firms that have a homothetic and separable production function. The demand for the factors of production (capital, labor and intermediate inputs) is determined by cost minimization for some level of output Q_s. Thanks to the separability assumption on the technology this minimization can be made using a two step procedure. At the up-most level of the decision tree the problem is to minimize

$$v_s Q_s = \sum_{t \in S} P_{.t_s} X_{.t_s} + w {L_s}^v + r {K_s}^v \tag{1.19}$$

subject to

$$\log(Q_s) = \alpha_{L_s} \log {L_s}^v + \alpha^v_{K_s} + \sum_{t \in S} \alpha_{t_s} \log(X_{.t_s}) \tag{1.20}$$

assuming prices and output scale fixed. Here ${L_s}^v$ and ${K_s}^v$ are variable capital and labor inputs and $X_{.t_s}$ indicates amounts of intermediate composite inputs from sector t to sector s and $P_{.t_s}$ the unit price of that aggregate good. The first order conditions yield

$$X_{.t_s} = \alpha_{t_s} \frac{v_s Q_s}{P_{.t_s}} \tag{1.21}$$

In the case of product differentiation by geographic origin $P_{.t_s}$ stands for a composite good of domestic and imported intermediate inputs, given by

$${P_{.t_s}}^{1-\sigma_s} = {\beta_{t_s}}^{\sigma_s} {P_{t_s}}^{1-\sigma_s} + {\beta_{w_{ts}}}^{\sigma_s} {P_{w_{ts}}}^{1-\sigma_s} \tag{1.22}$$

and

$$X_{.t_s} = \left(\beta_{t_s} {X_{t_s}}^{\frac{\sigma_s - 1}{\sigma_s}} + \beta_{w_{ts}} {X_{w_{ts}}}^{\frac{\sigma_s - 1}{\sigma_s}} \right)^{\frac{\sigma_s}{\sigma_s - 1}} \tag{1.23}$$

The second stage optimization then yields intermediate inputs demands according to origin.

$$X_{t_s} = \beta_{t_s} \left(\frac{P_{.t_s}}{P_{t_s}} \right)^{\sigma_s} \frac{\alpha_{t_s} v_s Q_s}{P_{.t_s}} \tag{1.24}$$

$$X_{w_{ts}} = \beta_{w_{ts}} \left(\frac{P_{.t_s}}{P_{w_{ts}}} \right)^{\sigma_s} \frac{\alpha_{t_s} v_s Q_s}{P_{.t_s}} \tag{1.25}$$

In the case where firms of a certain sector produce differentiated products (but there is no product differentiation by origin), a similar method to that developed by S.D.S has been introduced by Ethier (1982). In this case $X_{.t_s}$ is a composite good of different varieties from sector t used as intermediate inputs in sector s.

Therefore, X_{t_s} is given by,

$$X_{.t_s} = \left(\sum_{\omega \in \Omega} \beta_{t_s\omega} {x_{t_s\omega}}^{\frac{\sigma_s^n - 1}{\sigma_s^n}} \right)^{\frac{\sigma_s^n}{\sigma_s^n - 1}} \tag{1.26}$$

and the associated composite price by,

$$P_{.t_s} = \left(\sum_{\omega \in \Omega} {\beta_{t_s\omega}}^{\sigma_s^n} {p_{t_s\omega}}^{1-\sigma_s^n} \right)^{\frac{1}{1-\sigma_s^n}} \tag{1.27}$$

With the assumption of symmetrical firms within domestic (foreign) boundaries[5] and therefore equal prices for all domestic (foreign) varieties and following the

[5]If domestic and foreign firms are also symmetric then domestic and foreign varieties of the same sector will have equal price and then I obtain the following simplified expression for the composite price $P_{.t_s}$

$$P_{.t_s} = {\beta_{t_s\omega}}^{\frac{\sigma_s^n}{1-\sigma_s^n}} n_t^{\frac{1}{1-\sigma_s^n}} p_{t_s} \tag{1.28}$$

This formulation implies an average cost function of the form $c(w, r, {p_{t_s}}^{\frac{1}{1-\sigma_s^n}})$. Observe that the larger n_t, the lower the effective price of intermediate inputs. Thus diversity in available inputs increases the productivity of the firm (since average costs are decreasing in n_{t_s}).

procedure outlined for the consumer, the demand of sector s for domestic intermediate varieties originating in sector t is easily derived:

$$x_{t_s} = {\beta_{t_s}}^{\sigma_s^n} \frac{p_{t_s}^{-\sigma_s^n}}{{\beta_{t_s}}^{\sigma_s^n} n_t {p_{t_s}}^{1-\sigma_s^n} + \beta_{wt_s}^{\sigma_s^n} n_{w_t} {p_{wt_s}}^{1-\sigma_s^n}} \tag{1.29}$$

1.2.2 Pricing Behavior

In the case of imperfectly competitive markets in a general equilibrium framework two different approaches are found in the economic literature. Following Negishi (1961) firms may maximize profits based on any arbitrary "subjective"-"perceived" demand curves. The extreme alternative assumes that firms make their pricing decisions based on their "true"-"objective" demand functions. Whichever the assumption, the competitive game has to be defined. There are two types of competitive games that have received most attention: the Cournot-Nash quantity setting approach and the Bertrand-Nash price setting approach.

Imperfect competition can provide interesting results with respect to patterns of trade through oligopolistic rivalry for market power, increasing returns to scale and product differentiation at the industry level. A first case arises when firms of a particular sector within each country produce homogeneous goods with constant returns to scale but due to trade barriers or consumer preferences for the home good they can make a distinction between output delivered to their home market and output delivered in the foreign market. In the case of homogeneous goods Bertrand-Nash equilibrium implies marginal cost pricing and therefore is not considered.

In a Cournot-Nash equilibrium a firm will maximize profits with respect to their individual sales in the domestic and foreign markets.

$$\pi_s = P_s\left(C_s\right) c_s + P_{e_s}\left(E_s\right) e_s - CT_s \tag{1.30}$$

where C_s and E_s are respectively domestic and foreign consumption demands for the domestic good, P_s and P_{e_s} are the associated prices and c_s and e_s are the individual firms respectively demands. CT_s are the firms total (variable) costs, which I assume to be identical for all firms in the same sector.

First order conditions give the following pricing rules for sales in the domestic and foreign demand

$$\frac{P_s - v_s}{P_s} = -\frac{1}{\epsilon_s n_s} \tag{1.31}$$

and

$$\frac{P_{e_s} - v_s}{P_{e_s}} = -\frac{1}{\epsilon_s^* n_s} \tag{1.32}$$

This is the Lerner rule of pricing where the right hand side of the equations represent the individual's firms perceived domestic and foreign demand elasticities and $\epsilon_s = \frac{\partial C_s}{\partial P_s}\frac{P_s}{C_s}$ and $\epsilon_s^* = \frac{\partial E_s}{\partial P_{e_s}}\frac{P_{e_s}}{E_s}$ the market domestic and foreign demand elasticities for the domestic good respectively. Derivation of the market demand elasticities gives us,

$$\frac{P_s - v_s}{P_s} = -\frac{1}{n_s}\left[-\frac{1}{\sigma_s} + \left(\frac{1}{\sigma_s} - 1\right) F_s\right] \tag{1.33}$$

and

$$\frac{P_{e_s} - v_s}{P_{e_s}} = -\frac{1}{n_s}\left[-\frac{1}{\sigma_s} + \left(\frac{1}{\sigma_s} - 1\right) F_s^*\right] \tag{1.34}$$

where $F_s = \frac{P_s C_s}{\rho_s E}$ and $F_s^* = \frac{P_{e_s} E_s}{\gamma_s \overline{Y}_w}$ are the domestic and foreign market shares of the domestic industry in total domestic and foreign expenditure respectively.[6]

Given the fact that consumers generally have a marked preference for the domestic good and that the home country is small, the share of the domestic firm in its own market will be larger than its share in the foreign market. Consequently, the firm will perceive a more elastic demand curve in its foreign market, with the result that it will charge lower prices to foreign than to domestic customers. This practice is known in the literature as "reciprocal dumping".

In terms of patterns of trade the implication of this model is that it allows for intrasectoral trade patterns. One may see this result by rewriting the above equations as

$$P_s \left[1 + \frac{1}{n_s}\left[-\frac{1}{\sigma_s} + \left(\frac{1}{\sigma_s} - 1\right) F_s\right]\right] = v_s \tag{1.35}$$

and

$$P_{e_s} \left[1 + \frac{1}{n_s}\left[-\frac{1}{\sigma_s} + \left(\frac{1}{\sigma_s} - 1\right) F_s^*\right]\right] = v_s \tag{1.36}$$

where the left hand side is the marginal revenue and the right hand side is marginal cost. I observe that due to the negative sign of $\left(\frac{1}{\sigma_s} - 1\right) F_s$, and the fact that $\frac{1}{n_s} F_s \gg \frac{1}{n_s} F_s^*$, if P_{e_s} was equal to P_s, then the marginal revenue of the individual firm in the foreign country would be larger than its marginal cost and therefore it would be profitable for the firm to increase its output in this market and reduce its price, i.e; dump its price in the foreign market. Thus in

[6]The treatment of intermediate goods make this formula much more complicated for exposition purposes.

this type of model rivalry of ologopolistic firms serves as an independent cause of intra-industry trade.[7]

In the above case increasing returns to scale though may be introduced to explain the oligopolistic structure of the industry are not essential in the explanation of intra-industry patterns. Alternatively one may assume that total costs of the firm include fixed costs. A Bertrand-Nash equilibrium with homogeneous goods in this case is not possible since "destructive" price competition will equate prices to marginal cost and since there are fixed costs, average costs will not be covered. In a Cournot-Nash equilibrium where domestic firms produce homogeneous goods which compete with imperfect foreign substitutes, there will be intra-industry trade in order for firms to exploit economies of scale, even if the possibility of price discrimination is removed (Harris 1988)

Another interesting case with increasing returns to scale arises when firms are able to differentiate their products so that they are not perfect substitutes for either existing competitors or potential entrants. One extreme case arises if firms in the same sector have symmetrical cost functions and market shares everywhere (domestic and foreign), then consumption demand will be the same for all varieties in a sector and the single producer will compete equally well with any other producer in the domestic and foreign market and he will derive the same profit for any variety choice that is not supplied by others. As long

[7]Brander and Krugman (1983) develop a two country-two firm model with identical cost and preference functions in which case oligopolistic rivalry and "reciprocal dumping" is the sole driving force of international trade and of intra-industry trade patterns. In this case it is transport costs that makes the firm a high- cost shipper to the other market. Thus it must have a smaller market share in the foreign market, a lower perceived elasticity of demand and therefore a smaller mark-up over marginal costs.

as there are more potential varieties than are actually produced, each firm will prefer to produce a different variety than compete with other producers for the same variety. The existence of fixed costs here limits the number of goods produced. Otherwise the assumption that each good is produced by a single producer would not hold. So each country specializes in producing different sets of varieties and they trade with each other. In this case product variety is the sole cause of trade.

A more general case arises when oligopolistic rivalry for market share is also a cause for trade for firms producing differentiated products. Due to product differentiation both the Cournot and Bertrand equilibria exists. In what follows I will present the Cournot case, for the simple case where there is segmentation of domestic and foreign markets due to the existence of non-tariff trade barriers. It is also assumed that firms in a sector of the same geographic origin have symmetrical costs (Mercenier 1995).

The individual domestic firm will maximize profits with respect to its sales in the domestic and foreign markets

$$\pi_s = p_s\left(c_s\right) c_s + p_{e_s}\left(e_s\right) e_s - CT_s \tag{1.37}$$

where c_s and e_s represent the domestic and foreign demand for an individual variety produced by a single domestic firm and CT_s is the firm's total cost and includes variable cost and fixed costs in this case. Observe that there is no subscript for variety. Due to the symmetry between varieties in a sector they will all have the same price and be sold in the same quantity.

The first order condition gives us the Lerner mark-up rule

$$\frac{p_s - v_s}{p_s} = -\frac{1}{\epsilon'_s} \tag{1.38}$$

where $\epsilon'_s = \frac{\partial c_s}{\partial p_s}\frac{p_s}{c_s}$ is the domestic demand elasticity for an individual variety of sector s such that

$$\frac{1}{\epsilon'_s} = \frac{1}{\sigma_s}\left[(s_s - 1) + \frac{1}{\epsilon_s}s_s\right] \tag{1.39}$$

where $s_s = \frac{p_s c_s}{\rho_s E}$ is the domestic firms domestic market share.

Deriving for ϵ'_s and substituting in (1.39) gives us the following expression for ϵ'_s,

$$\frac{1}{\epsilon'_s} = -\frac{1}{\sigma_s} + \left(\frac{1}{\sigma_s} - 1\right)s_s \tag{1.40}$$

Similarly I obtain the first order condition for varieties sold in the foreign market,

$$\frac{p_{e_s} - v_s}{p_{e_s}} = -\frac{1}{\epsilon^{*\prime}_s} \tag{1.41}$$

where $\epsilon^{*\prime}_s = \frac{\partial e_s}{\partial p_{e_s}}\frac{p_{e_s}}{e_s}$. and

$$\frac{1}{\epsilon*'_s} = -\frac{1}{\sigma_s} + \left(\frac{1}{\sigma_s} - 1\right)s^*_s. \tag{1.42}$$

$s^*_s = \frac{p_{e_s} e_s}{\gamma_s \overline{Y}_w}$ is the foreign market share of domestic varieties. I shall refer to a General Oligopoly model in this case as it accommodates for both the product differentiation and the reciprocal dumping explanations for trade.

With the symmetry assumption $s_s = \frac{1}{n_s}$ Then

$$\lim_{n_s \to \infty} \frac{1}{\epsilon'_s} = -\frac{1}{\sigma_s} \tag{1.43}$$

and the analogous is true for sales in the foreign market.[8] This is the pure Spence-Chamberlenian monopolistic competition case which implies that for large number of firms (entry occurs until the marginal firm can just make it even) the price mark-up is independent of the individual firms market share, since the firm perceives the latter to be negligible (Krugman and Helpman, 1985).

1.2.3 Equilibrium Conditions

CGE models with imperfect competition distinguish between a short-run equilibrium and a long-run equilibrium. The short-run is perceived as a period in which industry structure is fixed. This is a period where noncompetitive firms incur pure profits or losses, as there is no entry or exit of firms. Therefore, number of firms in each industry are held constant. Prices are determined by the Lerner mark-up conditions and output is demand determined. A long-run equilibrium is one where the structure of the industry is allowed to vary. Free entry and exit of firms requires that profits are null.

1.2.4 Results for Welfare

Within the framework of CGE models with perfect competition, a number of external shock and policy evaluation studies have been undertaken. Many of them are summarized in Shoven and Whalley (1984) for developed countries and Decaluwé and Martens (1988) for developing countries.

[8] I have assumed here that the domestic country and the rest of the world have the preferences for varieties; i.e, σ_s is the same for the domestic as well for the foreign consumer

One of the most common application for these models has been in the estimation of the welfare effects after trade liberalization. The common result of numerous country studies has been that the effects of trade liberalization are small. A reasonable explanation seemed to be that in fact trade elasticities are much smaller than these assumed in traditional trade models. Some studies have accounted for this either by employing the Armington assumption of imperfect substitution between goods of different origins or, alternatively, imperfections in the market structure.

In addition to explaining sluggish trade reaction and, therefore, weak welfare effects of trade liberalization, many authors argued that the incorporation of the "new trade theory" in the CGE models would actually substantially increase the welfare gains obtained with the perfectly competitive models. The reason for this is the "pro-competitive" effect that trade liberalization would have in this context.

In the Harris (1984) model of monopolistic competition, the removal of trade barriers increases imports and, consequently, decreases the market share of the domestic firm. This will increase the perceived elasticity of demand for domestic products and therefore, through the mark-up price equation, the price charged by the domestic firm will drop and the quantities produced will increase (pro-competitive effect). Of course, this situation may squeeze those firms that are already operating at sub-optimal capacity and, therefore, reduce welfare. The Harris model demonstrate a way out of this dilemma by assuming free entry and exit of firms. Trade liberalization will reduce the number of firms

in the protected manufacturing sectors that come under pressure and thus will help the remaining firms to achieve greater scale economies. The net welfare gain from trade liberalization for Canada were found to be four times larger than the gains estimated from the competitive model.

In Smith and Venables (1988), trade liberalization of the European internal market is implemented in two different ways. First, there is a reduction of intra-EC barriers and, second, there is a loss of the firms ability to price discriminate between national markets. The latter experiment implies that firms are losing the monopoly power they have in their domestic market and replacing it by the EC average market power. The welfare gains created by the pro-competitive effects of market integration were found to be much more substantial than the gains associated with the removal of intra-EC barriers.

As it may be obvious by now, the Armington specification is used in a rather ad hoc manner in models with perfect competition as an alternative way of explaining intra- industry in two-country models since products of different origin face a different demand curve. In effect, a recent study by V.D. Norman (1990) has attempted to evaluate in a two-country setting, the quantitative importance of modeling market structure in the framework of a computable general equilibrium models in order to capture intra-industry trade. In other words, he evaluated the necessity of explicitly modeling imperfect competition and product differentiation versus an ad hoc modeling of intra-industry trade following the Armington assumption. The study found that the latter assumption though it provides for a reasonable approximation of intra-industry trade,

it performs quite badly with respect to inter-industry effects and with regard to welfare effects.

In particular, the study found that the oligopoly models will give larger real income effects than the Armington model.

1.3 An illustrative experiment: An increase in Government Spending

My aim is to provide a quantitative assessment of an increase in Government spending, an experiment inspired by the Community Support Framework (CSF), a new program implemented by the European Union (Some details on the CSF program are provided in Appendix A).

My objective, therefore, will be to compare qualitatively and quantitatively the results obtained when alternative assumptions on the market structure are used to analyze the effects of policy, an increase in government spending in our case.

I will consider the following versions of the model:

1) Perfect competition where domestic and foreign goods are imperfect substitutes.

2)Monopolistic competition with homogeneous products (à la Harris).

3) Pure monopolistic competition with product differentiation (à la Spence-Chamberlain).

4) General oligopoly with price discrimination (Mercenier 1995).

In what follows I will describe the structure of a general equilibrium that

will allow us to test the effects of the CSF within the context of the above scenarios. This model is large enough in scope so that it permit us to pass from one scenario to the other by changing some competitiveness assumptions and some initial calibration.

1.4 The Applied General Equilibrium Model

First are defined the different commodity sets. Sectors of activity are identified by indices s and t, with S representing the set of all industries so that $s, t = 1, ..., S$. S is partitioned into the subset of competitive constant returns-to-scale sectors, denoted C, and the subset of non-competitive increasing returns-to-scale industries, which I note $\overline{C}$. There are only two countries Greece and the rest of the EU. I will substitute the aggregation of Greek and rest of the EU variables with a dot ; for instance $c_{.s}$ refers to consumption of goods of sector s originating from Greece and the rest of the EU.

1.4.1 Households

Domestic final demand decisions in Greece are made by a single representative household. Consumers preferences are given by

$$\log(C) = \sum_{s\in S} \rho_s \log(c_{.s}) \qquad \sum_{s\in S} \rho_s = 1, \tag{1.44}$$

$$c_{.s} = \left(\delta_s c_s^{\frac{\sigma_s-1}{\sigma_s}} + \delta_{m_s} c_{m_s}^{\frac{\sigma_s-1}{\sigma_s}}\right)^{\frac{\sigma_s}{\sigma_s-1}} \qquad s \in C, \tag{1.45}$$

$$c_{.s} = \left(n_s \delta_s c_s^{\frac{\sigma_s-1}{\sigma_s}} + \overline{n}_s^* \delta_{m_s} c_{m_s}^{\frac{\sigma_s-1}{\sigma_s}}\right)^{\frac{\sigma_s}{\sigma_s-1}} \qquad s \in \overline{C} \tag{1.46}$$

where δ_s and δ_{m_s} are consumption share parameters and σ_s are substitution elasticities and where $c_{.s}$ and $s \in C$ is a composite good of domestic $c_s$and imported goods c_{m_s} and $c_{.s} \in \overline{C}$, is a composite good of products of individual firms, under the usual assumptions of symmetry. Consumption decisions are made at two levels. At the first level, the consumer chooses the optimal amount of a composite good $c_{.s}$ given constant expenditure shares (ρ_s). At the second level he chooses the optimal composition of the composite good in terms of geographic origin for the competitive industries (the Armington specification) and in terms of individual firms products for the non-competitive industries (the Dixit-Stiglitz specification). Final demands c_s are given by maximization of (2.1), (2.2), and (2.3), subject to

$$p_C C = \sum_{s\in C} p_s c_s + \sum_{s\in C} p_s c_{m_s} + \sum_{s\in\overline{C}} p_s n_s c_s + \sum_{s\in\overline{C}} \overline{p}_{m_s} \overline{n}_s^* c_{m_s} \tag{1.47}$$

$$= (1-\tau)\left(\sum_{s\in S} wL_s + \sum_{s\in S}[rK_s + \Pi_s]\right), \tag{1.48}$$

where p_C denotes consumption composite prices, τ is the rate of direct taxation and $\overline{n}^* s$ are the number of firms in the rest of the E.U. Finally I assume that capital and labor are mobile between sectors in Greece , but there are no international movements of these factors.

1.4.2 The Government

The government is treated here in a similar fashion as the consumer; it decides how much to allocate in investment and consumption demand by maximizing an utility function subject to it's budget constraint which is the sum of direct and indirect taxation and transfer payment from the European Community. Government consumption final demands are therefore given by maximization of

$$\log(C_g) = \sum_{s\in S} \rho_{g_s} \log(c_{g.s}) \qquad \sum_{s\in S} \rho_{g_s} = 1, \tag{1.49}$$

$$c_{g.s} = \left(\delta_{g_s} c_{g_s}{}^{\frac{\sigma_s-1}{\sigma_s}} + \delta_{m_{g_s}} c_{g_{m_s}}{}^{\frac{\sigma_s-1}{\sigma_s}}\right)^{\frac{\sigma_s}{\sigma_s-1}} \qquad s \in C, \tag{1.50}$$

$$c_{g.s} = \left(n_s \delta_{g_s} c_{g_s}{}^{\frac{\sigma_s-1}{\sigma_s}} + \overline{n}_s^* \delta_{g_{m_s}} c_{g_{m_s}}{}^{\frac{\sigma_s-1}{\sigma_s}}\right)^{\frac{\sigma_s}{\sigma_s-1}} \qquad s \in \overline{C} \tag{1.51}$$

subject to

$$p_{C_g} C_g = \sum_{s\in C} p_s c_{g_s} + \sum_{s\in C} p_s c_{g_{m_s}} + \sum_{s\in \overline{C}} p_s n_s c_{g_s} + \sum_{s\in \overline{C}} \overline{p}_{m_s} \overline{n}_s^* c_{g_{m_s}} \tag{1.52}$$

$$= \tau Y + TF, \tag{1.53}$$

where p_{C_g} denotes government consumption composite prices, c_{g_s} and $c_{g_{m_s}}$ government domestic and import demands and Y is the consumers revenue, TF are transfer payment from the European Union.

1.4.3 Firms

Competitive industries

In competitive industries, input demands by producers result from minimization of variable unit costs v_s.

$$v_s Q_s = \sum_{t \in C} \left(p_{ts} x_{ts} + \overline{p}_{m_{ts}} x_{m_{ts}} \right) + \sum_{t \in \overline{C}} \left(p_{ts} x_{ts} + \overline{p}_{m_{ts}} x_{m_{ts}} \right) + w L_s^v + r K_s^v \quad (1.54)$$

subject to the production function

$$\log(Q_s) = \alpha_{Ls} \log(L_s^v) + \alpha_{Ks} \log(K_s^v) + \sum_{t \in S} \alpha_{ts} \log(x_{.ts}) \quad (1.55)$$

Where

$$x_{.ts} = \left(\beta_{ts} x_{ts}^{\frac{\sigma_t - 1}{\sigma_t}} + \beta_{m_{ts}} x_{m_{ts}}^{\frac{\sigma_t - 1}{\sigma_t}} \right)^{\frac{\sigma_t}{\sigma_t - 1}} \qquad t \in C$$

and

$$x_{.ts} = \left(n_t \beta_{ts} x_{ts}^{\frac{\sigma_t - 1}{\sigma_t}} + \overline{n}_t^* \beta_{m_{ts}} x_{m_{ts}}^{\frac{\sigma_t - 1}{\sigma_t}} \right)^{\frac{\sigma_t}{\sigma_t - 1}} \qquad t \in \overline{C},$$

where $x_{.ts}, t \in C$, $x_{.ts}, t \in \overline{C}$ are composite intermediate inputs of domestic x_{ts} and imported $x_{m_{ts}}$ goods produced in the competitive sectors (the Armington specification) and the imperfectly competitive firms, (the Ethier specification) respectively. To guarantee homogeneity of degree one of the unit costs in prices I set

$$\alpha_{Ls} + \alpha_{Ks} + \sum_{t \in S} \alpha_{ts} = 1,$$

where α and β are share parameters and $\beta_{ts} = 0$, if t is non-traded. Profit maximization implies marginal cost pricing in the competitive sectors so that

$$p_s = v_s, \qquad s \in C.$$

Non-competitive industries

In the non-competitive industries, individual firms face fixed primary factor costs. Thus, total unit costs V_s and marginal costs v_s are no longer equal. Total unit costs are given by

$$V_s = v_s + \frac{\left[wL_s^F + rK_s^F\right]}{Q_s}, \qquad s \in \overline{C} \tag{1.56}$$

where Q_s, L_s^F, K_s^F denote respectively the individual firm's output, fixed labour and fixed capital.

When firms can price discriminate they will charge a different price in the domestic and the foreign market according to the Lerner formula

$$\frac{p_s - v_s}{p_s} = \frac{-1}{\epsilon_s'}, \tag{1.57}$$

and

$$\frac{p_{e_s} - v_s}{p_{e_s}} = \frac{-1}{\epsilon*_s'} \tag{1.58}$$

where ϵ_s' and $\epsilon*_s'$ are the firm's perceived elasticity of demand in the domestic and the EU markets respectively. In each case, perceived demands are calculated assuming that in each region individual clients' current price expenditure on the whole industry is unaffected by its own action. When firms behave *à la Bertrand-Nash*, it is straightforward to show that this elasticity is the sum of the elasticities of each component of the domestic consumption and investment demands) and EU demands with respect to the firm's price, weighted by the relative importance of each sub-demand in the firm's total sale to each region.

$$\epsilon'_s = -\sigma_s + (\sigma_s - 1)\left[f_s + f_{g_s} + int_s\right] \tag{1.59}$$

where

$$f_s = \left(\frac{c_s}{c_s + c_{g_s} + \sum_{t\in S} x_{t_s}}\right)\left(\frac{p_s c_s}{\rho_s k Y_d}\right) \tag{1.60}$$

$$f_{g_s} = \left(\frac{c_{g_s}}{c_s + c_{g_s} + \sum_{t\in S} x_{t_s}}\right)\left(\frac{p_s c_{g_s}}{\rho_{g_s}\left(\mu\tau Y + \theta TF\right)}\right) \tag{1.61}$$

$$int_s = \left(\frac{x_{t_s}}{c_s + c_{g_s} + \sum_{t\in S} x_{t_s}}\right)\left(\frac{p_s x_{t_s}}{\alpha_{t_s} v_s Q_s}\right) \tag{1.62}$$

and

$$\epsilon *_s = -\sigma_s + (\sigma_s - 1)\left(\frac{p_{e_s} e_s}{\beta_s \overline{Y}_w}\right) \tag{1.63}$$

In the pure monopolisic competition scenario firms cannot price discriminate so the perceived elasticity of demand in the Greek and the EU market is the same and furhtemore it is independent of the individual firms share in either market, $\epsilon'_s = \epsilon^*_s = -\sigma_s$. In the monopolisticly competitive with homogeneous goods case the mark-up rule reflects domestic and foreign market shares, but since there is no product differentiation by variety the Armington specification is used for both competitive and non competitive sectors. Since there is no price discrimination in this model export price is set equal to domestic prices.

With the number of firms in each industry fixed, individual firm profits may be nonzero in which case

$$\Pi_s = n_s\left[p_s\left(c_s + \sum_{t\in S} x_s\right) + p_{e_s} e_s\right] - n_s V_s Q_s \tag{1.64}$$

1.4.4 General Equilibrium

A general equilibrium[9] is a vector of prices p_s, p_{e_s}, w, r such that

- Supply equals demand on each market :

$$Q_s = \left[c_s + c_{g_s} + \sum_{t \in S} x_{st} + e_s \right], \qquad s \in S \tag{1.65}$$

$$L = \sum_{s \in S} L_s = \sum_{s \in C} L_s^v + \sum_{s \in \overline{C}} [L_s^v + L_s^F], \qquad i \in W \tag{1.66}$$

$$K = \sum_{s \in C} K_s^v + \sum_{s \in \overline{C}} n_s [K_s^v + K_s^F], \tag{1.67}$$

where L and K represent fixed labor and capital endowments;

- Profits equal zero in all competitive industries;

- Firms in non-competitive industries mark up prices over marginal costs according to the oligopolistic assumption implemented.

- In non-competitive sectors, the number of firms n_{is} is fixed.

1.5 Data Set and Calibration Procedure

1.5.1 Data Set

The adopted sectoral breakdown of activities is detailed in (Table 1.1). The data base includes bilateral trade flows, separate input-output tables for domestic and imported inputs, final demands by type and sectoral origin, production and labor earnings figures. Some of this data was send to us by the bank of Greece. The rest was collected from standard international publications. A RAS procedure was used to provide consistency of the input-output table of 1980 with the other sources.

[9]The model is less than "full" general equilibrium as the rest-of-world is summarized by exogenous prices, varieties and income.

The calibration procedure for the perfectly competitive general equilibrium is straight forward and it involves the determination of the unknown variables and parameters residually so that they are consistent with our initial data.

The Armington case will serve as an illustration. Substitution parameters σ_s are set exogenously (Table 1.2). From production, input output tables and labor earnings I obtain the value of capital earnings and total costs. Given the assumption of constant returns to scale in all sectors (no fixed costs) I readily calculate the variable capital and labor costs. Choosing initial producer prices equal to one Iobtain marginal costs from marginal cost pricing. I thereafter calibrate for the values of the cost and demand function parameters, the equilibrium wage, rental rate of capital and total labor and capital employment. Finally the distributional parameters in the C.E.S subutility functions and the composite prices are determined as well.

The general oligopoly case requires some special attention. I have adopted the Mercenier (1995) methodology for the joint determination of the base-year price set and cost structure consistent with the base year data set with optimal price discrimination by the individual competitors and with the equilibrium concept. With regard to the latter one should note that in the case of imperfectly competitive markets there is a choice between short-run fixed number of firms equilibrium and long run-free entry-exit with zero profits equilibrium. The first choice requires additional statistical information on economic profits and a more complex calibration procedure. The choice adopted here is a long run-zero profit equilibrium which implies that prices are equalized to average

unit costs. From (1.40) and (1.42) I observe that the firm's optimal mark-up depends on the product differentiation elasticities and on observed market shares in the domestic and foreign markets.

Let $\tilde{\tau}_s$ and $\tilde{\tau*}_s$ denote the actual current price trade flows to the domestic market and foreign markets respectively. The problem is to split $\tilde{\tau}_s$,$\tilde{\tau*}_s$ into their price (p_s), (p_{e_s}) and quantity (τ_s),$(\tau*_s)$ components . Making use of the symmetry assumption between domestic and foreign firms, it is easy to see that, for calibration purposes, the perceived elasticities ϵ'_s, $\epsilon*'_s$ may be written as:

$$\epsilon'_s = \epsilon'_s(\tilde{\tau}_s, \sigma_s), \qquad s \in \overline{C}, (1.68)$$

where $\epsilon'_s(.)$ denotes a known function, and σ_s is imposed from extraneous information.

Substituting in the Lerner formula and rearranging, I have

$$\frac{p_s}{v_s} = \frac{\epsilon'_s(\tilde{\tau}_s, \sigma_s)}{\epsilon'_s(\tilde{\tau}_s, \sigma_s) + 1}, \qquad s \in \overline{C} \tag{1.69}$$

and

$$\frac{p_{e_s}}{v_s} = \frac{\epsilon*'_s(\tilde{\tau*}_s, \sigma_s)}{\epsilon*'_s(\tilde{\tau*}_s, \sigma_s) + 1}, \qquad s \in \overline{C} \tag{1.70}$$

so that, for a given level of v_s, the prices charged by firms on the domestic and foreign markets may be computed from the data and the known structure of preferences and technologies implicit in $\epsilon'_s(.)$ and $\epsilon*'_s(.)$. By definition, the average selling price $\bar{p}_s$ of the domestic firm satisfies

$$\bar{p}_s\,(\tau_s + \tau*_s) = \tilde{\tau}_s + \tilde{\tau*}_s \tag{1.71}$$

or, equivalently,

$$\frac{\overline{p}_s}{v_s}\left(\frac{\tilde{\tau}_s}{\left[\frac{p_s}{v_s}\right]}+\frac{\tilde{\tau^*}_s}{\left[\frac{p_{e_s}}{v_s}\right]}\right)=\tilde{\tau}_s+\tilde{\tau^*}_s, \qquad s\in\overline{C} \tag{1.72}$$

With $\overline{p}_s$ fixed at unity by normalization, equations (2.16) and (2.18) jointly determine the variable unit costs v_s and the segmented-market price system consistent with the data set and the type of competition (Bertrand-Nash)[10]date assumed to prevail at base year. In the case of pure monopolistic competition with differentiated goods $\epsilon'_s=-\sigma_s$, and in the alternative case with homogeneous goods $\epsilon'_s=\epsilon^*_s=\epsilon'_s(\tilde{\tau}_s,\tilde{\tau^*}_s,\sigma_s)$, both elasticities are constant. As there is no price discrimination in both cases domestic and export prices are equal.

In both cases the initial values for domestic and export prices are set equal to one and the marginal costs are calibrated from the relevant Lerner conditions.

Table (1.3) reports on the ratio of marginal to average costs (the inverse of the scale elasticities) for the above cases.

In the zero-profit equilibrium, the firm's total unit cost V_s and average selling price $\overline{p}_{is}$ are equalized, which, using (2.8), determines the domestic firm's fixed costs $(wL^F_s+rK^F_s)$.

Therefore,

$$wL^F_s+rK^F_s=v_sQ_s\left[\frac{V_s}{v_s}-1\right], \qquad s\in\overline{C}. \tag{1.73}$$

Due to the lack of reliable data on the composition of fixed costs, it is assumed that fixed and total costs have the same share of capital and labor inputs.

[10]remark that with this calibration method the parameter σ_s does not depend on the type of market structure

1.6 Results

1.6.1 Perfect Competition

In Table 1.4, I report the results for the perfectly competitive case. Increased government spending will drive prices up in all sectors leading to an increase in the cost of living. Wages and the rental rate of capital will rise as well, but not sufficiently to compensate for the increase in the cost of living. As a result consumers welfare which is measured in terms of real revenue deteriorates. In terms of sectoral results only the sectors to which government spending is mostly aimed (office machinery, other manufacturing and services), will benefit from an expansion in their output. The remaining sectors following a crowding out of private demand will reduce their production levels. As domestic prices rise, exports drop and imports increase leading to an improvement in the terms of trade.

1.6.2 Imperfect Competition

Fixed Number of Firms

Table 1.5 and Table 1.6 reproduce the results I obtain in the the two non-competitive cases with constant elasticity of demand, homogeneous goods in one case, differentiated in the alternative. A comparison of these two tables indicate qualitatively similar results with those obtained in the perfect competitive case. Nevertheless, in those noncompetitive sectors where output declines firms will suffer negative economic profits and there will be a deterioration in

economic efficiency as lower output implies that firms will produce at higher average costs (see Figure 1.1, Appendix B).

The more interesting results are presented in the General Oligopoly case (Table 1.7) where there is a significant divergence between domestic and export prices. In three out of five noncompetitive sectors, the increase in prices of exports is significantly less than the price increase for sales in the domestic markets; as the share of domestic firms in the foreign markets is smaller than their domestic share, the demand for exports is more elastic. In two sectors in particular, pharmaceutical and motor vehicles, the share of domestic firms in the foreign market decreases after the initial shock, leading to an increase in the export demand elasticity, and to a drop in export prices. This result implies that the increase in marginal costs following the increase in returns of factors of production has been absorbed by a decrease in the firms mark-up for exports (see Figure 1.1, Appendix B). Overall, the welfare effects are larger in all non-competitive cases.

Variable Number of Firms

When I allow for free entry/exit, the firms in the noncompetitive sectors that suffered negative economic profits will exit the market. Though output in all these sectors will decrease, output per firm increases indicating that fewer firms will survive at a larger individual scale and will produce with lower average costs. This "rationalization" effect is reflected in the efficiency gains reported in all noncompetitive scenarios. The opposite mechanism is at work at the sole

sector, office machinery, that has experienced positive economic profits in the short-run. A comparison of the results in Tables 1.8 - 1.10 indicate, as in the no entry/exit scenario, that the divergence in results is most striking in the General Oligopoly case (Table 1.10). Furthermore, this scenario, permits us to demonstrate the difference between the monopolistic competitive case with homogeneous goods (Table 1.8) on one hand and with product differentiation on the other (Table 1.9). I observe that the welfare losses reported in the latter case are almost double the size of those in the homogeneous products case. The reason for this is that in the product differentiation case where consumers value variety, the exit of firms is reflected in a loss of consumer welfare.

In Appendix C, I reproduce the experiment but we now double the number of firms of the original equilibrium. As the general oligopoly case (Table /nolinebreak1.2C) now approaches the pure monopolistic competition case (Table 1.1C) observe that as expected, the results I obtain in the two models converge. Furthermore, there are positive welfare gains in this case. As the number of firms is larger, the efficiency gains from the rationalization effect are larger as well. There will also be a greater reallocation of resources from the competitive to the noncompetitive sector as demonstrated by the larger increase in the rental rate of capital.

1.7 Conclusion

The purpose of this study has been to evaluate in a case study, the importance of explicitly modelizing oligopolistic interaction and product differentiation in applied general equilibrium models. Inspired by the European CSF program, I have examined the case of an increase in government spending in the Greek economy. Diverging effects on welfare, efficiency, industry reallocation, and trade gave us the grounds for comparison. Four variants of the Greek Economy were constructed. In the first variant markets behave competitively, but domestic and foreign products were considered as imperfect substitutes (the Armington assumption) The second and third variants assumed oligopolistic markets where firms face a constant price elasticity of demand. I distinguished between monopolistic competition with homogeneous goods in one case, and pure monopolistic competition with product differentiation in the alternative case. The fourth variant was a general oligopoly model with a variable price elasticity of demand, that permits for price discriminating between the domestic and export market. I conducted the experiment under alternative assumptions of no entry/exit and free entry/exit of firms. My results in all cases, competitive and non-competitive, indicated a deterioration in consumers welfare as the increase in government spending led to a rise in the cost of living, not compensated by increases in the returns to the factors of production. Nevertheless, the welfare effects in the noncompetitive cases were larger. This result, in the no-entry/exit case reflects efficiency losses following the reduction

tion in output of certain noncompetitive sectors and in the free-entry/exit case a reduction in varieties following the exit of firms from the losing sectors. The distinction between the different noncompetitive models is more clear in the free entry/exit of firms case, as the product differentiation models produce larger welfare effects (negative).

Table 1.1: Sectoral Breakdown of Activities

- Agriculture and primary products	$\in C$	(SITC: 2,3,4)
-Food, beverage and tobacco	$\in C$	(SITC: 1,0)
-Pharmaceutical products	$\in \overline{C}$	(SITC: 54; Nace-clio: 257)
-Chemistry other than pharmaceutical products	$\in C$	(SITC: 5-54)
-Motor vehicles	$\in \overline{C}$	(SITC: 78; Nace-clio: 350)
-Office machinery	$\in \overline{C}$	(SITC: 75; Nace-clio: 330)
-Other machinery and transport materials	$\in \overline{C}$	(SITC: 7-75-78)
-Other manufacturing industries (textile, wood, paper, metallurgy, minerals)	$\in C$	(SITC: 6,8,9)
-Transport and services	$\in C$	
Notes: C =competitive, $\overline{C}$ = non-competitive		

Table 1.2 : Elasticities of Substitution σ_s

- Agriculture and primary products	2
-Food, beverage and tobacco	2
-Pharmaceutical products	5
-Chemistry other than pharmaceutical products	5
-Motor vehicles	10
-Office machinery	10
-Other machinery and transport materials	7
-Other manufacturing industries (textile, wood, paper, metallurgy, minerals)	4
-Transport and services	2

Table 1.3: Calibrated Ratios of Marginal to Average Costs under Alternative Market Structure Assumptions

Agricult.	Food Beverage	Pharm.	Chemist.	Road Vehicles	Office Mach.	Other Mach.	Other . Manuf.	Services
General Oligopoly								
		0.81	0.78	0.82	0.87	0.83		
Pure Monopolistic Competition, Differentiated Goods								
		0.80	0.80	0.90	0.90	0.86		
Monopolistic Competition, Homogeneous Goods								
		0.81	0.78	0.82	0.87	0.83		

Table 1.4: General Equilibrium Effect of an Increase in Government Spending, Perfect Competition with Product Differentiation by Origin (% Changes).

Aggregate Indicators	
Welfare (% equiv. var.)	-0.005
Wage rate	3.65
Rental rate of capital	4.76
Cost-of-living index	4.56
Terms of trade	4.11

Agricult.	Food Beverage	Pharm.	Chemist.	Road Vehicles	Office Mach.	Other Mach.	Other . Manuf.	Services
Export price(% change)								
4.54	4.63	4.16	4.37	4.23	4.28	3.92	3.67	
Domestic price(% change)								
4.54	4.63	4.16	4.37	4.23	4.28	3.92	3.67	4.63
Output (% change)								
-0.63	-0.40	-5.81	-2.01	-4.94	0.50	-4.65	0.68	1.14
Exports(%)								
-8.49	-8.65	-24.84	-19.26	-33.95	-34.22	-23.61	-16.51	
Imports(%)								
8.64	8.46	20.61	19.65	34.87	21.33	22.66	18.26	

Table 1.5: General Equilibrium Effect of an Increase in Government Spending, Monopolistic Competition with Product Differentiation by Origin, Fixed Number of Firms (% Changes).

Aggregate Indicators	
Welfare (% equiv. var.)	-0.012
Wage rate	4.18
Rental rate of capital	5.42
Cost-of-living index	5.14
Terms of trade	4.68
Efficiency gains (%)	-0.66

Agricult.	Food Beverage	Pharm.	Chemist.	Road Vehicles	Office Mach.	Other Mach.	Other . Manuf.	Services
Export price(% change)								
5.16	5.26	4.64	4.92	4.76	4.84	4.42	4.20	
Domestic price(% change)								
5.16	5.26	4.64	4.92	4.76	4.84	4.42	4.20	-2.10
Profits (% of value added)								
		-1.49	-0.34	-1.06	0.46	-1.12		
Output (% change)								
-0.81	-0.54	-4.23	-1.13	-4.99	3.92	-4.31	0.38	1.04
Ratio of marginal and average costs (% change)								
		-1.24	-0.30	-0.98	0.45	-0.79		
Efficiency gains (%)								
		-1.37	-0.27	-0.99	0.46	-1.05		
Exports(%)								
-9.58	-9.75	-20.30	-21.37	-37.20	-37.65	-26.11	-18.60	
Imports(%)								
9.75	9.56	17.01	22.26	39.60	24.86	25.47	20.90	

Table 1.6: General Equilibrium Effect of an Increase in Government Spending, Pure Monopolistic Competition with Differentiated Goods, Fixed Number of Firms (% Changes)

Aggregate Indicators	
Welfare (% equiv. var.)	-0.008
Wage rate	4.41
Rental rate of capital	5.41
Cost-of-living index	5.12
Terms of trade	4.67
Efficiency gains (%)	-0.51

Agricult.	Food Beverage	Pharm.	Chemist.	Road Vehicles	Office Mach.	Other Mach.	Other . Manuf.	Services
Export price(% change)								
5.16	5.26	4.66	4.92	4.78	4.84	4.42	4.19	
Domestic price(% change)								
5.16	5.26	4.66	4.92	4.78	4.84	4.42	4.19	5.26
Profits (% of value added)								
		-1.14	-0.30	-0.60	0.36	-0.96		
Output (% change)								
-0.80	-0.52	-4.26	-1.12	-5.03	3.93	-4.30	0.40	1.05
Ratio of marginal and average costs (% change)								
		-0.95	-0.27	-0.56	0.35	-0.68		
Efficiency gains (%)								
		-1.05	-0.24	-0.57	0.36	-0.90		
Exports(%)								
-9.57	-9.74	-20.38	-21.36	-37.34	-37.65	-26.11	-18.56	
Exports(%)/Export price(%)								
1.86	1.85	4.37	4.34	7.80	7.78	5.91	4.43	
Imports(%)								
9.75	9.67	17.08	22.27	39.78	24.87	25.48	20.87	

Table 1.7: General Equilibrium Effect of an Increase in Government Spending, General Oligopoly with Differentiated Goods, Fixed Number of Firms (% Changes)

Aggregate Indicators	
Welfare (% equiv. var.)	-0.009
Wage rate	4.31
Rental rate of capital	5.59
Cost-of-living index	5.26
Terms of trade	4.82
Efficiency gains (%)	-0.58

Agricult.	Food Beverage	Pharm.	Chemist.	Road Vehicles	Office Mach.	Other Mach.	Other . Manuf.	Services
Export price(% change)								
5.32	5.43	-3.04	2.53	-3.99	1.59	1.83	4.32	
Domestic price(% change)								
5.32	5.43	4.78	4.98	4.12	5.02	4.46	4.32	5.44
Profits (% of value added)								
		-1.52	-0.42	-1.52	0.48	-1.22		
Output (% change)								
-0.85	-0.58	-4.35	-1.11	-3.28	3.83	-4.29	0.32	1.01
Efficiency gains (%)								
		-1.40	-0.26	-0.63	0.45	-1.04		
Exports(%)								
-9.85	-10.04	-20.82	-21.92	-38.07	-38.54	-26.74	-19.08	
Exports(%)/Export price(%)								
1.85	1.85	6.84	8.65	9.52	24.14	14.58	4.41	
Imports(%)								
10.03	9.85	17.54	22.66	34.65	26.24	25.97	21.607	

Table 1.8: General Equilibrium Effect of an Increase in Government Spending, Monopolistic Competition with Product Differentiation by Origin, Variable Number of Firms (% Changes).

Aggregate Indicators	
Welfare (% equiv. var.)	-0.006
Wage rate	4.11
Rental rate of capital	5.44
Cost-of-living index	5.14
Terms of trade	4.66
Efficiency gains (%)	0.06

Agricult.	Food Beverage	Pharm.	Chemist.	Road Vehicles	Office Mach.	Other Mach.	Other . Manuf.	Services
Export price(% change)								
	5.28	4.63	4.93	4.76	4.03	4.39	4.15	
Domestic price(% change)								
5.18	5.28	4.63	4.93	4.76	4.03	4.39	4.15	5.28
Number of Firms (% change)								
		-4.52	-1.29	-5.23	3.72	-4.53		
Output (% change)								
-0.75	-0.47	-4.16	1.06	-4.91	4.01	-4.22	0.53	1.11
Output per individual firm (% change)								
		0.92	0.82	0.94	1.08	0.93		
Efficiency gains (%)								
		0.11	0.05	0.06	0.03	0.07		
Exports(%)								
-9.60	-9.78	-23.87	-22.38	-40.48	-35.34	-29.34	-18.41	
Exports(%)/Export price(%)								
1.85	1.85	5.15	4.54	8.50	7.30	6.67	4.43	
Imports(%)								
9.85	9.67	17.09	22.37	39.71	24.97	25.46	20.82	

Table 1.9: General Equilibrium Effect of an Increase in Government Spending, Pure Monopolistic Competition with Differentiated Goods, Variable Number of Firms (% Changes).

Aggregate Indicators	
Welfare (% equiv. var.)	-0.016
Wage rate	4.07
Rental rate of capital	5.39
Cost-of-living index	5.19
Terms of trade	4.33
Efficiency gains (%)	0.04

Agricult.	Food Beverage	Pharm.	Chemist.	Road Vehicles	Office Mach.	Other Mach.	Other . Manuf.	Services
Export price(% change)								
5.16	5.26	4.66	4.92	4.78	4.84	4.42	4.19	
Domestic price(% change)								
5.16	5.26	4.66	4.92	4.78	4.84	4.42	4.19	5.26
Number of firms (% of value added)								
		-4.54	-1.28	-5.27	3.71	-4.57		
Output (% change)								
-0.78	-0.48	-4.27	-1.12	-5.02	3.96	-4.37	0.49	1.10
Output per individual firm (% change)								
		0.94	0.87	0.95	1.07	0.96		
Efficiency gains (%)								
		0.06	0.04	0.03	0.02	0.04		
Exports(%)								
-9.58	-9.71	-19.55	-21.19	-36.98	-37.89	-25.77	-18.38	
Imports(%)								
9.78	9.58	17.18	22.39	39.86	24.88	25.75	20.73	

Table 1.10: General Equilibrium Effect of an Increase in Government Spending

General Oligopoly with Differentiated Goods,

Variable Number of Firms (% Changes).

Aggregate Indicators	
Welfare (% equiv. var.)	-0.015
Wage rate	4.06
Rental rate of capital	5.39
Cost-of-living index	5.20
Terms of trade	4.34
Efficiency gains (%)	0.04

Agricult.	Food Beverage	Pharm.	Chemist.	Road Vehicles	Office Mach.	Other Mach.	Other . Manuf.	Services
Export price(% change)								
5.17	5.24	-3.14	2.41	-4.13	1.44	1.74	4.14	
Domestic price(% change)								
5.17	5.24	5.11	4.90	4.72	4.72	4.51	4.14	5.25
Number of Firms (% change)								
		-3.74	-1.40	-5.35	3.05	-4.34		
Output (% change)								
-0.78	-0.48	-5.02	-1.06	-4.85	4.10	-4.49	0.50	1.09
Output per individual firm (% change)								
		1.34	0.76	0.90	1.34	1.04		
Efficiency gains (%)								
		-0.42	0.08	0.01	0.12	-0.039		
Exports(%)								
-9.59	-9.72	-19.64	-21.18	-36.84	-37.80	-5.77	-18.37	
Imports(%)								
9.80	9.59	18.3	22.22	39.37	24.29	26.00	20.72	

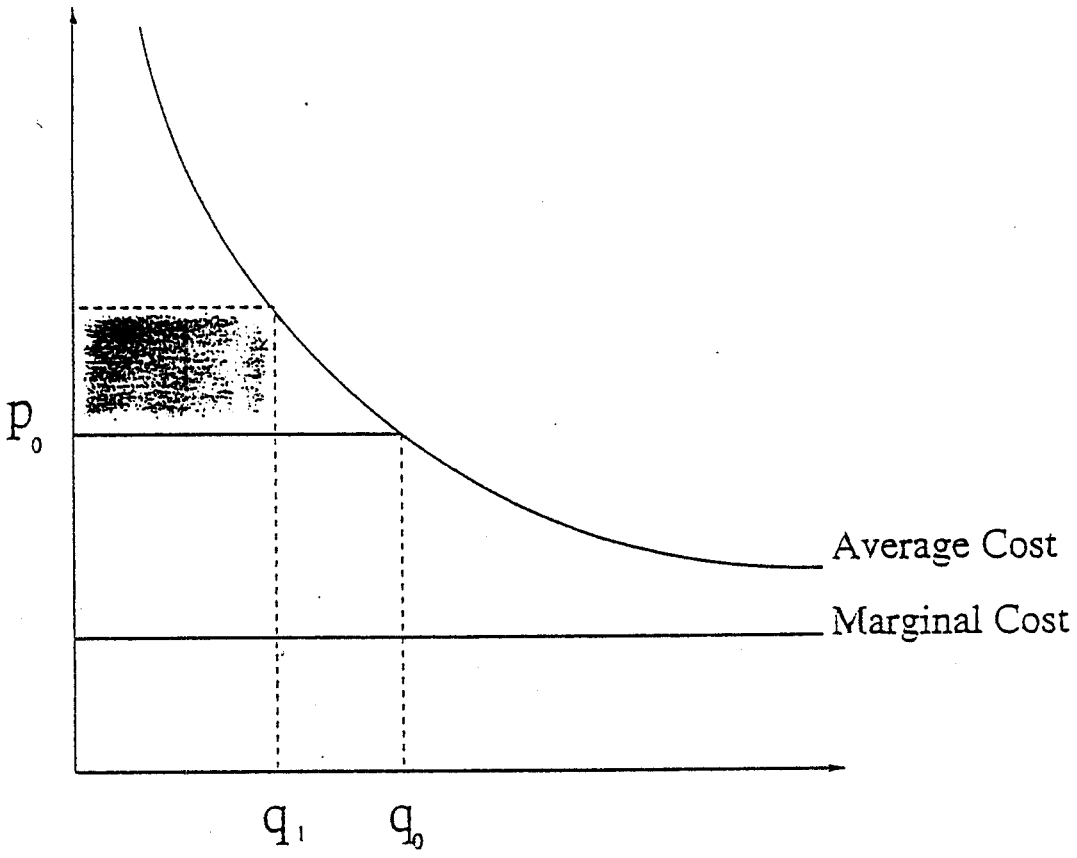
1.8 Appendix A: The Community Support Framework.

The main beneficiaries of the European Community Support Framework (CSF) program are Greece, Ireland, Portugal and parts of France, Italy and Northern Ireland. By 1993 the whole program represented one quarter of the EU budget. Greece in particular has received in the period 1989-1993, transfers from the Community that amount approximately to 2 % of its GDP. The greatest portion of these funds concerns public expenditures mainly in the services and transport sectors.

The CSF, therefore represents a transfer from the CEE to the government of the recipient countries. An important attached element of these transfers is an "additionality "principle, which requires that these proceeds will be spent in addition rather than in substitution of planned domestic public expenditures. Hence if the CSF implies an additional income for the government, it also means additional expenditures so that the country's budget deficit should not be affected. There is another part of the CSF that involves spending in human resources and concerns training in industry, tourism,energy and transport and school vocational training. These training programs are supported by direct income transfers to households.

1.9 Appendix B: Partial Equilibrium Analysis of an Increase in Government Spending.

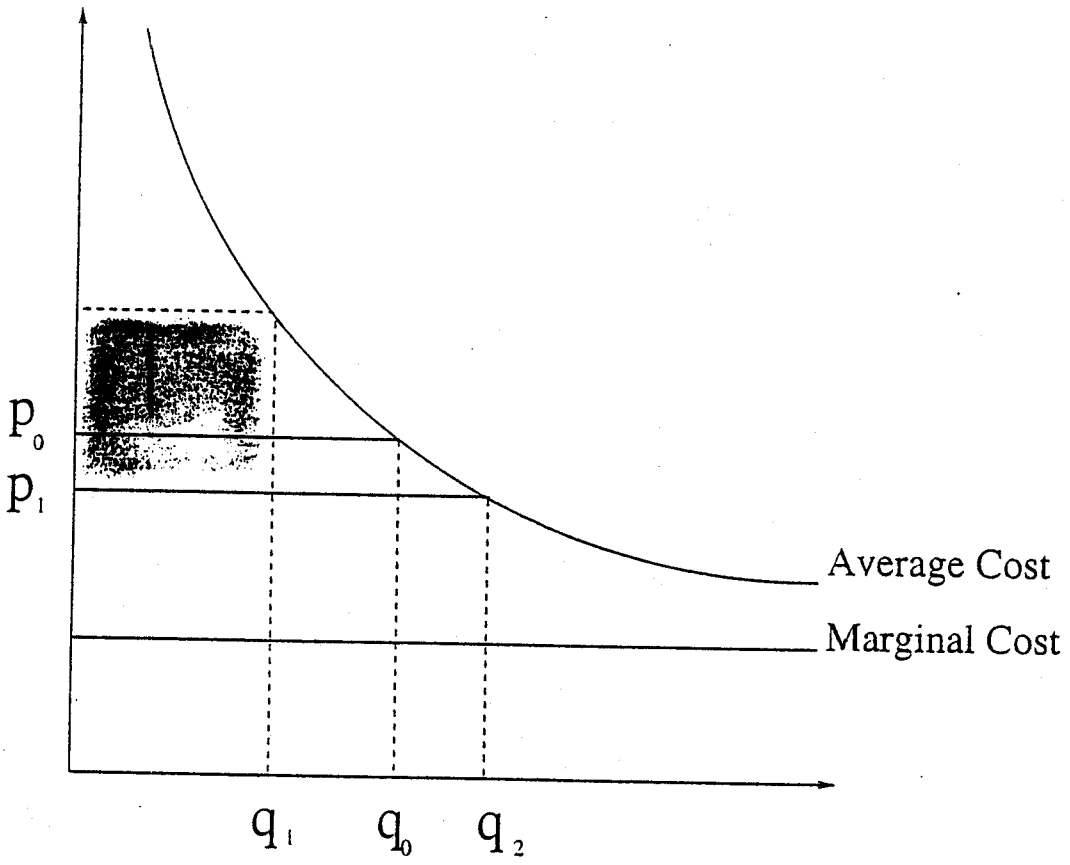
Figure 1.1: Partial Equilibrium Analysis of an Increase in Government Spending: The Case of Constant Elasticity of Demand.



Initial equilibrium is given by price $P_0 = MC = AC_0$ and individual firms product q_0. At this point profits are zero. In the no entry/exit scenario, following the exogenous shock, there will be a decrease in demand in some of the

non-competitive sectors and therefore a decrease in the individual firms output. Assuming fixed marginal costs and given the fixed mark-up assumption, the new equilibrium will be at (q_1, P_0). Consequently, there will be negative profits (the shaded area) for the individual firm as it will not be able to cover its average costs. Furthermore, as the latter costs are higher than in the initial equilibrium there will be efficiency losses in production. In the free-entry scenario, negative profits will force some firms to exit the market and zero profit equilibrium implies that the smaller number of surviving firms will operate on a larger scale. The new equilibrium will be at the initial level of prices and output, (P_0, q_0) but the total number of firms in the sector will have decreased. It is easy to see how general equilibrium effects will affect this story and thereby the sign and the amplitude of the movement towards the new equilibrium. When returns to the factors of production are taken into consideration the steepness of the average cost curve will be affected by shifts in the relative prices of the primary factors of production, while changes in relative prices of intermediate goods move both curves up and down. I may add to the above complex interactions between income and substitution effects on the demand side that will also play a role in the determination of the new equilibrium.

Figure 1.2: Partial Equilibrium Analysis of an Increase in Government Spending: The Case of Variable Elasticity of Demand.



Initial equilibrium is identical with figure 1.1, at (p_0, q_0). In the no-entry/exit scenario, the variable elasticity of demand assumption implies that the new equilibrium prices may be higher or lower than p_0. Lets assume that one such equilibrium is (p_1, q_1). In this case negative profits are larger than in the fixed

mark-up scenario. Therefore, in the alternative scenario of free entry the expected exit of firms is larger. At the new zero-profit equilibrium (p_1, q_2), there will be extra efficiency gains as the firm has moved down on its average cost curve.

1.10 Appendix C

Table 1.1C: General Equilibrium Effect of an Increase in Government Spending

Pure Monopolistic Competition with Differentiated Goods,

Variable Number of Firms, Larger Number of Firms (% Changes).

Aggregate Indicators	
Welfare (% equiv. var.)	0.004
Wage rate	4.65
Rental rate of capital	6.19
Cost-of-living index	5.85
Terms of trade	5.03
Efficiency gains (%)	0.04

Agricult.	Food Beverage	Pharm.	Chemist.	Road Vehicles	Office Mach.	Other Mach.	Other . Manuf.	Services
Export price(% change)								
5.90	6.01	5.34	5.64	5.48	5.53	5.08	4.72	
Domestic price(% change)								
5.90	6.01	5.34	5.64	5.48	5.53	5.08	4.72	6.02
Number of Firms (% change)								
		-5.04	-0.43	-4.80	8.26	-4.28		
Output (% change)								
-0.89	-0.56	-4.71	-0.22	-4.50	8.56	-4.03	0.29	1.05
Output per individual firm (% change)								
		0.93	0.51	0.93	1.04	0.94		
Efficiency gains (%)								
		0.08	0.04	0.03	0.03	0.05		
Exports(%)								
-10.84	-11.02	-21.90	-23.94	-41.03	-42.15	-28.81	-20.60	
Imports(%)								
11.28	11.01	19.48	25.59	45.78	29.10	29.35	23.86	

Table 1.2C: General Equilibrium Effect of an Increase in Government Spending General Oligopoly with Differentiated Goods, Variable Number of Firms, Larger Number of Firms (% Changes).

Aggregate Indicators	
Welfare (% equiv. var.)	0.004
Wage rate	4.65
Rental rate of capital	6.19
Cost-of-living index	5.85
Terms of trade	5.03
Efficiency gains (%)	0.06

Agricult.	Food Beverage	Pharm.	Chemist.	Road Vehicles	Office Mach.	Other Mach.	Other . Manuf.	Services
Export price(% change)								
5.19	6.02		1.92	4.44	2.22	4.05	3.82	
Domestic price(% change)								
5.19	6.02	5.53	5.60	5.45	5.45	5.10	4.72	6.02
Number of Firms (% change)								
		-4.58	-0.57	-4.90	7.62	-4.21		
Output (% change)								
-0.90	-0.57	-5.04	-0.17	-4.43	8.68	-4.07	0.29	1.06
Output per individual firm (% change)								
		1.10	0.29	0.90	1.13	0.96		
Efficiency gains (%)								
		-0.12	0.09	0.07	0.1	0.03		
Exports(%)								
-10.86	-11.03	-21.97	-23.93	-41.00	-42.12	-28.82	-20.61	
Imports(%)								
11.24	11.03	20.36	25.45	45.57	28.68	29.44	23.87	

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Chapter 2

An Evaluation of Welfare Effects of the Completion of the Single European Market: The case of Greece

2.1 Introduction

This paper aims at evaluating the welfare and industry effects of the completion of the Single European Market on Greece. Most previous studies on the completion of the Internal Market (Europe "1992") have singled out a few "larger" North-European members and have aggregated the "smaller" South European members with the rest-of-the-European members. An exception is the attempt of Giasorek, Smith and Venables (1992) to highlight the effects on some "smaller", "less developed" European members by separatedly identifying Spain/Portugal and Greece/Ireland. Interestingly enough, though in the first set of models the aggregate "the rest-of-Europe" is essentially nonaffected by Europe "1992" , in the Giasorek et al, study it is in these "smaller" countries that the completion of the internal market has a stronger effect. In view of the concerns over unequal benefits stemming from the European Union for the "Northern" and "Southern" partners, the above results suggest that in order for any conclusion to be valid for this group of countries, a further disaggregation along North-South lines and in particular an identification of a "smaller" country is necessary. For this reason our study should be of interest not only to those concerned with the Greek economy, but also to those concerned by the effect of the completion of the Single Market on other "smaller"-"less industrialized" -"Southern" countries.

The methodology I have used is that of Mercenier (1995). It consists of a static multicountry, multisector general equilibrium model with increasing

returns to scale, imperfect competition and product differentiation at the firm level. By completion of the Single Market I will refer here to the elimination of nontariff trade barriers (NTB) within the European Community which is expected to force firms to adopt a single pricing rule within Europe determined on the basis of their EU-average monopoly power. The fundamental mechanisms underlying the model is the following. At the eve of integration, NTB's confer to oligopolistic firms the power to price discriminate between national markets. It will in general be the case that firms will charge higher prices in the domestic rather than in foreign markets because of the larger market share they have in the former and the greater price unresponsiveness which causes the domestic demand to be less elastic to prices. With integration, NTB's are dismantled and consequently price discrimination should cease. As firms are expected to move to a single price strategy, one expects domestic prices to decrease and export prices to rise. If consumer prices decline relative to factor prices, consumers will be better off. In addition, there may be production efficiency gains the magnitude of which will depend to some extent on whether entry/exit of competitors is allowed for. Thus, under the assumption of no entry/exit, efficiency gains could result if existing firms produce greater quantities, therefore at lower unit costs. This effect could be magnified when we allow for free exit/entry. In this case, firms that experience negative profits due to the drop in domestic prices will exit the industry, making it possible for the remaining firms to expand their production and move further down on their average cost curves. This positive outcome from industry restructur-

ing, could be offset by the welfare and efficiency cost due to a decrease in the available variety of products. This is because I assume that:

1) consumers have a love for varieties type of preferences (Dixit-Stiglitz 1977),

2) production efficiency in all sectors (competitive and non competitive) increases with the number of intermediate inputs available (Ethier 1982).

This work differs from Giasorek and al, (1992) in more than one respect. First, in the latter study Greece is aggregated with Ireland: there is no justification whatsoever for this except mere modelling convenience. Second, the authors adopt a pricing rule that is rather ad hoc: they assume that firms charge the same prices in intermediate and final markets, though the monopoly power underlying the pricing strategy is based on final demands only. Furthermore, they make the simplistic assumption that the proportion in which each industry uses the products of other countries is identical. Finally, their calibdration procedure sets the burden on product-differentiation parameters rather than scale elasticities as is the case here.

The chapter is organized as follows: In section 2.2 I make a short presentation of NTB's. Section 2.3 briefly presents the alternative methods of interpreting the effects of Europe "1992" in models of imperfect competition. Section 2.4 sets a "Southern" perspective to the issue of European integration while section 2.5 provides a description of some features specific to the industrial structure of the Greek economy and suggests how an integrated European market may affect this structure. The description of the theoretical

model, the data set and the calibration procedure are found on sections 2.6 and 2.7 respectively. Industry and welfare results are presented in section 2.7 for two alternative market structure scenario's: no-entry/exit case (fixed number of firms), and the free entry/exit case (variable number of firms). In section 2.8 I report results assuming that the European integration is implemented in all European countries but Greece. It is argued that to evaluate the true cost/benefits of Greece's decision to be part of the European Single Market, the international environment generated by this simulation is more relevant than the pre-"1992" international environment. The general conclusion from all the above results is presented in section 2.9.

2.2 Non-Tariff Barriers in Europe

Though tariffs on intra-EU trade have been almost completly abolished for sometime, non-tariff barriers still exist and the EU "1992" program is meant to abolish them. These barriers that appear to be widespread and be common to all countries can be grouped as follows [1]

(i) customs controls and other administrative formalities (physical barriers);

(ii) limited access to public procurement;

(iii) national differences in standards and technical regulations (technical barriers);[2]

[1]The European Economy, Social Europe p25.

[2]For a definition of technical standards and regulations as well as examples of existing trade barriers in this category see Appendix A.

(iv) tax frontiers (fiscal barriers);

(v) import quotas and other measures permitted by virtue of Article 115 of the Treaty of Rome.[3]

Barriers (i) and (iii) may be classified as cost increasing barriers. In the first case, customs formalities involve delays and various kinds of administrative procedures which impose a cost on the movement of all goods between member countries. In the second case national norms and technical standards require producers to manufacture or package goods in forms which are different for other EU markets than those for their own domestic markets. Both these elements produce a wedge between the cost of domestic goods and delivered exports, considerably larger than the transport cost involved.

In addition to increasing costs all of the above mentioned trade barriers limit access to EU market, and in some instances the barrier is prohibitive as is the case with public procurement.

The European Commission prepared a list of 40 industries that were identified as the most sensitive to the abolition of the non-tariff trade barriers and the completion of the internal market. In addition to the level of non-tariff measures the other criteria that the Commission adopted to identify the sensitive sectors included indicators of market segmentation (price dispersal for identical products sold in the EU), of economies of scale as well as of the degree of intra-EU trade. This list was then adapted to each individual member

[3]To the above list Greece has added export subsidies as an important trade barrier. The sectors that were mostly affected by these barriers were identified to be the steel, aluminum and leather sectors.

country, taking into account their specificities. In the case of Greece, the steel, food processing, textile and leather goods industries were added to the most sensitive sectors. The sensitive sectors were found to represent 56.7% of value added and 61.5% of employment in the Greek industry. This is much more than in other European countries which led the European Commission to conjecture that the Greek economy will be particularly affected by the completion of the single European market.

2.3 Impact of Europe "1992" in Models of Imperfect Competition.

The effect of the Europe "1992" program is two fold:

1) the cost of intra-industry trade will be reduced by the abolition of custom controls and by the harmonization of technical standards;

2) increased trans-border price-arbitraging which should prevent firms to set different prices in different national markets, i.e. force firms to switch from a segmented market to an integrated pricing behavior.

The first effect will boost intra-EU trade. Increased foreign competition means that local oligopolistic firms will face more elastic domestic demands and be forced to reduce mark-ups which in turn will squeeze profits. Welfare gains are expected to be greatest in those industries with the greatest economies of scale and with high intensities of intra-EU trade. This mechanism operates with firms acting as price discriminating oligo polists: their decisions in each individual market depends on their market

share in that specific market. This is the *segmented market* hypothesis.

The second component of the "1992" program should result in a different market organization: firms would no longer make their decisions on the basis of their market shares in individual markets but on their market share in the whole of the European market. This is the *integrated market* case. The reason for this behavioral shift is that prior to "1992" non-tariff trade barriers prevented consumers from equalizing cross-border prices through arbitrage and therefore empowered firms to price discriminate between the segmented national markets. The dismantling of NTB's restores cross-border arbitraging and enforces firms to act on an integrated EU market basis charging the same price across countries in the European Union. Since sales patterns in virtually all goods display substantial home country bias, with firms having a much larger share in their home markets than that of other European markets, the policy outcome implies a shift to a more competitive market structure. Firms will reduce their home market price-markup and eliminate their dumping practice in the export markets within the EU. This could result in a reduction of intra-EU trade, which in fact is the opposite effect of the first policy variant.

In both policy variants European consumers will benefit from the reduction in average price-cost margins and from more efficient technologies through industry restructuring.

Giasorek, Smith & Venables (1992), Haaland and Norman (1992) have attempted to evaluate Europe "1992" in studies where both policy variants were incorporated. Therefore, they estimated the effects of:

1) a simple reduction in the costs of intra-EC trade of 2.5 per cent of the value of trade;

2) the same cost reduction, coupled with the assumption that the EC becomes a single market.

In Harrisson & al, (1994) we find comparable estimates of welfare gains of the above studies for both prime policies. Welfare gains were reported significantly higher in the second variant for all cases, tripled in the Giasorek study and doubled in the Haaland study. Mercenier (1995), who does not evaluate the first policy variant in the Europe "1992" experiment, obtained larger estimates of welfare gains than the other two studies with only the prime policy variant. Mercenier and Schmitt (1995) replace the assumption of recoverable fixed costs and therefore costless free entry/exit of firms used in the other models with the assumption of firm specific "sunk" costs that become barriers to entry/exit of firms. Though welfare changes, in this particular model, were found to be robust to the introduction of sunk costs, the industrial structure remained essentially unaffected resulting to only minor efficiency gains from trade liberalization. Finally, Mercenier and Akitoby (1994) include intertemporal effects of Europe "1992" and they find that welfare gains roughly double in the long-term for the larger European countries.

2.4 Europe "1992" and the "Southern" Members of the E.U.

Most applied general equilibrium studies on the completion of the internal market model only a few major North European members, i.e, countries that though not identical are similar in terms of aggregate economic performances, factor endowments and industrial structure. The estimated welfare effects of Europe "1992", were found to be positive in all cases. The effects of Europe "1992" on the "Southern", "less industrialized" countries of Europe adds another concern to the unification process. Indeed, three Southern economies are substantially different from the other member countries, both by their industrial structure and by their living standards. These countries have the lower per capita GDP in the EU: in 1989, per capita GDP in Portugal and Greece was 46% below EU average, and Spains' living standards was 24% below the European average.

In terms of external performances, these countries share some common characteristics: their highly competitive sectors are mostly in traditional activities (footwear, clothing and textiles), where they enjoy a comparative advantage. There are also important differences between these economies. The Spanish economy has some industries with higher capital or skilled labor components, such as, domestic-type electrical appliances, lighting equipment and motor vehicles, while Ireland distinguishes itself from the other less developed European countries, by the fact that it is well placed in some high technology sectors such as data processing, telecommunications and pharmaceuticals,

while its external performance is poor in the traditional sectors of footwear, clothing and textiles.

Given these conditions what can these countries expect from Europe "1992" ? One can envisage two possible scenarios. In the first scenario, the decline in import prices due to the elimination of non-trade barriers increases intra-EU trade and each member state specializes in those sectors where it enjoys comparative advantage. The three Southern Mediterranean countries would experience a boost of exports to the rest of the EU in those sectors where they initially enjoyed a comparative advantage, that is roughly speaking in industries with high unskilled labor content. There are two inherent risks in this scenario. The first involves the loss of market shares in EU trade of the Southern European countries from other "less developed" countries, that are not members of the European Union but possess greater comparative advantages in these sectors. The second is a longer term risk as it implies that the Southern members will specialize in sectors that are low in R&D and therefore have limited potential for growth. This is a case where the fears of a two speed-Europe seem realistic.

A second scenario is that the completion of the internal market will lead to increased competition and more intense exploitation of economies of scale. If this is the case, there will be a reallocation of resources from the traditional industries to industries with higher technological component and greater potential for growth. This scenario involves an increase of the levels of human and physical capital in these countries; furthermore, foreign investment could

contribute to this process by favoring technology transfer from the Northern, more advanced members. Ireland provides an interesting example as it has managed to develop a high technology industrial sector thanks to foreign investment.

In order to capture the pro-competitive and economies of scales effect it is evident that a model with imperfect competition is required. From the two policy variants summarized in the previous section the second variant is the one that gives the larger pro-competitive effects since the effective shares of each individual firm are reduced following the removal of non-tariff barriers. Nevertheless, to the extent that the "less developed" EU members appear in existing applied general equilibrium models they are aggregated with other European Union countries in various disaggregation schemes. Interestingly, in most studies the results obtained for these regions differ significantly. Indicatively, Mercenier (1995) in his study for EC-10 aggregates Greece with Netherlands, Ireland, Belgium and Denmark and finds the lesser gains for this group of countries when compared with the "larger" EU members (in terms of percentage changes in welfare, efficiency gains and output expansion). In Giasorek, Smith and Venables (1991), the rest-of-the EU aggregate includes also Spain and Portugal and in this case the largest percentage changes in output and factor demands are recorded for this group in particular. It is evident therefore, that further disaggregation of this group, preferably along North-South lines and separately identifying a "small country" should be more clarifying with respect to the consequences of "Europe 1992 " for the Southern

less developed members of the EU. Moreover, the results obtained from such disaggregation would be even more valuable, in view of the expected further enlargement of the EU to embrace Eastern-European countries and possibly Turkey.

Finally, one should mention that an "intertemporal" model would probably illustrate better the salient effects of "1992" for the "less developed"-"Southern" members. In Mercenier and Akitoby (1994), the results for the rest-of-the-EC aggregate (which is the same as in Mercenier 1995) indicate a contraction of short investment and of long term production capacities, reflecting a shift towards more labor-intensive activities and the relative decline of returns on physical capital. Furthermore, for these countries there are virtually no long-term welfare gains. One cannot fail to wonder whether these pessimistic predictions would resist to a more appropriate country disaggregation.

2.5 The Structure and Perspectives of the Greek Industry.

The Greek industry is characterized by a particular dual structure that sets this economy apart from the others within Europe. Indeed in some industries such as the clothing, footwear, furniture, machinery and leather industries, small firm size is the prevailing feature, with an average level of employment of 4.5 employees per establishment. This is considerably lower than the EU averages but also lower than in other Mediterranean economies supposed to

be similar: for instance, Portugal's average is 15 employees per establishment (Vernathakis.H, 1989, pp 269-283). Also remarkable is the high concentration rate in industries such as tobacco, cotton, wool and knitting, paper, chemicals, petroleum oil processing, metallurgy and vehicles production (Katseli. L, 1990).

According to Katseli (ibid) structural duality in the case of Greece can be attributed to the development of "state-corporatism" [4] The industrial sector was gradually sorted into two categories: the "official" and the "unofficial" sectors. The former sector represented about 26% of total employment by 1983 and consisted of enterprises that were directly or indirectly owned by the government and the state-bank. Industries in the official sector include some traditional industries such as tobacco, oil refinery and metallurgy products but also some modern industries, chemical and transportation products in particular. The private firms in this sector are family owned and they are subject to preferential treatment granted by the public sector. As a result, barriers to entry have been erected in the form of legal barriers, sector specific regulations, and discriminatory application of domestic fiscal instruments[5] that counter the trend towards overall trade liberalization that occurred in the same

[4] "State corporatism is the voluntary cooperative regulation of conflicts over economic and social issues through a highly structured and interpenetrated set of political relationships by the state, banks and business augmented at times by unions and political parties... Strong corporatist structures have a pervasive ideology of social partnership shared by the leaders of government, banks and business; they rely on the cooperative efforts of relatively centralized institutions representing those interests and they usually lack in worker militancy" (Katzenstein 1983).

[5] Until 1980 this included an array of ad-valorem and specific taxes and selective discrimination against imports either directly through nominal rate differentiation or indirectly through notional changes in the tax base (Georgakopoulos 1989).

period, mostly due to the accession agreement with the EU.

Thus in the period 1970-1980 although the Nominal Effective Protection Rate (NEPR) decreased for most industrial sectors it increased or remained high for firms in the official sector. Not surprisingly the sector for which the NEPR has risen by most, the oil refinery sector, is one of the most highly concentrated sectors where in 1984 the largest 15 firms out of a total of 212 owned virtually 100% of the total assets (Papandreou 1988). The concentration rate is also very high in all the other sectors that also enjoyed high nominal and effective protection during the same period.

Preferential treatment granted by the public sector to the official sector also included limited access to investment subsidies and to bank credit at subsidized, negative real rates. Soon it became overcapitalized and eventually overindebted as real rates rose in the 1980's. Subsequently, "soft budgeting"[6] by the corporatist state has prevented the exit by loss-making firms through extension of subsidies and protection. Indicatively in the period 1979-1986 while loss making firms accounted for 40% of all firms, bankruptcy rates were only 7%, and they reflected shutdowns not of the large loss-making firms but of small firms (Papandreou, ibid). In conclusion, the overall effect of "state corporatism" and "soft budgeting" helped to create an "official sector" that is characterized by high concentration levels and overcapitalization. In contrast, the "unofficial" sector consists of small firms which have limited or no access

[6]According to Kornai a firm's budget constraint is soft when the strict relationship between expenditure and earnings has been relaxed, because excess expenditures over earnings will be paid by some other institutions, typically the state (Kornai, 1986, p.4.)

to bank credit and which is significantly undercapitalized.

Greece's integration in the European Community in 1981 led to a decrease in protection rates which by 1985 had dropped to an average of 33.6% down from 45% in 1975 (Giannitsis, 1988). However this liberalization has not been taking place with equal force in all sectors. According to Giannitsis nominal protection rates decreased for the traditional sectors and increased for the modern sectors, to decrease only after 1985. Furthermore, if one takes into consideration production and export subsidies that were still permitted until 1985 effective rates of protection only slightly decreased even for the traditional industrial sector.

How is "Europe 1992" to have a favorable effect on the structure of the Greek industry? As is apparent, state corporatism and soft budgeting has created effective protection from foreign competition allowing large firms to exercise monopolistic power in the domestic market. The largest 300 firms that control over 70% of all assets have maintained in the past substantial price-cost mark-ups as they have been sheltered from competition (Katseli, ibid). Therefore, increased competition due to integration will force Greek firms to lower their price-cost mark-ups significantly. One effective way to lower costs, is to exploit economies of scale more fully, thus moving down the average cost curve. Furthermore, as "soft budgeting" ceases the loss-making firms will be obliged to exit the market, leading to a possible further output expansion for survivors.

In what follows I will present the theoretical model that I have used to

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In what follows I will present the theoretical model that I have used to

estimate the pro-competitive effect of "Europe 1992" on the industrial structure and welfare of Greece. I will limit my analysis to the evaluation of the switch from market segmentation to market integration, i.e., from a general equilibrium with price differentiation to one with single pricing with the EU.[7]

[7]In fact the effect from the reduction in intra-industry trade costs following "1992" is expected to be of a lesser magnitude in the case of Greece compared to other member countries: cost-increasing NTB's in the case of Greece are limited to specific sectors, mostly biscuits, beer and leather (Social Europe-National Reports, 1992)

2.6 The Applied General Equilibrium Model

First are defined the different commodity sets. Sectors of activity are identified by indices s and t, with S representing the set of all industries so that $s, t = 1, ..., S$. S is partitioned into the subset of competitive constant returns-to-scale sectors, denoted C, and the subset of non-competitive increasing returns-to-scale industries, which I note $\overline{C}$. Countries are identified by indices i and j, with $i, j = 1, ..., W$ and $W = EEC \cup ROW$, where the first subset represents the EEC10, and the last subset represents the OECD countries that do not belong to EEC. In a multicountry, multisector framework, it is necessary to keep track of the trade flows by their geographical and sectoral origin and destination. Thus, a subscript $isjt$ indicates a flow originating in sector s of country i with industry t of country j as recipient. Since it will be necessary more than once to aggregate variables with respect to a particular subscript, to avoid unnecessary proliferation of symbols, occasionally I will substitute a dot for the subscript on which aggregation has been performed; for instance, $c_{.si}$ is an aggregate of c_{jsi} with respect to the first subscript.

2.6.1 Households

Final consumption decisions in each country are made by a representative consumer whose preferences are given by:

$$U_i = \sum_{s \in S} \rho_{si} \log(c_{.si}) \qquad \sum_{s \in S} \rho_{si} = 1, \tag{2.1}$$

$$c_{.si} = \left(\sum_{jw} \delta_{jsi} c_{jsi}^{\frac{\sigma_s - 1}{\sigma_s}} \right)^{\frac{\sigma_s}{\sigma_s - 1}} \qquad s \in C, \tag{2.2}$$

$$c_{.si} = \left(\sum_{j \in W} n_{js} \delta_{jsi} c_{jsi}^{\frac{\sigma_s - 1}{\sigma_s}} \right)^{\frac{\sigma_s}{\sigma_s - 1}} \qquad s \in \overline{C} \tag{2.3}$$

where δ_{jsi} are share parameters and σ_s are substitution elasticities and where $c_{.si}$ and $s \in C$ is a composite good of domestic and imported goods and $c_{.si}$, $ss \in \overline{C}$ is a composite good of products of individual firms. Consumption decisions are made at two levels. At the first level, the consumer chooses the optimal amount of a composite good $c_{.si}$ given constant expenditure shares (ρ_{si}). At the second level he chooses the optimal composition of the composite good in terms of geographic origin for the competitive industries (the Armington specification) and in terms of individual firms products for the non-competitive industries (the Dixit-Stiglitz specification). Final demands c_{jsi} are given by maximization of (2.1) , subject to (2.2), (2.3) and to the consumer's budget constraint, i.e. the sum of wage earnings, capital rentals and pure profits,

$$Y_i = \sum_{j \in W} \sum_{s \in C} p_{js.} c_{jsi} + \sum_{j \in W} \sum_{s \in \overline{C}} p_{jsi} n_{js} c_{jsi} \tag{2.4}$$

$$= \sum_{s \in S} w_i L_{is} + \sum_{s \in S} [r_i K_{is} + \Pi_{is}], \tag{2.5}$$

where p denotes prices and L_{is} , K_{is} labor and capital supply respectively. This type of formulation recognizes the possibility for non-competitive firms to price discriminate between countries (p_{jsi}) but not for competitive industries ($p_{js.}$). Also I assume that both capital and labor are mobile between sectors

but not between countries.

2.6.2 Firms

Competitive industries

In competitive industries, input demands by producers result from maximization of variable unit costs v_{is}.

$$v_{is}Q_{is} = \sum_{j\in W}\sum_{t\in C} p_{jt.}x_{jtis} + \sum_{j\in W}\sum_{t\in \overline{C}} p_{jti}x_{jtis} + w_i L^v_{is} + r_i K^v_{is} \qquad (2.6)$$

subject to the production function

$$\log(Q_{is}) = \alpha_{Lis}\log(L^v_{is}) + \alpha_{Kis}\log(K^v_{is}) + \sum_{t\in S}\alpha_{tis}\log(x_{.tis}) \qquad (2.7)$$

Where

$$x_{.tis} = \left(\sum_{j\in W}\beta_{jtis}x_{jtis}^{\frac{\sigma_t-1}{\sigma_t}}\right)^{\frac{\sigma_t}{\sigma_t-1}} \qquad t\in C$$

and

$$x_{.tis} = \left(\sum_{j\in W} n_{jt}\beta_{jtis}x_{jtis}^{\frac{\sigma_t-1}{\sigma_t}}\right)^{\frac{\sigma_t}{\sigma_t-1}} \qquad t\in \overline{C},$$

where $x_{.tis}$, $t \in C$, $x_{.tis}$, $t \in \overline{C}$ are composite intermediate inputs of goods produced in the competitive sectors (the Armington specification) and the imperfectly competitive firms, (the Ethier specification) respectively. To guarantee homogeneity of degree one of the unit costs in prices I set

$$\alpha_{Lis} + \alpha_{Kis} + \sum_{t\in S}\alpha_{tis} = 1,$$

where α and β are share parameters and $\beta_{jtis} = 0$, $\forall j \neq i$ if t is non-traded. Profit maximization implies marginal cost pricing i the competitive sectors so

that

$$p_{is.} = v_{is}, \qquad s \in C.$$

Non-competitive industries

In the non-competitive industries, individual firms face fixed primary factor costs. Thus, total unit costs V_{is} and marginal costs v_{is} are no longer equal. Total unit costs are given by

$$V_{is} = v_{is} + \frac{\left[w_i L_{is}^F + r_i K_{is}^F\right]}{Q_{is}}, \qquad s \in \overline{C} \tag{2.8}$$

where Q_{is}, L_{is}^F, K_{is}^F denote respectively the *individual* firm's output, fixed labour and fixed capital.

When markets are initially segmented, firms charge a different price in each market according to the Lerner formula

$$\frac{p_{isj} - v_{is}}{p_{isj}} = \frac{-1}{E_{isj}}, \quad s \in \overline{C} \tag{2.9}$$

where $E_{isj} < 0$ is the firm's perceived elasticity of demand for market j. In each case, perceived demands are calculated assuming that in each country individual clients' current price expenditure on the whole industry is unaffected by its own action and thus assumes that

$$\frac{\partial \rho_{sj} Y_j}{\partial a_{isj}} = 0, \qquad j = 1, \ldots, W \tag{2.10}$$

$$\frac{\partial \alpha_{sjt} v_{jt} Q_{jt}}{\partial a_{isj}} = 0, \qquad j = 1, \ldots, W \quad t = 1, \ldots, S \tag{2.11}$$

where a_{isj} denotes the strategic variable of the firm producing in country i, sector $s \in \overline{C}$.

If firms are assumed to behave *à la Bertrand-Nash*, it is straightforward to show that this elasticity is the sum of the elasticities of each component of country j's aggregate demand with respect to the firm's price, weighted by the relative importance of each sub-demand in the firm's total sale to country j . In the alternative case where firms are assumed to behave *à la Cournot-Nash*, the computation of this elasticity is made extremely complex because of the distinction between final and intermediate demands; indeed, one has to inverse the log-linearized aggregate demand system for each country and for each non-competitive sector (see Appendix B).

In the case where the number of firms in each industry are fixed, individual firm profits may be nonzero in which case

$$\Pi_{is} = n_{\text{is}}\pi_{is} = \sum_{j \in W} p_{isj} n_{\text{is}} \left[c_{isj} + \sum_{t \in S} x_{isjt} \right] - V_{is} n_{is} Q_{is}, \quad s \in \overline{C}.$$

Naturally with free entry and exits, profits are set to zero.

2.6.3 General Equilibrium

A general equilibrium is a vector of prices (p_{isj}, w_i, r_i) such that

• Supply equals demand on each market :

$$Q_{is} = \sum_{j \in W} \left[c_{isj} + \sum_{t \in S} x_{isjt} \right], \qquad s \in S, i \in W \tag{2.12}$$

$$L_i^{sup} = \sum_{s \in C} L_{is}^v + \sum_{s \in \overline{C}} [L_{is}^v + L_{is}^F], \qquad i \in W \tag{2.13}$$

$$K_i^{sup} = \sum_{s \in C} K_{is}^v + \sum_{s \in \overline{C}} n_{is}[K_{is}^v + K_{is}^F], \qquad i,j \in W_j \qquad (2.14)$$

where L_i^{sup} and K_i^{sup} represent fixed primary factor endowments;

- Profits equal zero in all competitive industries;
- Firms in non-competitive industries mark up prices over marginal costs according to (2.9). The perceived elasticity E_{isj} is evaluated at equilibrium prices and demands, so that, even though the firm may be slightly mistaken on the true demand curve it faces, it correctly perceives the prices that will clear the markets for the quantities actually produced;
- In non-competitive sectors, the number of firms n_{is} may be either fixed in which case profits may be different from zero, or alternatively they may be endogenously determined in which case profits are nil.

The Rest-of-the-World wage rate is chosen as the numéraire.

2.7 Data Set and Calibration Procedure

2.7.1 Data Set

The base year is 1982; EU therefore is actually EEC-10. Greece, Great Britain, Germany, Italy and France are identified separately, whereas the rest of the European countries are aggregated as RE. The adopted sectoral breakdown of activities is detailed in Table 2.1 We have kept the disaggregation of Mercenier (1995) in order to keep the symmetry of the model. Of course there are some sectors, as for example the paper product sector, that are noncompetitive and are characterized by significant non-tariff barriers (European Economy,1993, Table 2, p180), high concentration rates (Katseli 1990, Table 7, p96) and

potential economies of scale (Social Europe, p 192). Nevertheless as long as there is no significant product differentiation, classifying these sectors with the competitive sectors should not significantly affect our results.

The database includes bilateral trade flows, separate input-output tables for domestic and imported inputs, final demands by type and sectoral origin, production and labor earnings figures. In the case of Greece, some of this data was sent to us by the Bank of Greece. The rest was collected from standard international publications. A RAS procedure was used to provide consistency of the input-output table of 1980 with the other sources.

Table 2.1: Sectoral Breakdown of Activities

- Agriculture and primary products	$\in C$	(SITC: 2,3,4)
-Food, beverage and tobacco	$\in C$	(SITC: 1,0)
-Pharmaceutical products	$\in \overline{C}$	(SITC: 54; Nace-clio: 257)
-Chemistry other than pharmaceutical products	$\in C$	(SITC: 5-54)
-Motor vehicles	$\in \overline{C}$	(SITC: 78; Nace-clio: 350)
-Office machinery	$\in \overline{C}$	(SITC: 75; Nace-clio: 330)
-Other machinery and transport materials	$\in \overline{C}$	(SITC: 7-75-78)
-Other manufacturing industries (textile, wood, paper, metallurgy, minerals)	$\in C$	(SITC: 6,8,9)
-Transport and services	$\in C$	
Notes: C =competitive, $\overline{C}$ = non-competitive		

Table 2.2 : Elasticities of Substitution σ_s

- Agriculture and primary products	2
-Food, beverage and tobacco	2
-Pharmaceutical products	5
-Chemistry other than pharmaceutical products	5
-Motor vehicles	10
-Office machinery	10
-Other machinery and transport materials	7
-Other manufacturing industries (textile, wood, paper, metallurgy, minerals)	4
-Transport and services	2

2.7.2 Calibration Procedure

The calibration of the competitive side of the model is quite standard [see for instance Srinivasan and Whalley (1986)]. More subtle is the joint determination of the base-year price system and cost structure, consistent with the base-year data set, with the optimal price-discrimination by individual competitors and with the free-entry equilibrium concept.

The procedure devised by Mercenier (1995) for the joint determination of the price-system and of the variable unit costs of individual producers can be derived as follows.

From (2.9), and the Appendix B a firm's optimal mark-up depends on the product differentiation elasticities $[\sigma_s(\in \overline{C})]$ and on observed market shares. Let $\tilde{e}_{isj}$ denote the actual current price trade flows. The problem is to split $\tilde{e}_{isj}$ into its price (p_{isj}) and quantity (e_{isj}) components. Making use of the symmetry assumption between national firms, it is easy to see that, for calibration purposes, the perceived elasticities E_{isj} may be written as:

$$E_{isj} = \mathbf{E}_{isj}(\tilde{e}_{isj}, \sigma_s), \qquad s \in \overline{C}, \tag{2.15}$$

where $\mathbf{E}_{isj}(.)$ denotes a known function, and σ_s is imposed from extraneous information.

Substituting in the Lerner formula and rearranging, I obtain

$$\frac{p_{isj}}{v_{is}} = \frac{\mathbf{E}_{isj}(\tilde{e}_{isj}, \sigma_s)}{\mathbf{E}_{isj}(\tilde{e}_{isj}, \sigma_s) + 1}, \qquad s \in \overline{C} \tag{2.16}$$

so that, for a given level of v_{is}, the prices charged by firms on each national market may be computed from the data and the known structure of preferences

and technologies implicit in $\mathbf{E}_{isj}(.)$. By definition, the average selling price $\bar{p}_{is}$ of the firm operating in country i satisfies

$$\overline{p}_{is} \sum_{j}^{W} e_{isj} = \sum_{j}^{W} \tilde{e}_{isj}, \tag{2.17}$$

or, equivalently,

$$\frac{\overline{p}_{is}}{v_{is}} \sum_{j}^{W} \frac{\tilde{e}_{isj}}{\left[\frac{p_{isj}}{v_{is}}\right]} = \sum_{j}^{W} \tilde{e}_{isj}, \qquad s \in \overline{C} \tag{2.18}$$

With $\overline{p}_{is}$ fixed at unity by normalization, equations (2.16) and (2.18) jointly determine the variable unit costs v_{is} and the segmented-market price system consistent with the data set and the type of competition (Cournot-Nash, Bertrand-Nash) assumed to prevail at base year. In Table 2.3 I report, the calibrated price spread between average domestic (the first row) and average export prices (the second row) for the noncompetitive sectors in the Cournot-Nash case. As expected export prices are consistently lower than domestic ones in all countries, reflecting the smaller market power of firms in their export relative to their domestic market. Furthermore, the above price spread is larger for Greece than for the other country members of the EU. One may, therefore expect that if there are benefits from Europe 1992, these benefits will be higher for Greece than for the rest of the European Community, indicative of the less competitive structure of Greek industry. The initial price spread for the Bertrand case is not reported as it is insignificant. Therefore, all calibration and simulation results henceforth, will not include the case where firms compete in prices, since the move to a single European market will have only extremely modest consequences.

In the zero-profit equilibrium, the firm's total unit cost V_{is} and average selling price $\overline{p}_{is}$ are equalized, which, using (2.8), determines the firm's fixed costs $(w_i L_{is}^F + r_i K_{is}^F)$.

Therefore,

$$w_i L_{is}^F + r_i K_{is}^F = v_{is} Q_{js} \left[\frac{V_{js}}{v_{js}} - 1 \right], \qquad s \in \overline{C}. \tag{2.19}$$

Due to the lack of reliable data on the composition of fixed costs, I assume that, in each country, fixed and total costs have the same share of capital and labor inputs. Table 2.4 reports on the calibrated ratios of marginal to average costs (the inverse of the scale elasticities). We observe that this ratio for Greece is systematically smaller than that of the other EU countries in all oligopolistic industries by values ranging from 0.08 for the pharmaceutical sector to 0.003 for the transportation and other machinery sector.

2.7.3 Design of the Experiment

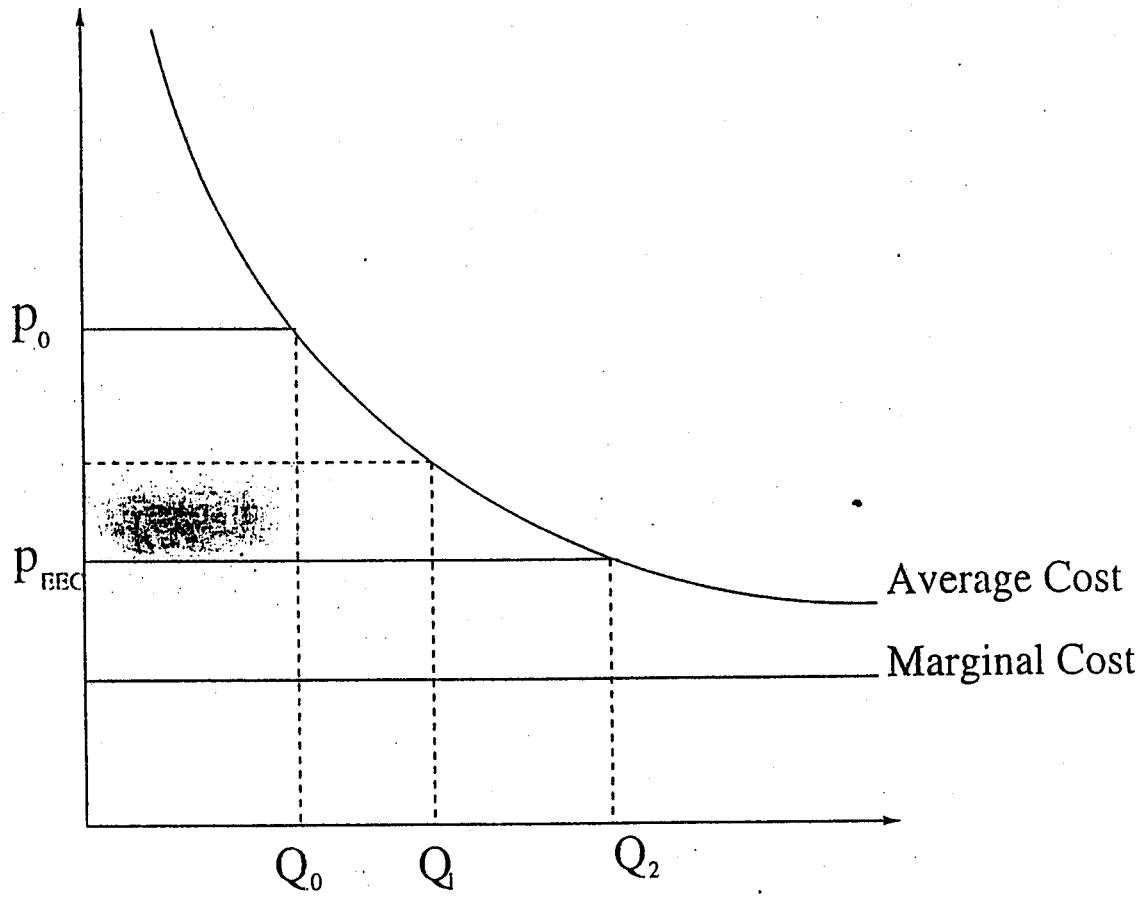
The experiment of market integration consists of assuming a single perceived elasticity based on an EU-aggregated demand for all firms in the non-competitive sectors, i.e.

$$E_{isj} = E_{is\text{EEC}}, \qquad i \in W, s \in \overline{C}, j \in \text{EEC}$$

The aggregate-demand based elasticity will typically be larger than the one used for pricing in the pro-integration equilibrium. Therefore, the move to a single-price strategy within the Community will induce a reduction of the price charged on the own market together with an increase in export prices.

The conjecture is that average prices charged to the EU will decrease and more output will be produced at lower average costs, the pro-competitive effect. Despite output expansion firms may not be able to cover average costs of production at these lower average selling prices and might incur negative profits. The latest mechanism is illustrated in Figure 2.1 for a single firm. Here, p_0 is the firm's initial average selling price, Q_0 the corresponding zero-profit output. The no-price-discrimination constraint is conjectured to force the firm to reduce it's average markup over costs. Let p_{EEC} denote the new price and Q_1 the corresponding output level. Even though the firm has moved down it's average cost curve, the price-induced sales expansion is not large enough to prevent it from experiencing negative profits (the shaded area). Zero-profit equilibrium requires that a smaller number of surviving firms will operate on a larger scale Q_2 with average costs equal to p_{EEC}. However, it is easy to imagine how general equilibrium effects may affect this intuitive story. The steepness of the average cost curve will be affected by movements in primary factor prices, whereas changes in relative prices of intermediate goods move both curves up and down affecting the average-to-marginal-cost ratio. Furthermore, complex interaction between income and substitution effects on the demand side will determine both the the sign and the amplitude of the move from Q_0 to Q_1.

Figure 2.1: Effect of Europe "1992", Partial Equilibrium Analysis.



2.8 Results: Effects to Greece of 'Europe 92'

2.8.1 Fixed Number of Firms.

The results from the case of fixed number of firms are presented in Table 2.5. I then highlight some sectoral variables of special interest, in addition to the standard aggregate indicators. All results are percent deviations from the initial segmented equilibrium. The first thing to observe is that most notable changes are experienced in the sectors of pharmaceuticals and road vehicles. A glance at the calibrated price spread within the EU (Table 2.4) indicates that indeed these are the sectors that one expects to be most affected by the "1992" program: these are the sectors where price discrimination is more important. As predicted from the theoretical discussion switching from the segmented to the integrated market induces a notable drop in the within Europe average selling prices of the above sectors, and to a lesser degree of the sector "office machinery". The decrease in average prices induces an increase in demand and a net increase in real output, reaching an approximate 32% and 30% increase in the pharmaceutical and vehicle sectors respectively. However, this cost-saving output expansion is not sufficient to compensate for the loss in revenues so that firms in these sectors experience economic losses in the post-integration equilibrium.

A second inspection reveals that in the transport and the chemical sectors prices charged within the integrated EU will increase (when compared to the numeraire) (as is also the case in all competitive sectors), while the output

expansion is only minimal. Given the initial calibrated price spread, these sectors are indeed the ones that should be the least affected from the "internal" market experiment, according to a partial-equilibrium based intuition. As these sectors have an initially weak domestic market share and therefore already before "1992" a relatively high elastic demand curve, the integration process will only make this elasticity slightly larger. Thus, other general equilibrium effects, such as the increase in aggregate income, the increase in price of factors of production and that of intermediate import prices seem to counterbalance the Partial Equilibrium effect, leading to a small increase in the average selling prices to the EU and only a minor increase in total output. Overall, the individual firms in these sectors will not be induced to better exploit the potential economies of scale, but there will be some real cost savings due to the small but positive output expansion. Despite the increase in prices for chemicals, average costs increase more, so firms in this industry will also experience negative profits.

Similar remarks hold for the "transport equipment" sector which however experiences a larger output expansion so that the cost savings due to a better exploitation of scale economies is more significant.

Overall, there is a clear shift of resources from the competitive to the non-competitive sectors reflected by the drop of real output in the former sectors. This means a shift of resources to the most capital intensive sectors as indicated by the relative increase of the rental rate of capital. As returns to the factors of production increase by more than the cost of living index, consumers

in the country experience a net welfare gain. Overall there is a net gain in felicity (measured in terms of equivalent variation)[8] which however remains modest at 0.48%. Also, the Greek economy has become globally more efficient as shown by the aggregate efficiency gains. These gains which in fact report the real cost savings achieved due to increased scale on initial output, are particularly high for the "pharmaceutical" and "vehicle" sectors.

[8]Using the price vector that existed before the introduction of a specific policy, the equivalent variation measure of utility, asks what income change at the current prices would be equivalent to the prices and income that the consumer will face after the policy change)

2.8.2 Variable Number of Firms

Table 2.6 reports the results in the alternative case where the number of firms is endogenous. This scenario could be interpreted as a "long term equilibrium" (even though there is no capital accumulation) since the entry and exit of firms takes time. Given that profits in the "short run" are negative in all imperfectly competitive sectors, there will be exit of firms. As one expects the percentage change in the number of firms in an industry is inversely related to the degree of market concentration and positively related to the magnitude of negative economic profits. Therefore, the largest exit takes place in the pharmaceutical (largest negative economic profits) and transportation equipment sectors (the less concentrated).

Naturally the automobile sector which is both very concentrated and has been affected the least from negative economic profits will experience a rather minimal loss of firms and will remain rather concentrated. We immediately observe that welfare effects in this scenario are more modest, reflecting the cost for consumers of less varieties. Higher concentration implies a smaller number of varieties available for consumption and therefore a deepening effect on consumer satisfaction.

Finally, when compared with the other countries of the EU I find that the industry reallocation effects are of greater magnitude in Greece, reflecting the fact that the Greek economy was more strongly shielded against foreign competition. Efficiency gains are almost fourfold of Italy's and welfare effects are also higher than for the other countries to the exception only of Italy (Table

2.7).

Even more stunning are the efficiency gains that are almost fourfold of those of Italy's. These results are consistent with both the predictions of the European Commission [9] and with the results of Giasorek and al, (1992). Even though a rigorous comparison is difficult to make because of differences in sectoral disaggregation and country breakdown their results indeed suggest that the aggregate region of "Greece and Ireland" will benefit the most from the completion of the internal market. Finally, one may expect that had Greece been aggregated with the rest of the member countries of the EU i.e., with countries with more competitive industrial structure such as Belgium, the results would be of a lesser magnitude. In Mercenier (1995) where the country breakdown scheme includes Greece in the Rest-of-EU aggregate the welfare gains are among the lowest in the EU (0.15%).

2.9 Effects of Europe "1992" in the Hypothetical Case where Greece does not Adopt the "EU 1992" Integration Program.

In order to get a better understanding of what causes the Greek economy to benefit from the European integration effort, I have to simulate the hypothetical case according to which Greece does not adopt the "1992" program. In this case all effects on the Greek economy will be indirect, i.e., can be interpreted as a change in Greece's exogenous "rest of the world" environment.

[9] Social Europe p 180

In this scenario, Greek firms in the non-competitive sectors still have the ability to price discriminate between their domestic and export markets after "1992" but their European Union competitors will be constrained to adopt the unique pricing rule for domestic and export sales within the Union. It is expected that the prices of the later will increase, favoring therefore Greek exports to the European Union, which ceteris paribus should rise. However, to this positive effect for Greek exports there is a negative effect that should be taken into consideration: the unique pricing rule also implies a drop in prices of domestic sales for the countries members of the EU and consequently a boosting of domestic demand to the detriment of the demand for imports from all origins. It is the net effect of these two counter balancing forces that will determine the significance of the "1992" program for Greek welfare and industry structure in this scenario. Table 2.9 presents some of the results from this experiment. We see that the share of Greek exports in total EU imports increase, a consequence of the reduction in intra-EU trade to the benefit of non-EU trade partners. However, there is a decrease in the share of Greek exports in total EU demand (the sum of domestic and import demand) this time a consequence of an increase in domestic demand that the countries members of the EU experience (Table 2.8). The net effect is a slight drop in the demand for Greek exports and a slight deterioration of consumers welfare and of the country's terms of trade. The mechanism is that for some sectors (vehicles, office machinery and other machinery), there is a decrease in exports and a reduction in total output per firm, as is reflected by the efficiency losses as

firms produce at higher average costs. Firms in these sectors will experience negative profits. In the chemical sector, this mechanism is reversed.

When firms are endogenous, a partial equilibrium framework implies that Greek firms from the sectors with negative profits will exit the market and the zero profit condition for Greek producers would ensure that the remaining firms would expand their production. Therefore, there would be a reduction in the loss off efficiency gains in these sectors.

However, EU firms will also respond to profit conditions by entry or exit and this latter effect is of greater significance to the Greek economy. The resulting reduction in intra-EU trade in this scenario is larger than in the alternative with fixed number of firms (Table 2.8), and the net effect on Greek exports is less unfavorable. This is demonstrated by the almost insignificant aggregate reduction in efficiency gains and the smaller reduction in output per firm in this case (Table 2.9).

We conclude from this simulation that had Greece chosen to withhold it's participation to the "1992" integration program it would have suffered slightly negative effects from the European structural adjustment. It is indeed, the participation of Greece in the European Union, and the pro-competitive effect that the latter has on the domestic firms behavior that leads to positive welfare gains.

2.10 Conclusion

I have estimated the effects of Europe "1992" in a context of a general multi-country, multi-sector equilibrium model. Europe "1992" has been interpreted as the halting of the individual firm's price discriminating behavior following the dismantling of non-tariff trade barriers.

The country disaggregation that was adopted has singled out Greece from the rest of the European Community. This has been shown to be of significant consequence since Greece has a particular industrial structure that sets it apart from the rest of the member countries. As shown by the results, Greece's relatively lesser competitive structure in the pre "1992" equilibrium makes this country most likely to benefit from the EU integration effort: according to the model, it would benefit more than most other EU partners with the exception of Italy. The source of these welfare gains is indeed the pro-competitive effect on domestic firms behavior, for as it was demonstrated, had Greece not participated in the "1992" it would have experienced a deterioration in it's welfare.

Table 2.3: Calibrated Price Spread (Cournot-Nash)

	Pharmacy	Chemistry	Road Vehicles	Office Machinery	Other Mach & Transp. Materials
GR	1.000 0.62594	1.000 0.98296	1.000 0.58182	1.000 0.76088	1.000 0.96862
G.B.	1.001 0.98668	1.000 0.99714	1.004 0.78062	1.001 0.97064	1.000 0.998401
D	1.001 0.99249	1.000 0.99715	1.006 0.90428	1.001 0.96871	1.000 0.99842
FR	1.000 0.99542	1.000 0.99831	1.016 0.76488	1.003 0.97162	1.000 0.99665
IT	1.000 0.99259	1.000 0.99682	1.010 0.68709	1.003 .89961	1.000 .99725
RE	1.000 0.988582	1.000 0.99793	1.010 0.91208	1.014 0.97913	1.000 0.99826
ROW	1.000 0.99726	1.000 0.99892	1.000 0.82370	1.001 0.99076	1.000 0.99947

Table 2.4: Calibrated Ratios of Marginal to Average Costs

(Cournot-Nash)

	Pharmacy	Chemistry	Road Vehicles	Office Machinery	Other Mach. & Trans. Materials
GR	0.709	0.797	0.837	0.872	0.853
GB	0.798	0.800	0.873	0.897	0.857
D	0.799	0.799	0.886	0.897	0.857
FR	0.799	0.800	0.865	0.895	0.857
IT	0.799	0.799	0.855	0.889	0.857
RE	0.798	0.800	0.886	0.897	0.857
ROW	0.799	0.800	0.879	0.899	0.857

Table 2.5: Effects of the '1992' Program, Fixed Number of Firms (% Changes, Cournot-Nash)

Aggregate Indicators	
Welfare (% equiv. var.)	0.48
Wage rate	2.02
Rental rate of capital	2.43
Cost-of-living index	1.60
Terms of trade	0.96
Efficiency gains (%)	3.21

	Agricult.	Food Beverage	Pharm.	Chemist.	Road Vehicles	Office Mach.	Other Mach.	Other . Manuf.	Services
Avg. Sale Price to EEC (% change)									
	2.18	2.32	-13.47	1.43	-9.99	-1.10	0.20	1.91	2.31
Profits (% of value added)									
			-4.36	-0.66	-0.94	-2.48	-2.13		
Output (% change)									
	-0.43	-0.41	31.80	0.07	28.90	3.31	1.77	-0.71	-0.23
Efficiency gains (%)									
			13.40	0.02	10.68	1.05	0.42		

Table 2.6: Effects of the '1992' Program,

Variable Numbers of Firms (% Changes, Cournot-Nash)

Aggregate Indicators	
Welfare (% equiv. var.)	0.45
Wage rate	1.21
Rental rate of capital	1.78
Cost-of-living index	1.14
Terms of trade	0.39
Efficiency gains (%)	4.21

Agricult.	Food Beverage	Pharm.	Chemist.	Road Vehicles	Office Mach.	Other Mach.	Other . Manuf.	Services
Avg. Sale Price to EEC (% change)								
1.62	1.69	-12.63	0.92	-9.81	-0.58	-0.21	1.23	1.69
No. of Firms (% change)								
		-7.24	-2.50	-0.70	-4.78	-9.60		
Output (% change)								
-0.27	-0.22	27.275	0.01	28.11	2.19	-0.09	-0.28	-0.09
Efficiency gains (%)								
		15.54	0.61	10.78	2.26	2.36		

Table 2.7: Effects of the '1992' Program; Comparisons with the other EU countries, Variable Numbers of Firms, (% Changes)

	Welfare	Eff.Gains
GR	0.45	4.20
GB	0.44	1.72
D	0.13	0.55
FR	0.37	0.10
IT	0.66	1.01
RE	0.18	0.39
ROW	-0.01	-0.07

Table 2.8: '1992' effects in the case of Greece's nonparticipation.

	Agricultural	Food Beverage	Pharm.	Chemist.	Road Vehicles	Office Mach.	Other Mach.	Other Manuf.
Average EU Domestic Demand (% change)								
Fix.N. of Firms	0.60	0.50	1.20	0.75	22.73	9.20	0.97	0.60
Var.N. of Firms	0.50	0.39	0.99	0.63	23.14	7.37	0.75	0.47
Intra-EU Trade (% change)								
Fix.N. of Firms	0.27	0.54	-2.68	-0.05	-77.41	-25.55	0.01	0.62
Var.N. of Firms	0.22	0.40 0.39	-2.91	-0.21	-80.45	-27.48	-0.07	0.61

Table 2.9: '1992' effects to Greece in the case of it's nonparticipation.

Aggregate Indicators	Fixed Number of Firms	Variable Number of Firms
Welfare (% equiv. var.)	-0.01	-0.0004
Wage rate	0.18	0.08
Rental rate of capital	0.16	0.10
Cost-of-living index	0.16	0.10
Terms of trade	-0.02	0.01
Efficiency gains (%)	-0.03	-0.0005
Share of Greek exports in EU imports (%,nc).	4.70	5.76
Share of Greek exports in total EU demand (%,nc).	-2.79	-2.12

	Agricult.	Food Beverage	Pharm.	Chemist.	Road Vehicles	Office Mach.	Other Mach.	Other . Manuf.	Services
(Profits (% of value added)									
Fix.N.			0.06	0.02	-0.19	-0.02	-0.06		
Output (% change)									
Fix.N.	0.02	0	0.02	0.07	-0.09	-0.05	-0.22	0.03	-0.01
Var.N.	0.03	0.01	0.03	0	-0.04	-0.01	-0.01	0.02	0
Efficiency gains (%)									
Fix.N.			0	0.02	-0.05	-0.02	-.06		
Var.N.			0.2	0	-0.02	0	0		

2.11 Appendix A: Types of Non-Tariff Barriers.

Technical standards are voluntarily agreed codifications of the form, functioning, quality, compatibility and/or exchangeability of methods, products, processes and services.

Technical regulations are specifications as to form, construction, performance (etc.) of products, service and sometimes even of processes and methods, included or referred to in public law, e.g. for health, safety, environmental and consumer protection.

Technical certification comprises arrangements such as technical inspection, testing and comparisons, for identifying conformity to given standards or regulations. The evidence is usually found in testing reports. For simplicity, products may carry and marketing may employ approval signs and comformity of certification marks.

Content/denomination regulations. These barriers prevent a producer from using a generic name unless its product conforms to certain content requirements. The most well-know content law is the reinheitsgebot, or beer purity law, in Germany.

Example : Beer purity law in Germany

The Reinheitsgebot, in effect for four and a half centuries, stipulated that beer containing substances other than hops, malted barley, yeast, and water could not be sold in Germany under the name "beer". Partially as a result of this law, the German beer market is highly fragmented--over 1200 breweries exist--and imports make up only about 1% of consumption. Recently, the European Court of Justice ruled that imported beer containing other substances can use the beer product name.

Source: The European Economy (1993), Social Europe: p 40.

2.12 Appendix B: The Computation of the Perceived Price Elasticities

(a) The Segmented Market Case: When the firms behave *à la* Bertrand-Nash, it is easy to show that the perceived-price elasticity is

$$E_{isj} = -\sigma_s + (\sigma_s - 1)\left(\frac{c_{isj}}{(c_{isj} + \sum_t x_{isjt})}\frac{p_{isj}c_{isj}}{\rho_{sj}Y_j} + \sum_t\left(\frac{x_{isjt}}{(c_{isj} + \sum_t x_{isjt})}\frac{p_{isj}x_{isjt}}{\alpha_{sjt}v_{jt}Q_jt}\right)\right),$$

When they behave *à la* Cournot-Nash, the perceived price-elasticity is straightforward but tedious to establish. Using standard calculus, it can be shown that to determine E_{isj}, the following system has to be solved:

$$0 = \sum_{k=i\cap W} n_{ks}\varepsilon^k_{ksj}\tilde{\varepsilon}^i_{ksj} + (n_{is}-1)\varepsilon^i_{hsj}\tilde{\varepsilon}^i_{isj} - \sigma_s\tilde{\varepsilon}^i_{hsj} + \frac{\varepsilon^i_{hsj}}{E_{isj}}, h = 1, \ldots$$

$$1 = \sum_{k\in i\cap W} n_{ks}\varepsilon^k_{isj}\tilde{\varepsilon}^i_{ksj} + (n_{is}-1)\varepsilon^i_{isj}\tilde{\varepsilon}^i_{isj} + \frac{(\varepsilon^i_{isj} - \sigma)}{E_{isj}}$$

where the variables:

$$\tilde{\varepsilon}^k_{isj} = \frac{\partial \log(p_{isj})}{\partial \log\left[c_{ksj} + \sum_t x_{ksjt}\right]}, \qquad k = 1, ..., W,$$

are cross-elasticities determined jointly with E_{isj}, and the coefficients ε^k_{isj} , k=1,...,W, are cross-price elasticities:

$$\varepsilon^k_{isj} = [\sigma_s$$

$$-1\left\{\frac{c_{isj}}{\left[c_{isj}+\sum_t x_{isjt}\right]}\frac{p_{ksj}c_{ksj}}{\rho_{sj}Y_j} + \sum_t\left[\frac{x_{isjt}}{\left[c_{isj}+\sum_t x_{isjt}\right]}\frac{p_{ksj}x_{ksjt}}{\alpha_{sjt}v_{jt}Q_{jt}}\right]\right\}.$$

(b) The Integrated Market Case:

When firms behave *à la* Bertrand-Nash, the firm's monopoly power on the European-wide market is a weighted average of its monopoly power on each individual market:

$$\varepsilon_{isEEC} = \frac{\sum\limits_{j \in EEC} \frac{\partial \log \left[c_{isj} + \sum\limits_t x_{isjt} \right]}{\partial \log \ p_{isj}} \left[c_{isj} + \sum\limits_t x_{isjt} \right]}{\sum\limits_{j \in EEC} \left[c_{isj} + \sum\limits_t x_{isjt} \right]}.$$

When firms behave *à la* Cournot-Nash, the perceived price elasticities $1/E_{isEEC}$ are computed from the system once $\tilde{\varepsilon}^k_{isj}$ and ε^k_{isj} are replaced by the EEC-aggregated elasticities $\tilde{\varepsilon}^k_{isEEC}$ and ε^k_{isEEC}.

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Chapter 3

Trade Policies, Endogenous Growth and Welfare in a Model With R&D and Differentiated Products

3.1 Introduction

Current policy recommendations on trade related issues have often been based on recent developments in endogenous growth theory. One of the attractive features of this whole new generation of models is that they permit the analyst to go beyond the traditional static effects of trade and industrial policy. Static models with perfect competition suggest that policy intervention will distort prices and will lead to a net welfare loss to the countries involved. As the perfectly competitive models proved increasingly more inadequate in explaining modern economic phenomena, the imperfectly competitive alternative shed new light and questioned the long held "common" economic wisdom on interventionist issues. Nevertheless, as Paul Krugman, argued in a seminal paper, the "new theory" of trade does not provide firm grounds for interventionist policies. But then how could one fail to notice the rapid growth rates that Japan have achieved notwithstanding its highly protected economy at the same period ? Or is it that import barriers were in fact conducive to such a growth? As economists were called to account for paradigms of rapid, sluggish convergent or divergent growth rates, the case of trade policies was back in the scholar's agenda. The revived concern over growth issues provided a new perspective for evaluating trade policies. It is in fact the evolution of growth theory, and the passage from "exogenous" growth models, where growth ceases in the long run, to endogenous models where growth is sustained, that provided the theoretical framework that would allow the link between growth and

international trade.

Our work is indeed inspired by the contribution that the developments in endogenous growth theory have had in evaluating trade and industrial policies. I wanted to build a model to simulate the effects of different policies on the growth rates of trade partners. Moreover, I was concerned in complementing this analysis with one on the welfare of the countries involved. I found the field fertile since given the dynamic nature of the endogenous growth models we could base our results on the whole transition period from one steady state to another. We also found it unexploited since most studies that we are aware of confine themselves to an analytical or even numerical comparison of welfare from one steady state to another, thus not taking into account the very important period that intervenes. We found through simulations that when intertemporal welfare considerations are taken into account, growth conducive policies may be less desirable for one trade partner. Not surprisingly the opposite could hold true in the case of a policy that may reduce growth but promote discounted intertemporal welfare for one trade partner.

I have chosen a model originally constructed by Helpman and Grossman that belongs in the category of endogenous growth models. The engine of growth in this model is R&D, which allows the introduction of new types of capital and output as a function of all existing varieties of capital goods. What is needed in such a model to generate endogenous growth is the incentive for R&D not to decrease over time. Therefore, the production function in this model exhibits "constant returns" to the number of varieties which assures

steady state constant growth rates even with diminishing returns to each type of capital. To this respect the model shares the same features as the model of Romer (1986) in which case the production function for Y is given by

$$Y = AL^{1-\alpha} \int_{w=0}^{n} x_i^{\alpha}(\omega) d\omega$$

where L is labour input and $x(\omega)$ is a particular variety of intermediate input x. In addition if we assume that firms producing intermediate inputs are symmetric (ω stands for an individual variety) then we may rewrite the above equation as

$$Y = AL^{1-\alpha} n x^{\alpha}$$

We can clearly see here that there are constant returns to the number of varieties (n).

In addition, here Helpman and Grossman attribute a second role to R&D, not necessary for endogenous growth rates but which enriches the model significantly. Therefore, R&D not only is responsible for increasing the existing varieties of capital goods, but also may have spillovers on the aggregate stock of knowledge. Hence the existence of spillovers from R&D activities will generate constant returns to investments in R&D which will motivate firms to keep investing constant amounts of resources to this type of activity. As a result the stock of knowledge will increase at a constant rate. Since general knowledge reduces the cost of producing consumption goods the amount of production will also be growing at a constant rate

$$Y = AL^{1-\alpha} \int_{\omega=0}^{n} x^{\omega}(\omega) d\omega$$

where n is the number of varieties in the world.

The model makes the same predictions as other models of R&D developed by Helpman and Grossman. The reason is that what is needed to generate endogenous growth rates is a never decreasing incentive for research, irrespective of the reason in particular. Indicatively, in their papers "Endogenous Product Cycles" (1989) firms do R&D to develop new varieties of consumption goods. In contrast, in the paper "Quality Ladders and Product Cycles" (1990) firms are modeled as trying to increase the quality of a constant number of varieties of goods. In the present model, firms do R&D to develop new varieties of capital goods. Again, the underlying mechanisms that generate endogenous growth are the same.

Finally, it is worth noting that an interesting feature of the present model is the finding that endogenous growth can be generated with knowledge accumulation alone. The absence of capital or labor accumulation differentiates this model from other models of endogenous growth. These models share the common feature of either 1) constant returns to the factor(s) accumulated (Rebelo, 1991 and Lucas, 1988).[1]or 2) decreasing returns to the factor that is accumulated but increasing returns to scale at the aggregate level (Romer, 1986).[2].

Helpman and Grossman 1990, predict that in a two country-one repre-

[1]In Rebello the accumulating factor is physical capital K and $Y = AK_t$ and in Lucas $Y = AK^b(uhL)^{1-b}$ in which case the accumulating factors are physical capital K and human capital h.

[2]In this case $Y_i = K^b L^{1-b} R^n$ where R^n is an index of cumulative investment in capital stock and enters as an externality in the individual firms production function

sentative consumer setting where one country has a comparative advantage in R&D, trade liberalizing but also trade restricting policies may prove conducive to global long run growth rates as long as R&D is encouraged/discouraged in the country with comparative advantage/disadvantage in this type of activity. I argue in this paper that when welfare effects to the individual countries are taken into consideration, a policy that leads to a higher global growth rate in the steady state may be detrimental to the welfare (in present value) of one of the countries involved. I demonstrate this result by performing simulations using a model where the welfare of each country is singled out: I show that under reasonable conditions transitional structural adjustment costs may offset the long term gains for one of the two countries. The simulation results can be interpreted as picturing North American-European trade. This chapter is organized as follows: Sections 3.2 and 3.3 describe the growth model and the intertemporal welfare analysis, section 3.4 presents the calibration and simulation results for two selected cases and section 3.5 concludes the analysis.

3.2 The Model

The world consists of two countries. Each country has three sectors of production; production of consumption goods y, capital goods and R&D. The two countries are different with respect to their ability in doing R&D. There is one type of labor which is considered to be fixed in each country.

In what follows we retain the following notational conventions: upper case letters are used to signify aggregate variables. When followed by a subscript

they are expressed per country and/or per sector, if not they refer to sums over sectors and countries. Lower case letters are used to identify varieties and all variables measured per variety. For example X stands for the aggregate demand for capital goods while x for the demand for a particular variety of capital goods. Smaller case letters are also used for parameters. There are seven sets of subscripts: the subscript $i = 1, 2$ refers to countries, Y , x, and n symbolize the consumption, capital goods and R&D sectors respectively, c describes composite goods or composite prices, m refers to imports and finally L refers to labor.

3.2.1 Consumers

Consumers in both countries have identical homothetic preferences and they maximize a time separable utility function

$$U_{i(t)} = \int_t^{\infty} e^{-\rho(\tau - t)} \log u_i(\tau) d\tau \tag{3.1}$$

where ρ is the subjective discount rate and $u(\tau)$ is the instantaneous subutility function, which is strictly concave and linearly homogeneous.

We have assumed that consumers derive utility by consuming a composite good that is a C.E.S. aggregate of domestic and imported consumption goods so that these goods are imperfect substitutes in consumption. The instantaneous utility takes the form

$$u_i = c_i = \left[\alpha_{y_i}(Y_i - E_{Y_i})^{-\rho} + \alpha_{m_i} M_{Y_i}^{-\rho}\right]^{-1/\rho} \tag{3.2}$$

where

Y_i is the production of the consumption good by country i,
M_{Yi} are imports of the consumption good by country i,
and E_{Yi} are exports of the consumption good by country i.

The solution to the classical maximization problem, given expenditure and prices, would give us u^*. Alternatively we may derive the instantaneous demand for domestic and imported goods by minimizing the cost of acquiring the composite good c_i, $p_{y_i}(Y_i - E_{Y_i}) + p_{my_i}M_{Y_i}$ subject to the constraint

$$c_i \geq u_i^*.$$

The instantaneous consumption demand for the domestic and foreign good is given therefore by:

$$Y_i - E_{Y_i} = \alpha_{y_i}^{\sigma} \left(\frac{p_{cy_i}}{p_{y_i}} \right)^{\sigma} u_i^* \tag{3.3}$$

$$M_{Y_i} = \alpha_{m_i}^{\sigma} \left(\frac{p_{cy_i}}{p_{my_i}} \right)^{\sigma} u_i^* \tag{3.4}$$

where

p_{cyi} is the price of the composite good for country i,
p_{my_i} is the price of the imported consumption good, where $p_{my_i} = T_{y_j} p_{y_j}$,
with $T_{y_j} > 1$, if a tariff is imposed on the consumption good produced in country j,
p_{y_i} is the price of the domestic good,
$\sigma = 1/(1+\rho)$ is the elasticity of substitution between domestic and imported goods.

The associated aggregate consumption price index is:

$$p_{cy_i}^{1-\sigma} = \alpha_{y_i}^{\sigma} p_{y_i}^{1-\sigma} + \alpha_{m_i}^{\sigma} p_{my_i}^{1-\sigma} \tag{3.5}$$

so that the budget constraint

$$E_i = p_{cy_i} u^* = p_{y_i}(Y_i - E_{Y_i}) + p_{my_i} M_{Y_i} \tag{3.6}$$

is satisfied. Substitution of (3.3) and (3.4) into (3.1) generates an indirect utility function

$$V[p_{cy_i}(t), p_{y_i}(t), p_{my_i}(t)]E_i(t).$$

Thereafter, the consumer will choose the optimal path of expenditure. At this stage the representative consumer will maximize:

$$V_i(t) = \int_t^\infty [\log E_i(\tau) + \log V(p_{cy_i}(\tau), p_{y_i}(\tau), p_{my_i}(\tau))]\, d\tau$$

subject to the constraint

$$\int_t^\infty e^{-[R(\tau)-R(t)]} E_i(\tau) d\tau \leq \int_t^\infty e^{-[R(\tau)-R(t)]} \omega_i(\tau) L d\tau + Z_i(t)$$

where $Z_i(t)$ is the value of his asset holdings at time t and $w_i(\tau)$ is the wage rate of country i and

$$R(t) = \int_0^t \dot{R}(z) dz$$

where $\dot{R}(z)$ is the interest at time z. Because of integrated world markets, the interest rate is common to all consumers.

The first order conditions to this problem gives the optimal expenditure path for both countries.

$$\frac{\dot{E}_i}{E_i} = \dot{R} - \rho \tag{3.7}$$

Figure 3.1: Steady State Dynamics when $h/H < 1/s$

In this case there is a unique steady state as shown by point 1 and a saddle path (shown by the arrows) that converges to it. In order for this to happen h/H must be of smaller value than $1/s$ and $1/s$ and h/H must lie between b_{min} and b_{max}; i.e, the smaller and the larger of the b_i's. We also observe that the steady state equilibrium growth rate must lie between zero and ρ; a negative

3.2.2 Producers of Consumption Goods

Producers of consumption goods are perfect competitors, earning zero profits. Each country produces one consumption good using as inputs domestic labor and capital goods from both countries.

The production function for country one is given by

$$Y_1 = BA_{Ly_1} L_{y_1}^{1-\beta} X_{c_1}^{\beta} \tag{3.8}$$

where X_{c_1} is a composite good of varieties of domestic and imported capital goods.

$$X_{c_1} = \left(\int_0^{n_1} [x_1(\omega) - e_{x_1}(\omega)]^{\alpha} d\omega\right)^{1/\alpha} + \left(\int_0^{n_2} m_{x_1}(\omega)^{\alpha} d\omega\right)^{1/\alpha} \tag{3.9}$$

$$\tag{3.10}$$

where $x_1(\omega)$ is the domestic production of variety ω of the capital good produced in country one, $e_{x_1}(\omega)$ is country one's exports of capital good, $m_{x_1}(\omega)$ is country one's imports of capital goods, n_1, n_2 are varieties of capital good produced in country 1 and country 2 respectively. Since, as it will be argued later, all varieties developed in the same country bear the same price and are produced in the same quantity, we may thereafter omit ω. Consequently we may rewrite the above equation as

$$X_{c_1} = n_1^{1/\alpha}(x_1 - e_{x_1}) + n_2^{1/\alpha} m_{x_1} \tag{3.11}$$

Profit maximization gives us the demand for labor

$$L_{y_1} = \frac{(1-\beta) p_{y_1} Y_1}{w_1} \tag{3.12}$$

and the demand for the composite good x_{c_1} is

$$X_{c_1} = \frac{\beta p_{y_1} Y_1}{p_{cx_1}}.$$

Thereafter, producers decide on the composition of the good x_{c_1}. They now minimize their expenditure

$$p_{x_1}(x_1 - e_{x_1}) + T_{x_2} P_{x_2} m_{x_2}$$

subject to

$$X_{c_1} = n_1^{1/\alpha}(x_1 - e_{x_1}) + n_2^{1/\alpha} m_{x_1}$$

where

$$p_{cx_1} X_{c_1} = \beta p_{y_1} Y_1.$$

The solution to this problem gives the domestic and import demand for capital goods. Therefore,

$$x_1 - e_{x_1} = \frac{p_{cx_1}^{\epsilon-1}}{p_{x_1}^{\epsilon}} \beta p_{y_1} Y_1 \tag{3.13}$$

where $\epsilon = 1/(1-\alpha)$.

$$m_{x_1} = \frac{p_{cx_1}^{\epsilon-1}}{T_{x_2}^{\epsilon} p_{x_2}^{\epsilon}} \beta p_{y_1} Y_1 \tag{3.14}$$

$$p_{cx_1}^{1-\epsilon} = n_1 p_{x_1}^{1-\epsilon} + n_2 T_{x_2}^{1-\epsilon} p_{x_2}^{1-\epsilon} \tag{3.15}$$

$$p_{cx_1} X_{c_1} = p_{x_1} x_1 + p_{x_2} T_{x_2} x_2 \tag{3.16}$$

$$X_1 = n_1(x_1 - e_{x_1}) + n_1 m_{x_2} = n_1 x_1 \tag{3.17}$$

where $\epsilon = 1/(1-\alpha)$,X_1 is the total demand for all the varieties produced in country 1 and T_{x_2} are the tariffs imposed by country 1 on the capital imports from country 2.

By analogy we get

$$x_2 - e_{x_2} = \frac{p_{cx_2}^{\epsilon-1}}{p_{x_2}^{\epsilon}} \beta p_{y_2} Y_2 \tag{3.18}$$

$$m_{x_2} = \frac{p_{cx_2}^{\epsilon-1}}{T_{x_1}^{\epsilon} p_{x_1}^{\epsilon}} \beta p_{y_2} Y_2 \tag{3.19}$$

$$p_{cx_2}^{1-\epsilon} = n_2 p_{x_2}^{1-\epsilon} + n_1 T_{x_1}^{1-\epsilon} p_{x_1}^{1-\epsilon} \tag{3.20}$$

$$p_{cx_2} X_{c_2} = p_{x_2} x_2 + p_{x_1} T_{x_1} x_1 \tag{3.21}$$

$$X_2 = n_2(x_2 - e_{x_2}) + n_2 m_{x_1} = n_2 x_2 \tag{3.22}$$

where

$$X_{c_2} = n_1^{1/\alpha}(x_2 - e_{x_2}) + n_2^{1/\alpha} m_{x_1} = \frac{\beta p_{y_2} Y_2}{P_{cx_2}} \tag{3.23}$$

By substitution we get the following demand function for X_1 and X_2.

$$X_1 = \frac{n_1 \beta [T_{x_1}^{\epsilon} p_{y_1} Y_1 / p_{cx_1}^{1-\epsilon} + p_{y_2} Y_2 / p_{cx_2}^{1-\epsilon}]}{(T_{x_1} p_{x_1})^{\epsilon}} \tag{3.24}$$

and

$$X_2 = \frac{n_2 \beta [T_{x_2}^{\epsilon} p_{y_2} Y_2 / p_{cx_2}^{1-\epsilon} + p_{y_1} Y_1 / p_{cx_1}^{1-\epsilon}]}{(T_{x_2} p_{x_2})^{\epsilon}}. \tag{3.25}$$

3.2.3 Producers of Capital Goods

Producers of capital goods are Bertrand Chamberlenian competitors producing each a distinct variety of capital good using labor as their sole input. Profit maximization in this case, implies a fixed mark-up over marginal cost. We assume that within each country there is one wage rate, and products of all capital goods share the same labor requirement. Therefore, varieties from the same country will bear the same price

$$p_{x_i} = \frac{w_i a_{Lx_i}}{\alpha} \tag{3.26}$$

where a_{Lx_i} is a country specific productivity measure of the capital goods sector. Finally producers of capital goods will have a demand for labor given by

$$L_{x_i} = a_{Lx_i} n_i x_i. \tag{3.27}$$

Though the fixed mark-up rule determines the price of each variety and cost minimization the demand for existing varieties of capital good, what determines the number of new varieties produced?

Production of new varieties depends on the total units of labor that engage in R&D and the stock of knowledge that already exists.

$$\dot{n}_i = \frac{L_{n_i} K}{a_{Ln_i}}$$

where

$\dot{n}_i$ is the addition of new varieties
L_{n_i} are units of labor employed in R&D,
K is the stock of knowledge,
and a_{Ln_i} is a country specific productivity measure for the R&D sector.

If we assume that knowledge embodied to new varieties adds incrementally by an equal amount to the already existing stock and that it is instantaneously diffused in both countries i.e. $K = n$, then

$$\dot{n}_i = \frac{L_{n_i} n}{a_{Ln_i}} \tag{3.28}$$

There will be engagement in R&D as long as the present value of the future

profits are equal to the current cost of R&D,

$$\int_t^{\infty} e^{-[R(\tau)-R(t)]}\pi_i(\tau)d\tau = c_{n_i}(t)$$

where instanteneous profits and costs are given by

$$\pi_i = (1-\alpha)p_{x_i}x_i \tag{3.29}$$

and

$$c_{n_i} = \frac{w_i a_{Ln_i}}{n} \tag{3.30}$$

Differentiation of the no arbitrage condition with respect to t gives

$$\frac{\pi_i + \dot{c}_{n_i}}{c_{n_i}} = \dot{R} \tag{3.31}$$

This is a standard no arbitrage condition which equates, the rate of interest to the instantaneous rate of return on shares in a firm that undertakes R&D.

3.2.4 Equilibrium Conditions

Equilibrium in the consumption goods market implies that the value of the consumption product in each country must be equal to what is locally consumed and what is exported.

From (3.3) and from the fact that at equilibrium $E_{x_1} = M_{x_2}$, $p_{my_2} = T_{y_1}p_{y_1}$ and $E_i = p_{cy_i}u^*$, the equilibrium in the consumption goods sector is given by

$$p_{y_1}Y_1 = \alpha_{y_1}^{\sigma}\frac{p_{cy_1}^{\sigma-1}E_1}{p_{y_1}^{\sigma-1}} + \alpha_{m_2}^{\sigma}\frac{p_{cy_2}^{\sigma-1}E_2}{T_{y_1}^{\sigma}p_{y_1}^{\sigma-1}}$$

where

$$\alpha_{y_1}^{\sigma}\frac{p_{cy_1}^{\sigma-1}}{p_{y_1}^{\sigma-1}} = s_{y_{11}}$$

where $s_{y_{11}}$ is the share of country one's expenditure that is allocated to the consumption of its own production of consumption goods, and

$$\alpha_{m_2}^{\sigma} \frac{{p_{cy_2}}^{\sigma-1}}{(T_{y_1} p_{y_1})^{\sigma-1}} = s_{y_{12}}$$

$s_{y_{12}}$ is the part of country two's expenditure that is allocated to the consumption of country one's consumption goods[3]. Therefore we may rewrite the equilibrium condition as

$$p_{y_1} Y_1 = s_{y_{11}} E_1 + \frac{s_{y_{12}} E_2}{T_{y_1}} \tag{3.32}$$

and by analogy

$$p_{y_2} Y_2 = s_{y_{22}} E_2 + \frac{s_{y_{21}} E_1}{T_{y_2}} \tag{3.33}$$

The equilibrium condition in the labor market implies that the demand of labor in the three sectors should be equal to the fixed supply of labour in each country.

$$L_i = L_{y_i} + L_{x_i} + L_{n_i}$$

or by substitution

$$L_i = (a_{Ln_i}/n)\dot{n}_i + a_{Lx_i} X_i + (1-\beta) p_{y_i} Y_i / w_i \tag{3.34}$$

[3]We can notice that when $T_{y_1} = T_{y_2} = 1$ and when

$$\alpha_{y_1} = \alpha_{m_1} = \alpha_{y_i} = \alpha_{m_i}$$

then

$$p_{cy_1} = p_{cy_2} = p_{cy}$$

and

$$s_{y_{12}} = s_{y_{11}}$$

3.2.5 Steady State and Convergence Conditions

Since the interest rate is endogenous in this model, we may choose the time pattern for one nominal variable. Let's assume that

$$p_{x_1} = n(a_{Lx_1}/a_{Ln_1})^{1/\epsilon} \tag{3.35}$$

Then from equations (3.30) and (3.35) we observe that $\dot{c}_{ni} = 0$. Therefore from the no arbitrage equation along with (3.29) and (3.30) we derive

$$\dot{R} = \frac{1}{\epsilon - 1}\frac{nX_1 a_{Lx_1}}{n_1 a_{Ln_1}} \tag{3.36}$$

We may define a variable z such that

$$p_{x_2} = zn\left(\frac{a_{Lx_1}}{a_{Ln_1}}\right)^{1/\epsilon} \tag{3.37}$$

Then $\dot{c_{n_2}}/c_{n_2} = \dot{z}/z$ which implies due to the no arbitrage equation that

$$\dot{R} = \frac{1}{\epsilon - 1}\frac{nX_2 a_{Lx_2}}{n_2 a_{Ln_1}} + \frac{\dot{z}}{z} \tag{3.38}$$

From (3.36) and (3.38) we get

$$\frac{\dot{z}}{z} = \frac{1}{\epsilon - 1}\frac{nX_1 a_{Lx_1}}{n_1 a_{Ln_1}} - \frac{1}{\epsilon - 1}\frac{nX_2 a_{Lx_2}}{n_2 a_{Ln_1}} \tag{3.39}$$

In order to have a steady state with convergence and positive R&D in both countries $\dot{z}/z$ should be equal to 0. Otherwise, p_{x_2} will either explode or tend to zero.

We see that from (3.24) and (3.25) that unless $T_{x_1} = T_{x_2} = 1$ there is no way to assure that there exists an equilibrium with positive R&D in both countries. The case would rather be that the country that protects more its

production of capital goods will grow infinitely faster than the other country which will see its R&D sector shrink to zero. In the alternative case where there are no tariffs imposed on imports of capital goods by any country (3.38) gives

$$\frac{\dot{z}}{z} = \frac{n^{1-\epsilon}(1-z^{1-\epsilon})}{\epsilon - 1} \frac{\beta(\sum_i p_{y_i} y_i)}{\sum_i n_i p_{x_i}^{1-\epsilon}} \tag{3.40}$$

We can clearly see that $z = 1$ is the necessary and sufficient condition for a steady state with positive R&D in both countries. Therefore we set

$$p_{x_2} = n(a_{Lx_2}/a_{Ln_2})^{1/\epsilon} \tag{3.41}$$

The relative productivity of labor in R&D production versus capital goods production in each country provides us with an evaluation of its comparative advantage in R&D. Therefore

$$b_i = (a_{Ln_i}/a_{Lx_i})^{\alpha}$$

and country 1 will be considered as having a comparative advantage in R&D if $b_1 < b_2$.

From substitution and for $T_{x_2} = T_{x_1} = 1$ we get,

$$w_i = \alpha b_i / a_{Ln_i}$$

$$c_{n_i} = \alpha b_i \sigma_i$$

and

$$X_i = \frac{n_i b_i^{1/\alpha} \beta \sum p_{y_i} Y_i}{n \sum_j n_j b_j} \tag{3.42}$$

where $\sigma_i = n_i/n$, is the share in total varieties of country i. Subsequently, we define country's i expenditure per variety $e_i = E_i/n$ and $g_i = \dot{n}_i/n_i$ country's i rate of variety growth. Therefore $\dot{e}_i/e_i = \dot{E}_i/E_i - \dot{n}/n$, where g is the global growth rate of varieties. At a steady state,

$$\frac{\dot{e}_i}{e_i} = 0$$

therefore,

$$\frac{\dot{E}_i}{E_i} = \overline{g}$$

and because of (3.12) and (3.31), $\dot{R} = \overline{g} + \rho$ and $\dot{c}_{n_i} = 0$.

Substituting these latest equations into the no arbitrage equation we derive

$$\overline{X}_i = \frac{a_{Ln_i}}{a_{Lx_i}} \overline{\sigma}_i (\overline{g} + \rho)(\epsilon - 1).$$

At steady state all prices, as well as all consumption goods per variety are constant. Therefore, labor employment at steady state in the three sectors is given by the following equations:

- in the consumption goods sector:

$$\frac{1-\beta}{\alpha b_i \overline{q}_i} \tag{3.43}$$

where

$$q_i = \frac{p y_i Y_i}{n}.$$

- in the capital goods sector:

$$a_{Ln_i} \overline{g\sigma}_i (\overline{g} + \rho)(\epsilon - 1). \tag{3.44}$$

• in the R&D sector:

$$a_{Ln_i}\overline{g}\overline{\sigma}_i. \tag{3.45}$$

As a result the labor market equilibrium condition may now be written as

$$h_i = \overline{g}\overline{\sigma}_i + (\epsilon - 1)(\overline{g} + \rho)\overline{\sigma}_i + \frac{(1-\beta)\overline{q}_i}{\alpha b_i} \tag{3.46}$$

where $h_i = L_i/a_{Ln_i}$ is the effective labor of country i.

We can easily verify that on the convergent path, the value of capital good production in country i is given by

$$p_{x_i}x_i = \frac{\sigma_i b_i}{\sum \sigma_i b_i}\beta \sum p_{y_i}Y_i \tag{3.47}$$

We may define

$$s_{x_i} = \frac{\sigma_i b_i}{\sum_i \sigma_i b_i}$$

as the part of country i's expenditure that goes into buying capital goods. Therefore,

$$p_{x_i}X_i = s_{x_i}\beta \sum p_{y_i}Y_i \tag{3.48}$$

At steady state,

$$p_{x_i}X_i = nb_i\overline{\sigma_i}(\overline{g} + \rho)(\epsilon - 1) \tag{3.49}$$

From (3.48) and (3.49) we derive the following expressions for the equilibrium in the capital goods

$$\sum_i b_i\overline{\sigma_i}(\overline{g} + \rho)(\epsilon - 1) = \beta \sum_i q_i \tag{3.50}$$

$$\overline{q}_i = \overline{s}_{y_{i2}}\overline{e}_2 + \frac{\overline{s}_{y_{i1}}\overline{e}_1}{T_{y_i}} \tag{3.51}$$

and consumption goods sectors, respectively. The last expression implies that the following ratio is satisfied:

$$\frac{\overline{q}_1}{\overline{q}_2} = \frac{\overline{s}_{y11}\overline{e}_1 + \overline{s}_{y12}\overline{e}_2}{\frac{\overline{s}_{y21}\overline{e}_1}{T_{y2}} + \overline{s}_{y22}\overline{e}_2} \tag{3.52}$$

Assuming that there are no international capital movements then steady state spending per capital good by consumers in each country i is proportional to the sum of that country's labor income, net profits and net transfers from the government.

Therefore,

$$\overline{e}_1 = \alpha b_1 \frac{L_{n_1}}{a_{L_{n_1}}} + \alpha b_1(\overline{g} + \rho)\overline{\sigma}_1 - \alpha b_1 \overline{g}\overline{\sigma}_1 + \frac{\overline{s}_{y12}\overline{e}_2}{(T_{y_1} - 1)} T_{y_1}$$

$$\overline{e}_1 = \alpha b_1 h_1 + \alpha b_1 \rho \overline{\sigma}_1 + \frac{\overline{s}_{y12}\overline{e}_2}{(T_{y_1} - 1)} T_{y_1} \tag{3.53}$$

and

$$\overline{e}_2 = \alpha b_2 \frac{L_{n_2}}{a_{L_{n_2}}} + \alpha b_2(\overline{g} + \rho)\overline{\sigma}_2 - \alpha b_2 \overline{g}\overline{\sigma}_2 + \frac{\overline{s}_{y21}\overline{e}_1}{T_{y_2}}(T_{y_2} - 1)$$

$$\overline{e}_2 = \alpha b_2 h_2 + \alpha b_2 \rho \overline{\sigma}_2 + + \frac{\overline{s}_{y21}\overline{e}_1}{T_{y_2}}(T_{y_2} - 1) \tag{3.54}$$

Given that

$$\sum_i \overline{\sigma}_i = 1, \tag{3.55}$$

equations (3.46) and (3.52)-(3.50) through (3.54) fully describe the steady state equilibrium.

3.2.6 Determinants of Long Run Growth

In order to obtain a clear demonstration of the determinants of long run growth we simplify the model by assuming that there are no impediments to trade, therefore setting $T_{y_1} = T_{y_2} = 1$. In this case the model reduces to the following set of dynamic equations:

$$\frac{\dot{e}}{e} = \frac{\beta e}{\alpha\sigma} + \frac{1-\beta}{\alpha} se - H - \rho$$

and

$$\dot{\sigma} = h - \frac{1-\beta}{\alpha} e - \sigma \left[H - \frac{1-\beta}{\alpha} se \right]$$

where $\sigma = \sum_i \sigma_i b_i$, $s = \sum_i s_i b_i$, $e = \sum_i e_i$, $H = \sum_i L_i / a_{Ln_i}$, and $h = \sum_i b_i h_i$. These two equations constitute an autonomous system of differential equations in e and σ. Then

$$\frac{\dot{n}}{n} = g = H - \frac{\beta e}{\sigma} - \frac{1-\beta}{\alpha} se$$

provides a complete description of the evolution of the number of products in each country. From e, σ, and g the path for the other variables are easily derived.

At steady state $\dot{e}$ and $\dot{\sigma}$ are zero so the steady state values of $\overline{e}$ and $\overline{\sigma}$ are calculated from the following pair of equations

$$\frac{\beta \overline{e}}{\alpha \overline{\sigma}} + \frac{1-\beta}{\alpha} s\overline{e} = H + \rho$$

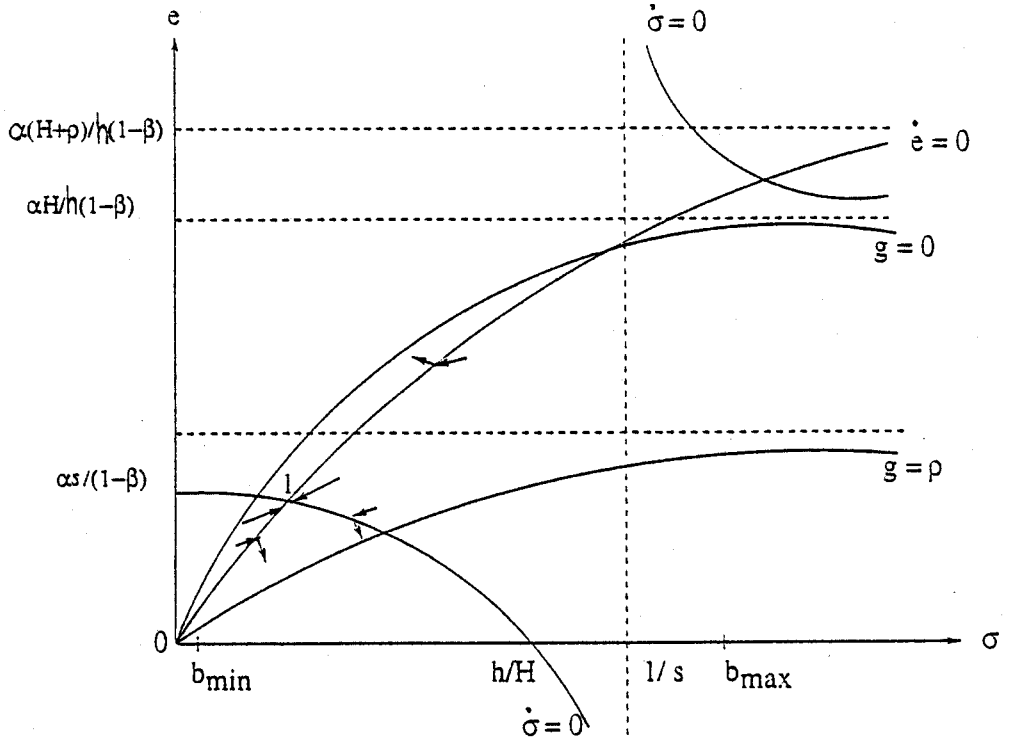
and

$$\frac{(1-\beta)}{\alpha} \overline{e} (1 - \overline{\sigma} s) + \overline{\sigma} H = h.$$

For $1/s > h/H$ there is a unique solution for $\overline{e}$ (Figure 3.1) and $\overline{\sigma}$ consistent with $\overline{g}$ and which is stable. For $1/s < h/H$ there will be two solutions of which only one is stable (Figure 3.2). This will be the case when the $\dot{\sigma} = 0$ curve intersects the $\dot{e} = 0$ curve from below. This occurs when

$$\frac{\beta\overline{e}}{(H+\rho)\overline{\sigma}^2} > \frac{\alpha H - (1-\beta)s\overline{e}}{\overline{\sigma}H - h}.$$

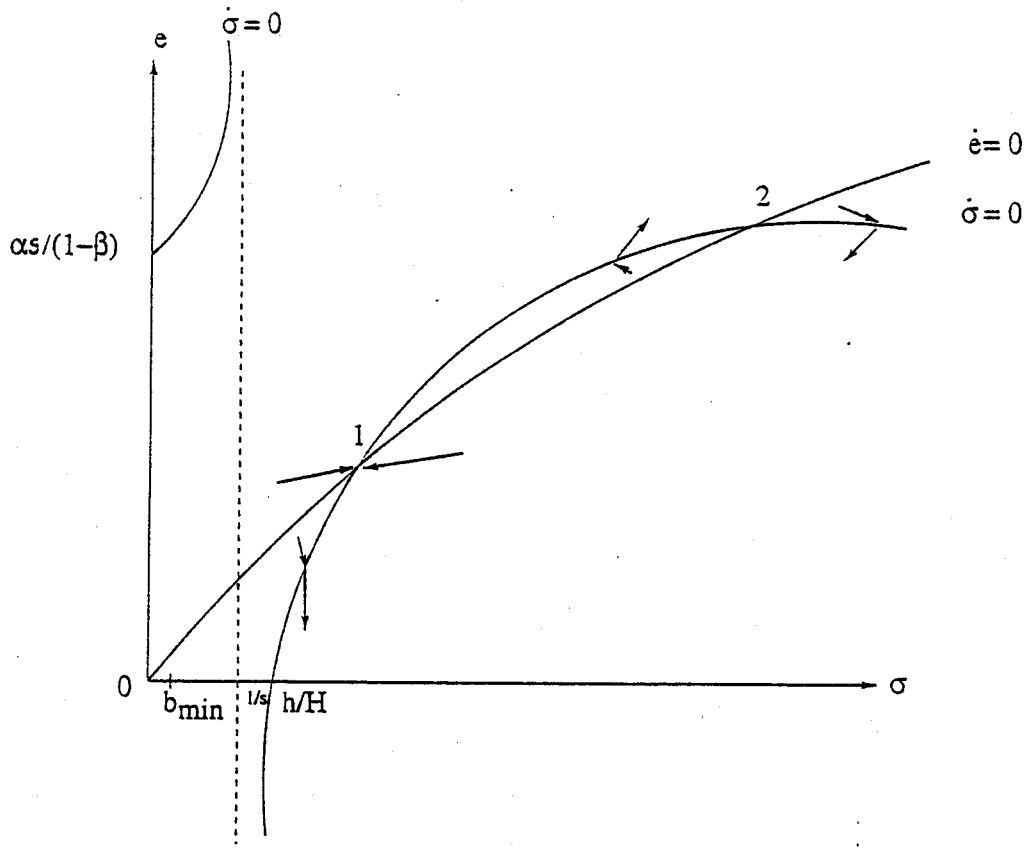
Figure 3.1: Steady State Dynamics when $h/H < 1/s$



In this case there is a unique steady state as shown by point 1 and a saddle path (shown by the arrows) that converges to it. In order for this to happen h/H must be of smaller value than $1/s$ and $1/s$ and h/H must lie between b_{min} and b_{max}; i.e, the smaller and the larger of the b_i's. We also observe that the steady state equilibrium growth rate must lie between zero and ρ; a negative

growth rate is not possible as the number of blueprints cannot decline while a steady state growth rate that is larger than the subjective discount rate would imply unbounded utility.

Figure 3.2: Steady State Dynamics when $h/H > 1/s$



In this case $h/H > 1/s$, a situation which is produced when, for example the shares of the two countries' final output are in proportion to their relative effective labor forces; when $h_1/s_1 = h_2/s_2$. In this case there are two equilibrium solutions: the equilibrium at point 1 demonstrates saddle-path stability and the equilibrium at point 2 is locally unstable.

Given the structure of the model, Helpman and Grossman predict, among other things the following:

Proposition 1: A stronger relative demand for the final good of the country with comparative advantage in R&D lowers the long-run share of this country in the number of capital products, and lowers long-run growth of the world economy.

Proposition 2: An equiproportionate once and for all increase in the effective labor force of both countries accelerates long-run growth.

Proposition 3: The long run growth is higher the larger is the effective labor force of the country with comparative advantage in R&D. A larger effective labor force in the country with comparative disadvantage in R&D may be associated with faster or slower growth depending upon the extent of productivity differences.

3.3 Intertemporal Welfare Analysis

The above propositions concern long-run growth , and on the effect of exogenous shocks, including implementation of trade and industrial policies on this. I have complemented this argumentation by adding a welfare analysis to the issues involved.

Indeed, it is tempting to make policy recommendations based on long term growth rates, but a higher asymptotic growth rate does not imply higher welfare. This is not to say that welfare analysis have never been done with models similar to the one we have described (if not numerically, at least analytically).

However, these studies most often consist of comparisons of the instanteneous levels of utilities in the two steady states, before and after policy implementation. They do not capture the effect of the transitional period to long run equilibrium on welfare. I shall show, by use of a numerical version of the previous model, that taking into account transitional cost and benefits, rather than looking only at long term effects, may change the sign of the induced welfare effect of a policy.

In discrete time, the discounted intertemporal sum of utility of country i is given by

$$U_i = \underbrace{\sum_{t=0}^{T-1} \gamma^t c_i}_{Component1} + \underbrace{\frac{\gamma^T c_i}{1-\gamma(1+g_T)}}_{Component2}$$

where

$$c_i = \frac{e_i n_i}{p_{cy_i}} = \frac{E_i}{p_{cy_i}}$$

Component 1 measures the discounted sum of utility from time zero up to time T (with \$gamma $= e^{-\rho}$) at which the economy may be considered to have reached its steady state. Beyond T, utility grows at the steady growth rate $\overline{g}_T$. The discounted utility from T onwards is given by Component 2. Two welfare criteria are used, based on Hicksian compensating and equivalent variations respectively. In a static framework, the CV (compensating variation) criteria takes the equilibrium levels of incomes and prices after a policy change and asks how much income must be taken away or added in order to return households to their prechange utility levels. In contrast, the EV (equivalent variation)

takes the old equilibrium incomes and prices and computes the changes in income at given prices needed to achieve new equilibrium utilities. Formally (Shoven and Whalley 1984),

$$CV_i = \frac{U_i^A - U_i^B}{U_i^A} E_i^A$$

and

$$EV_i = \frac{U_i^A - U_i^B}{U_i^B} E_i^B$$

In a dynamic context the above variables are intertemporal discounted sums before (B) and after (A) policy change. [1]

---

[1]

$$E_i = \underbrace{\sum_{t=0}^{T-1} \gamma^*(t) E_i}_{Component1} + \underbrace{\frac{\gamma^{*T} E_i}{1 - \gamma^*(1 + g_T)}}_{Component2}$$

where *gamma** is the discount factor, now function of the interest rate, which becomes a constant once the economy has reached its steady state.

3.4 Calibration of the model and simulation results

Inspired by the North American Free trade agreement and the unification of the European market, I therefore, applied my simulations to a North America-North European trade context. An additional element for this choice is the fact that both trade blocks have similar consumer preferences, production structures and are both involved in R&D activity. Nevertheless, the following results are strictly simulation results and therefore they do not measure the true effects of the North-American trade agreements nor those of the European unification neither are they an accurate representation of the actual economies involved.

3.4.1 Norh American Freer Trade and North American-European trade and gro¬th

I assume that one of the consequences of freer trade between North American countries, through the creation of a free trade zone (as in the case of FTA and NAFTA), is an increase in the world share of final goods (consumption) produced in the countries affected by the agreement and consequently a decrease in the demand for goods produced outside the particular trade zone, Europe in this case. In my simulation I will consider the case of freer trade between Canada and the United States (which I will henceforth refer to as the North America block) and I will exclude Mexico, which I consider, at date, as an imitating rather as an innovating country. Europe will also consist

of the Northern members of the European Union; i.e, countries that may be considered as having similar capacities to innovate.

In this experiment composite prices are the same in both countries and therefore the shares of expenditure of each country allocated to the consumption good of a specific origin are the same ($s_{y11} = s_{y12} = s_{yNA}$, the share of total world expenditure allocated to the goods originating in Northern America and $s_{y21} = s_{y22} = s_{yEU}$, the share of total world expenditure allocated to the goods originating in Northern Europe). Furthermore, given the specification of prices along the convergence path these shares are constant. We have approximated the value for these parameters by using data on GNP for 1991. Therefore GNP for the U.S.A and Canada was approximately 5,694 billions US$ dollars and GNP for the Northern European countries approximately 5,184 billions (World Competitiveness Report, 1993). This will give a share in total production of 0.51738 for the U.S.A and Canada and of 0.48262 for the Northern European countries. Total employment, in Canada and the U.S.A was at the same year 121.48 millions and in Northern Europe 104.8 millions. We have approximated R&D employment by the number of scientists and engineers employed in the industrial sector of the relevant countries. We observed, that the percentage of scientists in total industrial R&D personnel is much higher in North America, than in Northern Europe. In particular, about 75% of total R&D personnel in the U.S.A are engineers and scientists while the equivalent percentage for the Northern European countries range from 18% to slightly over 35% (The World Competitiveness Report, 1993). We have calculated approximately 590

thousand of R&D scientists in U.S.A and Canada and 217 thousand in Northern Europe. Normalizing total employment in U.S.A and Canada as equal to 1, we get total employment for Northern Europe equal to 0.8, R&D employment in U.S.A and Canada and Northern Europe equal to 0.03910 and 0.01439 respectively. We approximated the growth rate of varieties at initial steady state g_0, by the compounded annual growth rate of patents granted in the U.S for the period 1985-1991 which was about 4.63% (ibid). We made the simplifying assumption that capital goods productivity is the same for both Northern America and Northern Europe and we set the initial value of total varieties equal to 1. The personal discount rate was set equal to 0.08. The values of shares in new varieties as well as the R&D productivity parameters consistent with the observed shares in final expenditure and the long-run employment equilibrium is given in Table 3.1 and Table 3.2. We observe that Northern America will have a comparative advantage over Northern Europe in R&D. Table 3.2 also presents the values of some key variables at the initial equilibrium. For these values of parameters and steady state variables $\frac{1}{s} - \frac{h}{H}$ has a positive value (0.64). In this case there exists a unique steady state equilibrium and a saddle path to it. Table 3.3 gives the saddle point equilibrium values for the same variables after the increase in the world expenditure share of North American manufactures (consumption). This shock is represented by a change in the values of $s_{y_{NA}}$ and $s_{y_{EU}}$ from 0.51738 and 0.48262 to 0.56 and 0.44 respectively. This corresponds to an approximately 8% increase in the expenditure share of the manufactured (consumption) good originating in

U.S.A and Canada.

We may easily verify henceforth the predictions of Helpman and Grossman. The increase in the demand for the North American consumption good results in a shift in the resources of these countries towards their manufacturing (consumer) sector and away from the sector that conducts research. The opposite effect is manifested in Northern Europe, which will experience a shift of resources towards its R&D sector. As a result the share in total varieties of capital goods produced by Northern Europe increases (Figure 3.3) and that of Northern America decreases (Figure 3.4). Since the former group of countries is the least efficient in conducting this activity, global growth rates in the new steady state will fall (Figure 3.5) .

3.4.2 Tariff protection of the North European Market, North American-European trade, gro¬th and ¬elfare.

This simulation on the effects of tariff protection on trade, growth and welfare trading partners, is inspired by one of the mechanisms involved in the creation of the European Union: the elimination of all trade barriers between the country members and the adoption of a Common external trade policy. This Common external trade policy may in effect be interpreted as an increase in the protection of the European market from its world competitors through the imposition of a Common tariff on imports of goods from third countries. I shall therefore consider, for the purpose of my simulations the effect of an imposition of a 10% by the North European countries on imports

of final goods from the North American block. My model is calibrated in such a way so that the initial equilibrium values of the two cases studied coincide. In this case, however composite prices facing each country differ and therefore relative shares of expenditure to the same good allocated by each country as well. In order to endogenise these variables we need to have an estimate of the elasticity of substitution between the domestic and the imported good. We have set this value equal to 0.5.

Table 3.4 reports the steady state values after the imposition of the tariff, and figures (3.6) to (3.7) the convergence path of some key variables. As could be expected the results we obtain here are the opposite of those obtained in the previous case. The imposition of a tariff on North American consumption goods causes a shift of resources towards the R&D sector and since this block enjoys a comparative advantage in R&D, global growth rates increase. Despite this increase in long run growth rates, the European Union will suffer a welfare loss (Table 3.5) due to the initial abrupt decrease in its growth rates (figure 3.9). Though the Union's consumption at steady state will grow at a higher growth rate[4] the initial abrupt drop in growth rates and the lower growth rates during the transition period will take their toll to the economy's welfare. North America to the contrary experiences a net welfare gain despite the negative effect that this policy has on its consumption sector. This result is again explained by the high growth rates that this country experiences during the transition period.

[4]as indicated by Component 2

3.5 Conclusion

In this chapter I have analyzed a dynamic, two country-two representative consumer model of trade and growth. The analysis is similar to the model of Grossman and Helpman 1990 in the following respects: the source of growth is uniquely endogenous technological improvements which stem from the profit maximizing behavior of firms, there are assumed cross country differences in efficiency in the technology improving activity (R&D) and in manufacturing of intermediate goods. Therefore, our simulation results confirms the predictions of the forementioned authors: Any trade policy that shifts resources towards the consumption good sector of the country that has a comparative advantage (disadvantage) in R&D will decrease (increase) global long run growth rates.

However my analysis, by replacing the single representative consumer assumption with one where consumers of the two countries are treated separately, allows for a complementary intertemporal welfare analysis for each individual trading country. The simulation results indicate that policy recommendations based solely on the expected effects on long run growth rates may be misleading; though growth rates at the steady state may increase, welfare of one of the trading partner may deteriorate.

Table 3.1: Specification of Parameters and Endowments

	Northern America	Northern Europe
Productivity Parameters		
a_{Ln_i}	0.9413808	3
Capital a_{Lx_i}	0.9413808	0.9413808
Demand Parameters		
Discount Rate (ρ)	0.08	0.08
α	0.8	0.8
β	0.4	0.4
Production Shares s_{y_i}	0.51738	0.48262
Labor Endowments L_i	1	0.8

Table 3.2: Equilibrium Solution for North American-North European trade model.

	North America	North Europe
Shares of Varieties σ_i	0.89644	0.10356
Growth Rates g_i	0.04633	0.04633
Number of Varieties n_i	0.89644	0.10356
Sectoral Employment		
Consumption Goods L_{y_i}	0.53447	0.62862
Capital Goods L_{x_i}	0.42644	0.15699
R&D L_{n_i}	0.03910	0.01439
Expenditure e_i	0.90719	0.55594
Production/Variety q_i	0.75699	0.70614
Composite Price p_{cy_i}	3.33888	3.33888
Sectoral Prices		
Consumption Goods p_{y_i}	0.89375	0.77770
Capital Goods p_{x_i}	1.00000	0.79310
Capital Sector Output	0.45299	0.16676

Table 3.3: The effect of Freer North American Trade on North American-North European production structure and growth

	North America	North Europe
Shares of Varieties σ_i	0.85588	0.14412
Growth Rates g_i	0.04024	0.04024
Number of Varieties n_i	1.79619	0.30245
Sectoral Employment		
Consumtion Goods L_{y_i}	0.58006	0.57466
Capital Goods L_{x_i}	0.38752	0.20794
R&D L_{n_i}	0.03242	0.01740
Expenditure e_i	0.90459	0.56250
Production/Variety q_i	0.82157	0.64552
Composite Price p_{cy_i}	6.47265	6.47265
Sectoral Prices		
Consumption Goods p_{y_i}	1.73260	1.50763
Capital Goods p_{x_i}	2.01746	1.66444
Capital Sector Output	0.41165	0.22089

Table 3.4: The Effect of Tariff Protection of the North European Market on North American-North European production structure and growth.

	North America	North Europe
Shares of Varieties σ_i	0.90048	0.09952
Growth Rates g_i	0.04697	0.04697
Number of Varieties n_i	2.16301	0.23906
Sectoral Employment		
Consumption Goods L_{y_i}	0.52965	0.63434
Capital Goods L_{x_i}	0.43053	0.15164
R&D L_{n_i}	0.03982	0.01402
Expenditure e_i	0.90745	0.58336
Production/Variety q_i	0.75018	0.71256
Composite Price p_{c_i}	3.33888	3.50964
Sectoral Prices		
Consumption Goods p_{y_i}	1.93685	1.68536
Capital Goods p_{x_i}	2.36432	1.87515
Capital Sector Output	0.45734	0.16108
Expenditure Shapes for Consumption Goods		
Produced in Country 1 $s_{y_{1i}}$	0.51738	0.52927
Produced in Country 2 $s_{y_{2i}}$	0.48262	0.47073

Table 3.5: Welfare Effect of Tariff Protection of the North European Market

	DISCOUNTED SUM OF UTILITY (before policy)	DISCOUNTED SUM OF UTILITY (after policy)	COMPENSATED VARIATIONS
North Europe	1.76097	1.73908	-0.01258
North America	9.52707	9.72223	0.02007

Figure 3.3: Effect on North American Product Shares (σ_{NA}) of Freer North American Trade

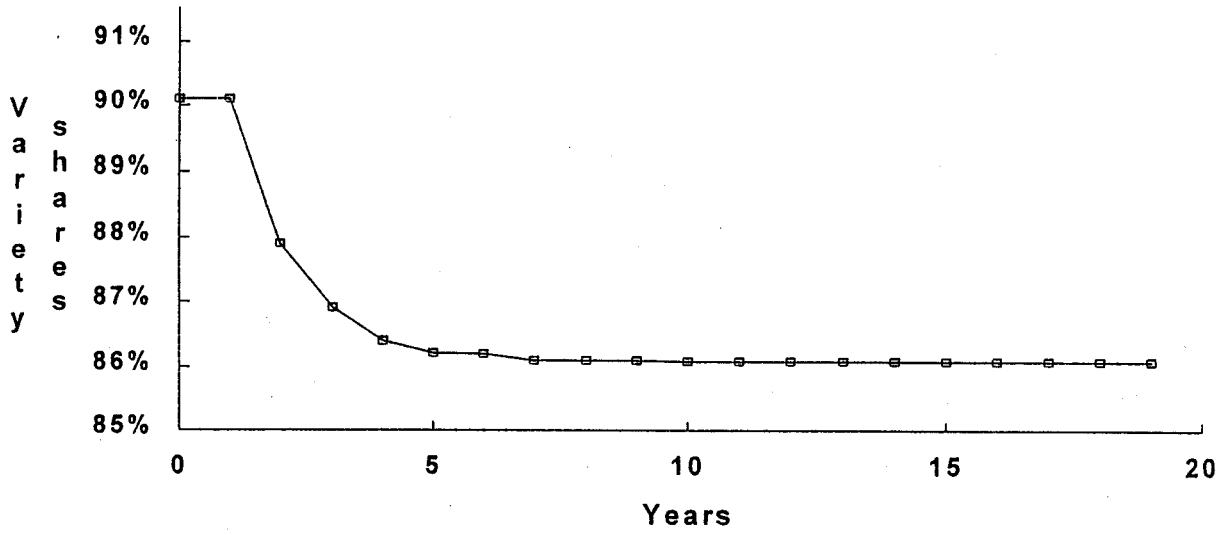


Figure 3.4: Effect on North European Product Shares (σ_{EU}) of Freer North American Trade.

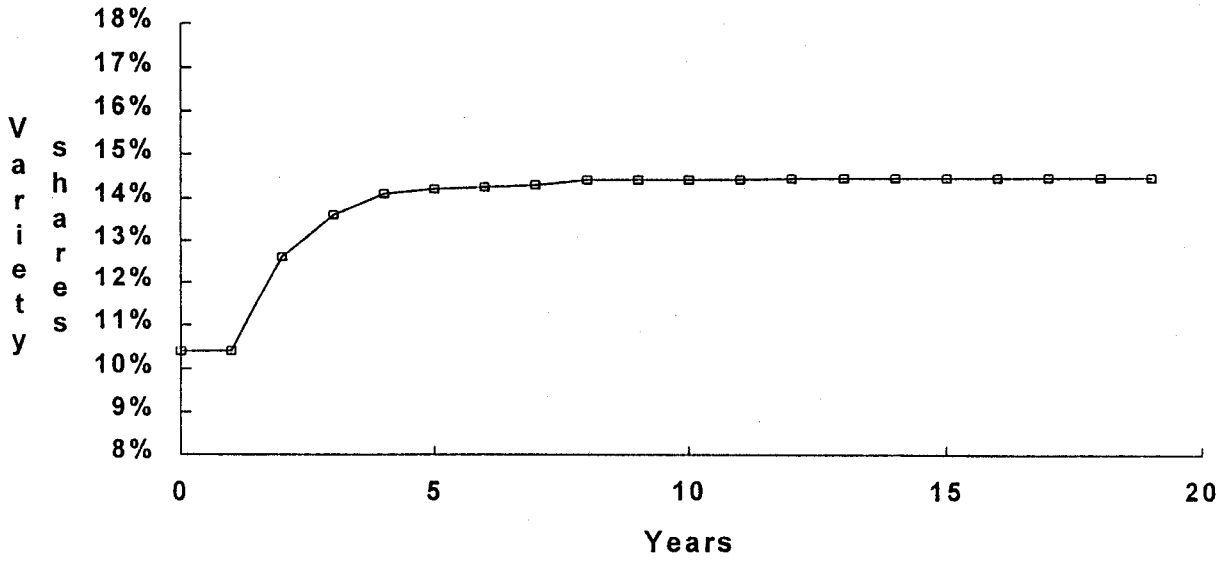


Figure 3.5: Effect on Growth Rates (g) of Freer North American Trade.

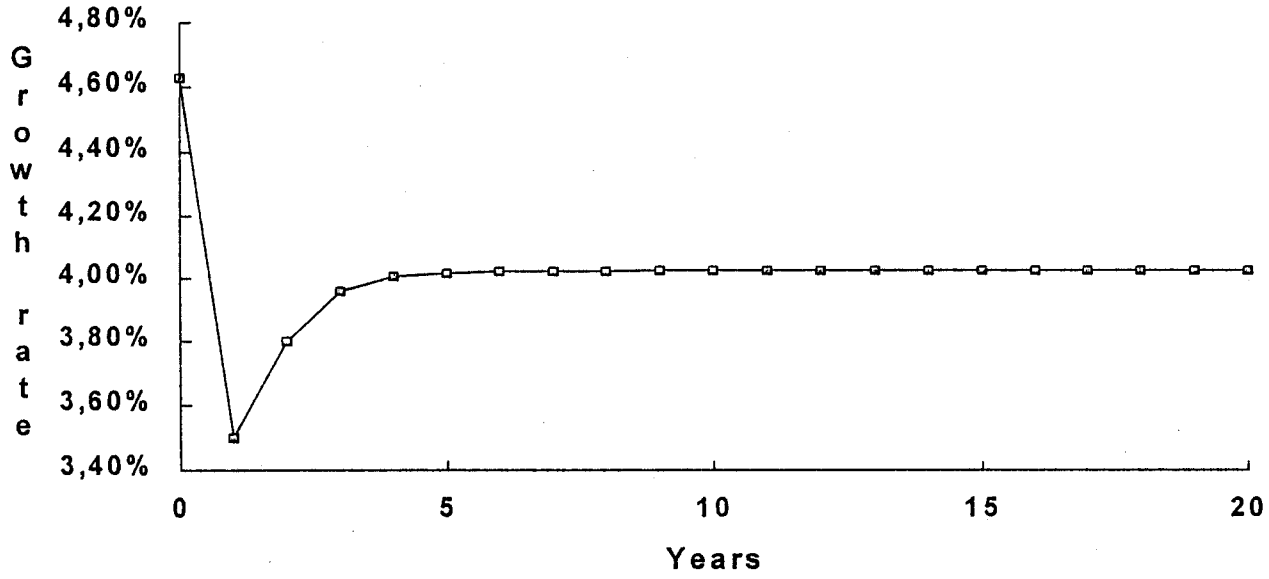


Figure 3.6: Effect on North American Product Shares (σ_{NA}) of Tariff Protection of the North European Market

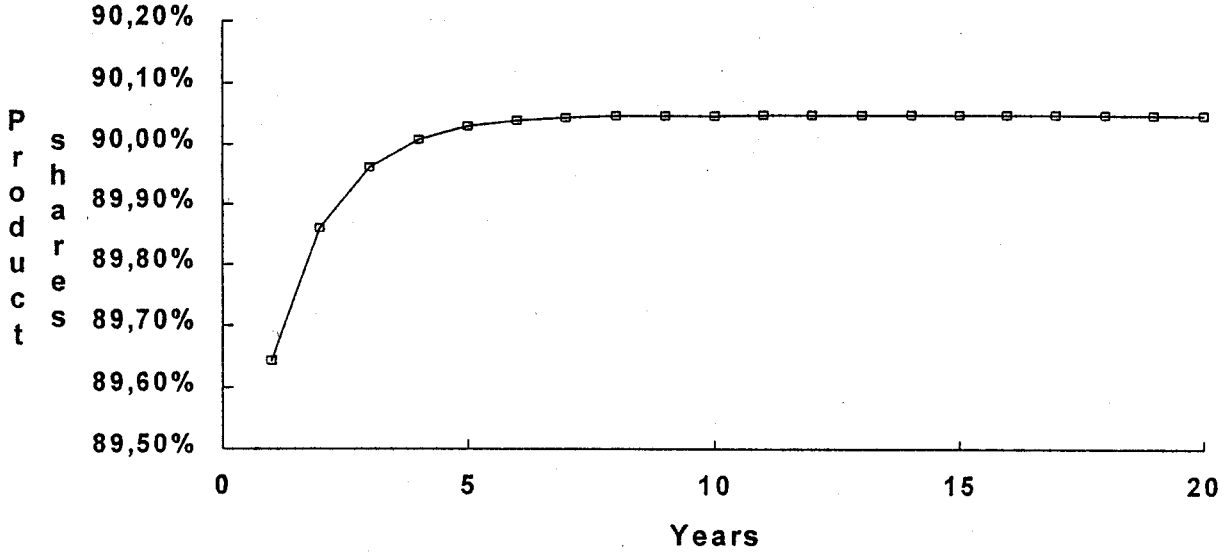


Figure 3.7: Effect on North European Product Shares (σ_{EU}) of Tariff Protection of the North European Market.

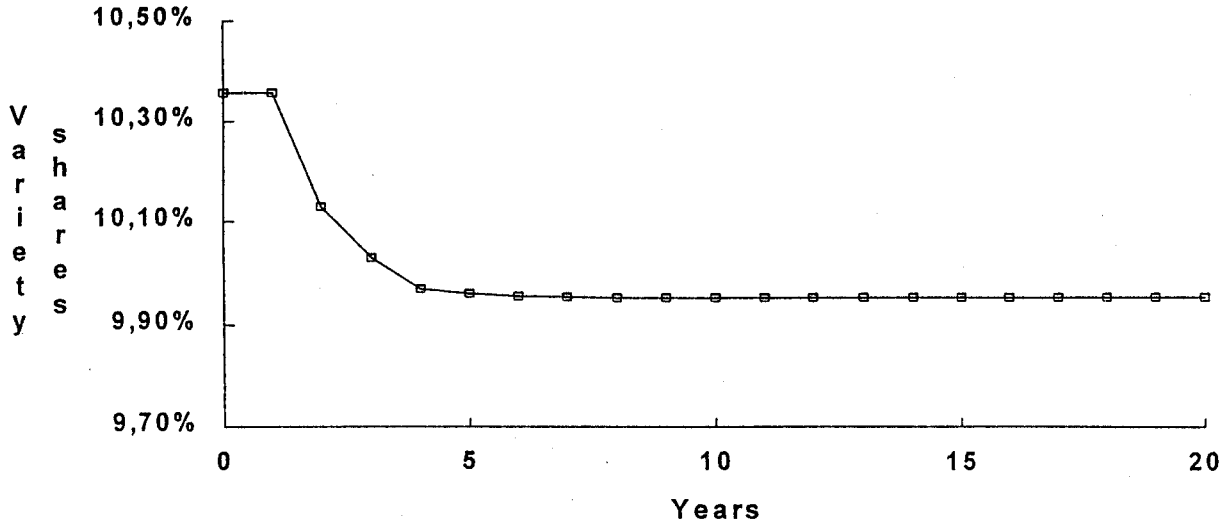


Figure 3.8: Effect on North American Growth Rate (g_{NA}) of Tariff Protection of the North European Market.

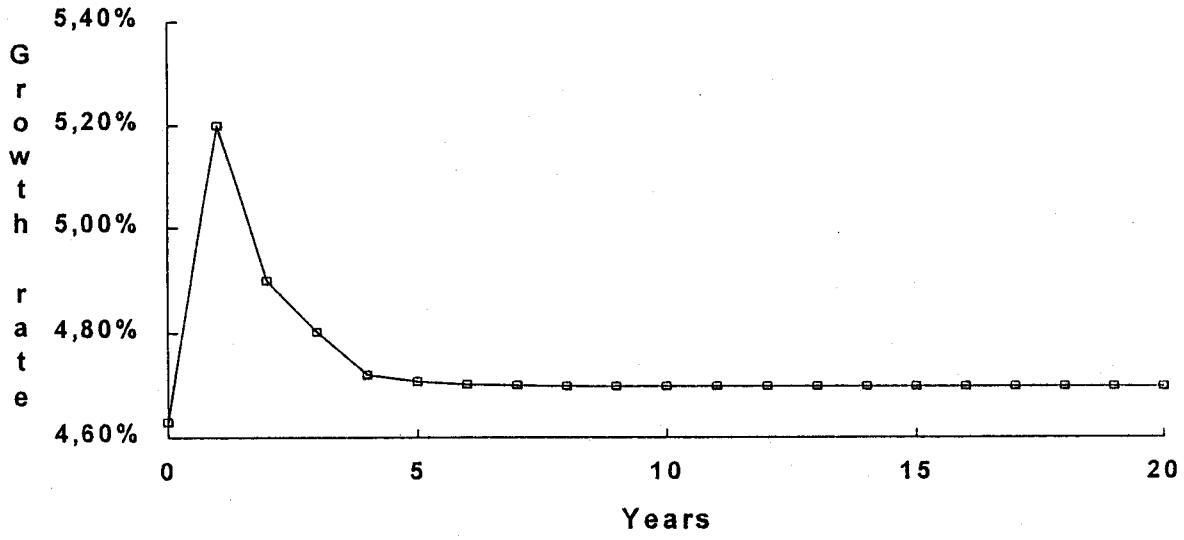
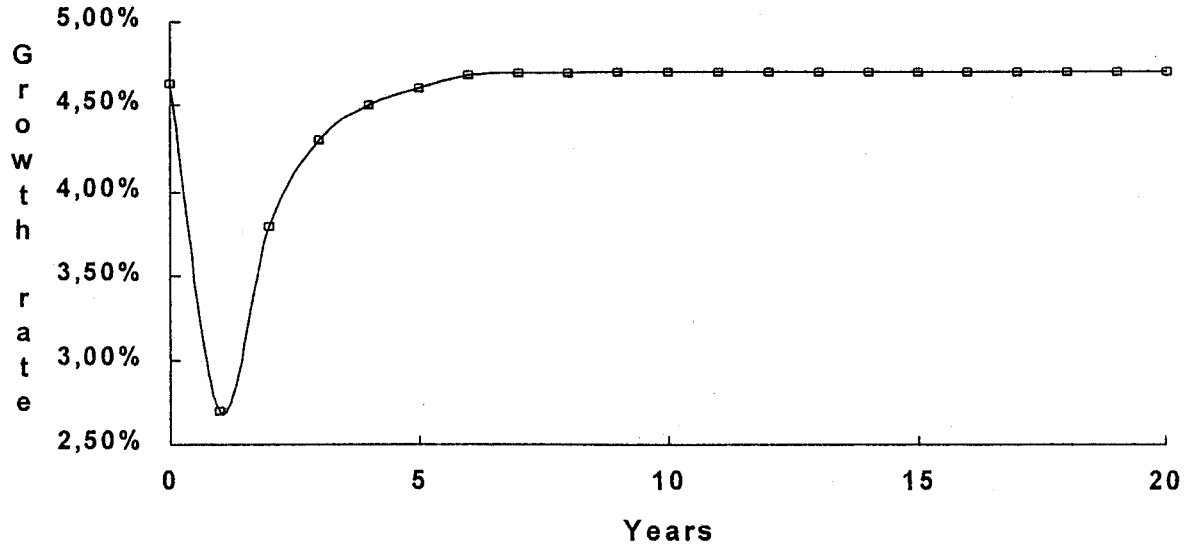


Figure 3.9: Effect on North European Growth Rate (g_{EU}) of Tariff Protection of the North European Market.



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